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Idaho Nuclear Technology and Engineering Center Tank Farm Facility Conceptual DOE and HWMA/RCRA Closure Approach

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ABSTRACT

This document outlines the conceptual approach for closure of the Idaho Nuclear Technology and Engineering Center (INTEC) Tank Farm Facility (TFF) tank system located at the Idaho National Engineering and Environmental Laboratory (INEEL). The INTEC TFF tank system has been historically used for the storage of high-level mixed (radioactive and hazardous) waste from spent nuclear fuel reprocessing and other radioactive wastes derived from the INTEC mission operations. Therefore, closure will be performed to meet both U.S. Department of Energy (DOE) radioactive waste management requirements and Hazardous Waste Management Act (HWMA)/Resource Conservation and Recovery Act (RCRA) requirements. The TFF tank system consists of eleven nominal 300,000-gallon below-ground stainless steel tanks contained within concrete vaults of various construction; four inactive 30,000-gallon stainless steel tanks; and valve boxes, encasements, and various process and instrumentation piping associated with the tanks. The tanks will be closed using RCRA performance-based standards and DOE low-level radioactive waste closure standards designed to protect human health and the environment by removing wastes and/or decontaminating the tank system. If, following waste removal and/or decontamination, performance-based standards cannot be met, the system will be closed to meet DOE alternative requirements and/or RCRA landfill standards.

EXECUTIVE SUMMARY

This document outlines the approach for closure of the Idaho Nuclear Technology and Engineering Center (INTEC) Tank Farm Facility (TFF) tank system located at the Idaho National Engineering and Environmental Laboratory (INEEL). The TFF tank system will be closed to comply with a Notice of Noncompliance/Consent Order (NON/CO) between the State of Idaho and the U.S. Department of Energy, Idaho Operations Office (DOE-ID). Since TFF has been used to store high-level radioactive and hazardous waste, closure will be in compliance with U.S. Department of Energy (DOE) radioactive waste management closure standards and to Hazardous Waste Management Act (HWMA)/Resource Conservation and Recovery Act (RCRA) closure standards. For the purposes of this closure the TFF tank system consists of eleven, nominal 300,000-gallon below-ground stainless steel tanks (WM-180 through WM-190) contained within concrete vaults of various construction; four, inactive 30,000-gallon stainless steel tanks (WM-103 through WM-106); and valve boxes, encasements, and various process and instrumentation piping associated with the tanks.

Closure of the TFF tank system will be conducted in phases, with the first phase being initiated upon receipt of authorization to proceed from DOE-ID and the DOE Deputy Assistant Secretary for Waste Management (based on approval of the DOE closure plans) and upon approval of the RCRA closure plan by the State of Idaho Division of Environmental Quality (IDEQ). As required by the NON/CO, the first of these closure plans must be submitted to IDEQ on or before December 31, 2000. The first phase of the TFF closure will include tanks WM-182 and WM-183 and will be used as a proof-of-process demonstration of the waste removal, decontamination, and sampling techniques. In addition, final closure of TFF must be integrated with pending Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) risk management decisions on contaminated soils surrounding the TFF tank system components. Subject to compliance with the NON/CO cease-use schedule, portions of TFF will remain operational to provide support for INTEC operations until alternative facilities are available. Waste liquids removed or generated during tank closure activities for a given phase will be transferred to operational INTEC tanks.

TFF is a unique system built over a number of years with a variety of equipment designs. Due to its use for storage of highly radioactive material and the overriding requirement for continued operation, the techniques used to close TFF will be different from those used for more standard tank closures. For this reason, specific closure plans will be prepared for each phase before closure activities for any given phase begins. While DOE closure plans will address closure of TFF as a whole, the HWMA/RCRA closure plan will address each phase, beginning with tanks WM-182 and WM-183. As required by HWMA/RCRA, because the tank vaults in TFF cannot be shown to meet secondary containment requirements, the HWMA/RCRA closure plans will include contingent actions to close each tank under landfill standards if they cannot meet performance based standards.

Closure to HWMA/RCRA performance-based standards and to DOE low-level radioactive waste closure standards will be attempted for each tank and associated equipment by removal or decontamination of high-level radioactive and hazardous wastes. Waste removal and decontamination will be conducted using site preparation, tank isolation, heel management, and vault isolation steps. When augmented with sampling and analysis to demonstrate decontamination effectiveness these actions will allow for assessment of attainment of DOE closure standards and HWMA/RCRA performance-based closure standards.

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ACRONYMS

APAD	air permit applicability determination
ASME	American Society of Mechanical Engineers
ALARA	as low as reasonably achievable
bgs	below ground surface
CA	Composite Analysis
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFA	Central Facilities Area
CFR	Code of Federal Regulations
CO	Consent Order
DOE	U.S. Department of Energy
DOE-HQ	U.S. Department of Energy Headquarters Office
DOE-ID	U.S. Department of Energy Idaho Operations Office
DQO	data quality objective
ECA	Environmentally Controlled Area
EIS	environmental impact statement
EM	Environmental Management
EPA	U.S. Environmental Protection Agency
ES&H	environment, safety, and health
ESRP	Eastern Snake River Plain
FAST	Flourinel Dissolution Process and Fuel Storage
FFA/CO	Federal Facility Agreement and Consent Order
FSP	Field Sampling Plan
gpm	gallons per minute
HASP	Health and Safety Plan
HLLW	high-level liquid waste
HLW	high-level waste
HWMA	Hazardous Waste Management Act
ICPP	Idaho Chemical Processing Plant
IDAPA	Idaho Administrative Procedures Act
IDEQ	State of Idaho Division of Environmental Quality
INEEL	Idaho National Engineering and Environmental Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center

LDUA	light duty utility arm
LLW	low-level waste
NESHAP	National Emission Standards for Hazardous Air Pollutants
NRC	U.S. Nuclear Regulatory Commission
NOAA	National Oceanic & Atmospheric Administration
NON	Notice of Noncompliance
NWCF	New Waste Calcining Facility
OU	Operable Unit
P&ID	piping and instrumentation diagram
PA	Performance Assessment
PCB	polychlorinated biphenyls
PEWE	Process Equipment Waste Evaporator
PTC	permit to construct
QA	quality assurance
QC	quality control
QAPjP	Quality Assurance Project Plan
RAF	Remote Analytical Facility
RCRA	Resource Conservation and Recovery Act
RI/FS	remedial investigation/feasibility study
ROVER	
SHPO	State Historical Preservation Officer
SNF	spent nuclear fuel
SRS	Savannah River site
SRPA	Snake River Plain Aquifer
SRP	Snake River Plain
STP	Site Treatment Plan
TSCA	Toxic Substances Control Act
TFF	Tank Farm Facility
TRU	transuranic
VOG	vessel off-gas
WCF	Waste Calcining facility
WIR	waste incidental to reprocessing
WSRC	Westinghouse Savannah River Company

Idaho Nuclear Technology and Engineering Center
Tank Farm Facility
Conceptual DOE and HWMA/RCRA Closure Approach

1. INTRODUCTION

This document outlines the conceptual plan for closing the Idaho Nuclear Technology and Engineering Center (INTEC) Tank Farm Facility (TFF) tank system located at the Idaho National Engineering and Environmental Laboratory (INEEL) (Figure 1). TFF will be closed in accordance with the requirements of the U.S. Department of Energy (DOE) Order 435.1, Radioactive Waste Management (DOE O 435.1, 1999), the Idaho Hazardous Waste Management Act (HWMA) [Idaho Administrative Procedures Act (IDAPA) 16.01.05.009], and the Resource Conservation and Recovery Act (RCRA) [40 Code of Federal Regulations (CFR) 265, 1999].

TFF tank system includes eleven 300,000 to 318,000-gallon stainless steel tanks (WM-180 through WM-190), hereafter referred to as 300,000-gallon tanks; four, inactive 30,000-gallon stainless steel tanks (WM-103 through WM-106); tank vaults and ancillary equipment (Figure 2). The TFF tank system will be closed to comply with a Notice of Noncompliance/Consent Order (NON/CO) between the State of Idaho and the U.S. Department of Energy, Idaho Operations Office (DOE-ID) (DOE-ID 1990). The closure of the TFF tank system will also include those ancillary tanks associated with TFF identified in the 1998 Voluntary Consent Order negotiations with the State of Idaho.

The conceptual approach is specific to activities that will be required to achieve deactivated high-level radioactive waste (HLW) facility closure and HWMA/RCRA closure of TFF. As closure of TFF is unique in comparison to other HWMA/RCRA closures, TFF closure activities are being designed with flexibility as an important concern. As such, the first two TFF tanks (WM-182 and WM-183) are being closed as a demonstration project and proof of process for closure of the entire TFF.

To comply with DOE O 435.1, the following supporting documentation will demonstrate that closure activities ensure both short- and long-term protection of the public and environment: DOE Deactivated HLW Facility 1st and 2nd Tier DOE Closure Plans, Performance Assessment (PA), waste incidental to reprocessing (WIR) determination, and Composite Analysis (CA). The WIR determination will demonstrate that residual material in the tanks at the time of closure is not HLW, allowing the tanks to be closed to DOE low-level radioactive waste (LLW) closure standards or to alternative requirements for waste classification supported by analysis and approved by DOE. Also, to comply with HWMA/RCRA requirements, the tanks will be closed using performance-based or landfill standards as described in the HWRA/RCRA closure plan.

The closure of TFF will be conducted in accordance with the schedule outlined in the second modification to the CO (DOE-ID 1998). The 300,000-gallon tanks will be closed in phases (rather than all tanks at one time or one at a time), each of which will constitute partial closure of TFF and HWMA/RCRA unit. Each phase will address the complete system (i.e., the ancillary tanks, sumps, and equipment associated with those tanks being closed). Subject to compliance with the NON/CO cease-use schedule, portions of TFF will remain operational to provide support for INTEC operations until alternative facilities are available. Waste liquids removed or generated during tank closure activities for a given phase will be transferred to operational INTEC tanks. These liquids will be reduced in volume with existing INTEC treatment systems pending storage, treatment, and disposition using methods being

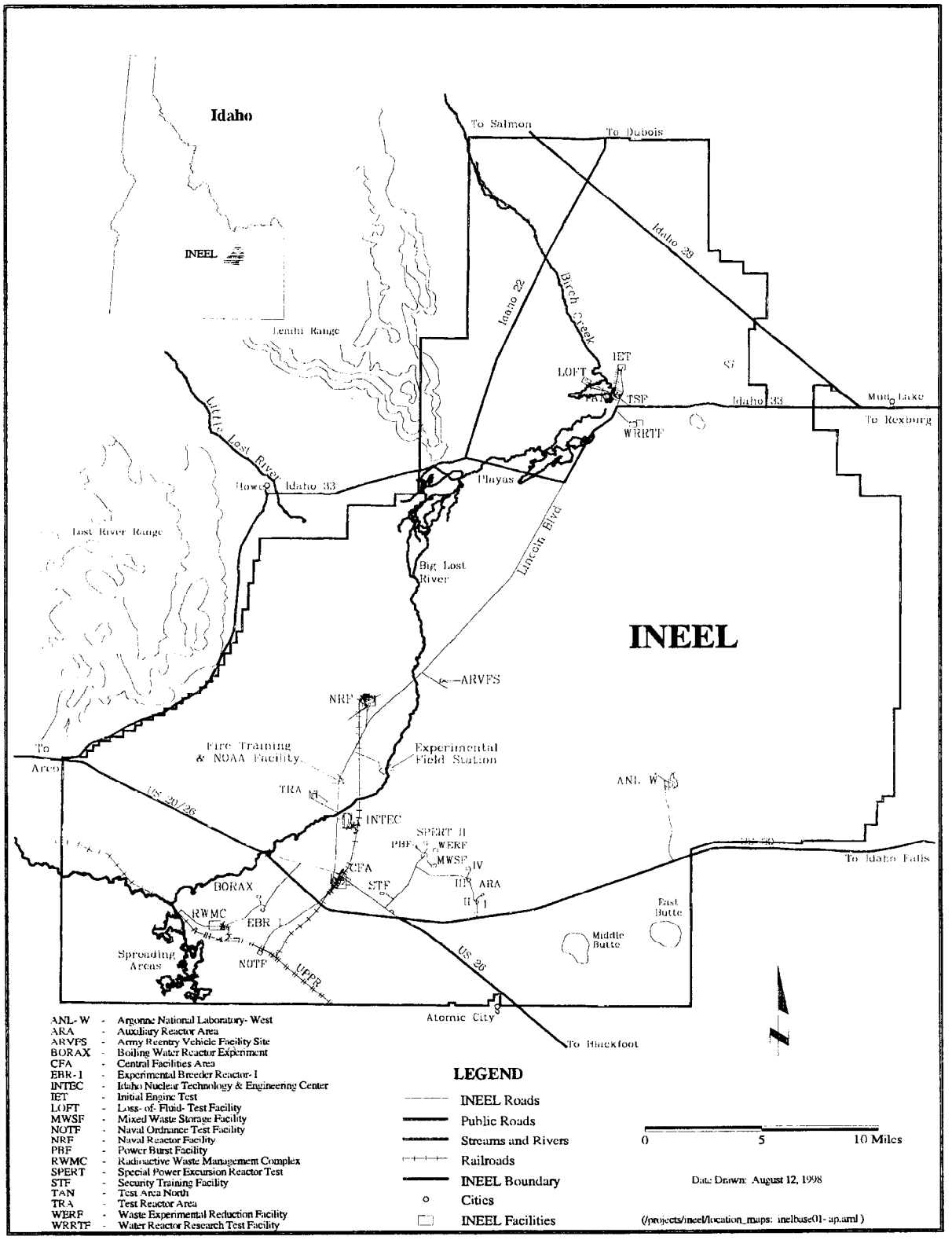
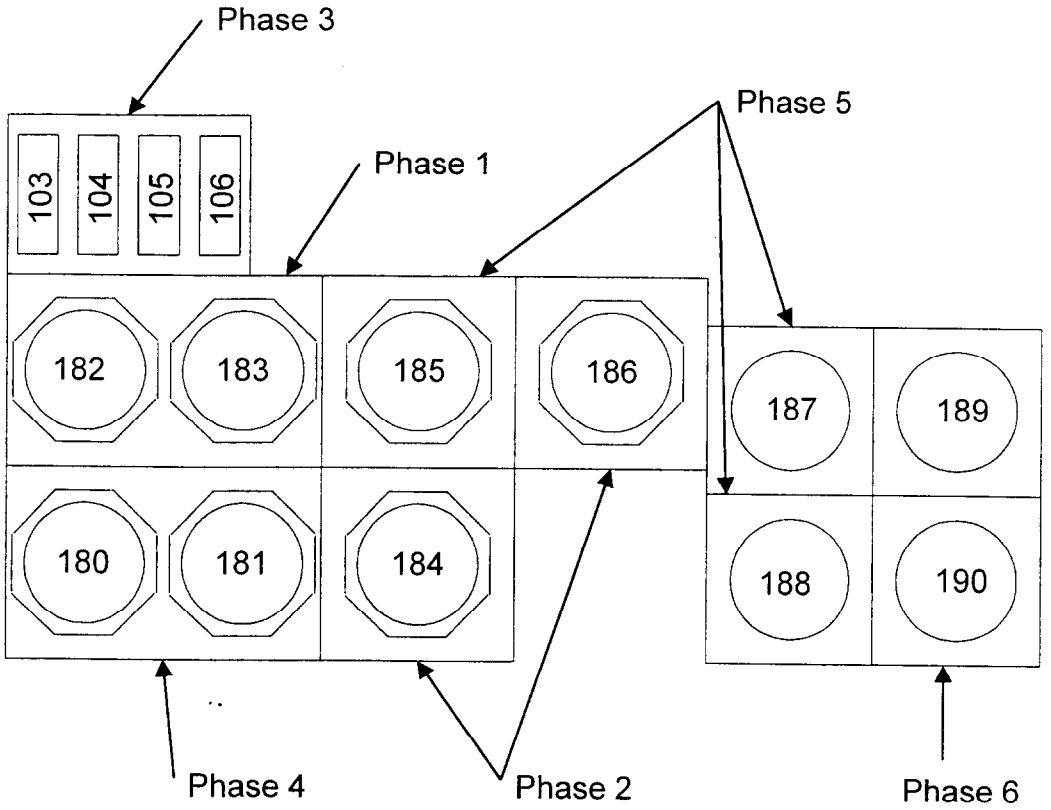


Figure 1. INEEL Map.



Phase 1	WM-182
	WM-183
Phase 2	WM-184
	WM-186
Phase 3	WM-103
	WM-104
	WM-105
	WM-106
Phase 4	WM-180
	WM-181
Phase 5	WM-185
	WM-187
	WM-188
Phase 6	WM-189
	WM-190

Figure 2. Schematic of TFF and the closure phases.

identified by the HLW and facility disposition environmental impact statement (EIS) currently in preparation. As required by the NON/CO, the HWMA/RCRA closure plan for the first phase will be submitted to the State of Idaho Department of Environmental Quality (IDEQ) on or before December 31, 2000. The 1st Tier DOE HLW facility closure plan is planned to be submitted to DOE-ID and the U.S. Department of Energy Headquarters Office (DOE-HQ) on or before December 31, 2000.

Each of the tanks and associated equipment comprising TFF is unique due to different initial designs and modifications that have occurred over the past 40+ years. Additionally, due to its historical use for storage of HLW and hazardous wastes, TFF is different from typical storage units because it must be closed to meet both radioactive waste management and hazardous waste management regulations. Adding to the complexity of the situation, TFF will continue to operate while closure actions take place for individual tank system components. Keeping the TFF tank system operational during closure actions is paramount to ensuring that INTEC continues to meet its operational and fiduciary missions. Therefore, a phased closure approach is necessary to continue operations. Complexities arising from keeping TFF operational include maintaining the cathodic protection system, the TFF vessel off-gas (VOG) system, the TFF tank system overpressure relief system, the waste transfer system, and the TFF tank system excess vacuum relief system. For example, a single centralized VOG system maintains a negative pressure of 0.5 in. of water with airflow balanced in all of the 300,000-gallon tanks. Closing individual tanks and isolating portions of the VOG system will require modifying the operation or the equipment of the remaining VOG system to allow continued operation.

Closure of TFF system components to HWMA/RCRA performance-based standards and to DOE LLW or transuranic (TRU) waste closure standards will include removal or decontamination of HLW and hazardous wastes. If portions of TFF cannot meet HWMA/RCRA performance-based standards and/or DOE closure standards, those portions will be closed to RCRA landfill standards and/or DOE alternative requirements. Additionally, final closure activities must be integrated with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) environmental restoration risk management decisions being made on contaminated soils surrounding TFF tank system components. The proposed methods to obtain closure are based on an analysis conducted for the feasibility of closing TFF tanks WM-182 and WM-183. It is anticipated that these methods will be revised as information is gained from mock-ups, sampling data, and lessons learned from closure implementation.

Every effort is being taken to use lessons learned in previous HLW tank closures from throughout the DOE complex. Most applicable to the INTEC TFF closure program is the experience gained during the DOE Savannah River Site (SRS) tank closure program from 1996 through today. While the primary regulations under which the SRS tanks were closed are different from those applicable to the TFF tanks (Clean Water Act and DOE Order 5820.2a at SRS versus HWMA/RCRA and DOE Order 435.1 at the TFF), lessons learned from public and regulatory agency involvement and from the SRS WIR determination (among others) are being applied to the INTEC TFF closure plan.

Primary SRS HLW Tank Closure documentation included:

- SRS Environmental Management Ten Year Plan (DOE 1996a)
- SRS Federal Facility Agreement
- HLW System Plan [Westinghouse Savannah River Company (WSRC)1996]
- HLW Tank Closure Program Plan (DOE 1996b)

- Industrial Wastewater Closure Plan for F- and H-Area tanks (the general closure plan) (DOE 1996c)

- Tank Specific Closure Modules (DOE 1997).

In addition to these documents, which are identified in the SRA Tank Closure Program Plan, a WIR determination for SRS is being obtained with direct and substantive U.S. Nuclear Regulatory Commission (NRC) involvement.

INEEL INTEC TFF closure documentation currently in preparation or being scoped include:

- Base Documents
  - HLW Tank Closure Project Execution Plan
  - RCRA Closure Approach [Lockheed Martin Idaho Technologies Company (LMITCO 1998]
  - DOE Closure Strategy
  - RCRA Closure Plan with Contingent Landfill Closure Plan
  - WIR determination
  - 1st Tier DOE Closure Plan (to obtain Authorization to Proceed)
  - 2nd Tier DOE Closure Plan
- Supporting Documentation
  - PA
  - CA
  - Monitoring plan
  - Institutional Controls and Land Use Limitations
  - Project schedule
  - Conceptual design
  - Inspection and Corrective Action Plan

As described in DOE M 435.1, NRC involvement in the WIR determination is being considered but may occur to a lesser extent than was the case for SRS. DOE O 435.1 was not in existence at the time SRS began tank closure and therefore it was decided that NRC review of SRS tank closure plans was appropriate.

2. TFF BACKGROUND

This section of the report is intended to provide an overview of the INTEC facility and TFF tanks and equipment. A discussion of the environmental characteristics of the INEEL and INTEC is contained in Appendix A.

In 1953, INTEC, formerly the Idaho Chemical Processing Plant (ICPP), was chartered to recover fissile uranium by reprocessing spent nuclear fuel (SNF) (Figure 3). In April 1992, DOE discontinued reprocessing SNF and called for a shutdown of the reprocessing facilities at INTEC. The current mission for INTEC includes management and storage of SNF, treatment and storage of HLW, and treatment and storage of LLW generated from past and present operations and activities. The TFF tank system stores liquid mixed waste (hazardous and radioactive) from plant operations and decontamination efforts (INEEL 1998) (Figure 4). Due to the historical and continued storage of mixed waste, TFF is regulated as both an interim status HWMA/RCRA tank system and as a radioactive waste storage facility.

The high-level liquid radioactive waste (HLLW) previously stored at TFF was generated as a direct result of reprocessing SNF, while LLW was generated from incidental activities, such as equipment decontamination associated with operation of INTEC. Although the liquid radioactive waste currently in TFF is stored and treated in the same manner as HLLW, it is actually a mixed TRU waste (DOE-ID 1996). Since the cessation of spent fuel processing, no additional HLLW has been, or is planned to be, generated. Furthermore, all HLLW that had been generated has been removed from TFF and calcined. Appendix B presents a summary of available data on current and historic TFF tank contents and tank construction information.

TFF was the subject of a NON issued by the U.S. Environmental Protection Agency (EPA) in January 1990 because the eleven large liquid storage tanks could not be certified as meeting the secondary containment requirements of HWMA/RCRA. In addition, five of the tank vaults (WM-182 through WM-186) may not meet current structural seismic requirements. The CO that followed (March 30, 1992) from the NON required INEEL to permanently cease use of five of the 300,000-gallon storage tanks (WM-182 through WM-186) and associated vaults by March 31, 2009. The CO also required that the DOE permanently cease use of the remaining six 300,000-gallon storage tanks (WM-180, WM-181, and WM-187 through WM-190) and the associated vaults be taken out of service by June 30, 2015.

On August 18, 1998, an amended NON/CO was signed that addressed the schedule for cease-use and subsequent HWMA/RCRA closure of TFF. In the amended NON/CO, DOE-ID committed to cease-use of the Pillar-and-Panel tanks (Tanks WM-182, WM-183, WM-184, WM-185, and WM-186) by June 2003, with closure following. The first HWMA/RCRA closure plan must be submitted to IDEQ on or before December 31, 2000. The DOE deactivated HLW facility closure plan will also be submitted to DOE-ID on or before December 31, 2000. The cease-use of the remaining tanks (Tanks WM-187, WM-188, WM-189, WM-190) would occur by the end of 2012, followed by their closure.

2.1 Tank Farm Description

The TFF tank system equipment includes storage tanks, associated underground piping, diversion valve boxes, VOG systems, and buildings. The TFF closure-unit boundary is defined as the tanks, vaults, piping, and valves within the fenced area of TFF. The soil around and under the HWMA/RCRA unit falls under the regulatory agreement in the Federal Facilities Agreement/Consent Order (FFA/CO) (DOE-ID 1991) and is managed through the CERCLA process.

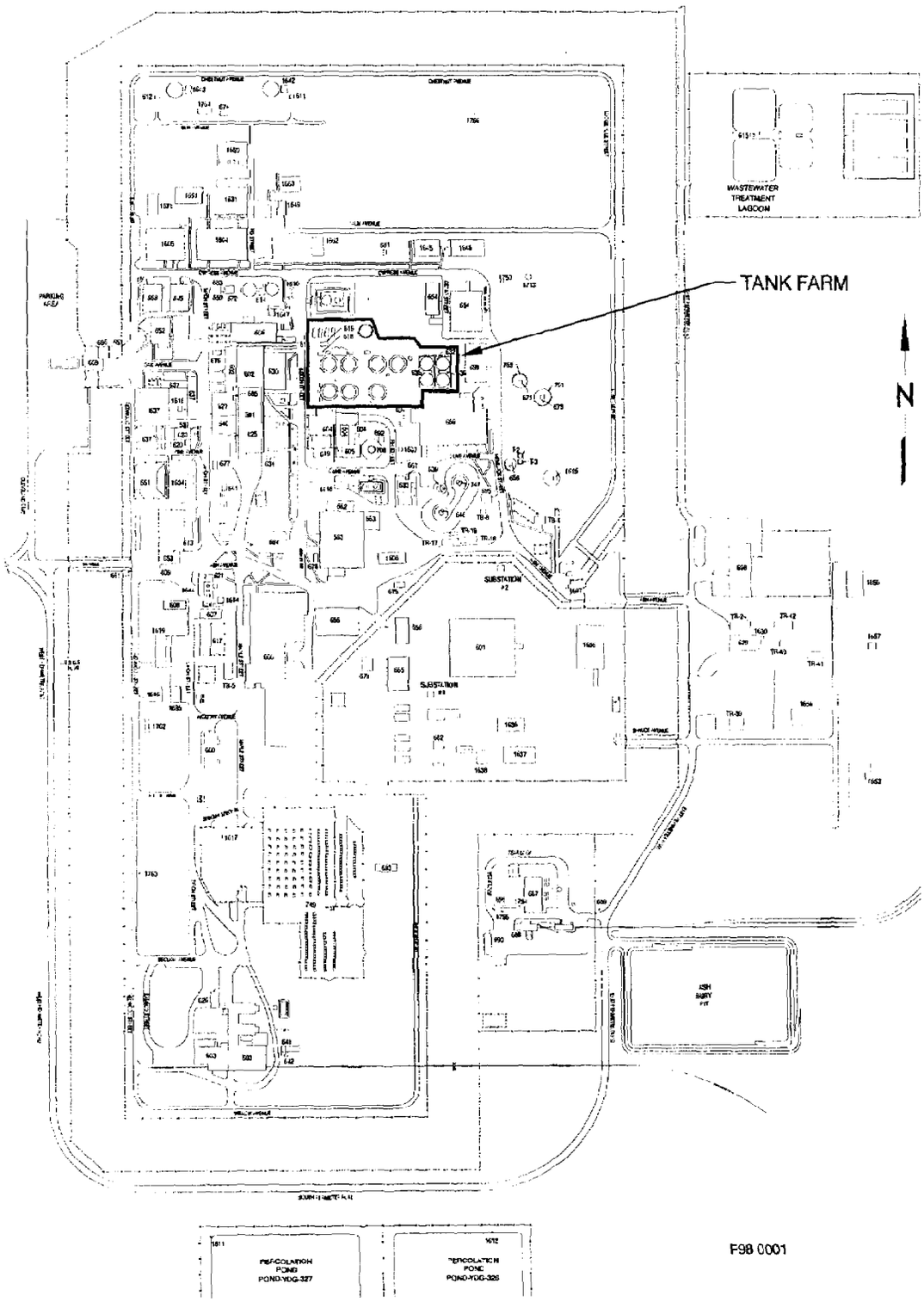


Figure 3. Idaho Nuclear Technology and Engineering Center.

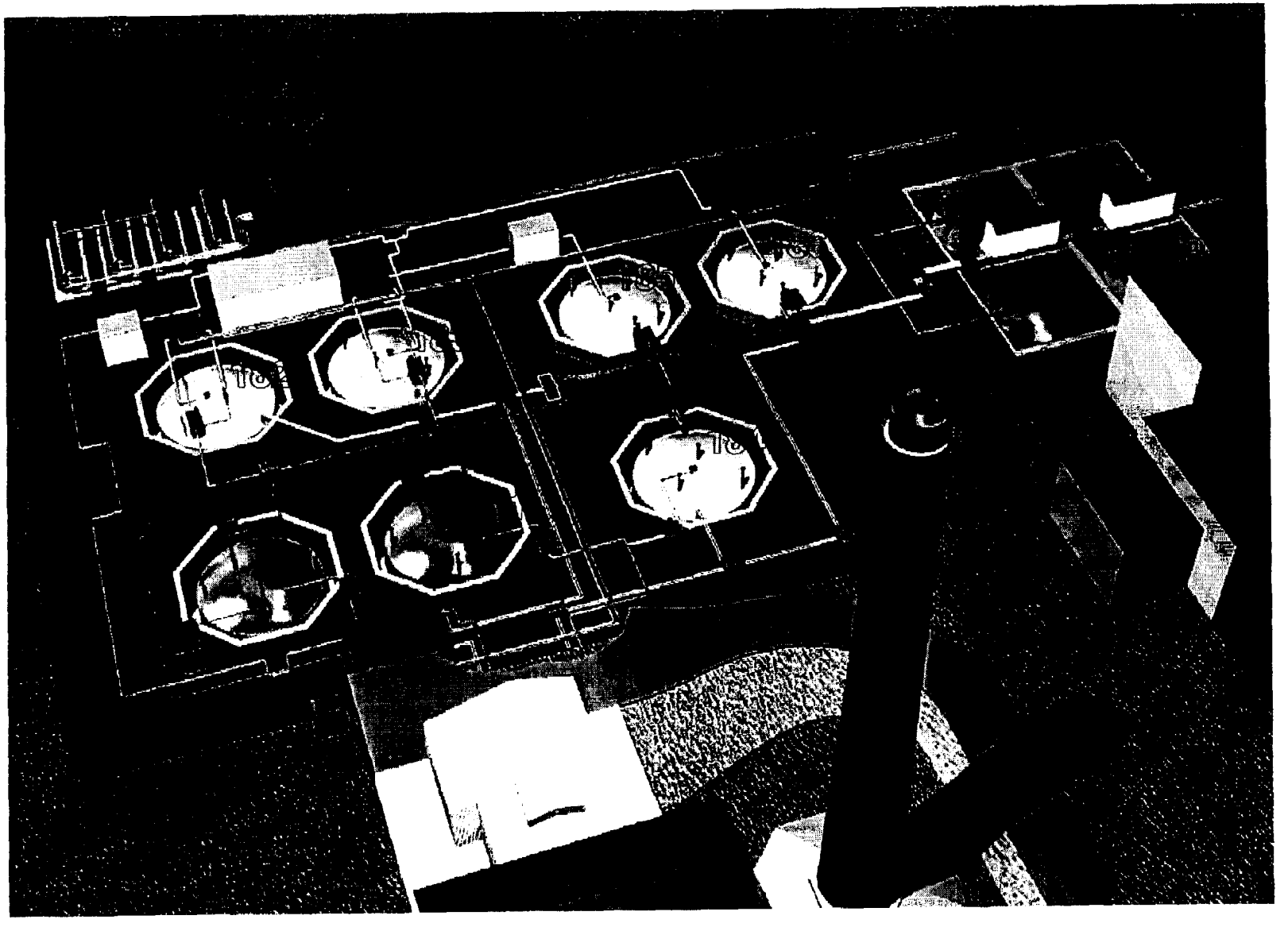


Figure 4. Tank Farm Facility.

2.1.1 300,000-Gallon Waste Storage Tanks

The eleven, nominal 300,000-gallon stainless steel tanks are similar in size, have a 50-foot diameter, an overall height of approximately 30 to 32 ft, and are contained in unlined, underground concrete vaults. Tanks WM-180 and WM-181 are bolted to the floor of their respective vaults, while tanks WM-182 through WM-190 rest on a thin, sand layer atop a concrete pad in their respective vaults. The vault floors are approximately 45 ft below grade. Eight of the eleven 300,000-gallon tanks contain stainless steel cooling coils located inside the tanks on the walls and floors. These cooling coils have been used to maintain the liquid waste below predetermined temperatures to minimize corrosion of the stainless steel tanks.

Tanks WM-180 and WM-181, constructed in 1951-1952, are slightly larger (318,000 gallons) than the other nine tanks (300,000 gallons). Additional tanks were put into service as the scope of the INTEC operations increased. Tanks WM-182 through WM-184 were constructed in 1954-1955; WM-185 and WM-186 were constructed in 1955-1957; and WM-187 and WM-188 were constructed in 1958-1959. TFF tank construction was completed when Tanks WM-189 and WM-190 were built in 1964. Figure 5 is a drawing of a typical 300,000-gallon tank and ancillary equipment (WM-182).

Access to the 300,000-gallon tanks is provided through risers. Each tank has four or five 12-in. risers. Tanks WM-184 through WM-190 also have one or two 18-in. risers. Most risers have equipment installed in them such as probes for level measurement, corrosion coupons, or waste transfer equipment (steam jets and airlifts). Steam jets and airlifts placed inside the tanks are used for liquid waste transfers to other vessels. With the exception of Tanks WM-189 and WM-190, two steam jets are located inside each tank. WM-189 and WM-190 have one steam jet and one airlift per tank. A single steam jet can transfer waste out of a tank at approximately 50 gallons per minute (gpm), and an airlift can transfer waste out of a tank at approximately 35 gpm. The steam jet and airlift intakes are located 3 to 12 in. above the tank floor, limiting the amount of liquid waste that can be removed from the tanks. The liquid remaining, after the tanks have been emptied to the extent possible using the steam jets and/or airlifts, is referred to as a heel and contains liquids and solid sediments which have collected in the tank over time. The heels could range in volume from approximately 3,000 to 12,000 gallons when waste is removed with existing jets.

2.1.1.1 Tank Vaults. The 300,000-gallon tanks are contained in unlined concrete vaults patterned after one of three basic designs. Tanks WM-180 and WM-181 are enclosed in cast-in-place octagonal vaults. Tanks WM-182 through WM-186 are contained in pillar-and-panel style octagonal vaults (Figure 6). The remaining tanks (WM-187 through WM-190) are enclosed in a cast-in-place square or octagonal 4-pack configuration. The concrete vault roofs are covered with approximately 10 ft of soil to provide radiation shielding. None of the vaults can be inspected to verify compliance with HWMA/RCRA secondary containment requirements.

2.1.2 30,000-Gallon Waste Storage Tanks

The four, inactive 30,000-gallon tanks (WM-103 through WM-106) were constructed in 1954 and are stainless steel below-ground storage tanks that sit on reinforced concrete pads located north of tank WM-182. The tanks are approximately 11.5 ft in diameter by 38 ft in length and are covered by compacted gravel. Like the 300,000-gallon tanks, the 30,000-gallon tanks do not have secondary containment that meets the requirements of HWMA/RCRA. These tanks were taken out of service in

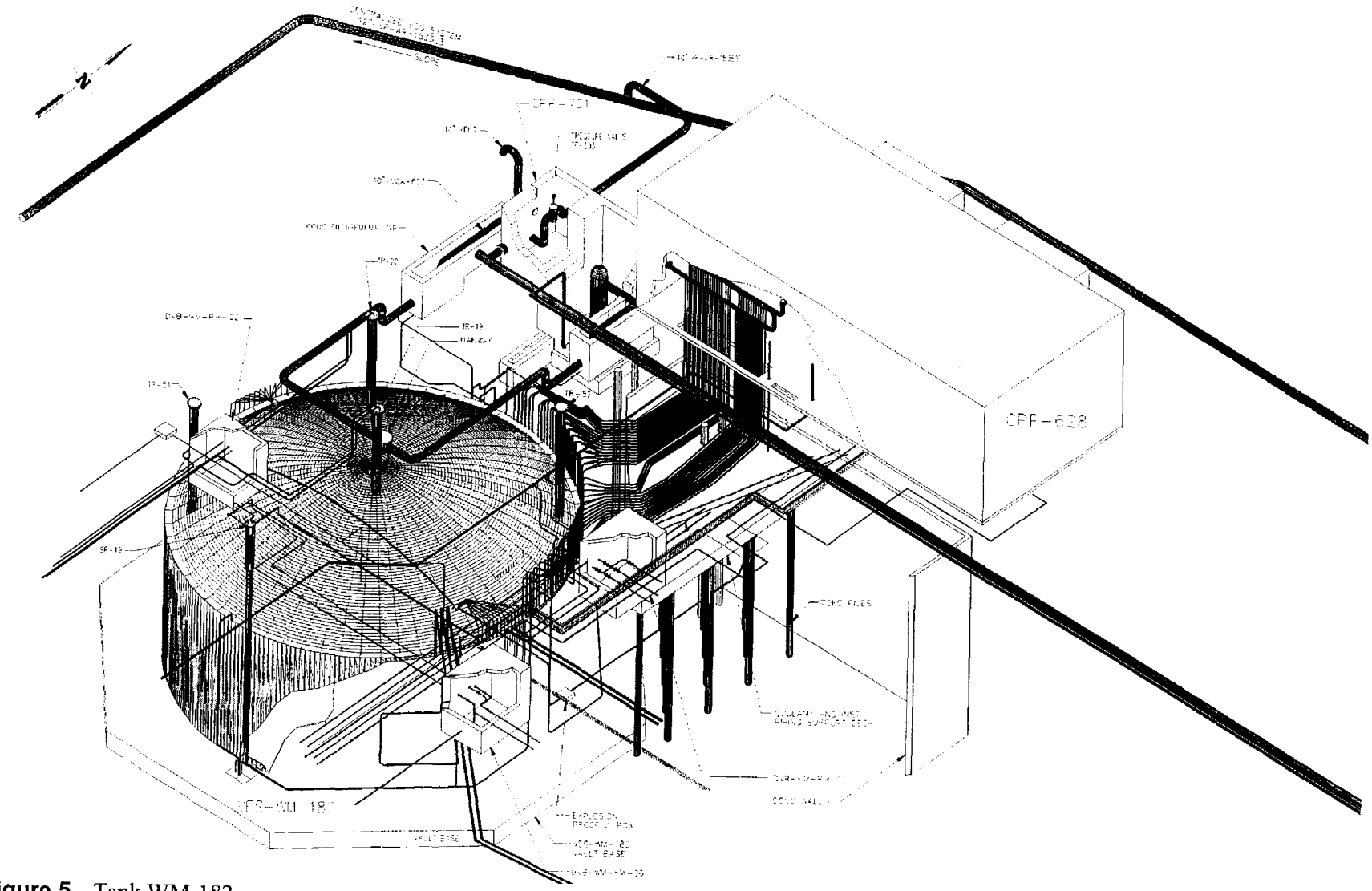


Figure 5. Tank WM-182.

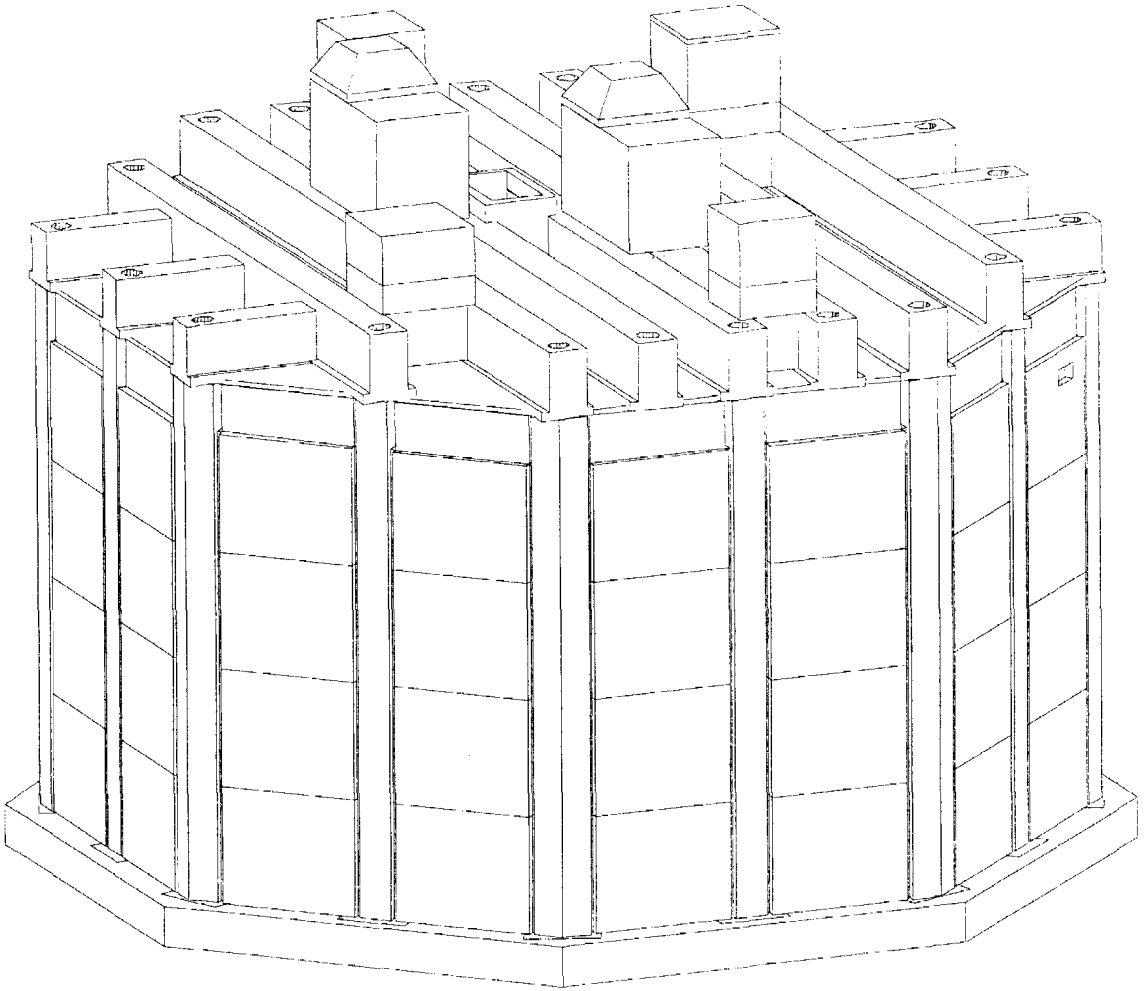


Figure 6. Pillar-and-Panel Vault Design.

February of 1983 (Spaulding et al. 1998). The inlets to these tanks have been subsequently cut and capped; however, the outlets are still operational, which allows tank decontamination activities to occur and allows a small amount of steam condensate to collect in the tanks from a downstream steam valve. A decontamination of these tanks occurred in February 1990 with a flush using approximately 12,000 gallons of water.

2.1.3 Ancillary Systems

Liquid waste transfers at TFF are managed through a system of lines, valves, and diversion boxes. This system is designed to enable transfers to and from other INTEC areas and between the waste storage tanks. Waste transfers currently take place through pipes housed in stainless steel-lined concrete troughs or double-walled stainless steel pipe that are generally covered with 10 to 15 ft of soil. Originally, there were three main types of pipe encasements in TFF: split tile, stainless steel-lined concrete troughs, and double-walled stainless steel pipe. However, during TFF upgrades, pipe sections encased with the split tile have either been replaced or abandoned in place. Those portions abandoned in place are being evaluated under the CERCLA process as part of Waste Area Group 3 (WINCO 1992) and are not included in the DOE deactivated HLW and HWMA/RCRA TFF closure.

Liquid waste is routed through waste transfer valves located in underground, stainless steel-lined concrete boxes (referred to as valve boxes). The waste transfer valves are manually operated using reach rods. The valve boxes are designed to provide access to the valves for inspection and maintenance. In addition to the waste transfer equipment, TFF tanks contain cooling, decontamination, instrumentation, and VOG pipelines.

Valve boxes and piping encasements have provisions for drainage of liquids from decontamination efforts or from leakage. Valve boxes (and attached encasements) installed at the time of tank construction drain to a nearby tank vault sump where liquids can then be transferred to the Process Equipment Waste Evaporator (PEWE). Generally, valve boxes constructed subsequent to tank construction (during TFF upgrade projects) drain to a common header and sump, from which any accumulated liquid may be transferred.

3. REGULATORY REQUIREMENTS

Table 1 outlines regulatory and DOE directive requirements applicable to TFF closure. The conceptual TFF closure strategy and anticipated documentation requiments are also presented in the table. The DOE directives listed in the table are identified in DOE Manual 435.1, Section I.1.E as applicable to radioactive waste management. These requirements will be applied as appropriate to specific TFF closure activities. During TFF closure planning, a tailored set of environmental, safety, and health (ES&H) requirements will be identified through application of an accepted evaluation process such as the necessary and sufficient closure process. This table will be modified as TFF closure planning progresses and the ES&H requirements are further identified.

3.1 Radioactive and Hazardous Waste Management

TFF has been used to store HLW and hazardous waste and will, therefore, be closed to DOE radioactive waste management closure standards and HWMA/RCRA closure standards (DOE O 435.1, 1999; DOE M 435.1, 1999; DOE G 435.1, 1999; 40 CFR 265, [as incorporated by IDEQ at IDAPA 16.01.05.009]). Closure strategies, and the documentation needed to obtain approval prior to initiating closure activities, are described in Section 5.

Upon completion of the waste removal and decontamination closure activities, it is expected that (1) the TFF tank system will not contain HLW, (2) residual material in TFF would be LLW or TRU waste meeting closure standards, and (3) any residual hazardous wastes would meet performance-based standards. If, for portions of the facility, these standards cannot be met, a contingent closure strategy using RCRA landfill standards and/or DOE alternative requirements will be implemented.

3.2 Other Applicable DOE Orders

In addition to DOE O 435.1, DOE M 435.1 identifies numerous other DOE orders applicable to radioactive waste management, including (1) analysis of environmental impacts, (2) analysis of operations information, (3) classified waste, (4) conduct of operations, (5) criticality safety, (6) emergency management, (7) environmental and occurrence reporting, (8) environmental monitoring, (9) hazard analysis documentation and authorization basis, (10) life-cycle asset management, (11) mixed wastes (covered by HWMA/RCRA), (12) packaging and transportation, (13) quality assurance, (14) radiation protection, (15) records management, (16) release of waste containing residual radioactive material, (17) safeguards and security, (18) safety management, (19) site-evaluation and facility design, (20) training and qualification, (21) waste minimization and pollution prevention, and (22) worker protection (DOE M 435.1 1999, Sec. I.1.E). Table1 reflects the DOE orders identified in DOE M 435.1.

Considering the unique purpose for which the TFF tank system was used and the variety of equipment designs, meeting performance-based standards for closure presents several challenges, particularly with respect to worker protection and waste minimization. One of the most critical requirements for closure is the as low as reasonably achievable (ALARA) criteria for exposure to ionizing radiation. The ALARA criteria (10 CFR 835) require that efforts be made to minimize the radiation exposure to personnel and that all radiation exposure incurred is economically commensurate with the work accomplished. The radiation fields should be reduced through decontamination, shielding, and distance to protect the safety and health of workers. Additionally, secondary waste generation from tank and equipment decontamination must be reduced to the maximum extent practicable. Any isolation activities being conducted on tanks within TFF must minimize the interference with ongoing operations at TFF, as liquid waste must be transferred to and from those tanks that are still operational. These types of.

Table 1. TFF Closure Regulatory Requirements and DOE Directives.

Category	Requirement	TFF Closure Strategy	Documentation
Radioactive Waste Management	DOE Draft O 435.1, Radioactive Waste Management (replaces DOE O 5820.2A when approved and issued)	TFF closure activities will be planned and conducted in accordance with DOE O 435.1 and its associated manual (DOE M 435.1) and guidance (DOE G 435.1).	1st and 2nd Tier DOE closure plans, WIR determination, PA, CA, TFF Closure Design, DOE Closure Report
Hazardous Waste Management	40 CFR 265 (as incorporated by IDEQ at Idaho Administrative Procedures Act [IDAPA] 16.01.05.009), Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	TFF closure activities will be planned and conducted in accordance with 40 CFR 265 (as incorporated by IDEQ at IDAPA 16.01.05.009).	HWMA/RCRA closure plan, Sampling and Analysis Plan, Quality Assurance Project Plan, TFF Closure Design, Certification of Closure
Management of Polychlorinated Biphenyls	40 CFR 761, Polychlorinated Biphenyls (PCB)	During TFF closure planning, tank liquids and valve box paint will be sampled to determine whether PCBs are present.	If PCBs are detected, the closure plan will identify performance-based standards and closure design requirements to comply with 40 CFR 761.
Air Pollution Control	IDAPA 16.01.01, Rules for the Control of Air Pollution in Idaho 40 CFR 61.90 et seq., National Emission Standards for Emissions of Radionuclides	During TFF closure planning, an Air Permit Applicability Determination will be prepared to assess the potential air and radionuclide emissions and National Emission Standards for Hazardous Air Pollutants (NESHAPs) requirements from proposed TFF closure activities. To determine NESHAPs compliance, modeling will be conducted to estimate the maximally exposed individual dose at the INEEL site boundary.	Air Permit Applicability Determination, Permit to Construct, Application to Construct (to be determined)
Stormwater Management	40 CFR 122.26, Stormwater Discharges	TFF closure will be designed to eliminate stormwater runoff from the site.	Revise INTEC Stormwater Management System, Revise INTEC Stormwater Pollution Prevention Plan
National Historic Preservation	36 CFR 800, Protection of Historic and Cultural Properties	If determined applicable, TFF closure planning will include consultation with the Idaho State Historic Preservation Officer (SHPO) and compliance with any stipulations prior to performing closure activities.	Memorandum of Agreement (identifies the mitigation requirements)

Table 1. (continued).

Category	Requirement	TFF Closure Strategy	Documentation
Analysis of Environmental Impacts	10 CFR 1021, National Environmental Policy Act Implementing Procedures DOE O 451.1A, National Environmental Policy Act Compliance Program	The INEEL HLW and Facility Disposition Environmental Impact Statement is in preparation and is expected to be issued in draft form in November of 1999.	Environmental Impact Statement
Analysis of Operations Information	DOE O 210.1, Performance Indicators and Analysis of Operations Information	TFF closure planning will ensure that proper environment, safety, and health (ES&H) performance indicator data are collected during TFF closure activities.	Incorporate ES&H Performance Indicator Program and Implementation Plan, as needed
Classified Waste	DOE O 5632.1C, Protection and Control of Safeguards and Security Interests DOE O 5633.3B, Control and Accountability of Nuclear Materials	TFF closure planning will determine whether these DOE orders are applicable to TFF closure and waste management activities.	If determined applicable, revise the existing Safety and Security Program, Physical Inventory Program, and Material Control and Accountability Plan, as needed
Conduct of Operations	10 CFR Part 820, Procedural Rules for DOE Nuclear Activities DOE O 5480.19, Conduct of Operations Requirements for DOE Facilities	TFF closure planning will ensure closure activities are conducted to meet established operation performance and safety objectives.	Incorporate operational and safety programs, as needed
Criticality Safety	DOE O 420.1, Facility Safety	During TFF closure planning, the applicability of nuclear criticality safety requirements will be determined and documented.	If determined applicable, modify Criticality Safety Program, as needed
Emergency Management Program	DOE O 151.1, Comprehensive Emergency Management System	TFF closure activities will be conducted in accordance with an emergency management program.	Incorporate Emergency Management Program, as needed
Environmental and Occurrence Reporting	DOE O 231.1, Environment, Safety and Health Reporting DOE O 232.1A, Occurrence Reporting and Processing of Operations Information	TFF closure activities will include providing appropriate ES&H data and reports to meet established reporting requirements.	Incorporate ES&H Reporting Manual, as needed Incorporate Occurrence Reporting Program, as needed

Table 1. (continued).

Category	Requirement	TFF Closure Strategy	Documentation
Environmental Monitoring	DOE O 5400.1, General Environmental Protection Program DOE O 5400.5, Radiation Protection of the Public and the Environment 10 CFR 834	TFF closure activities will include performing and supporting the necessary environmental monitoring requirements. Following closure, post-closure monitoring will be incorporated into CERCLA monitoring programs.	Incorporate Environmental Monitoring Plans and requirements, as needed
Floodplains/Wetlands	10 CFR 1022, Compliance with Floodplains/Wetlands Environmental Review Requirements	It is conservatively assumed that some of the structures and closure activities will encroach onto the limits of the 100-year floodplain. If DOE determines that the project is impacting the defined limits of the 100-year floodplain, then a floodplain assessment will be prepared to determine impacts associated with the action.	Floodplain Assessment, if applicable
Hazard Analysis Documentation and Authorization Basis	DOE P 450.4, Safety Management System Policy DOE O 425.1, Startup and Restart of Nuclear Facilities DOE O 5480.21, Unreviewed Safety Questions DOE O 5480.22, Technical Safety Requirements DOE O 5480.23, Nuclear Safety Analysis Reports	TFF closure planning will include development of hazard analysis documentation and maintenance of an authorization basis, as required.	Hazard Baseline Documents, as determined applicable Note: the type of documents required may include a combination of either a Safety Analysis Report, Health and Safety Plan (HASP) to comply with 29CFR 1910.120, Basis for Interim Operation, technical safety requirements, or other types of documented analysis (e.g., Auditable Safety Analysis) and work packages used to plan and control work tasks.

Table 1. (continued).

Category	Requirement	TFF Closure Strategy	Documentation
Life-Cycle Asset Management Facility Disposition Management	DOE O 430.1, Life-Cycle Asset Management DOE O 4330.4B, Maintenance Management Program	TFF closure planning will ensure accurate documentation of TFF physical assets and systems and will allow reliable analysis of existing and potential hazards to the public and workers.	1st and 2nd Tier DOE closure plans, Safety Management System, TFF Closure Design, DOE Closure Report
Packaging and Transportation	DOE O 460.1A, Packaging and Transportation Safety DOE O 460.2, Departmental Materials Transportation and Packaging Management 49 CFR 171 – 180, Hazardous Materials Regulations	Wastes removed from TFF as part of closure activities will be properly packaged and transported in accordance with established procedures and requirements.	Revise Waste Management and Transportation Plan, as needed
Quality Assurance	10 CFR 830.120, Quality Assurance Requirements DOE O 414.1, Quality Assurance (replaces 5700.6C) EPA QA/R-5 EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations	TFF closure planning will include development of a quality assurance program and necessary quality assurance project plans and procedures. TFF closure activities will be conducted in accordance with the quality assurance program.	Quality Assurance Program, Quality Assurance Surveillance Plan, Quality Assurance Project Plan

Table 1. (continued).

Category	Requirement	TFF Closure Strategy	Documentation
Worker Protection Radiation Protection Hazardous Substances Protection	DOE O 440.1A, Worker Protection Management for DOE Federal and Contractor Employees 29 CFR 1910.120 and 29 CFR 1926.65, Hazardous Waste Operations and Emergency Response for General Industry and Construction 10 CFR 835, Occupational Radiation Protection DOE O 5400.5, Radiation Protection of the Public and the Environment 29 CFR 1910.120 and 29 CFR 1926.65, Hazardous Waste Operations and Emergency Response for General Industry and Construction	TFF closure activities will be planned and performed to ensure worker protection and reduce radiation exposure to ALARA criteria. During TFF closure planning, a Safety Management System will be developed including detailed ES&H requirements and procedures to ensure radiation protection and hazardous substance protection. TFF closure and sampling activities will be designed to minimize radiation exposure to ALARA criteria.	Safety Management System including Health and Safety Plan, TFF Closure Design, Health and Safety Plan Incorporate Radiation Protection Program, as needed
Records Management	DOE O 200.1, Information Management Program DOE O 414.1, Quality Assurance (replaces 5700.6C) EPA QA/R-5 EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations	TFF closure activity records will be established and maintained in accordance with established records management procedures. Post-closure records will be maintained as part of the CERCLA program records.	Incorporate Records Management Program, as needed
Release of Waste Containing Residual Material	DOE O 5400.5, Radiation Protection of the Public and the Environment 40 CFR 261	TFF closure activities may result in rinsates and wastes suitable to be released with residual radioactive and/or hazardous constituents. The process for determining and documenting that the waste can be released will be performed in accordance with the order and associated guidance.	Revise Radiation Protection Program and Waste Management and Transportation Plan, as needed

Table 1. (continued).

Category	Requirement	TFF Closure Strategy	Documentation
Safeguards and Security	DOE O 470.1, Safeguards and Security Program	TFF closure planning will determine the applicability of this DOE Order requirements to TFF closure and waste management activities.	If determined applicable, revise the existing Safeguards and Security Program, as needed
Safety Management System	DOE P 450.4, Safety Management System Policy DOE P 450.5, Line Environment, Safety and Health Oversight 48 CFR 970.5204-2, Integration of environment, safety, and health into work planning and execution 48 CFR 970.5204-78 and 48 CFR 970.0470-2, Laws, Regulations, and DOE Directives 48 CFR 970.1001, Performance-based contracting 29 CFR 1910.120 and 29 CFR 1926.65, Hazardous Waste Operations and Emergency Response for General Industry and Construction	TFF closure planning will include use of the existing Integrated Safety Management System specific to TFF closure activities.	Safety Management System including Health and Safety Plan, hazard analyses and hazard baseline documentation, tailored ES&H requirements using Work Smart Standards process
Site Evaluation and Facility Design	DOE O 420.1, Facility Safety DOE O 430.1, Life-Cycle Asset Management	TFF closure planning will determine and document the applicability of the orders and requirements to TFF closure activities. DOE O 420.1, Facility Safety, establishes facility safety requirements related to nuclear safety design criteria, nuclear criticality safety, and natural phenomena hazards mitigation.	Safety Management System, Hazard baseline documentation, as determined applicable

Table 1. (continued).

Category	Requirement	TFF Closure Strategy	Documentation
Training and Qualification	DOE O 360.1, Training DOE O 5480.20A, Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities 29 CFR 1910.120 and 29 CFR 1926.65, Hazardous Waste Operations and Emergency Response for General Industry and Construction	TFF closure activities will be conducted in accordance with established training and qualifications requirements.	Incorporate Training Program and Technical Qualifications Program, as needed Safety Management System Quality Assurance Program
Waste Minimization and Pollution Prevention	Executive Order 12856, Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements Executive Order 12873, Federal Acquisition, Recycling, and Waste Prevention DOE O 5400.1, General Environmental Protection Program	TFF closure activities will be planned and performed to include waste minimization and pollution prevention measures.	Incorporate Waste Management and Minimization Plan, as needed

Note: This table outlines regulatory and DOE directive requirements applicable to TFF closure and presents the conceptual TFF closure strategy and types of documentation anticipated to be generated. During TFF closure planning, a tailored set of environmental, safety and health (ES&H) requirements will be identified through application of an accepted evaluation process such as the Work Smart Standards. This table will be modified as TFF closure planning progresses and the ES&H requirements are further identified.

issues affect the ease with which any performance-based closure standards can be attained and that attainment demonstrated

3.3 Toxic Substances Control Act

In 1997, it was reported to the EPA that small quantities of PCB-contaminated material went to the PEWE system, and therefore possibly to TFF. Therefore, prior to the completion of closure, the tank contents will be analyzed to determine whether polychlorinated biphenyl (PCB) compounds are present. Sample results and/or process knowledge will be used to determine if Toxic Substances Control Act (TSCA) regulations for management and disposal of PCBs are applicable. Also, the possibility exists that paint containing PCBs was applied to surfaces of the tanks, and equipment, (e.g., valve boxes). PCBs were routinely added to some paint as part of its original formula prior to 1970. The valve boxes coated with paint potentially containing high levels of PCBs are considered PCB bulk product waste under the definition in TSCA regulation 40 CFR 761.3:

> "PCB bulk product waste" means waste derived from manufactured products containing PCBs in a non-liquid state, at any concentration where the concentration at the time of designation for disposal was ≥50 ppm PCBs. . . . PCB bulk product waste includes, but is not limited to:
>
> (1) Non-liquid bulk wastes or debris from the demolition of buildings and other man-made structures manufactured, coated, or serviced with PCBs. . . .

If the bulk product (PCB coated) waste is radioactive, the regulations in 40 CFR 761.50(b)(7) allow it to be disposed of "without regard to the PCB component." 40 CFR 761.50(b)(7)(ii) states:

> "Any person disposing of PCB/radioactive waste must do so taking into account both its PCB concentration and its radioactive properties. If, taking into account only the properties of the PCBs in the waste (and not the radioactive properties of the waste), the waste meets the requirements for disposal in a facility permitted, licensed, or registered by a State as a municipal or non-municipal non-hazardous waste landfill (e.g., PCB bulk product waste under § 761.62(b)(1)), then the person may dispose of the PCB/radioactive waste, without regard to the PCB component of the waste, on the basis of its radioactive properties in accordance with all applicable requirements for the radioactive component of the waste."

In summary, if the PCB paint coated equipment is radioactive, it can be disposed of based on the radioactive element alone. However, if the equipment is not radioactive, it may be disposed at an approved municipal or industrial (solid waste) landfill. During TFF closure design, this interpretation will be again confirmed with EPA to ensure that the risk-based disposal option is not applicable to this type of PCB bulk product waste.

3.4 Occupational Safety and Health

In addition to DOE order requirements for radiation and worker protection, occupational safety and health standards for general industry (29 CFR 1910.120) and construction (29 CFR 1926.65) will apply to TFF closure activities. These standards apply to operations involving hazardous wastes

conducted at treatment, storage, and disposal facilities; TFF is regulated as an interim status facility (40 CFR 265, [as incorporated by IDEQ at IDAPA16.01.05.009]).

3.5 CERCLA Program Integration

FFA/CO directs CERCLA activities and environmental restoration milestones at the INEEL. The CERCLA program manages previous spills and releases associated with the operation of TFF. The contamination and subsequent remediation activities will be evaluated to ensure closure activities are consistent with the overall INTEC remediation activities. Contaminated areas or Operable Units (OU) as defined by the FFA/CO, currently being investigated in the vicinity of TFF, include OU 3-13 and OU 3-14. OU 3-13 Comprehensive RI/FS has been completed and decisions for the surface water and perched water at TFF are included in the Final OU 3-13 Record of Decision. TFF lies within the boundaries of (and is largely enveloped by) OU 3-14. OU 3-14 includes 11 soil contamination sites within TFF and interstial soil between the 11 contaminated sites, and Snake River Plain Aquifer (SRPA) groundwater within the INTEC facility fence.

The CERCLA program has reached consensus on the surface and perched groundwater at TFF in the OU 3-13 Record of Decision. The CERCLA program will be investigating and determining remediation requirements and implementing potential remedial actions related to soil and SRPA groundwater contamination inside the INTEC fence line at OU 3-14. TFF closure will be conducted in a manner compatible with the CERCLA activities to the extent practicable. This includes consideration of cumulative risk impacts from contaminants remaining after HWMA/RCRA closure and transfer of any required post-closure responsibilities to the CERCLA program such as capping and environmental monitoring of TFF. Timing of these activities is included in the TFF closure schedule information presented in Section 4.

3.6 Legal Agreements

Numerous requirements imposed by legal agreements (Consent Orders) or similar binding agreements apply to the closure of tanks WM-182 and WM-183. The following provides a brief description of these agreements:

- INEEL Site Treatment Plan (STP) - Before implementation of the project, the waste volumes generated will be estimated to ensure that they are within the limits identified in the INEEL STP. If the volumes exceed the STP limits, the plan will be updated to reflect these volumes.

- Notice of Non-compliance/Consent Order (NON/CO) – The NON/CO, 2nd Modification, requires that Tank No. WM-182, WM-183, WM-184, WM-185, and WM-186 permanently cease use by June 30, 2003 with cease-use for the remainder of the TFF tanks by December 31, 2012.

3.7 Environmental Permits and Regulatory Coordination

In addition to the requirements associated with the DOE radiological and HWMA/RCRA closure of TFF, there are environmental regulatory requirements that must also be met. The environmental analysis and permits, licenses, and other agreements associated with protecting the environment and public that are expected requirements for closure of tanks WM-182 and WM-183 are presented below.

3.7.1 Air Permitting Applicability Determination

An air permit applicability determination (APAD) will be prepared to assess the potential air and radionuclide emissions from proposed TFF closure activities. Idaho regulates emissions of criteria air pollutants, toxic air pollutants and radionuclides associated with the Clean Air Act (CAA). The regulations for air pollution control in Idaho are located in IDAPA 16.01.01, Rules of the Department of Health and Welfare "Rules for the Control of Air Pollution in Idaho." The APAD will identify whether the HWMA/RCRA closure of TFF will be eligible for an exemption or if it will require a permit to construct (PTC) from the State of Idaho as identified in IDAPA 16.01.01.201. The closure of tanks would modify the INTEC air system by eliminating sources to the stack and would potentially establish new sources of potential contaminants. Based on this scenario, it is conservatively estimated that these modifications will require PTC approval.

EPA, through the National Emission Standards for Hazardous Air Pollutants (NESHAP) regulations of 40 CFR 61 , regulates potential radionuclide emissions. The APAD will also identify the NESHAPs requirements. To determine NESHAPs compliance, modeling is conducted to estimate the dose to the maximally exposed individual at the INEEL site boundary. If the modeled, unmitigated, potential emissions exceed 0.1 mrem/year at the INEEL site boundary, a continuous emissions monitor will be required on the new or modified emission source, in accordance with NESHAPs. If the radionuclide emissions exceed 0.1 mrem/year using 40 CFR 61, Appendix D criteria, an application to construct will be required. This monitoring will be required of all emission points for activities associated with TFF closure. All radiological emissions to the environment, including those from all point and diffuse sources, must demonstrate compliance with the NESHAP Standard (40 CFR 61.93) and be submitted for reporting in the INEEL NESHAP Annual Report per 40 CFR 61.94.

3.7.2 National Historic Preservation Act

TFF is potentially eligible for listing in the National Register of Historic Places as contributing elements to the INEEL National Historic District. If determined applicable, activities associated with the closure of TFF will require consultation with the Idaho State Historic Preservation Officer (SHPO) in accordance with 36 CFR 800, the regulations implementing the National Historic Preservation Act. Based on this consultation, the SHPO will identify stipulations that must be met prior to performing closure activities that impact the facility. These stipulations will be documented in a Memorandum of Agreement that identifies the mitigation requirements. It is estimated that the Memorandum of Agreement and stipulation performance will require 90 days to complete. This consultation and compliance, required by Section 106 of the National Historic Preservation Act, will be conducted before the initiation of any closure activities.

3.7.3 Clean Water Act Compliance

The Clean Water Act prohibits the "discharge of toxic pollutants in toxic amounts" to navigable waters of the United States. To ensure that there are no improper discharges associated with the closure or post-closure activities, TFF closure will be designed to eliminate the runoff from the site to the waters of the U.S. This will be accomplished by the design of the TFF stormwater management plan being integrated in the INTEC stormwater management system. As necessary, the INTEC Stormwater Pollution Prevention Plan will be revised to reflect any modifications required to manage runoff from TFF during closure and post-closure activities.

4. TFF CLOSURE STRATEGY

The strategy for closure of TFF includes partial closure of groups of tanks, in sequence, until all tanks and associated equipment are closed. To be protective of human health and the environment, the closure process will remove or decontaminate radioactive and hazardous wastes to the extent technically and economically practicable. By removing waste and decontaminating TFF equipment, HWMA/RCRA closure to performance-based standards may be achievable. To achieve performance-based closure, the tanks and ancillary equipment will be emptied to the extent possible and decontaminated. Rinsates from tank decontamination and residual decontaminated material remaining in the tank system will be sampled to determine if DOE performance objectives and RCRA closure performance standards have been met. If these performance-based closure standards cannot viably be met on some or all portions of the facility, those portions of the facility will be closed to RCRA landfill standards and/or DOE WIR alternative requirements (DOE G 435.1, 1999, Sec. II.B [2][b]2).

If closure under RCRA landfill standards and DOE WIR alternative requirements are required, actions outlined in the contingent portions of the DOE and HWMA/RCRA closure plans would be implemented. Examples include, but are not limited to, vault grouting, pipe capping and grouting, grouting of tank heel residuals, and stormwater run-on/run-off controls. Closure cap installation and postclosure care and monitoring of TFF would be coordinated with the CERCLA program. Many of the actions associated with the contingent HWMA/RCRA closure plan will be implemented to meet DOE radioactive waste disposal requirements regardless of whether HWMA/RCRA closure to performance-based standards can be achieved. Closing TFF to HWMA/RCRA performance-based standards would remove postclosure care, monitoring, and permit requirements, which would be implemented if TFF is closed to HWMA/RCRA landfill requirements. Additionally, closure to HWMA/RCRA performance-based standards allows a greater range of future use for TFF facilities. Options for future activities for TFF are currently being evaluated in the HLW and facilities disposition EIS, so attempts to obtain HWMA/RCRA closure of TFF to performance-based standards does not predispose decisions being considered as part of the EIS. Given the requirements to remove key radionuclides to the maximum extent practicable and know the hazardous constituents and radionuclides remaining in TFF residuals at closure, pursuing HWMA/RCRA closure to performance-based standards provides an effective professional engineering review and oversight mechanism for closure actions, even if ultimately unsuccessful. HWMA/RCRA delisting of tank residuals is not expected to be required under either of the HWMA/RCRA standards (performance based or landfill) under which the TFF unit may be closed.

The process flow model illustrating the planned strategy for DOE and HWMA/RCRA closure of the TFF tanks is shown in Figure 7. The strategy is consistent with the following DOE M 435.1 WIR evaluation criteria and 40 CFR 265.197 (as incorporated by IDEQ at IDAPA 16.01.05.009) requirements:

- At closure, the wastes [HLW-contaminated equipment, components, etc.] have been processed, or will be processed, to remove key radionuclides to the maximum extent that is technically and economically practicable (DOE M 435.1 II.B.[2][a])

- At closure, the owner or operator must remove or decontaminate all hazardous waste and waste residues (40 CFR 265.197, as incorporated by IDEQ at IDAPA 16.01.05.009).

The process illustrated in Figure 7 identifies several decision points, but is generic and conceptual in nature. Decision points include:

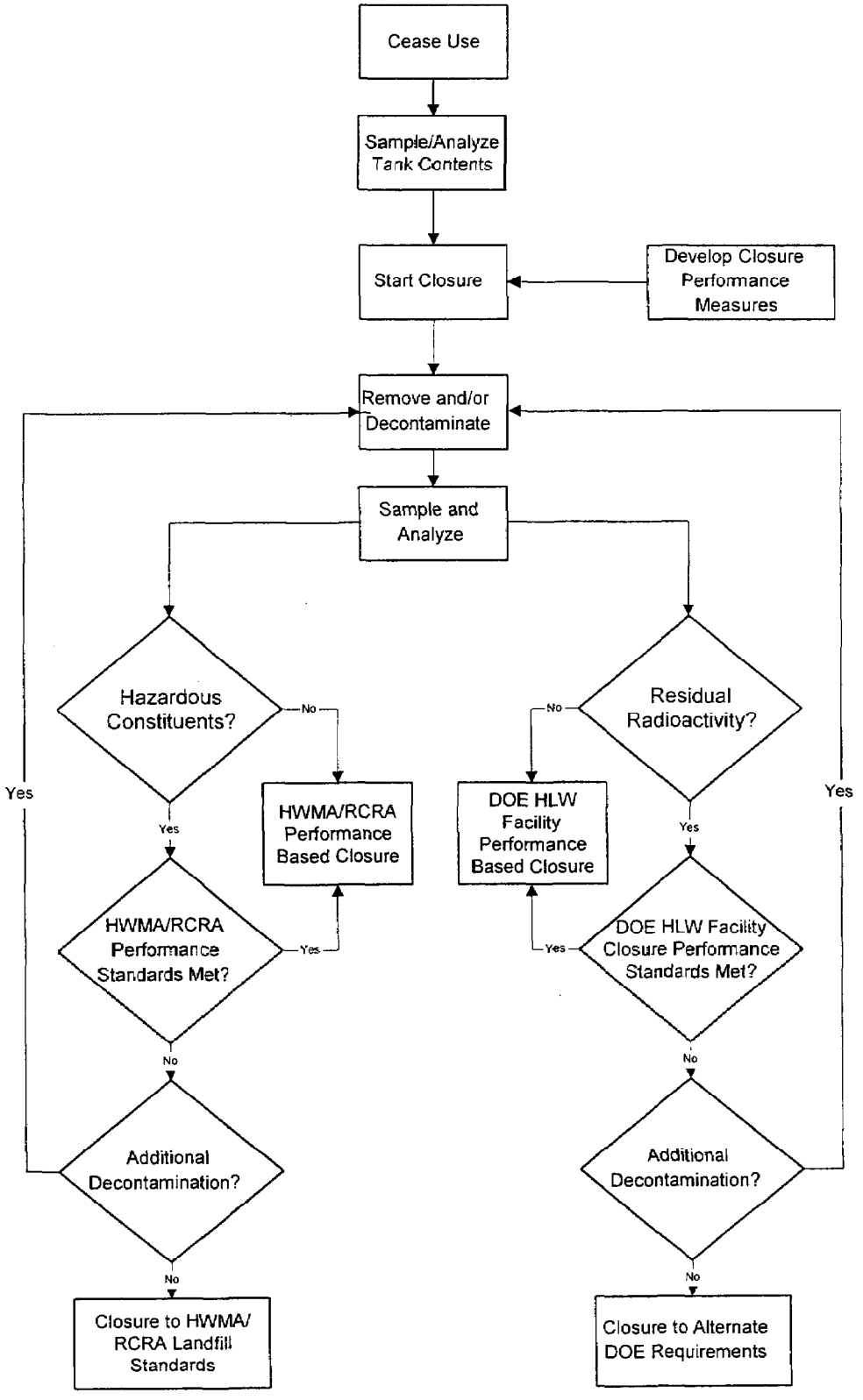


Figure 7. TFF Closure Strategy.

1. Did sampling and analysis of material in the tank after decontamination identify the presence of radioactive and/or hazardous constituents associated with TFF?

2. If radioactive and/or hazardous constituents were found, were they found at concentrations below applicable closure performance standards and objectives?

3. If radioactive and/or hazardous constituents were found at concentrations above applicable closure performance standards and objectives, is additional decontamination warranted?

A set of integrated documentation will be prepared to obtain DOE-ID, DOE-HQ and IDEQ approval and authorization to proceed with closure activities (Figure 8). The DOE-required documents will be developed for closure of TFF as a whole, while the RCRA/HWMA closure plan will be developed only for Phase 1 of the TFF closure, which includes tanks WM-182 and WM-183. The purpose of this strategy is to obtain DOE-HQ Office of Environmental Management (EM) approval of the overall methodology, thereby allowing closure activities to proceed for future groups of tanks without further specific written approval from DOE-HQ; this approach is recognized in DOE G 435.1 Section II.B.(2)(b). The DOE-ID Field Element Manager will review and approve the 1st Tier DOE Closure Plan and WIR determination then submit them to the DOE-HQ Deputy Assistant Secretary for Waste Management for review and approval. Closure of tanks WM-182 and WM-183 (Phase 1) will be a demonstration of the tank closure methods and lessons learned can be applied to closure of the remainder of the Tank Farm Facility.

4.1 General Closure Sequence

Closure of the individual TFF tanks is currently planned to occur using the general sequence illustrated in Figure 7. The twelve steps identified as the general closure sequence in Figure 7 include:

1. Storage of liquid waste
2. Empty to heel with existing jets
3. Video and sample heel
4. Flush tank and piping
5. Empty to heel with existing jets
6. Wash tank and pump
7. Video and sample heel residuals
8. Evaluate tank residuals against closure performance objectives
9. Displace heel with grout
10. Grout piping

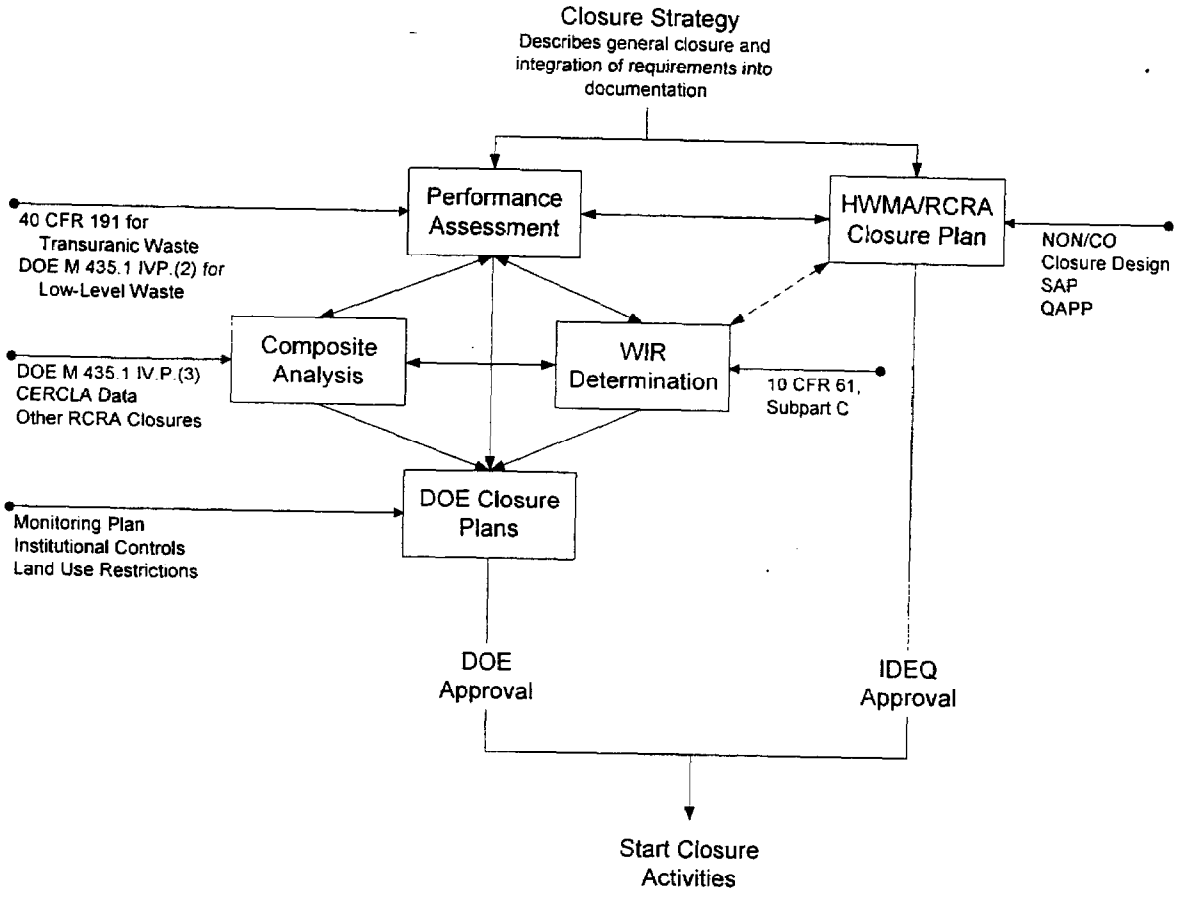


Figure 8. TFF Closure Integrated Documentation.

11. Fill tank vault with grout

12. Fill tank and vault with grout

Steps 1 through 4 are considered part of the tank deactivation. Steps 5 through 8 are the minimum required to remove waste and decontaminate a given tank such that RCRA/HWMA clean closure performance standards may be attained. These steps may be repeated as necessary until no longer effective, i.e., additional decontamination is no longer economically practical. The last four steps will remove remaining tank residuals to the extent readily feasible and stabilize the residuals and the final waste form. These last four steps will be implemented to fulfill DOE requirements and leave the wastes in a solid physical form. Additionally, if required, they will constitute part of the contingent actions for RCRA/HWMA closure to landfill standards.

Several assumptions and decisions are incumbent with this general sequence or individual closure sequence steps. These include:

- INEEL Environmental Restoration is managing soils and abandoned piping surrounding the existing TFF.
- Decontamination is no longer feasible after the start of grout addition
- Quality assurance will be documented through implementation of up front quality programs and procedures, i.e., TFF closure final waste forms will not be physically characterized
- Existing waste removal jets are the only method to be used to remove waste and tank residuals and will only be lowered below their current location after addition of grout

4.2 TFF DOE Closure Strategy

Draft DOE G 435.1 provides three closure paths for deactivated HLW facilities such as TFF: (1) decommissioning, (2) following the CERCLA process, and (3) meeting the requirements of a DOE-approved facility/site-specific closure plan. Closure of TFF will proceed according to the third path: a DOE-approved facility/site-specific closure plan. This third closure path is appropriate because (1) decommissioning requires that closure meet requirements for unrestricted or restricted release of property, which is acknowledged in DOE G 435.1 as unlikely for HLW facilities, and (2) the CERCLA process is not applicable because the closure of operating equipment and facilities, such as, TFF, is not regulated by CERCLA authorities or procedures, as acknowledged by DOE G 435.1 Section II.U.

DOE G 435.1 identifies an integrated set of documentation required for obtaining authorization from the DOE-HQ Deputy Assistant Secretary for Waste Management to proceed with the closure of a deactivated HLW facility. To comply with DOE O 435.1 and its associated manual and guidance, the following supporting documentation will be developed to demonstrate that TFF closure activities will ensure long-term protection of the public and environment:

- DOE deactivated HLW facility 1st and 2nd tier closure plans (DOE closure plans)
- WIR determination

- PA (part of WIR determination and DOE closure plans)

- CA (part of DOE closure planning).

The 1st and 2nd Tier DOE Closure Plans will define the approach and closure activities to be performed to ensure both short- and long-term protection of the public and environment in accordance with the identified performance objectives. The PA will ensure and document that at the completion of closure actions TFF residuals will meet LLW disposal performance objectives (DOE M 435.1 IV.P.[2]). Using the PA, the WIR determination will document that the residual radioactive material remaining in the deactivated TFF can be managed as either LLW or TRU waste. In addition, the CA will be conducted to ensure that the cumulative impacts from all current and planned closure facilities meet the established performance objectives and closure standards.

4.2.1 DOE Closure Plans

As specified by DOE M 435.1 a closure plan will be developed that defines the approach and plans by which closure of each facility within the site is to be accomplished. This plan must be completed and approved prior to the initiation of physical closure activities and updated periodically to reflect the current analysis and status of individual facility closure actions. Closure plans prepared for DOE will include a 1st tier closure plan for the TFF facility which will be approved by DOE Office of Environmental Management and a 2nd tier closure plan approved at DOE-ID for each tank or group of tanks to be closed. As stated in DOE M 435.1 Section II.U.(3)(a),

"The plan shall include, at a minimum, the following elements:

1. Identification of the closure standards/performance objectives to be applied from Chapter III [Transuranic Waste] or IV [Low-Level Radioactive Waste] of the DOE M 435.1

2. A strategy for allocating waste disposal facility performance objectives from the closure standards identified in the closure plan among the facilities/units to be closed at the site

3. An assessment of the projected performance of each unit to be closed relative to the performance objectives allocated to each unit under the closure plan

4. An assessment of the projected composite performance of all units to be closed at the site relative to the performance objectives and closure standards identified in the closure plan

5. Any other relevant closure controls including a monitoring plan, institutional controls, and land-use limitations to be maintained in the closure activity."

The DOE closure plans will address the three phases of facility closure for TFF; (1) operational or interim closure, (2) final facility closure, and (3) institutional closure. For TFF, it is expected that interim closure will occur as a DOE/RCRA action, and final closure will occur as a CERCLA action in conjunction with remedial actions for OU 3-14. Institutional closure will occur through implementation of the INEEL Land Use Plan (DOE-ID, 1995), use restrictions, and continued maintenance of previous

closure actions. Other relevant closure controls that will be developed as part of this closure plan include a monitoring plan, institutional controls, and land-use limitations.

4.2.1.1 1st Tier DOE Closure Plan. The 1st Tier DOE Closure Plan defines the approach for ensuring the long-term protection of the public and the environment from the closure of TFF and for obtaining an authorization to proceed prior to physical closure actions. Included as part of this approach are the purpose and objectives of the closure action and a general discussion of how the specific closure action fits with other past, planned closure actions. The 1st Tier DOE Closure Plan will address the three phases of closure discussed in Section 4.1, above.

The 1st Tier DOE Closure Plan, which is to be approved by the Deputy Assistant Secretaries for Waste Management and Environmental Restoration per the requirement in Section I.2.D.(2) of DOE O 435.1, is intended to define and bound the parameters of the TFF closure. This level of closure plan will include the following topics:

- Closure methodology
- Schedules and assumptions
- Site and unit closure standards/performance objectives
- Strategy for allocating closure standards/performance objectives to individual units
- Alternatives
- Waste characterization data
- Stakeholder concerns.

DOE G 435.1 recognizes that the availability of some of the above information may be limited and therefore preliminary. However, it is considered necessary to ensure that a credible, bounding review can be conducted at the DOE EM level.

Once approved, the TFF 1st Tier DOE Closure Plan will be updated periodically, as determined by the Field Element Manager, to reflect revised analysis and the status of individual unit closure actions. The concept is that the closure plan is to be a living document that is constantly updated through the operation life of the closure activities, with specific information about the contents and actions of partial closures along with any other information necessary to support final closure. It is imperative that the relationship between the analysis conducted in the assessment of the projected performance of each unit and the assessment of the projected composite performance of all units be kept in mind as the closure activities commence. Any information that is incorporated into a closure plan or any changes made to the closure activities of a facility that impacts the analysis in either of these assessments will be incorporated as soon as possible so that the extent of their impact on the closure can be known and any required changes can be made effective as soon as possible.

Additionally, the closure plan will include the designs and approaches to be taken for each step in the closure process and will be coordinated with the monitoring plan for the site. The closure plan will

provide the details for accomplishing the closure requirements included in the design. The plan will provide a discussion of applicable DOE, Federal, and State closure requirements. A discussion of each activity that will be performed during each phase of the closure process and the relationship between the activities that will achieve the desired result of minimum maintenance and long-term stability will be provided. The methods for accomplishing each of the closure activities will be provided for each phase of the closure, including those methods that will be employed to minimize infiltration of water into the TFF tanks and the final landscape. The closure plan will discuss how contaminant migration will be controlled on both a short- and long-term basis. A description of any stabilization action that will be necessary will be included in the plan. Any additional requirements to minimize wind and water erosion or intrusion by plants and animals will also be provided.

The 1st Tier DOE Closure Plan will include a summary of how each of the activities will place TFF into a configuration that will allow meeting the performance objectives in both the short- and long-term. The schedule for completing the closure will accompany this summary. The schedule will show each phase of closure and the preparation and approval of related documents and permits, such as the final assessment of projected performance, projected composite performance of all units, safety analysis report, RCRA permit, or state approvals.

The closure plan will also address corrective action at each stage of the closure process. It will include all elements of the inspection program, methods of inspection, and the criteria for initiating corrective action. Specific corrective action responses for different scenarios will be included. These corrective actions include responses to contaminant migration, flooding and other natural phenomena, failure of monitoring equipment, excessive infiltration, erosion, and the presence of undesirable flora and fauna. The relationship between corrective actions to ensure compliance with performance objectives and the monitoring program will be clearly identified.

4.2.1.2 2nd Tier DOE Closure Plan. The second (or lower) tier closure plans, which will be approved by the Field Element Manager, or designee, will provide the detailed information related to specific unit closure actions that are bounded by the information that is contained in the 1st Tier DOE Closure Plan. The lower tier closure documentation will demonstrate that the performance objectives identified in the upper tier documentation will be met and maintained. Once DOE EM review/approval is gained on the first tier documentation and an authorization to proceed is issued, additional DOE EM approvals are not required, provided the boundaries and conditions defined in the DOE EM-approved first tier are not exceeded.

4.2.2 Waste Incidental to Reprocessing Determination

Certain waste streams produced during the generation of HLW waste may be determined as non-HLW through the WIR determination process (DOE G 435.1, 1999, Sec. II.B). Residual radioactive material remaining in a deactivated HLW management facility (such as TFF) is considered HLW unless it is determined to be TRU or LLW through the WIR process. A WIR determination for the waste residuals remaining in TFF at the time of closure must be made prior to performing irreversible closure activities. Implementation of the WIR process will ensure that DOE manages these waste streams within its regulatory authority for disposal.

DOE M 435.1 specifies two distinct processes by which DOE can determine whether or not reprocessing wastes can be managed as LLW or TRU waste through a WIR determination: (1) by citation and (2) by evaluation. Tank residuals whose removal is not considered to be technically and economically practical is one example used in DOE G 435.1 of a waste stream that is an expected

candidate for the evaluation process, and applies to the residual waste remaining at closure in TFF after waste removal or decontamination.

4.2.3 Performance Assessment

Radiological PAs are required for a variety of occurrences including LLW disposal, WIR determination, and closure of deactivated HLW facilities/sites. For example, DOE M 435.1 Criterion (b) for obtaining a WIR determination through the evaluation process is that the waste "will be managed to meet safety requirements comparable to the performance objectives set out in 10 CFR Part 61, Subpart C, *Performance Objectives*." Also, one of the required components of a closure plan for deactivated HLW facility/site is "an assessment of the projected performance of each unit to be closed". The requirement to prepare a PA prior to initiation of closure activities is reinforced in DOE G 435.1 which states "the requirement to conduct a PA to meet the criterion in Section II.B.(2)(b)*" (Waste Incidental to Reprocessing)* "should be coordinated with similar requirements in Section II.U, Site Closure, to avoid redundant analysis."

The PA will be iterative in nature as information on the postclosure content of TFF is developed. The PA will follow methods appropriate for the residual waste stream projected to be LLW or TRU waste:

- Low-Level Radioactive Waste Performance Assessment. This assessment should be consistent with the requirements of a PA as defined in Chapter IV, Section P.(2) of DOE M 435.1.

- Transuranic Waste Performance Assessment. This assessment should demonstrate compliance with the standards contained in 40 CFR 191, *Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Wastes* (DOE G 435.1 III.P).

DOE has developed guidelines and recommended formats for PAs. DOE guidance documents include:

- *Format and Content Guide and Standard Review Plan for U.S. DOE LLW Disposal Facility Performance Assessments*, 1996

- *Performance Assessment and Composite Analysis Review Guidance Manual*, 1999.

4.2.4 Composite Analysis

In accordance with facility/site closure plan requirements, "an assessment of the projected composite performance," a CA including all radioactive source terms which may interact with TFF residuals will be performed as part of the closure process. As such a site-specific radiological CA will be prepared and maintained that accounts for all sources of radioactive material that may be left at the DOE site and may interact with TFF. Projections of release and dose made in the CA will be used for planning, radiation protection activities, and future use commitments.

The CA provides a suggestion of what could conceivably happen if DOE did not act to protect public health and safety and provides information that DOE can use for planning. For example, the results of the CA can assist DOE in identifying those sources that most significantly contribute to the total

projected dose and in deciding on priorities for remediation or closure alternatives for active or inactive closure sites. Hazard implications for some sources may be so low that little needs to be done beyond land control, minor maintenance, and monitoring.

4.3 TFF HWMA/RCRA Closure Strategy

For HWMA/RCRA closure of interim status facilities, 40 CFR 265.111 (as incorporated by IDEQ at IDAPA 16.01.05.009) specifies that the owner or operator must close the facility in a manner that:

- Minimizes the need for further maintenance
- Controls, minimizes, or eliminates, to the extent necessary to protect human health and the environment, postclosure escape of hazardous waste, hazardous constituents, leachate, contaminated run off, or hazardous waste decomposition products to the ground or surface waters or to the atmosphere
- Complies with the closure requirements of 40 CFR 265.197 (as incorporated by IDEQ at IDAPA 16.01.05.009) for interim status tanks; e.g., the closure plan includes contingent closure actions for closure to landfill standards if the unit does not have compliant secondary containment.

Closure and post-closure care stipulated in 40 CFR 265.197 goes on to state:

> "At closure of a tank system, the owner or operator must remove or decontaminate all waste residues, contaminated containment system components (liners, etc.), contaminated soils, and structures and equipment contaminated with waste, unless § 361.3(d) of this chapter applies. The closure plan, closure activities, cost estimates for closure, and financial responsibility for tank systems must meet all of the requirements specified in subparts G and H of this part."

As contaminated soils surrounding TFF are being addressed under CERCLA, they are not included in the TFF unit being closed and are not subject to this requirement.

4.3.1 RCRA Performance-Based Closure

The RCRA performance-based standards will be developed in concert with IDEQ (Herman 1996). Under closure to performance-based standards, hazardous constituents may remain, yet the unit is left in a condition protective of human health and the environment and is suitable for closure. Should performance-based closure standards not be achievable, contingent actions identified in the tank-specific closure plan will be implemented under closure to landfill standards.

Specific steps to implement performance-based closure include:

1. Removal of hazardous waste and/or decontamination to the extent technically and economically practical
2. Performance of sampling activities to characterize tank system residuals

3. Completion of an assessment to determine if contaminant chemical concentrations in decontaminated TFF residuals present a risk of 10^{-4} or less

4. Determination of completion of closure. Either the 10^{-4} performance has been met, additional decontamination is prudent, or the contingent closure would be implemented and the system closed to landfill standards (Section 3.2.2).

The assessment identified in (3), above, will be used to determine if closure-performance standards have been attained and if there is a need/desire for additional decontamination measures. This evaluation for determining if performance standards are attained will use methodologies consistent with other risk assessments previously conducted at the INEEL and will use contaminant concentrations obtained by analysis of tank residuals, not concentrations prior to waste removal and/or decontamination. This approach will provide evidence that the closure is protective of human health and the environment and meets the closure-performance standard and the HWMA/RCRA performance based closure is complete. Closing TFF to HWMA/RCRA performance-based standards would remove postclosure care, monitoring, and permit requirements, which would be implemented if TFF is closed to HWMA/RCRA landfill requirements. Additionally, closure to HWMA/RCRA performance-based standards allows a greater range of future use for TFF facilities. Options for future activities for TFF are currently being evaluated in the HLW and facilities disposition EIS, so attempts to obtain HWMA/RCRA closure of TFF to performance-based standards does not predispose decisions being considered as part of the EIS. Given the requirements to remove key radionuclides to the maximum extent practicable and know the hazardous constituents and radionuclides remaining in TFF residuals at closure, pursuing HWMA/RCRA closure to performance-based standards provides an effective professional engineering review and oversight mechanism for closure actions, even if ultimately unsuccessful. HWMA/RCRA delisting of tank residuals is not expected to be required under either of the HWMA/RCRA standards (performance based or landfill) under which the TFF unit may be closed.

4.3.2 Closure to RCRA Landfill Standards

If HWMA/RCRA closure to performance based standards cannot be achieved TFF will be closed to HWMA/RCRA landfill standards. Actions which would be taken as part of TFF closure to landfill standards will be described in the contingent landfill closure plan to be included with as part of the HWMA/RCRA closure plan. Closure of a storage unit, such as TFF, to landfill standards requires strategies different from those used to close a disposal unit. TFF tank system closure to landfill standards would still require that wastes be removed to the low levels that do not require further care when capped (52 FR issue, 1987). Therefore, even if TFF is closed under landfill standards, the heels remaining in the tanks need to be removed and equipment decontaminated to the extent practicable.

An important part of closure to landfill standards is monitoring the closed facility by instituting a groundwater monitoring program. Conversely, performance-based closure does not rely on post-closure monitoring to determine that the closure has been protective. Because groundwater below the INTEC facility is currently contaminated with chemicals and radionuclides, it would be difficult to identify contamination sources using post-closure monitoring, again indicating the need for effective waste removal and decontamination at closure.

4.3.3 HWMA/RCRA Closure Plan

Because TFF is an HWMA/RCRA interim status hazardous waste management unit, an HWMA/RCRA closure plan is required to be submitted to IDEQ for approval before initiating closure activities. In accordance with the second modification to the NON/CO, the HWMA/RCRA closure plan

for the first tank to be closed must be submitted to the State of Idaho by December 31, 2000. The HWMA/RCRA closure plan will present closure objectives and methods, facility/tank descriptions and operating history, closure requirements and performance standards, closure process, contingent landfill closure, closure-generated waste handling and disposal, TFF partial interim and final closure actions, amendments, certification of closure requirements, and cost and liability requirements.

4.4 Approval Process and Schedule

In accordance with DOE O 435.1 (1999), approval of the 1st Tier DOE Closure Plan must be obtained from DOE-ID and DOE-HQ — including an authorization to proceed from the DOE-HQ Deputy Assistant Secretary for Waste Management — prior to initiating physical closure activities. Also, to comply with HWMA/RCRA requirements, approval of the HWMA/RCRA closure plan must be obtained from IDEQ. As discussed in Section 3, additional regulatory permits and approvals may be required to comply with the National Historic Preservation Act, Clean Water Act, CAA, other DOE orders and INEEL programs, the FFA/CO, and the TSCA (if determined applicable).

4.4.1 Closure Roles and Responsibilities

As previously described, closure of TFF requires completion of an integrated set of plans, analyses. Implementation of these plans requires the cooperation, review, and approval from a variety of operating and oversight organizations. Table 2 below is a summary which briefly identifies the primary cognizant organizations and describes their role and/or responsibility with regard to TFF closure planning and implementation.

4.5 TFF Component Closure Schedule

Tanks will be closed in groups (or phases), each of which is expected to take approximately 2 to 3 years to complete. As identified in Section 1, the TFF tanks will cease use in accordance with the NON/CO (DOE-ID 1998). Initiation of activities to support closure of tanks within TFF are currently planned to occur as indicated in Table 3.

Sequencing of tank closures was based on requirements of the NON/CO, augmented by estimated INTEC operational requirements, and a desire for early closure of those tanks with less robustly designed vaults. Specific criteria for grouping and planning for the order of tank closures include:

1. Emphasize closure of tanks with pillar and panel vault construction, as this construction design results in the lowest margin of safety during seismic events

2. Tank closures in groups of two or more for economy of scale and minimization of downtime (e.g., placing grout in second tank while waiting for grout in first tank to cure)

3. History of tank usage and expected composition of tank heels, i.e., as the demonstration phase of the TFF closure, tanks WM-183 and WM-183 are expected to bound the other tanks and are believed to be the tanks with the most and least residual solids, respectively

Table 2. TFF closure organizational roles and responsibilities.

Organization	Role
INEEL HLW Program	• Development of closure plans and analyses which are compliant with state and federal laws, DOE orders and guidance, and demonstrate that the TFF closure will be protective of human health and the environment. • Development of programs, projects, and processes to allow closure schedules to be met and to ensure closure generated waste storage and disposal is available. • Communicate and interface with DOE, the State of Idaho, and stakeholders • In concert with INEEL Environmental Affairs, development of effective and substantial stakeholder involvement opportunities.
INEEL ER Program	• Development of OU 3-14 remedial investigation and remediation options integrated and consistent with closure actions • Demonstration that environmental restoration activities are compliant with the substantive requirements of DOE M 435.1
INTEC Operations	• On site support for closure field activities • Conduct of TFF tank deactivation steps • Management and/or treatment of closure generated wastes
INEEL Engineering Services	• Develop conceptual and title designs for closure actions • Demonstration that closure design methods and equipment are effective and reliable.
INEEL Environmental Affairs	• Ensuring that closure plans and designs will result in closure actions compliant with environmental regulations • Development of documentation sufficient to obtain required environmental permits and approvals such that closure schedules are not impacted. • Assist in communication and interface with DOE and IDEQ to ensure TFF closure environmental regulatory issues are identified and resolved in a timely manner. • In concert with the INEEL HLW program, development of effective and substantial stakeholder involvement opportunities.
DOE-ID	• Develop and implement a formal review and approval process for closure plans and other closure documentation (e.g., PA and CA) prior to submission to DOE headquarters • Approval of WIR determinations and development of consultation methods with DOE-EM and with NRC (if option for consultation with NRC is selected) • Actively monitor closure operations to ascertain compliance with conditions or controls identified in authorization to proceed
DOE Office of Environmental Management	• Consultation/coordination with INEEL on WIR determination issues to ensure criteria are demonstrably met • Coordination to ensure timely DOE-HQ review and approval of closure plans and analyses • Coordination in development of authorization to proceed documentation
Deputy Assistant Secretary for Waste Management	• Review and approve 1st tier closure plan and issue authorization for closure activities to proceed

Table 2. (continued).

Organization	Role
IDEQ	• Review and approval of TFF HWMA/RCRA closure plans • Conduct of public involvement activities associated with solicitation of public comment on TFF HWMA/RCRA closure plans. • Voluntary consultation with INEEL personnel to identify and resolve TFF closure issues • As appropriate, approval and issuance of environmental permits to allow TFF closure actions
EPA	• If applicable, consultation to ensure compliant handling/disposal of TSCA regulated materials (PCBs)
NRC	• If requested and funded by DOE-ID, consult on closure methods and analyses conducted in support of WIR determinations.

Table 3. TFF Tank Closure Schedule.

Phase	TFF Tank Number	Estimated Completion of Closure Activities
1	WM-182	2003
	WM-183	2004
2	WM-184	2005
	WM-186	2006
3	WM-103	2008
	WM-104	2008
	WM-105	2008
	WM-106	2008
4	WM-180	2011
	WM-181	2009
5	WM-185*	2012
	WM-187	2013
	WM-188	2014
6	WM-189	2015
	WM-190	2015

* As allowed in the NON/CO, Tank WM-185 may be maintained as a spare for emergency waste storage.

4. Requirements for continued management and operability of TFF

5. Accessibility (near the edge of TFF) for ease of continued TFF usage.

With these criteria, tanks WM-182 and WM-183 were selected to be closed in the first phase of TFF tank system closure. Tank WM-182 contained waste from a limited number of fuel types and waste sources and is expected to have a comparatively noncomplex tank heel composition, while tank WM-183 held waste from a large number of fuel types and waste streams and is expected to have a more complex tank heel composition. Tanks WM-184 and WM-186 constitute the second phase and were chosen because they are pillar and panel tanks and do not contain cooling coils (and therefore were scheduled for closure after WM-182 and WM-183 which are pillar and panel tanks with cooling coils). The third phase of the TFF tank system closure includes tanks WM-180 and WM-181, selected for their accessibility and

because they are the oldest 300,000-gallon tanks. In a similar manner, the remaining tanks were selected for phased closure as indicated in Table 3 and illustrated in Figure 2.

As mentioned previously, the DOE O 435.1 required documents (DOE closure plans, WIR determination, PA, and CA) will be developed for closure of TFF as a whole, while the RCRA/HWMA closure plan will be developed only for Phase 1 of the TFF closure, which includes tanks WM-182 and WM-183.

4.6 Schedule for Document Development

Figure 9 presents an overall schedule for TFF closure actions, including CERCLA actions on soils surrounding TFF components.

General activities associated with obtaining these approvals include preparation of the following:

- RCRA/HWMA closure plan
- PA
- CA
- WIR determination
- DOE closure plans
- Environmental permits, regulatory coordination, and post closure activity definition

Table 4 provides a summary of the environmental permits and evaluations identified to date for Phase 1 TFF tank closures, including scheduled start dates.

Table 4. Potential Permits and Approvals for Closure of Tanks WM-182 and WM-183.

Regulation, DOE Order, Consent Order Permit Impacted	Discussion	Evaluation Start Date[1]
National Historic Preservation Act	Requires consultation with Idaho State Historic Preservation Officer and compliance with substantive requirements identified during consultation or in a Memorandum of Understanding.	10/01
Clean Water Act Compliance	Modification to the INTEC Stormwater Pollution Prevention Plan for stormwater runoff.	10/01
CAA Compliance	An Air Permitting Applicability Determination will identify CAA and NESHAPs requirements and applicable permits will be obtained.	12/00
DOE Orders, Regulations, and Requirements	National Environmental Policy Act (NEPA) (EIS coverage). Follow-on environmental checklist	10/01
	INEEL Site Treatment Plan	10/01
	Floodplain management	12/00
	DOE O 5820.2A (Draft O435.1)	3/99
FFA/CO	CERCLA coordination and agreements for transfer of postclosure responsibilities.	3/99[2]
TSCA Compliance	The system will be characterized to determine whether PCBs regulations are applicable.	6/99

[1] Unless otherwise identified, required permits and/or approvals are needed prior to the start of closure activities.

[2] This agreement is needed prior to submittal of the closure plan to the State of Idaho in 12/00.

DRAFT SHORT-TERM SCHEDULE OF TFF CLOSURE

11/19/1999

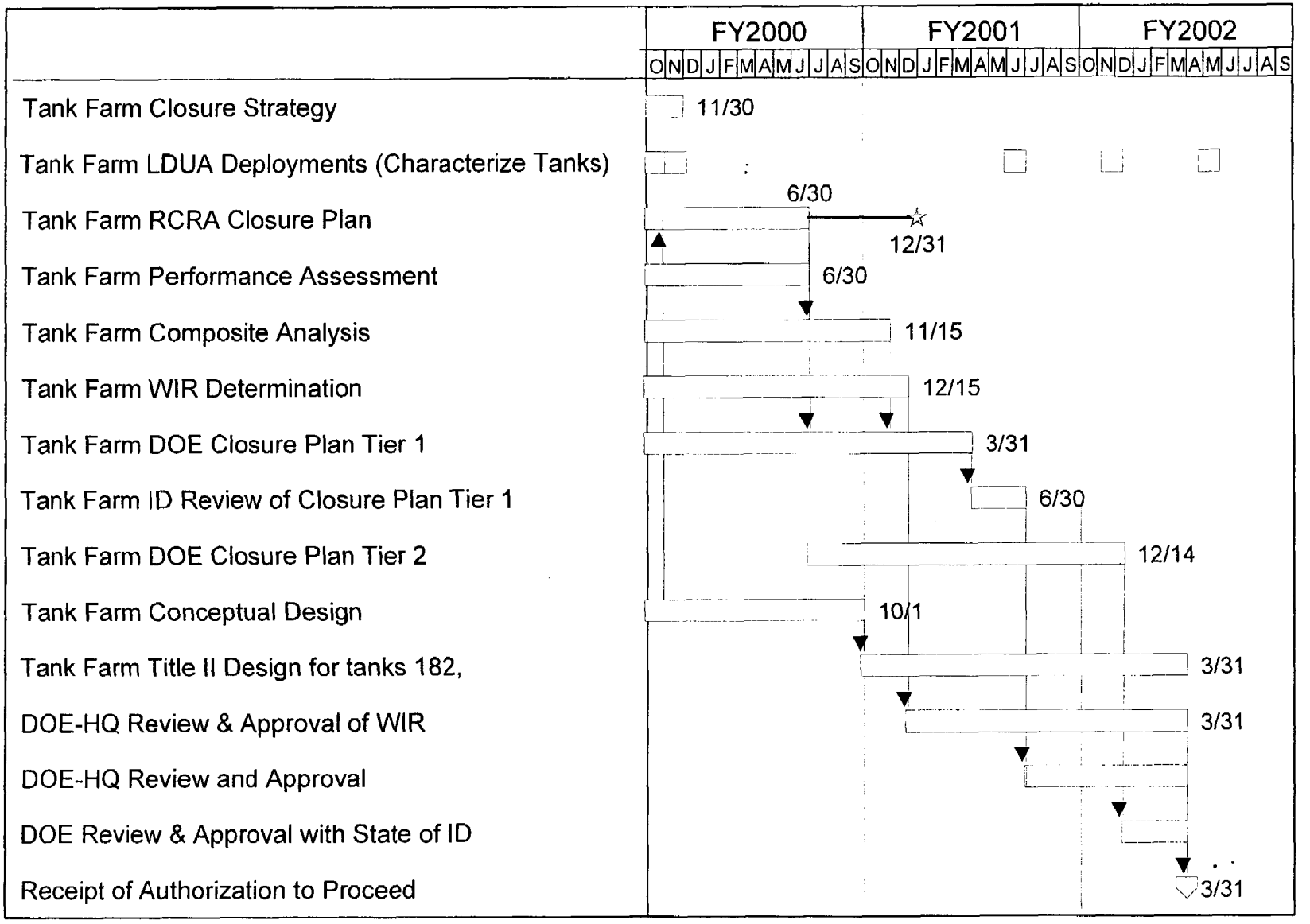


Figure 9. Draft Short-Term Schedule of TFF Closure.

5. TANK CLOSURE ACTIVITIES

The following discussion summarizes the preferred approach to waste removal, decontamination, and equipment closure (capping and grouting) as determined in a recently completed closure study on tanks WM-182 and WM-183 (Spaulding et al. 1998). Ongoing and future studies being conducted (or planned) to ensure that DOE O 435.1 (1999) and HWMA/RCRA closure requirements will be efficiently and economically met include:

- Evaluation and development of reliable methods to obtain samples from all tank system components
- Mock-up of tank conditions to determine effective tank access, waste removal, decontamination parameters, and grout placement
- Continued analysis for determination/development of decontamination methods.

Appendix C presents a summary of the TFF conceptual design and the current list of actions to be mocked-up prior to implementation in the TFF closure.

Activities that will be conducted to support TFF closure are:

- TFF site preparation
- Tank isolation
- Heel management
- Vault isolation
- Piping, vault and tank grouting (as necessary).

These activities are presented in general order of completion, but parts of following or succeeding activities may occur at any time. Additionally, some actions supportive of TFF closure may occur as part of normal TFF operations before the start of formal closure activities. The following discussion of these steps is an example based on a feasibility study of closure options for tanks WM-182 and WM-183 (Spaulding et al. 1998). Some existing and new equipment used in closure activities, such as submersible pumps and piping for grout placement, will be abandoned in the tanks following use to reduce personnel radiation exposure and limit generation of secondary waste streams such as solutions used for decontamination of such equipment.

Quantifying and/or removing uncertainties associated with closure of TFF is dependent on performing various tasks that will help characterize the tank contents, assess the quality of the data, and prepare closure design. These tasks include collecting samples of solids in the tank heels from tanks WM-182 and WM-183 and preparation of a mock-up of tank closure activities. Sampling and mock-up development will provide important data about the presence and concentration of hazardous constituents, hazardous waste, radionuclides, information about physical properties of the solids, and conduct of the closure activities.

5.1 Site Preparation and Tank Isolation

Site preparation includes providing items such as power, water, steam, control buildings, and enclosures to contain contaminants. Site preparation also includes removing as much liquid as possible using the existing jets in the tanks in preparation of tank isolation.

Tank isolation includes:

- Isolating the existing tank off-gas system from each tank and installing a temporary off-gas system
- Flushing the process waste lines used to transfer liquid to or from the tanks. A variety of decontamination solutions may be used. The process waste lines will be flushed by decontamination fluids to remove waste and reduce the radiation fields.
- Decontamination of the valve boxes. The valve boxes will be decontaminated with simple cleaning solutions. Since the drain lines from valve boxes flow directly to vault drain sumps, fluid used for valve box decontamination will be jetted out of the vault sumps prior to vault isolation.
- Isolating the process waste lines as necessary
- Washing the inside of each tank while removing the mixed heel and wash solution out of the tank.

The process waste lines will be isolated first because these lines contain higher levels of radioactive contamination than any other lines ancillary to the tanks being closed, resulting in a higher radiation exposure risk to personnel, and because these lines are directly tied to the operational portion of TFF and could allow additional waste into the tank system being closed (Spaulding et al. 1998).

5.2 Heel Management and Tank Decontamination

Heel management, associated with the 300,000-gallon tanks, will occur before closure activities begin, during tank isolation, and subsequent to tank decontamination and will include characterization of heel contents for contaminants of concern. Basin water from CPP-603 may be used for heel management and tank rinsing if it is available before tank isolation. The CPP-603 basin contains approximately 1.5 million gallons of water used for shielding of stored SNF. This water contains small amounts of radioactivity but no HWMA/RCRA hazardous waste. This water will be removed from the CPP 603 basin, once all SNF has been moved, to dry spent fuel storage facilities. Use of this basin water for heel management will help minimize the amount of liquid eventually processed by existing or future INTEC treatment systems.

Tank access is limited due to the high radiation fields and the number and configuration of tank risers. The equipment necessary to wash the tanks will be installed through the existing tank risers. Currently, the tank risers contain steam and process waste lines associated with the steam jets, corrosion coupons, and liquid-level indicators. As necessary, this equipment will be removed from the risers or lowered into the tank so that adequate space is available for the equipment required during closure activities. The corrosion coupons currently located in tanks may be removed for future analysis and the tank risers decontaminated using standard INTEC operating procedures. To remove as much of the heel

as is technically and economically practicable, removal methods, such as use of a submersible pump, will be evaluated.

Examples of techniques or equipment that may be used in the decontamination of TFF tanks include:

- Installation of video equipment in tanks to monitor decontamination progress. Video equipment is likely to be required to assist in remote closure and void-filling activities that take place inside the tank. Remote, in-tank activities will include closure operations, such as equipment installation and operation and tank washdown. Video equipment may also be used to document the conditions inside the tanks before and after tank closure activities (previous video tank inspections reveal that residues located on the tank walls and cooling coils are easily removed with a low-pressure water spray).

- Washing or decontamination of the tank interior may be performed with a low-pressure spray. Studies have been performed to choose the best tank decontamination equipment (Spaulding et al. 1998). The low-pressure (40 to 150 psi) spray, which also agitates the heel, and a submersible pump, used to pump the remainder of the heel to another tank, are currently proposed for use in tanks WM-182 and WM-183.

- Use of a solid stream spray nozzle attached to a 360-degree tank cleaning system for tank washdown

- A light duty utility arm (LDUA) currently being developed may be used for various sampling tasks.

Washing the tank internally is intended to remove residue buildup from the walls, flooring, and piping. Decontamination of the tank interior is also expected to agitate the heel, allowing for removal of residual sediments. Liquids and sediments removed/generated during waste removal and/or decontamination operations will be transferred to portions of the TFF tank system still in operation. These materials will be reduced in volume to the extent practicable using existing INTEC waste treatment systems (e.g., the PEWE). Eventually, the contaminated liquids removed from TFF during closure activities will be treated, based on decisions made by the HLW EIS currently in development.

Once the decontamination has been completed, the washing equipment will be de-energized, and the waste removal system will continue to remove the remaining heel until the pump loses suction. This will leave a residual heel of approximately 1 in. remaining in the tank. The residual material being removed at this point will be sampled to determine if decontamination was effective and if performance-based closure standards were attained. Decontamination is expected to continue until a determination is made that no further tank decontamination is required, either because the closure performance standards have been met, or it has been decided to close the tank to landfill standards.

If determined necessary, grout will then be pumped into the tank, allowing it to flow toward the waste removal system to remove additional residual liquid. The pump would continue to operate until encased by grout Additional grout may be placed over the solidified heel to cover the cooling coils, absorb any free liquids, and to ensure that tank buoyancy constraints are met (i.e., any grout subsequently placed in the tank vault will not float the tank (Spaulding 1998). Solids that are contained in the heel after decontamination and pH adjustment are unlikely to be soluble in the rinse waters, given that they are not soluble in the strong acids in which they have been immersed for years. Most of the solids in the tank are

metal oxides from plant operations and sand-like material that is very insoluble. The presence of leachable hazardous constituents in the heel solids is unlikely.

The closure process and equipment discussed above is specific to the 300,000-gallon tanks. A separate closure approach will be prepared for the 30,000-gallon TFF tanks (WM-103 through WM-106) and will describe decontamination efforts and/or sampling to confirm that past waste removal and decontamination efforts have been successful. Should sampling results indicate the need, additional decontamination will be performed.

5.3 Tank Vaults

Similar to the tanks, the tank vaults have risers through which equipment for decontamination and sampling can be placed. However, access is very limited in the case of the tank vaults, making thorough decontamination difficult. Each vault will be evaluated to determine the type and amount of effluent it may have received. Sumps within each vault collect liquids from valve boxes, piping encasements, and inflow of rainfall and snowmelt. Typically, inflow of water into the tank vaults occurs around the risers in the roof after large rainfall and snowmelt events. This rainfall/snowmelt infiltration and subsequent removal from the vault sumps appears to reduce contamination levels in those vaults where a release occurred. The liquids collected in the sumps are periodically removed for treatment in the PEWE. Decontamination of the vaults to performance-based standards will be demonstrated by sampling effluent removed from the vault sumps. This effluent will be removed from the vault sumps either by the jets or directly with equipment placed in the vaults through the risers.

5.4 Valve Boxes and Piping

Valve boxes have been periodically decontaminated with a variety of solutions over the life of TFF to allow personnel access for replacement of valves and other maintenance activities. If there is evidence that releases have occurred into the valve boxes since the last decontamination cycle, additional decontamination may be performed to meet the closure performance standard.

Following process waste-line isolation, those valve boxes requiring personnel access to perform closure activities will be sampled and/or surveyed for radiation and, if necessary, sufficiently decontaminated with nonhazardous decontamination solutions to allow entry. A low-volume spray nozzle, designed to enter the valve box through a decontamination stub, may be used to decontaminate the stainless steel liner contained within each valve box. The water will then flow from the valve box to the associated vault sump, flushing the valve box drain lines at the same time.

6. SAMPLING AND DATA REVIEW TO SUPPORT CLOSURE DECISIONS

Due to the unique nature of TFF, sampling and analysis performed to demonstrate that closure standards have been met may not always follow normal sampling and analysis protocols (EPA 1997). In addition to difficulties resulting from the presence of radiation fields and from requirements for keeping TFF operational, individual tanks and equipment have unique physical limitations that make developing defensible analytical data difficult. Although these limitations exist, defensible data may be obtained by taking advantage of a variety of non-typical sampling methods and opportunities.

6.1 Sampling Activities

Samples will be taken at several points during the closure process as required by the DOE closure plans and HWMA/RCRA closure plan. Sampling will be conducted before the start of closure activities to establish baseline conditions to evaluate worker health and safety and later to compare decontamination effectiveness. This baseline sampling is expected to be more thorough on the first tanks closed. Other sampling and analysis activities will be performed throughout the closure process (e.g., after washing with the first decontamination solution or after decontamination rinses to evaluate attainment of closure standards).

The preliminary sampling and analysis strategy for the closure of tanks WM-182 and WM-183 is to use a minimum of sampling events, occurring at points throughout the closure process, that will provide adequate characterization data. This strategy is designed to provide a defensible data set for closure, while using screening data to support decontamination calculations and minimize the number of samples sent for laboratory analysis. This strategy is cost-effective and minimizes radiation exposures to personnel.

Specifically, data will be collected to:

1. Initially characterize the tank heel
2. Confirm the neutralization of the heel
3. Demonstrate the effectiveness of the decontamination
4. Characterize the residual waste for attaining closure standards and performance objectives.

This data will be collected by a combination of sampling and analysis and real-time monitoring. The sampling activities may include:

- LDUA sampling
- Sampling during heel adjustment
- Sampling during removal and decontamination

- Final rinse sampling and LDUA Sampling
- Vault Sump rinsate sampling
- Pipe rinsate sampling
- VOG piping rinsate sampling.

Process knowledge will be used to determine if residuals in the vault sumps require decontamination, and triple rinsing (or other method identified in the closure design) will be used to decontaminate the piping and VOG piping.

The management of all waste materials generated while decontaminating TFF will be based on either the results of sampling each waste stream or process knowledge. Samples collected in support of TFF closure will be analyzed for hazardous waste characteristics, hazardous constituents appropriate for waste codes associated with TFF, and radionuclide identification and concentration. Based on chemical analysis results of these samples, additional decontamination may be performed or, if the closure standard has been met, subsequent decontamination attempts may be omitted. In summary, the rationale for taking samples at various points in the process includes:

1. Measurement of tank conditions against the closure performance standard
2. A check of decontamination effectiveness or heel management fluids
3. Identification of compounds that may contribute to residual risk when TFF is fully integrated into the CERCLA activities ongoing at INTEC.

Verification of closure to performance-based standards may be difficult in piping, valves, and other areas where high radiation fields and inaccessible locations make direct physical sampling of these structures difficult. However, where possible, samples will be collected to demonstrate that performance-based closure standards have been met.

The following sections describe some of the difficulties associated with sampling and identify some of the potential ways samples may be obtained from the various TFF components.

6.1.1 Tank Sampling

Radiation fields and limited access provide the primary limitations to sampling of tank internals. Difficulty in obtaining samples from within the tank may affect the precision, accuracy, representativeness, completeness, and comparability of samples obtained for evaluating whether closure standards have been attained. Determination of the condition/content of tanks will be based on samples obtained in a variety of ways. Examples of the tank sampling opportunities that may be used include:

- Collection of decontamination, rinsate, or heel samples from process sampling stations downstream of liquid removal jets [e.g., at the PEWE, HLW Evaporator, or New Waste Calcining Facility (NWCF)]

- Collection of decontamination, rinsate, or heel samples at the discharge of the submersible pump used for heel reduction

- Collection of liquid samples through risers with the LDUA or other grab sampling techniques.

Specific tank internal locations that may be difficult to directly sample include areas behind or underneath cooling piping and areas remote from the access risers. Decontamination and associated agitation are expected to mix tank residuals sufficiently to allow collection of representative samples with available techniques. Additionally, use of steam jets to transfer residual liquids to a location where they can be sampled may affect the representativeness of samples by adding a small amount of steam (water) to the liquid being transferred and may volatilize some constituents and thereby effect volatile compound analyses.

6.1.2 Tank Vault Sampling

Similar to the tanks, access to tank vaults is limited. However, the vault floor is sloped to the vault sumps and can be sampled in a variety of ways. For example, sumps can be accessed through 12-in. risers allowing direct sampling of sump contents, or the sump contents may be sampled using existing equipment for sump pumpdown and downstream PEWE sampling stations. While easier, this latter option has a disadvantage because the material being sampled passes through process piping not closed prior to collection. These sumps collect water from the tank vault, valve boxes, and piping encasements, requiring that the source of liquids in the sumps be evaluated for collection of meaningful samples. Several of the TFF tanks sit in vaults on a sand pad within a 6-in. high concrete curb. The sand is beneath the tanks for cushioning and is therefore inaccessible for direct sampling. However, alternative methods of sample collection are being evaluated, such as sampling liquid that has been in contact with this material.

6.1.3 Piping and Ancillary Equipment Sampling

Piping attached to the tanks within the unit boundary will be flushed and decontaminated. Solutions used in the piping will be either sampled directly, when possible, or drained to the tanks, at which time they may be sampled as described above for tanks. Sampling ports in existing piping, such as on lines from vault sumps to the PEWE, may be used for collecting decontamination fluid or rinsate samples from process waste lines. Verification samples for valve boxes and piping encasements will be collected directly when possible (for example, from the valve box itself) or from vault sumps, which collect valve box and piping encasement effluent.

6.1.4 Data Objectives and Review Process

The following activities will be performed and documented to ensure that defensible data are collected to support TFF closure decisions:

- **Proper planning to ensure defensible data.** The data collection cycle will involve three steps: planning, implementation, and assessment. During the planning phase, data quality objectives (DQO) will be established using EPA and DOE guidance to define quantitative and qualitative criteria for determining when, where, and how many samples (measurements) to collect and the desired level of confidence. These objectives, along with the sampling methods, analytical procedures, and appropriate quality assurance

(QA) and quality control (QC) procedures, will be documented in the Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPjP) for TFF closure. The data will then be collected in accordance with the FSP and QAPjP (commonly referred to as the Sampling and Analysis Plan). The data will undergo the data quality assessment process (involving verification, validation, and assessment) to ensure the DQOs were achieved.

- **Data review to support closure standards and objectives.** Data will undergo a formal review process involving verification, validation, and assessment to ensure established DQOs are met before being used to calculate risk for HWMA/RCRA performance-based standards or compliance with DOE performance objectives.

- **Notification and approval process.** A formal notification process will be established to ensure proper data review and approval before ceasing closure activities. Once closure standards and performance objectives are achieved, the data and analyses used to demonstrate closure attainment will be presented in the DOE Closure Report and HWMA/RCRA Closure Certification.

7. CERTIFICATION OF CLOSURE

In accordance with IDAPA 16.01.05.009 (40 CFR 265.115), within 60 days of completing the closure activities, a certification of closure will be provided by an independent, Idaho-registered professional engineer, the INEEL operating contractor, and/or the DOE-ID. The tanks will be independently assessed and certified by means of visual inspection and evaluation of supporting documentation through an independent, Idaho-registered professional engineer, who will verify that the performance of the approved closure plan has been attained. The professional engineer and owner/operator signatures on the closure certification, which is submitted to the IDEQ, will document the completion of closure activities in accordance with the approved HWMA/RCRA closure plan. The closure certification may also identify any minor changes to the closure plan made without prior approval of the IDEQ.

Also in accordance with DOE O 430.1A, Life Cycle Asset Management, a DOE Closure Report will be prepared and submitted for approval to DOE-ID. Closure of each phase of tanks will be considered complete upon receipt of written acceptance issued by the DOE-ID and IDEQ. Copies of documentation supporting the closure of each phase of tanks (starting with Phase 1, tanks WM-182 and WM-183) will remain in the project files in the event that information is requested by DOE-ID or IDEQ.

8. SUMMARY

Closure of TFF to DOE LLW or TRU waste closure standards and RCRA performance-based standards will be a priority. In the event these standards cannot be met, and closure under DOE alternative requirements and RCRA landfill standards is required, the removal and/or decontamination of waste and waste residues will already have been performed. DOE closure standards require completion of a PA and WIR determination to demonstrate that concentrations are within limits of the performance objectives. RCRA closure performance standards require completion of a risk assessment to demonstrate contaminant chemical concentrations in decontaminated TFF residuals present a risk of 10^{-4} or less. In addition, concentrations of remaining radionuclides and any hazardous constituents will be evaluated to any residual risk they may contribute to the TFF cumulative risk as determined in the OU 3-14 baseline risk assessment.

Assumptions incumbent in pursuing DOE closure standards and RCRA performance-based standards for closure of the TFF tank system include:

- The DOE O 435.1 required documents (DOE closure plans, WIR determination, PA, and CA) will be developed for closure of TFF as a whole, while the RCRA/HWMA closure plan will be developed only for Phase 1 of the TFF closure, which includes tanks WM-182 and WM-183

- Historical releases from TFF facilities are evaluated and administered under the INEEL CERCLA program and are not part of the TFF HWMA/RCRA closure

- Analytical results from samples of decontamination and rinse solutions are sufficient to demonstrate whether closure performance standards have been met for inaccessible areas that cannot be directly sampled or otherwise manually verified to have been completely decontaminated (due to physical constraints of the facility or worker health and safety concerns [ALARA]).

Actions planned to be implemented to close TFF under DOE closure standards/RCRA performance-based standards and or under DOE alternative requirements/RCRA landfill standards are similar. Both propose removing waste and decontaminating tanks, piping, vaults, and valve boxes and comparing sample results from decontaminated equipment against the performance and closure standards. Only after decontamination, would closure under DOE alternative requirements/RCRA landfill standards differ. Sampling to determine the effectiveness of decontamination may be difficult in some of the TFF components; however, a comprehensive sampling and analysis strategy will be established that will produce defensible data.

9. REFERENCES

10 CFR 61, 1999, "Licensing Requirements for Land Disposal of Radioactive Waste," *Code of Federal Regulations,* Office of the Federal Register, 1999.

10 CFR 835, "Occupational Radiation Protection," *Code of Federal Regulations,* Office of the Federal Register, 1999.

29 CFR 1910, "Occupational Safety And Health Standards," *Code of Federal Regulations,* Office of the Federal Register,

29 CFR 1926.65, "Safety And Health Regulations For Construction Hazardous Waste Operations and Emergency Response," *Code of Federal Regulations,* Office of the Federal Register,

36 CFR 800, "Protection Of Historic And Cultural Properties," *Code of Federal Regulations,* Office of the Federal Register,

40 CFR 61, "National Emission Standards for Hazardous Air Pollutants," *Code of Federal Regulations,* Office of the Federal Register,

40 CFR 191, "Environmental Radiation Protection Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes," *Code of Federal Regulations,* Office of the Federal Register, 1999.

40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations,* Office of the Federal Register, 1999.

40 CFR 761, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution In Commerce, And Use Prohibitions," *Code of Federal Regulations,* Office of the Federal Register,

Anderson, S. R., 1991, *Stratigraphy of the Unsaturated Zone and Uppermost Part of the Snake River Plain Aquifer at the Idaho Chemical Processing Plant and Test Reactor Area, Idaho National Engineering Laboratory, Idaho,* USGS Water-Resources Investigations Report 91-4010, IDO-220895.

Barraclough et al., 1967, Hydrology of the National Reactor Testing Station, Idaho, 1966, U.S. Geological Survey Open-File Report, Waste Disposal and Processing TID-4500, IDO-22049.

Bennett, C.M., 1990, *Streamflow Losses and Groundwater Level Changes along the Big Lost River at the INEL, Idaho,* USGS Water Resources Investigation Report 86-4204, DOE/ID-22091.

Bennett, C. M., 1986, Capacity of the diversion Channel Below the Flood-Control Dam on the Big Lost River at the Idaho National Engineering Laboratory, U.S. Geological Survey, Water Resources Investigations Report 86-4204.

Clawson, K. L., G. E. Start, and N. R. Ricks, eds., 1989, *Climatology of the Idaho National Engineering Laboratory*, 2nd Edition, DOE/ID-12118.

DOE Guide 435.1, July, 1999, "Implementation Guide for Use with DOE M 435.1," U.S. Department of Energy.

DOE Manual 435.1, July, 1999, "Radioactive Waste Management Manual," U.S. Department of Energy.

DOE Order 430.1.A, October 14, 1998, "Subject: Life Cycle Asset Management," U.S. Department of Energy.

DOE Order 435.1, July, 1999, "Radioactive Waste Management," U.S. Department of Energy.

DOE Order 5820.2a, Radioactive Waste Management

DOE 1996a, *Savannah River Site Environmental Management Ten Year Plan*, QC-96-005, Savannah River Operations Office, Aiken, South Carolina, July.

DOE 1996b, *High-Level Waste Closure Program Plan*, Rev 0, Savannah River Operations Office, Aiken, South Carolina, December.

DOE 1996c, *Industrial Wastewater Closure Plan for F- and H-Area High Level Waste Tank Systems*, Savannah River Operations Office, Aiken, South Carolina, July.

DOE 1996d, *Format and Content Guide and Standard Review for U.S. DOE LLW Dispoal Facility Performance Assessments,* U.S. Department of Energy, month 1996

DOE 1997. *Industrial Wastewater Closure Module for the High-Level Waste Tank 17 System*, Revision 2, Savannah River Site, U.S. Department of Energy, August, 1997.

DOE 1999, *Performance Assessment and Composite Analysis Review Guidance Manual,* U.S. Department of Energy, month 1999.

DOE-ID, 1999, *Comprehensive Work Plan for the Idaho Chemical Processing Plan OU 3-14 at the INEEL-(Draft) Chapter 2*, Idaho National Engineering and Environmental Laboratory, U.S. Department of Energy, May, 1999.

DOE-ID, 1998, *Second Modification to Consent Order to the Notice of Noncompliance*, U.S. Department of Energy, Idaho Operations Office; Idaho Department of Health and Welfare, Division of Environmental Quality; U.S. Environmental Protection Agency, Region 10, August 18, 1998.

DOE-ID, 1997, *Comprehensive RI/FS for the Idaho Chemical Processing Plan OU 3-13 at the INEEL-Part A*, RI/BRA Report (Draft), Book 1, Idaho National Engineering Laboratory, U.S. Herman, 1996

DOE-ID, 1996, *Regulatory Analysis and Proposed Path Forward for the Idaho National Engineering Laboratory High-Level Waste Program*, DOE/ID-10544, October, 1996.

DOE-ID, 1995, *Idaho National Engineering Laboratory Long-Term Land Use Future Scenarios*, November 1993.

DOE-ID 1991, *Federal Facility Agreement and Consent Order and Action Plan*, U.S. Department of Energy, Idaho Field Office; U.S. Environmental Protection Agency, Region 10; Idaho Department of Health and Welfare.

Gilbert K. L., T. E. Venneman, 1999, *A Regulatory Analysis and Reassessment of U.S. Environmental Protection Agency Listed Hazardous Waste Numbers for Applicability to the INTEC Liquid Waste System,* INEEL/EXT-98-01213, Rev. 1. February 1999.

Herman , S. A., and E. P. Laws, to RCRA/CERCLA National Policy Managers Regions 1 –X Agency, September 24, 1996,U.S. EPA, Subject, "Coordination between RCRA Corrective Action and Closure and CERCLA Site Activities",

INEEL, 1998, *ICPP Tank Farm Planning Through 2012*, INEEL/EXT-98-00339, April 1, 1998.

LITCO, 1995, *Lithology and Stratigraphy at the Idaho Chemical Processing Plant*, 1995.

LMITCO, 1998, *Idaho Nuclear Technology and Engineering Center Tank Farm Facility Conceptual HWMW/RCRA Closure Approach,* INEEL/EXT-98-01198, Lockheed Martin Idaho Technologies Company, December 1998.

NOAA and Morrison Knudsen Company, Inc., 1983, *Climatography of the Idaho National Engineering Laboratory (Update of Chapters 1 and 2 through 1983)*, IDO-12048A, (Draft).

Malde H. E., A. M. Pitt, J. P. Easton, 1971, *Geologic Investigation of Faulting Near the National Reactor Testing Station, Idaho (With a Section on Microearthquake Studies USGS Open-File Report 71-338,* DOE/EIS-0136-R-146, United States Geologic Survey, 1971.

Mann, Mann, L. J., 1986, *Hydraulic Properties of Rock Units and Chemical Quality of Water for INEL-1; A 10,265-Foot Deep Test Hole Drilled at the Idaho National Engineering Laboratory, Idaho,* USGS Water-Resources Investigations Report 86-4020, IDO-22070.

Matule, A.J., September 26, 1990, Interdepartmental Correspondence to D. C. Machovec, "Solid Sampling of WM-103 through 106,: AJM-20-90, Westinghouse Idaho Nuclear Company, Inc.

Mundorff, M. J., E. G. Crosthwaite, and C. Kilburn, 1964, *Ground Water for Irrigation in the Snake River Basin in Idaho*, U.S. Geological Survey, Water Supply Paper 1654.

Nace, R. L. et al., 1959, *Geography, Geology, and Water Resources of the National Reactor Testing Station, Idaho, Part 3, Hydrology and Water Resources*, IDO22034-USGS.

Orr, B. R. and L. D. Cecil, 1991, *Hydrologic Conditions and Distribution of Selected Chemical Constituents in Water, Snake River Plain Aquifer, Idaho National Engineering laboratory, Idaho, 1986 to 1988*, DOE/ID-22096, March.

Palmer, W. B., 1998, Interdepartmental Communication to J. T. Beck; Removing HLW from the Tank Farm, WBP-07-98, December.

Palmer, W. B., C. B. Millet, M. D. Staiger, and F.S. Ward, April 1998, ICPP Tank Farm Planning Through 2012, INEEL/EXT-98-00339, Lockheed Martin Idaho Technologies Company.

Patterson, M. W., Interdepartmental e-mail, to P. A. Tucker, March 30, 1999, "OU 3-14 Tank Farm, RI/FS Work Plan," Lockheed Martin Idaho Technologies Company.

Prestwich, S. M. and Bowman, 1980, *Completion and Testing Report; INEL Geothermal Exploratory Well One (INEL-1)*, U.S. DOE Idaho Operations Office, EG&G Idaho, Inc., IDO-10096.

PL 83-703, *The Atomic Energy Act of 1954, As Ammended.*

Robertson, J. B., R. Schoen, and J. T. Barraclough, 1974, *The Influence of Liquid Waste Disposal on the Geochemistry of Water at the National Reactor Testing Station, Idaho:* 1952-1970, U.S. Geological Survey Open-File Report, IDO-22053, Waste disposal and Processing TID-4500.

Schindler, R. E., LMITCO to B. H. O'Brian, LMITCO, June 9, 1999. Subject: "Composition of Wastes in Tank Farm," Schi-4-99.

Spaulding, B. C., M. M. Chadwick, K. D. McAllister, L. C. Tuott, and S. K. Evans, September 1998, INTEC TFF Tank WM-182 and WM-183 Closure Study, INEEL/EXT-98-00913, Lockheed Martin Idaho Technologies Company.

State of Idaho, "Rules, Regulations and Standards for Hazardous Waste," *Idaho Administrative Procedures Act,* Idaho Department of Health and Welfare, Department of Environmental Quality.

Swenson, M. C., April 21, 1999, Interdepartmental e-mail to P. A. Tucker, "Seismic qualification of 300,000-gal tanks," Lockheed Martin Idaho Technologies Company.

Swenson, M. C., August 24, 1990, Interdepartmental Communication to W. B. Palmer, Tank Farm RCRA Assessment, MCS-04-90, Westinghouse Idaho Nuclear Company, Inc.

Wichmann, Tom, Nicole Brooks, and Mike Heiser, October 1996, Regulatory Analysis and Proposed Path Forward for the Idaho national Engineering laboratory High-level Waste Program, Rev. 1, U.S. Department of Energy, Idaho Operations Office.

WINCO Environmental Restoration, *ICPP Environmentally Controlled Areas Reference Guide*, February, 1992.

WINCO, June 1986, ICPP Integrated Plant Manual Volume XII, ICPP Major Systems and Operation, Westinghouse Idaho Nuclear Company, Inc. (This manual is classified as "inactive/information only" and contains unclassified controlled nuclear information.).

WSRC 1996, *Savannah River Site High-Level Waste System Plan*, Rev. 7, HLW-OVP-96-0083, Aiken, South Carolina, November.

Appendix A

Site Physiography

A. SITE PHYSIOGRAPHY

This appendix describes the affected environment of the Tank Farm Facility (TFF), including the features of the Idaho National Engineering and Environmental Laboratory (INEEL), Idaho Nuclear Technology and Engineering Center (INTEC), and TFF that are important in the performance evaluation for the tank system closure: topography, geology, hydrology, land use and demographics, surface water, biota, and air quality. The information in this section was compiled primarily from the *Operable Unit (OU) 3-13 Remedial Investigation/Feasibility Study(RI/FS)* (DOE-ID 1997) with some information gathered from the *OU 3-14 Work Plan Chapter 2 (Draft)* (DOE-ID 1999) and the *Conceptual Hazardous Waste Management Act(HWMA)/Resource Conservation and Recovery Act (RCRA) Closure Approach* (LMITCO 1998).

A.1 Land Use and Demographics

The nearest INEEL boundaries are 51 km (32 mi.) west of Idaho Falls, 37 km (23 mi.) northwest of Blackfoot, 71 km (44 mi.) northwest of Pocatello, and 11 km (7 mi.) east of Arco, Idaho. With a population of approximately 1100, Arco is the largest boundary community in the area surrounding the Site. Approximately 121,500 people reside within a radius of 80 km (50 mi.) of the Site's operational center, which is the Test Reactor Area-INTEC area. There are no residents within 16 km (10 mi.) of that center, with Atomic City (population 25) being the closest boundary community.

The primary use of INEEL lands is to support facility operations and act as buffer and safety zones around the facilities. Virtually all of the work at the INEEL is performed within the site's primary facility areas. These areas, however, occupy only about 2% of the total INEEL land area. Other land uses include environmental research, ecological preservation, and socio-cultural reservation. INEEL land is also used for grazing, recreation, and connecting infrastructure, with the remaining land being essentially undisturbed.

Currently INTEC has a total land area of 200 acres and 106,070 m^2 (1,141,711 ft^2) of facilities. Land at INTEC is used to store spent nuclear fuel (SNF) and radioactive wastes for the U.S. Department of Energy (DOE). Other uses include a coal-fired steam plant, TFF storage facility, and wastewater treatment/disposal facilities. Before April 1992, SNF were reprocessed at the plant. With the DOE's decision to cease reprocessing operation, however, the need to store greater quantities of these fuels increased.

As the shutdown of INEEL facilities and the environmental restoration of INEEL land play greater roles, environmental studies are increasingly important elements in land use planning. These studies provide INEEL scientists, engineers, and planners with information about how nuclear reactor research has affected the environment and the extent of remediation necessary to restore the land.

To facilitate decisions about environmental restoration activities at the INEEL, Department of Energy Idaho Operations (DOE-ID) conducted analyses in 1994 to project reasonable land use scenarios at the INEEL for the next 100 years. These analyses, conducted with extensive public involvement, resulted in specific issues, assumptions, and constraints that guided the generation of facility and land use scenarios for the next 25, 50, 75, and 100 years, as published in *the Long-Term Land Use Future Scenarios for the Idaho National Engineering Laboratory* (DOE-ID 1995). More detailed information concerning participating individuals/ organizations, comments received, and explanations of the process used for producing future land use scenarios is included in that document. Assumptions used in the

development of future land use scenarios are included in the OU 3-13 RI/FS (DOE-ID 1997) in Section 2.2.2.

INTEC was one of the facilities that had future use scenarios projected. Land use scenarios are projected for the present situation, as well as for the next 25, 50, 75, and 100 years.

Present:	Interim storage of SNF, disposing of fuels, managing waste, and improving waste and water management techniques.
25-Year:	Continue use as industrial area, planned new waste treatment facility.
50-Year:	Approaching end of useful life if no new mission identified; decontamination and decommissioning with all or selected area for restricted industrial use.
75-Year:	Standby mode for restricted industrial use; reuse permitted, but no new development outside existing fence line.
100-Year:	Continuation as a restricted industrial area.

These planning assumptions and the constraints described above were used to project the most likely INEEL configuration. Over time, the planning assumptions and resulting long-term scenarios may need to be revised due to unforeseen developments.

A.2 Geology

A.2.1 Regional Geology

INEEL is located in south central Idaho on the Snake River Plain (SRP). The SRP is commonly divided into two regions: a western region, which is a northwest trending depositional basin, and an eastern region, which is a northeast trending volcanic plain (Malde 1991). The INEEL is located in the eastern region of the SRP. This volcanic plain is comprised of approximately 914 m (3,000 ft) of layered late Cenozoic basalt flows over a rhyolitic basement that is approximately 3,048 m (10,000 ft) deep (Malde 1991). The Eastern Snake River Plain (ESRP) is approximately 322 km (200 mi) long and ranges between 80 and 113 km (50 and 70 mi) in width (Anderson 1991). It is bounded on the west by the north flowing reach of the Snake River through the Hagerman Valley and on the east by the Island Park rhyolite deposits. The northern and southern boundaries consist of the basin and range mountains of south central Idaho (Malde 1991).

A.2.2 Subsurface Geology of INTEC

The subsurface of INTEC has been extensively drilled and sampled by the USGS in an effort to understand and monitor the movement of the groundwater and contaminants beneath INTEC. Only a summary of this information is presented in this report. For more detailed information, please refer to *Lithology and Stratigraphy at the Idaho Chemical Processing Plant* [Attachment 2 of LITCO (1995)] and to the *OU 3-13 RI/FS* (DOE-ID 1997).

To date 41 wells have been drilled at, and around, INTEC to depths that are below the upper limits of the Snake River Plain Aquifer (SRPA) (36 USGS monitoring wells, four production wells, and INTEC monitoring wells). Thirty-two wells have been drilled and are completed in the various perched water bodies beneath INTEC; and numerous holes have been drilled at INTEC in the surficial sediments to the top of the basalt. Two of the deep aquifer wells and 11 of the shallow perched wells were cored.

Figure A-1 is a generalized lithologic column showing the basalt flows and sedimentary interbeds beneath the INTEC and the geophysical response associated with each different geologic material, as determined by careful examination of core from INTEC.

The generalized lithologic column (Figure A-1) shows three typical lithologic sequences found in basalt flows beneath INTEC. The upper portion of the column indicates a massive, dry basalt grading downward into a moist vesicular basalt. The base of the flow rests on a saturated layer of sediments. The sediments cover a weathered, fractured vesicular basalt in which the vesicles and fractures have been filled to some extent with sediments from above. A set of horizontal sediment-filled fractures are shown below the upper weathered zone. These horizontal fractures overlay a dry, massive basalt, which grades into a saturated, vesicular basalt. The bottom of this flow unit overlies a tight, moist, sediment layer. The sediments then overlay a moist to dry layer of vesicular fractured basalt, which grades to a massive, dry basalt. Below the massive basalt is a basalt vesicular zone, followed by a fractured, weathered, vesicular zone. This is typical of a contact between two flows in which there are no sediments present. There may be some measurable amount of moisture due to the fracturing and vesicular nature of the basalt near the edge of flows. The basalt then grades to a massive, dry basalt.

Several stratigraphic units based on similar lithology and stratigraphic positions have been identified beneath INTEC. A generalized stratigraphic column is presented in LITCO (1995). This figure shows the stratigraphic units and gives a general description of the units. The unit thicknesses provided on the stratigraphic column are average thicknesses from the wells used to make the stratigraphic interpretation. A complete table of unit thicknesses is provided in *Lithology and Stratigraphy at the Idaho Chemical Processing Plant* [Attachment 2 of LITCO (1995)].

A.3 Hydrology

A.3.1 Regional Hydrology

The SRPA flows beneath INEEL and is about 322 km (200 mi) long and 89 to 113 km (55 to 70 mi) wide. It extends from Ashton and Big Bend Ridge on the northeast to Hagerman on the southwest and covers about 25,900 km^2 (10,000 mi^2). The aquifer consists of a series of basalt flows with interbedded sedimentary deposits and pyroclastic materials. The boundaries are formed by the contacts of the aquifer with less permeable rock at the margins of the plain (Mundorff et al. 1964). Robertson et al. (1974) estimated as much as 2 billion acre-ft of water may be in storage in the aquifer, of which about 500 M acre-ft are recoverable.

Groundwater in the SRPA generally occurs under unconfined conditions, but locally may be quasi-artesian or artesian (Nace et al. 1959). The quasi-artesian or artesian conditions are caused by layers of dense, massive basalt, or sediments with relatively low permeability. Nace et al. (1959) described quasi-artesian as the situation in which the groundwater level is first recognized during borehole drilling at a depth below the regional water table, and then the level rises significantly [1.5 to 15.2 m (5 to 50 ft)] to the level of the water table. This rise in water level simulates artesian pressure, but the conditions are not truly artesian. Nace et al. (1959) also noted water levels in some wells in the SRPA

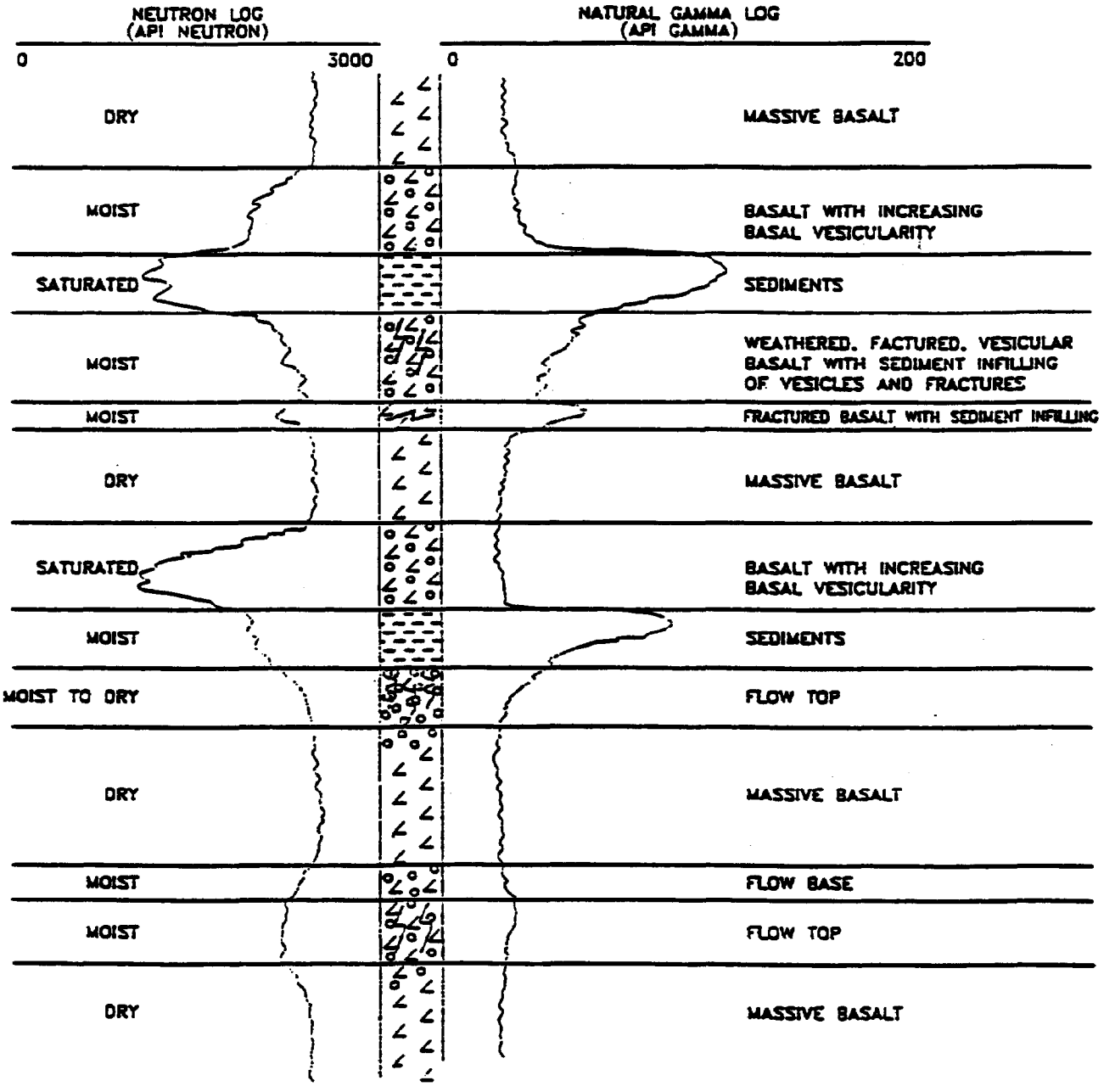


Figure A-1. Generalized lithologic column and associated geophysical response.

respond to fluctuations in barometric pressure similar to wells in confined aquifers, indicating that tight zones in the basalt may impede pressure equalization. True artesian or flowing artesian conditions in the SRPA were identified at Rupert, in parts of the Mud Lake Basin, and north of the American Falls Reservoir (Nace et al. 1959).

Recharge to the aquifer is primarily by valley underflow from the mountains to the north and northeast of the plain and from infiltration of irrigation water. A small amount of recharge occurs directly from precipitation. Recharge to the aquifer within INEEL boundaries is primarily by underflow from the northeastern part of the plain and the Big Lost River (Bennett 1990). Significant amounts of recharge from the Big Lost River have caused water levels in some wells at the INEEL to rise as much as 1.8 m (6 ft) in a few months after high flows in the river (Barraclough et al. 1967). Locally, the direction of groundwater flow is temporarily changed by recharge from the Big Lost River (Bennett 1990).

Estimates of the effective thickness of the SRPA at INEEL are variable. A 3,159 m (10,365 ft) deep geothermal test well (INEL-1) was drilled about 7.2 km (4.5 mi) north of INTEC in 1979. Subsurface geologic information from INEL-1 indicates that at least 610 m (2,000 ft) of basalt underlies the INEEL (Prestwich and Bowman 1980). Interpretations of hydrological data from INEL-1 by Mann (1986), indicate the effective base of the aquifer is 259 to 372 m (850 to1,220 ft) below ground surface (bgs). The depth to water at INEL-1 is about 122 m (400 ft) bgs, which suggests an effective aquifer thickness of 137 to 250 m (450 to 820 ft). Hydraulic conductivity of the basalt in the upper 244 m (800 ft) of the aquifer is generally 0.3 to 30.5 m/d (1 to 100 ft/d); whereas, the hydraulic conductivity of underlying rocks is several orders of magnitude smaller (Orr and Cecil 1991). Fracture filling from sediments and secondary mineralization is the principal reason for the decreased hydraulic conductivity.

The water table elevations range from 1,399 m (4,590 ft) in the northern part of INEEL to about 1,347 m (4,420 ft) south of INEEL; the depth to the water table varies from about 61.0 m (200 ft) bgs in the northern part of INEEL to about 274 m (900 ft) bgs in the southern part. The general direction of groundwater flow is to the south-southwest, and the average gradient is about 0.8 m/km (4 ft/mi) (Figure A-2) (Orr and Cecil 1991). Locally, however, the hydraulic gradient varies significantly and ranges from about 0.2 m/km (1 ft/mi) in the northern part of INEEL to a maximum of 2.8 m/km (15 ft/mi).

A.3.2 Local Hydrology

Thirty-three monitoring wells have been installed by the United States Geological Survey (USGS) around INTEC to characterize the occurrence, movement, and quality of water in the SRPA. The monitoring well network was designed to determine hydraulic-gradient changes that influence the rate and direction of groundwater and waste-constituent movement in the SRPA, identify sources of recharge to the aquifer, and measure the effect of recharge (Orr and Cecil 1991). Overall, the local groundwater flow is to the south-southwest, consistent with the regional groundwater flow.

The water level elevations indicate two separate sources of local recharge to the SRPA. One source for recharge is apparently from the percolation ponds, as indicated by elevated water levels measured in Wells USGS-51, -112, -113, -114, -115, and -116. Water level response to recharge from these ponds is indicated by a 0.6 m (2 ft) increase in Well USGS-113 and a .3 m (1 ft) increase in Well USGS-51. The water table in the SRPA downgradient from the percolation ponds has a bimodal shape, indicating a preferred flow direction toward the southwest, with a secondary flow component to the southeast.

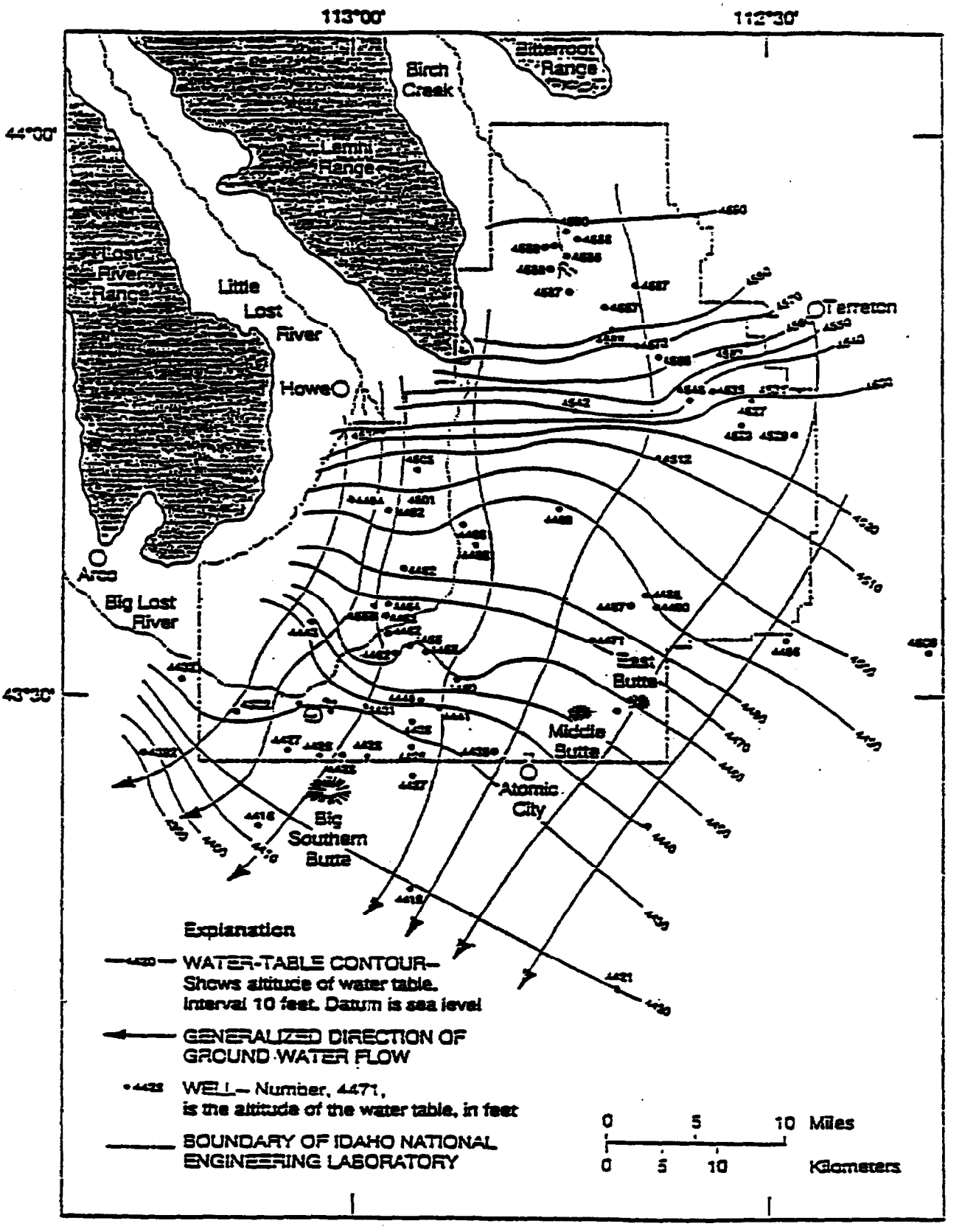


Figure A-2. Groundwater flow.

A secondary possible source of recharge to the SRPA may be indicated by unusually high water levels measured in Well USGS-47. The water levels measured in Well USGS-47 are consistently 0.3 to 0.6 m (1 to 2 ft) higher than corresponding water levels measured from the surrounding wells.

Possible causes for the unusually high water levels include local pumping, vertical hydraulic gradient, and well completion characteristics.

The local groundwater flow appears complex and is apparently affected by local recharge, variations in hydraulic conductivity, local pumping, and possibly vertical hydraulic gradients. Groundwater directly beneath INTEC generally flows to the southwest and southeast, with a minor flow component to the south. The local flow pattern likely results from local recharge (percolation ponds and sewage ponds), which creates the mounding in the water table, and possibly from pumping at the production wells. As the groundwater progresses beyond the influence of INTEC, it flows toward the southwest. The local hydraulic gradient is low, only 0.2 m/km (1.2 ft/mi) compared to the regional gradient of 0.8 m/km (4 ft/mi).

In addition to the SRPA, there are multiple perched water zones beneath INTEC. These perched water zones are discussed in detail in Section 2.6 of the OU 3-13 RI/FS (DOE-ID 1997). These are located in the alluvium, the upper basalt, and the lower basalt.

A.4 Surface Water

Human-made surface water features in the vicinity of INTEC consist of two percolation ponds used for disposal of water in the service waste system (formerly injected into the aquifer via the ICPP injection well) and sewage treatment lagoons for treated water. In addition, several landscaped areas at INTEC have historically been watered during the summer months and a network of ditches is used to channel runoff from the plant after precipitation events. Historically, precipitation runoff has been channeled to an old gravel pit (CPP-37-1) and both this pit and the unlined ditches may contribute recharge to the perched water bodies at INTEC.

The Big Lost River flows southeast from the Mackay Dam, through the Big Lost River Basin, past Arco, Idaho, and onto the SRP. The river flows onto the INEEL near the southwest boundary, curves to the northeast, and flows northward to its termination in the Big Lost River playas.

The Big Lost River basin includes parts of Custer and Butte Counties in south-central Idaho (Bennett 1990). The drainage area of the river, upstream of the INEEL, is approximately 3,262 km^2 (1,400 mi^2). Of the 2,305 km^2 (890 mi^2) within the boundaries of the INEEL, only 181 to 207 km^2 (70 to 80 mi^2) contribute to any significant surface runoff to the Big Lost River. Noncontributing areas of the Big Lost River basin within INEEL consist of small, topographically closed basins 2.6 to 26 km^2 (1 to 10 mi^2) in area.

The INEEL flood diversion system, located approximately 10.5 km (6.5 mi) downstream from the western INEEL boundary, was built in 1958 to divert high flows on the Big Lost River away from INEEL facilities. During winter months, most of the flow in the river is diverted to avoid accumulation of ice in the channel, thus reducing the possibility of flooding at downstream INEEL facilities.

INTEC is located on the alluvial plain approximately 61.0 m (200 ft) from the Big Lost River channel near the point where the channel intersects with Lincoln Boulevard on the INEEL. The elevation

of the Big Lost River channel immediately northwest of INTEC is 1,495 m (4,908 ft), and the elevation of the riverbank or berm is 1,497.1 m (4,912 ft). The average elevation of INTEC is 1,498.1 m (4,917 ft).

The INEEL diversion system diverts water from the Big Lost River during periods of high flow. The diversion dam across the Big Lost River permits the passage of less than 900 cubic ft per second during floods (Bennett 1986), and the river channel near INTEC can accommodate this flow. The maximum diversion capacity of the INEEL diversion system is 9,300 cubic ft per second, well above the 100-year flood stage (Bennett 1986). The Big Lost River poses no flood threat to INTEC as it flows northeast to its termination in the playas.

A.5 Topography

The land surface of INEEL is predominantly flat. The predominant relief on INEEL is the result of volcanic buttes and unevenly surfaced and fissured basalt flows. The elevations on the INEEL range from 1,585 m (5,200 ft) in the northeast to 1,448 m (4,750 ft) in the southwest, with the average being approximately 1,520 m (5,000 ft). A broad ridge on the ESRP extends through the Big Southern, Middle, and East Buttes on the southern portion of the INEEL, effectively separating drainage from the mountains in the north from that of the Snake River to the south. The Big Lost River flows onto the INEEL in the southwest and turns north, culminating in a series of playa lakes or sinks, where it infiltrates and recharges the SRPA. The majority of the land within the boundaries of the INEEL is relatively undisturbed and covered with sagebrush. Three public highways traverse the INEEL.

INTEC is located in the south-central portion of INEEL. The location of INTEC at INEEL is shown in Figure A-3. Elevation at INTEC is 1,498 m (4,917 ft), and the facility's northwest corner is located approximately 0.8 km (0.5 mi) southeast of the Big Lost River channel. Gravelly, medium-to-coarse textured soils derived from alluvial deposits occur in the vicinity of INTEC. The underlying basalt is covered with as much as 18.2 m (60 ft) of these soils, and the land surface is flat and covered with sagebrush.

A.6 Air Quality

A.6.1 Climatology and Meteorology

INEEL is located on the SRP, which is a large flat valley surrounded by mountains. Air masses cross this mountain barrier before entering the SRP. Most of the moisture is lost in crossing the mountain barrier; thus, INEEL has little annual rainfall and is classified as semi-arid.

The arid climate permits intense solar heating of the ground surface during the day and rapid cooling at night, especially during the summer months. In general, INEEL has a large, diurnal variation in temperature at ground level.

Mountain ranges to the north block many of the shallow, intensely cold, air masses moving out of Canada in the winter months. The climate in eastern Idaho is a more moderate climate than the climate in areas at similar latitudes east of the continental divide. The mountains can also serve as a barrier, where cold air masses that do enter the valley are frequently held in place for a week or longer.

The surrounding mountains tend to channel the winds in the region. The prevailing winds on the SRP are from the southwest and wind speeds are frequently greater than 8 km/hr (5 mi/hr). The second most frequent wind direction is from the northeast.

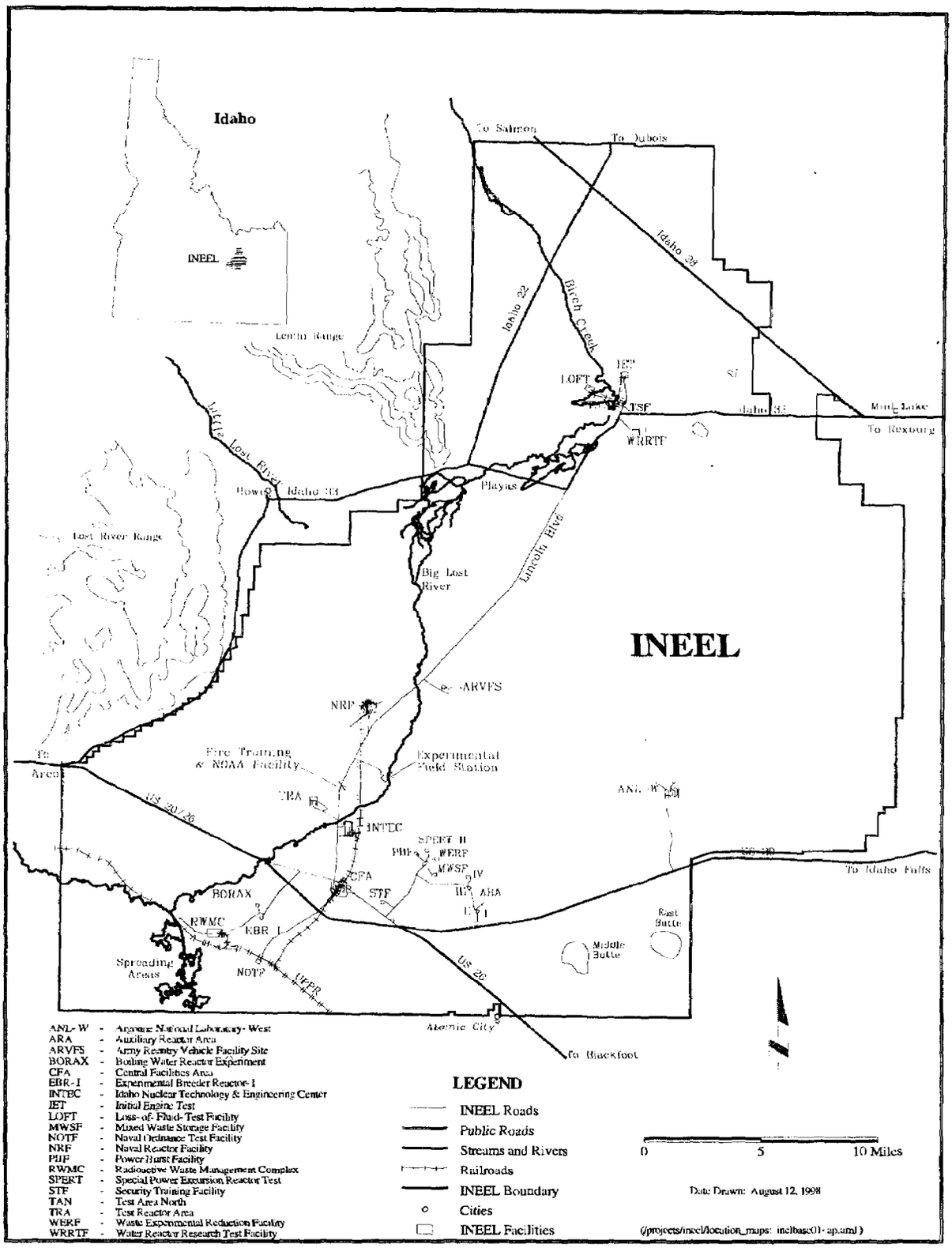


Figure A-3. Location of INTEC at INEEL.

Meteorological data have been collected at over 40 locations on or near INEEL since 1949. The weather station at the Central Facilities Area (CFA) was the first onsite station and appears on National Climate Center records as Idaho Falls 46 W. There are 27 active meteorological stations in operation on or near INEEL. Most of the meteorological monitoring within 80 km (50 mi) of the INEEL is conducted by the National Oceanic and Atmospheric Administration (NOAA) Air Resources Laboratories. A large database has been compiled and analyzed by NOAA (Clawson et al. 1989).

An overview of climatological data is available from summaries of temperatures, precipitation, snowfall and snow depth, wind speed and direction, and moisture content of the air. Much of the summary information comes from the monitoring station at CFA, which is located approximately 5 km (3 mi.) south of INTEC. Only small, local variations in climate would occur between the two facilities.

Temperatures at INEEL vary widely over the course of the year. Records for CFA indicate that the highest daily maximum temperature occurring between 1950 and 1988 was 38 °C (101 °F), and the lowest temperature recorded at CFA was –44 °C (-47 °F). The highest daily average temperature over the course of a month was 28 °C (83 °F) and the lowest daily average was –33 °C (-28 °F). Temperatures also vary greatly over the course of the day and, on average, span a 17 C° (30 F°) range. The maximum temperature range in 1 day at CFA spanned 50 C° (90 F°).

Average annual precipitation at CFA (1950 to 1988, inclusive) is 22.1 cm (8.7 in). The highest annual precipitation was 36.6 cm (14.4 in.) and the lowest was 11.4 cm (4.5 in.). Over the years, the wettest months have been May and June; however, recorded precipitation amounts of less than 0.3 cm (0.1 in.) have occurred in all months. Individual months have had as much as 11.2 cm (4.4 in) of precipitation and as little as no precipitation. The greatest amount of precipitation at CFA in a 1-hr period, and a 24-hr period, was .3 cm (0.5 in) and 4.1 cm (1.6 in), respectively, and occurred in the month of June.

From 1950 to 1988, the CFA averaged 70.1 cm (27.6 in) of snow per year. The maximum snowfall in a year was 151.6 cm (59.7 in). Maximum snowfall occurs in December and January. Little snow falls from May through October. June, July, and August are the only months with no recorded snowfall between 1950 and 1988. The maximum snowfall in a 24-hr period was 21.8 cm (8.6 in) and occurred in the month of March. A snowfall of 21.6 cm (8.5in) in a 24-hr period is recorded for January. The lowest annual snowfall at CFA was 17.3 cm (6.8 in). All months have gone without snowfall in at least 1 year during the recording period.

January and February have the highest average maximum snow depth at 10.4 cm (4.1 in). The highest recorded maximum snow depth was 51 cm (20 in) and occurred in March. December, January, and February also have had snow depths greater than 28 cm (11 in).

Average relative humidities at CFA range from 30 to 70%. Relative humidities are typically higher during the colder months (November through March). The relationship between relative humidity and temperature makes high relative humidities possible from small amounts of moisture when the temperature is low. Consequently, winter months may have high relative humidities from very low moisture contents. Relative humidities on summer afternoons are frequently lower than 15% and can be lower than 5%. Maximum absolute humidities can reach 100% in all months except July. Average minimum absolute humidities are below 16% in all months and below 0% from April through October.

From 1955 through 1961, the average air temperature in January (the coldest month) was 8.6 °C (16.5 °F) and the average dewpoint was –13.7 °C (7.4 °F). During July, the warmest month, the

temperature averaged 20.6 °C (69.0 °F) and the dewpoint averaged 0.8 °C (33.5 °F). The annual average temperature and dewpoint was 5.9 °C (42.6 °F) and –6.4 °C (20.4 °F) respectively. Low dewpoints and relative humidities indicate the environment at the INEEL is quite arid.

The most frequent winds at INTEC are southwesterly. Other significant components are westerly and northeasterly. Most windspeeds are less than 5.0 m/sec (11 mph). The peak wind gust at the CFA [6.1 m (20 ft) level] was 126 km/hr (78 mph), which occurred in January. All months have seen wind gusts of 97 km/hr (60mph) or greater. At 76.2 m (250 ft), the peak wind gust at CFA was 135 km/hr (84 mph) and occurred in March.

Severe weather on INEEL consists of thunderstorms, tornadoes, and funnel clouds. On the average, two to three thunderstorms occur during each of the summer months. Small hail may accompany the thunderstorms, but hail damage has not been reported at INEEL. Occasionally, rain in excess of the average monthly total precipitation may be recorded at a monitoring station on INEEL, as a result of a single thunderstorm. Nevertheless, precipitation from thunderstorms on INEEL is generally light and may evaporate before reaching the ground.

Since 1949, three small tornadoes, which caused no damage, occurred within the boundaries of the INEEL. Additionally, 10 confirmed, and three unconfirmed, funnel clouds have been observed since 1954 (NOAA and Morrison Knudsen 1983). NOAA records indicate a total of five funnel clouds and no tornadoes on the INEEL since 1950 (Clawson et al. 1989). Discrepancies in these records may be related to different methods of reporting and confirming tornadoes. No INEEL facilities have ever been damaged by a tornado.

Dust devils are also common in the region and can entrain dust and pebbles and transport them over short distances. Dust devils usually occur on warm sunny days with little or no wind. The dust cloud may be several hundred meters (yards) in diameter and extend several hundred meters (ft) in the air.

Vertical temperature and humidity profiles in the atmosphere determine atmospheric stability. Stable atmospheres are characterized by low levels of turbulence and less vertical mixing. Stability parameters at INEEL range from stable to unstable. Stable conditions occur mostly at night during strong radiative cooling. Unstable conditions can occur during the day when there is strong solar heating of the surface layer or whenever a synoptic scale disturbance passes over the region.

A.6.2 Ambient Air Quality

Air quality monitoring facilities at INEEL consist of two networks designed to monitor atmospheric transport of radionuclides on particulate matter and ambient concentrations of total suspended particulates. Although the air quality monitoring networks are designed to monitor emissions from the entire INEEL, select, low-volume particulate samplers in the vicinity of INTEC provide detailed data on ambient concentrations of radionuclides and particulates.

Historically, the contractor has operated one network and the other network has been operated independently by DOE. The contractor network consists of low-volume air samplers that operate at 0.14 m^3/min (5 ft^3/min). Particulate matter is collected on a membrane filter. The air filters are collected and analyzed every 2 weeks for gross alpha and gross beta activity. Filters are also analyzed monthly for selected gamma-emitting radionuclides. The air filters are analyzed for gross beta activity to determine if

increases in sample radioactivity warrants more immediate and/or more in-depth analysis by gamma spectrometry or radiochemistry.

The DOE network consists of 23 monitoring stations on and around INEEL. Each low-volume air sampler contains two filters: a membrane prefilter and charcoal-impregnated paper filter. Filters are collected and analyzed weekly. Gross beta activity for each filter is determined weekly as a screening technique and gamma spectrometry is conduced to obtain more detailed information. Composites of the membrane prefilters for each location are analyzed for specific radionuclides on a quarterly basis.

Appendix B

TFF Tank Contents and Construction Information

B. TFF TANK CONTENTS AND CONSTRUCTION INFORMATION

B.1 Equipment

The Tank Farm Faciltiy (TFF) is comprised of nine 300,000 gallon and two 318,000 gallon active stainless steel tanks, each of which is contained within a concrete vault; four inactive 30,000 gallon stainless steel tanks; and valve boxes, encasements, and various process and instrumentation piping associated with the tanks (LMITCO 1998). The physical layout of the Idaho Nuclear Technology and Engineer Center (INTEC) and TFF is depicted in Figure B-1. A conceptual view of TFF is depicted in Figure B-2.

B.1.1 Tanks

The following tanks at TFF have been designated as part of the closure unit as discussed in Section 4.2:

- Eleven tanks with a capacity of about 300,000 gallons. The tanks include nine 300,000-gallon tanks (WM-182 through WM-190) and two 318,000-gallon storage tanks (WM-180 and WM-181). These tanks are referred to as the 300,000 gallon tanks.

- Four inactive tanks with a capacity of 31,000 gallons (WM-103 through WM-106). As shown in Figure B-2, the four tanks are located north of WM-182. The four tanks are referred to as the 30,000-gallon tanks.

B.1.1.1 300,000 Gallon Tanks. The 300,000 gallon storage tanks, WM-180 through WM-190, are contained in belowgrade, unlined, octagonal (WM-180 through WM-186) or square (WM-187 through WM-190) concrete vaults. A diagram of Tank WM-182 is shown in Figure B-3 as an example of the construction and design of the tanks. The tanks are stand-alone, stainless steel, cylindrically shaped vessels. Each tank is administratively limited to storing 385,000 gallons of liquid waste. The inside tank diameter and wall height are 50 ft and 21 ft, respectively, with the exception of 23-foot walls for WM-180 and WM-181. The higher walls for these two tanks provide a storage capacity of 318,000 gallons for each tank. Tanks WM-182 through WM-190 are constructed with an 11-in. wide horizontal plate that connects the tank wall top to the dome. This horizontal plate provides a flat surface for process and instrumentation pipelines to penetrate the tank. Equally spaced gussets support the plate from underneath. Tanks WM 180 and WM-181 have no horizontal plate because the dome edge connects directly to the tank wall top. Tank domes are spherical in shape and rise above the tank wall from 8.5 to 8.7 ft.

Eight of the eleven tanks contain stainless steel cooling coils (WM-180 through WM-185 and WM-187 through WM-190) to maintain the liquid waste temperature below 35 °C for fluoride-containing waste and below 55 °C for nonfluoride containing waste. The liquid waste is maintained below these temperatures to minimize tank corrosion. The lower tank temperature also reduces the liquid surface evaporation rate. Demineralized water in the cooling coils, along with chromate additives, circulates through a closed system and is cooled by secondary cooling water.

Access to the 300,000-gallon tanks is provided through risers. Each tank has four to five 12 in. diameter risers. Tanks WM-184 through WM-190 also have two 18 in. diameter risers. Most risers have equipment installed in them, such as radio frequency probes for level measurement, corrosion coupons, or

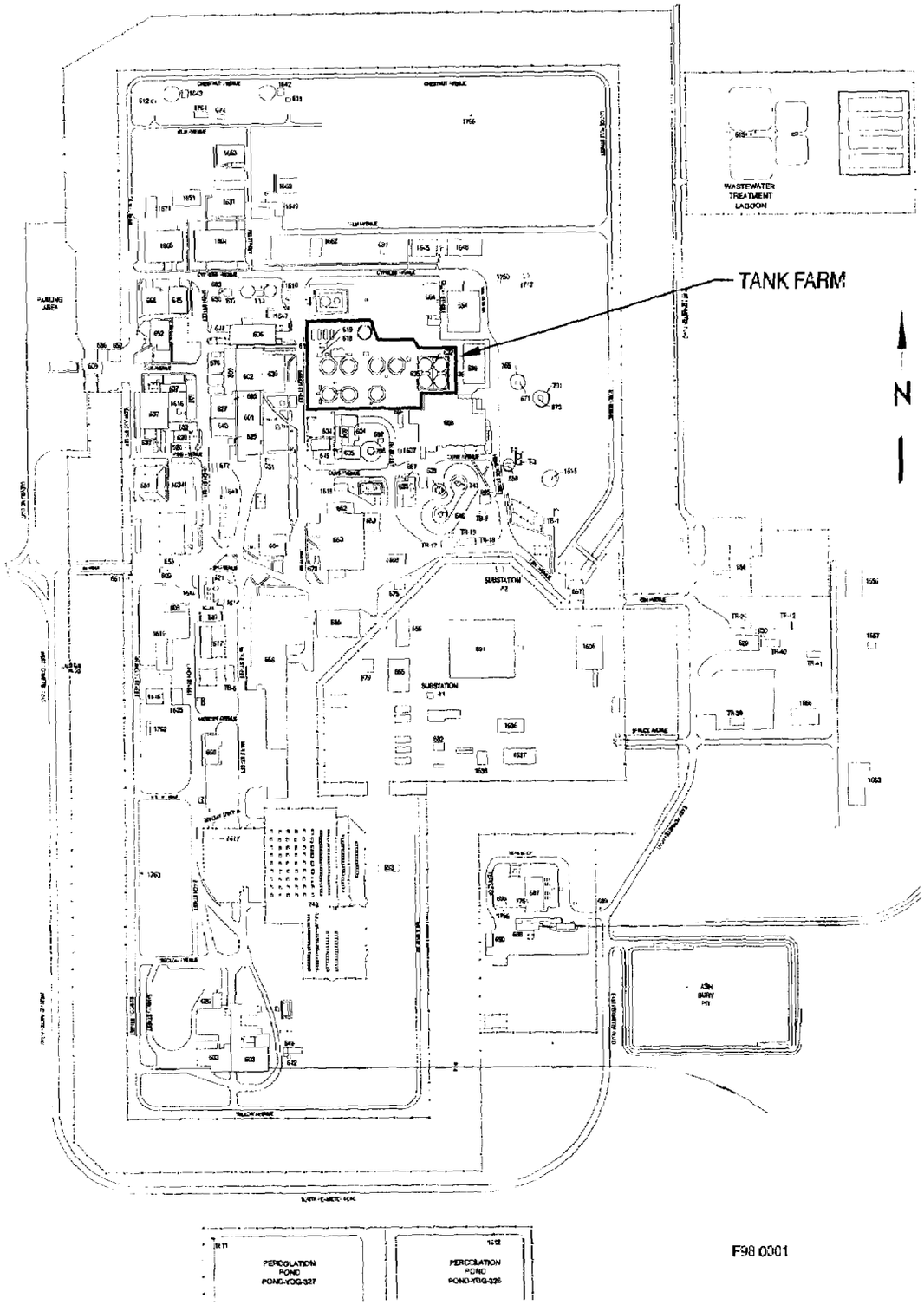


Figure B-1. TFF location at Idaho Nuclear Technology and Engineering Center.

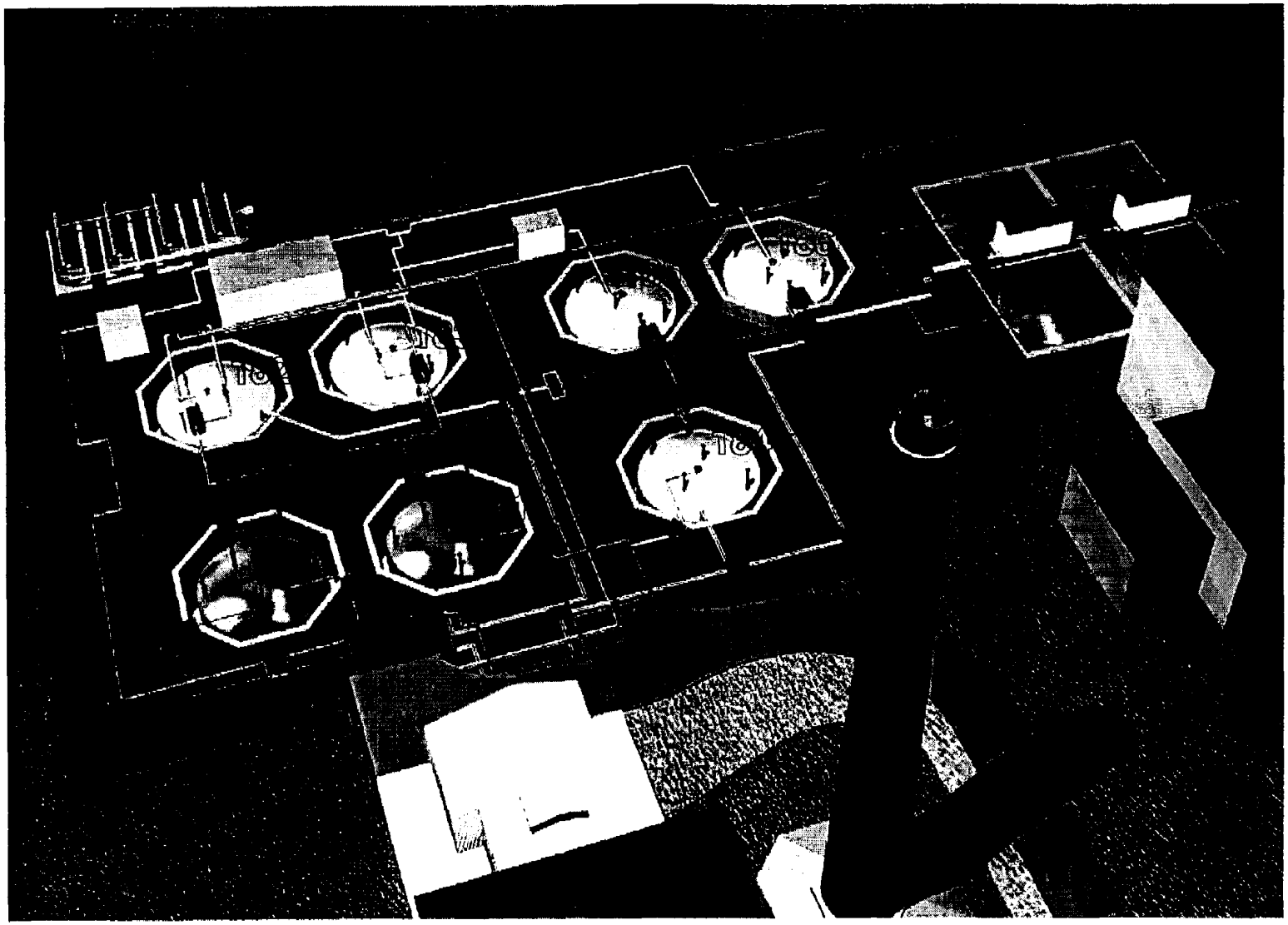


Figure B-2. Conceptual Overview of TFF.

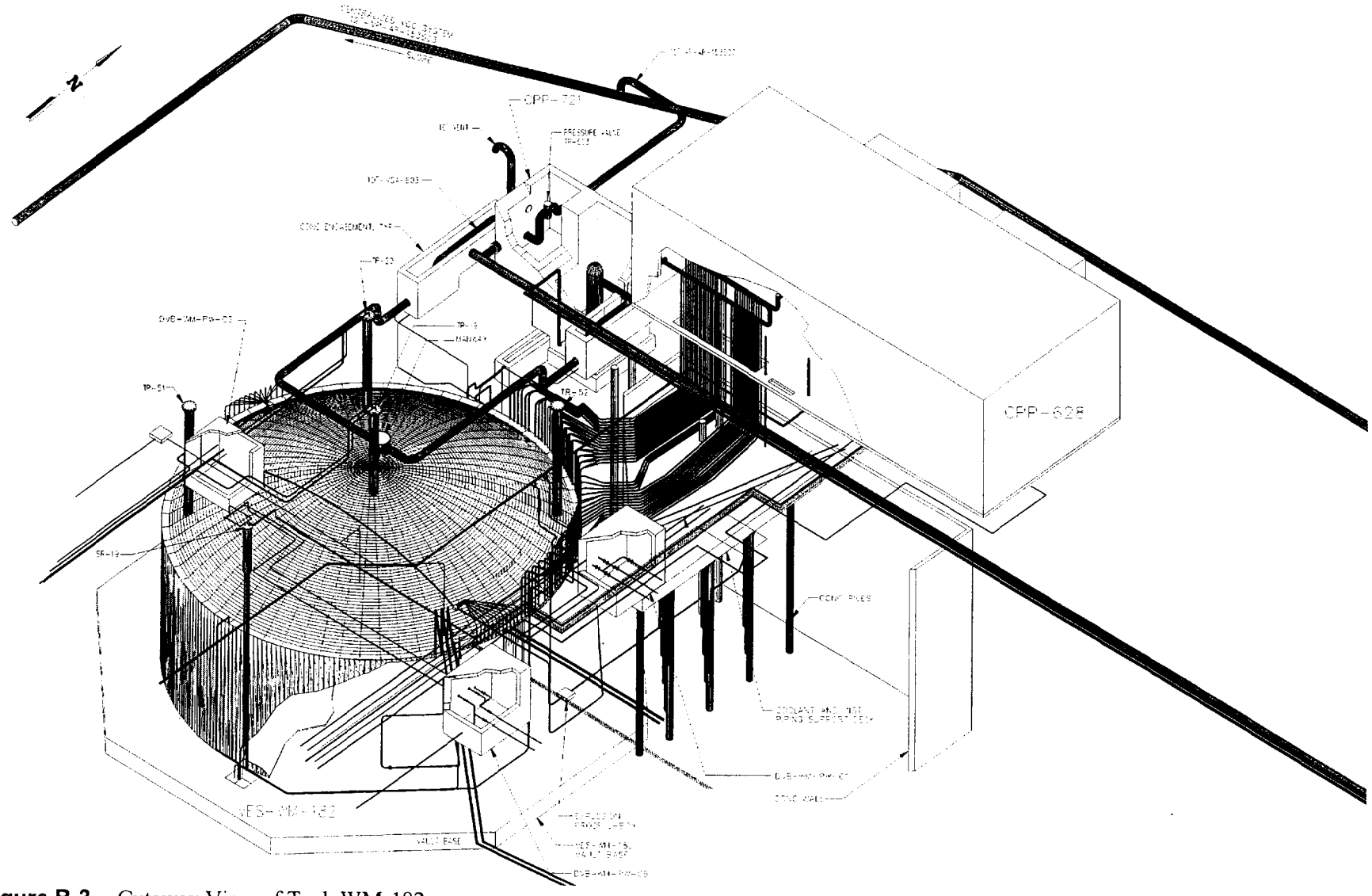


Figure B-3. Cutaway View of Tank WM-182.

waste transfer equipment (steam jets and airlifts). Two steam jets are located inside each tank, with the exception of WM-189 and WM-190, each of which has one steam jet and one air lift pump. A single steam jet can transfer waste out of a tank at approximately 50 gpm, and an airlift can transfer waste out of a tank at approximately 35 gpm. Table B-1 provides general construction information on the 300,000-gallon tanks.

B.1.2 30,000 Gallon Tanks

The four, inactive 30,000-gallon tanks are stainless steel belowground tanks on reinforced concrete pads. The tanks have a diameter of about 11.5 ft, are 38 ft long, and are covered by compacted gravel. Tanks WM-103, WM-104, WM-105, and WM-106 were buried at depths of 28.5, 29.0, 29.5 and 29.5 ft respectively. Like the 300,000 gallon tanks, the 30,000 gallon tanks do not have secondary containment that can be certified to meet Hazardous Waste Management Act (HWMA)/Resource Conservation and Recovery Act (RCRA) requirements. Unlike the 300,000-gallon tanks, the 30,000 gallon tanks do not have vaults.

The tanks rest on concrete slabs that are 47.5 × 17 × 1.25 ft thick. These slabs were constructed with a 0.75 × 1 ft high curb surrounding the slab perimeter to contain leaking waste. A gravel pad was placed inside the curb. Sumps 2 × 2 × 2 ft deep were cast into the northeast corner of each concrete slab.

Each tank has a total volume of 30,750 gallons. The tanks are horizontal cylinders with American Society of Mechanical Engineers (ASME) dished heads attached on both ends. Generalized information and tank dimensions can be found in Table B-2.

Underground pillars anchored to bedrock support the concrete pipe encasements associated with the 30,000-gallon tanks. The base slabs, upon which the tanks rest, are not supported by concrete but rest on undisturbed soil.

All four tanks contain stainless steel, closed loop, recirculating cooling coils to control liquid waste temperature, evaporation rate, and condensation accumulation. Base slab sump access is provided through a 24 in. diameter concrete riser that extends to grade level. A permanently installed sump jet pump obstructs the sump access riser interior.

Access to the 30,000 gallon tanks is provided by three 6-in. and one 3-in. diameter risers that reach to grade level. Tank jets are connected through the tank personnel access and extend underground to the other TFF locations. Tanks WM-103 and WM-104 are installed with four steam jets while tanks WM-105 and WM-106 are installed with two steam jets for liquid removal.

B.1.3 Vaults

The vault floors are approximately 45 ft below grade. The vaults containing the tanks are of three basic designs:

- Monolithic octagonal.
- Pillar and panel octagonal.

Table B-1. Design information summary for 300,000-gallon tanks

	WM-180	WM-181	WM-182	WM-183	WM-184	WM-185	WM-186	WM-187	WM-188	WM-189	WM-190
Design organization	Foster-Wheeler	Foster-Wheeler	Blaw-Knox	Blaw-Knox	Blaw-Knox	Fluor Corp.	Fluor Corp.	Fluor Corp.	Fluor Corp.	Fluor Corp.	Fluor Corp.
Tank subcontractor	Chicago Bridge and Iron (CBI)	CBI	CBI	CBI	CBI	CBI	CBI	Hammond Iron	Hammond Iron	Industrial Contractors	Industrial Contractors
Years Constructed	1951-1952	1951-1952	1954-1955	1954-1955	1954-1955	1957	1955-1957	1958-1959	1958-1959	1964	1964
Initial Service Date	1954	1953	1955	1958	1958	1959	1962	1959	1963	1966	Spare
Design codes	Unknown	Unknown	API-12C	API-12C	API-12C	API-12C	API-12C	API-12C	API-12C	API-650	API-650
Cooling coils	Yes	No	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes
Tank Diameter (ft)	50	50	50	50	50	50	50	50	50	50	50
Tank height to springline (ft)	23	23	21	21	21	21	21	21	21	21	21
Tank capacity (gal)	318,000	318,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000
Lower tank thickness (in)	0.3125	0.3125	0.3125	0.3125	0.3125	0.3125	0.3125	0.3125	0.3125	0.3125	0.3125
Upper tank thickness (in)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Corrosion allowance (mils)	Unknown	Unknown	125	125	125	125	125	125	125	125	125
Type of stainless steel	347	347	304 L	304 L	304 L	304 L	304 L	304 L	304 L	304 L	304 L
Design specific gravity	1.3	1.3	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Physical Characteristic		**Dimension**									
Dome height		8.7 ft (WM-180 and –181)[a]				8.5 ft (WM-182 through WM-190)[a]					
Approximate total tank volume		2,000 yd^3 [a,b] (WM-180 and –181)				1,825 yd^3 [a,b] (WM-182 through WM-190)					
Approximate dome volume		330 yd^3 [a,c] (WM-180 and –181)				300 yd^3 [a,c] (WM-182 through WM-190)					

a. Values shown in table are approximations to aid in cost estimation and provide a general tank description.

b. Estimated volume is based on the physical tank volume not the tank capacity.

c. Volume calculated using standard spherical cap equation, a diameter of 50 ft, and appropriate dome height.

Table B-2. Design information summary for 30,000 gallon tanks.

Tank Identification Number	WM-103	WM-104	WM-105	WM-106
Design organization	Blaw-Knox Company	Blaw-Knox Company	Blaw-Knox Company	Blaw-Knox Company
Vendor	Alloy Fabricators	Alloy Fabricators	Alloy Fabricators	Alloy Fabricators
Years Constructed	1954-1955	1954-1955	1954-1955	1954-1955
Total tank volume	30,750 gal[a]	30,750 gal[a]	30,750 gal[a]	30,750 gal[a]
Tank cylindrical length	38 ft[a]	38 ft[a]	38 ft[a]	38 ft[b]
Spherical heads (two per column)	ASME Standard Flanged and Dished Heads (~2 ft deep)[a]	ASME Standard Flanged and Dished Heads (~2 ft deep)[a]	ASME Standard Flanged and Dished Heads (~2 ft deep)[a]	ASME Standard Flanged and Dished Heads (~2 ft deep)[b]
Total tank length	42 ft	42 ft	42 ft	42 ft
Tank inner diameter	11.5 ft[a]	11.5 ft[a]	11.5 ft[a]	11.5 ft[b]
Tank wall thickness	11/16 in [a]	11/16 in [a]	11/16 in [a]	11/16 in [b]
Tank supporting base slab size	47.5 x 17 x 1.25 ft thick [c]	47.5 x 17 x 1.25 ft thick [c]	47.5 x 17 x 1.25 ft thick [c]	47.5 x 17 x 1.25 ft thick [c]
Liquid containment perimeter curb size	12 in high x 9 in wide [c]	12 in high x 9 in wide [c]	12 in high x 9 in wide [c]	12 in high x 9 in wide [c]
Tank access risers	Three 6-in diameter	Three 6-in diameter	Three 6-in diameter	Three 6-in diameter
	One 3-in diameter [c]	One 3-in diameter [c]	One 3-in diameter [c]	One 3-in diameter [c]
Sump riser (concrete pipe)	24-in diameter	24-in diameter	24-in diameter	24-in diameter
	Pipe wall is 3 in thick [c]	Pipe wall is 3 in thick [c]	Pipe wall is 3 in thick [c]	Pipe wall is 3 in thick [c]
Sump dimensions	2 x 2 x 2 ft [c]	2 x 2 x 2 ft [c]	2 x 2 x 2 ft [c]	2 x 2 x 2 ft [c]
Buried tank depths (dimensions to tank bottom)	28.5 ft [c]	28.5 ft [c]	28.5 ft [c]	28.5 ft [c]

a. Drawing 104807
b. Drawing 104809
c. Drawing 105027

- Monolithic square.

The vault roofs are covered with approximately 10 ft of soil to provide radiation shielding. The vault roofs are 6 in. thick concrete. Details of the various vaults are provided in Table B-3.

B.1.3.1 Monolithic Octagonal Vaults. The two oldest tanks at TFF, Tanks WM-180 and WM-181, were constructed from 1950 to 1953 and are contained in poured-in-place monolithic octagonal concrete vaults. These are the only vaults that have been qualified through analytical modeling to meet Performance Category (PC) -4 seismic criteria. The vault floors are octagonal and were poured on bedrock. They are flat with sump areas cast within the vault floor for liquid drainage. Vault CPP-180 (Tank WM-180) was installed with two sump areas, 2 × 2 × 4 ft deep in the southeast corner and 2.5 × 2.5 × 2 ft deep in the northeast corner. Vault CPP-781 (Tank WM-181) was installed with one sump area 2 × 2 × 4 ft deep in the southwest corner. The concrete vault walls were cast once the vault floors were poured. The concrete vault roof was cast in place. The vault roof was constructed to rise at an angle from the vault walls and flatten toward the middle. Concrete platforms, supported by vertical concrete pillars, were constructed between the vaults for WM-182 and WM-183. This platform supports the cooling coils, instrumentation pipelines, process waste pipelines, and their respective encasements.

B.1.3.2 Pillar and Panel Octagonal Vaults. The five tanks contained in vaults of pillar and panel construction, Tanks WM-182 through WM-186, were constructed from 1953 to 1957. Also in octagonal vaults, the tanks contained in the pillar and panel vaults are of prefabricated construction and, therefore, are not considered as robust as the tanks contained in monolithic vaults (Palmer et al. 1998). The pillar and panel vaults were not analyzed for and probably would not qualify for PC-4 seismic criteria (Swenson 1999). A diagram of the pillar and panel vault design is presented in Figure B-5. The octagonal concrete floors were poured on bedrock. Each floor has a 4-in. slope, beginning at the floor center and tapering to the slab edge. This slope creates a conical shaped floor. Sump areas, 1 × 1 × 1 ft deep, located on the north and south side of each vault, were cast within the vault floor. There is a 6 × 6-in. curb cast 6 ft in from the concrete base slab. The curb encloses an octagonal area 51 ft wide, encircling a sand pad.

The vault walls are constructed of concrete pillars and panels. A diagram of a pillar and panel vault can be seen in Figure B-4. The roofs are constructed of similar materials.

B.1.3.3 Monolithic Square Vaults. The four tanks contained in reinforced, poured-in-place, monolithic square, four-sectioned ("four pack") concrete vaults, Tanks WM-187 through WM-190, were constructed from 1959 to 1965. The vaults of these tanks are believed to meet PC-4 criteria, but the analysis for qualification was not performed (Palmer et al. 1998; Swenson 1999). The square concrete vault floors were poured side by side on bedrock. The floors are constructed with a 4 in. slope, beginning at the floor center and tapering to the slab edge. The slope creates a conical-shaped floor similar to the pillar and panel vaults. Two sump areas, 12 in. deep and 12 in. square, are cast within the vault floor. The sumps are located in the northwest and southeast corners for the WM-187 and WM-189 vaults and the northeast and southwest corners for the WM-188 and WM-190 vaults. A 6 × 6-in. octagonal curb was installed inside the square vault. The curb creates an octagonal area 51 ft wide, encircling a sand pad.

Table B-3. Design information summary for Vaults CPP-780 through CPP-786 and CPP-713.

	CPP-780	CPP-781	CPP-782	CPP-783	CPP-784	CPP-785	CPP-786	CPP-713			
	WM-180	WM-181	WM-182	WM-183	WM-184	WM-185	WM-186	WM-187	WM-188	WM-189	WM-190
Design organization	Foster-Wheeler	Foster-Wheeler	Blaw-Knox	Blaw-Knox	Blaw-Knox	Fluor Corp.	Fluor Corp.	Fluor Corp.	Fluor Corp.	Fluor Corp.	Fluor Corp.
Years Constructed	1951-1952	1951-1952	1954-1955	1954-1955	1954-1955	1957	1955-1957	1958-1959	1958-1959	1964	1964
Vault type	Monolithic octagonal [a]	Monolithic octagonal [a]	Pillar and panel octagonal	Pillar and panel octagonal	Pillar and panel octagonal	Pillar and panel octagonal	Pillar and panel octagonal	Monolithic square [a]	Monolithic square [a]	Monolithic square [a]	Monolithic square [a]
Inside width (ft)	56[1]	56[1]	58.9[6]	58.9[6]	58.9[6]	58.8[7]	58.8[7]	56[18]	56[8]	56[8]	56[8]
Wall thickness (ft)	2.33 or	2.33 or	0.5[9]	0.5[9]	0.5[9]	0.542[10]	0.542[10]	N = 3.5	N = 3.5	N = 3.5	N = 3.5
	1.75[1]	1.75[1]						S = 3.5	S = 3.5	S = 3.5	S = 3.5
								W = 1.5	W = 1.5	W = 3.5	W = 3.5
								E = 3.5[11]	E = 3.5[11]	E = 1.5[11]	E = 1.5[11]
Inside vault wall height (ft)	27.33[12]	27.33[12]	32[6]	32[6]	32[6]	29.5[13]	29.5[13]	32.6[14]	32.6[14]	32.6	32.6
No. of vault risers and sumps	1[15]	1[15]	2[16]	2[18]	2[18]	2[19]	2[20]	2[21]	2[22]	2[23]	2[24]
Maximum roof thickness (ft)	5.75[1]	5.75[1]	3.66[25]	3.66[25]	3.66[25]	3.5[26]	3.5[26]	4.5[27]	4.5[27]	4.0[28]	4.0[28]
Minimum roof thickness (ft)	1.25[1]	1.25[1]	0.5[29]	0.5[29]	0.5[29]	0.5[26]	0.5[26]	0.5[30]	0.5[30]	0.5[28]	0.5[28]
Vault top to grade (ft)	6.75[31]	6.75[31]	8.5 to 9[32,33]	9 to 9.5[32,33]	9[32]	9[34]	9[34]	9[27]	9[27]	9[28]	9[28]
Total vault volume (yd^3)[7]	3,386	3,386	3,229	3,229	3,229	3,229	3,229	3,737	3,737	3,737	3,737
Vault volume with tank in vault (yd^3)[7]	1,384	1,384	1,404	1,404	1,404	1,404	1,404	1,911	1,911	1,911	1,911

a. Cast-in-place.

1. INTEC Drawing 1033628
2. INTEC Drawing 105588
3. INTEC Drawing 106218
4. INTEC Drawing 106238
5. INTEC Drawing 117967
6. INTEC Drawing 105587
7. INTEC Drawing 106216
8. INTEC Drawing 106311
9. INTEC Drawing 105590
10. INTEC Drawing 106221
11. INTEC Drawing 106308/106311
12. INTEC Drawing 103362
13. INTEC Drawing 106220/106217
14. INTEC Drawing 106310
15. INTEC Drawing 103557
16. INTEC Drawing 105458
17. INTEC Drawing 105460
18. INTEC Drawing 105528
19. INTEC Drawing 106210
20. INTEC Drawing 106226
21. INTEC Drawing 106237
22. INTEC Drawing 106249
23. INTEC Drawing 117958
24. INTEC Drawing 117960
25. INTEC Drawing 105593
26. INTEC Drawing 106219
27. INTEC Drawing 106309
28. INTEC Drawing 119769
29. INTEC Drawing 105588
30. INTEC Drawing 106314
31. INTEC Drawing 103557
32. INTEC Drawing 105582
33. INTEC Drawing 105057
34. INTEC Drawing 106223

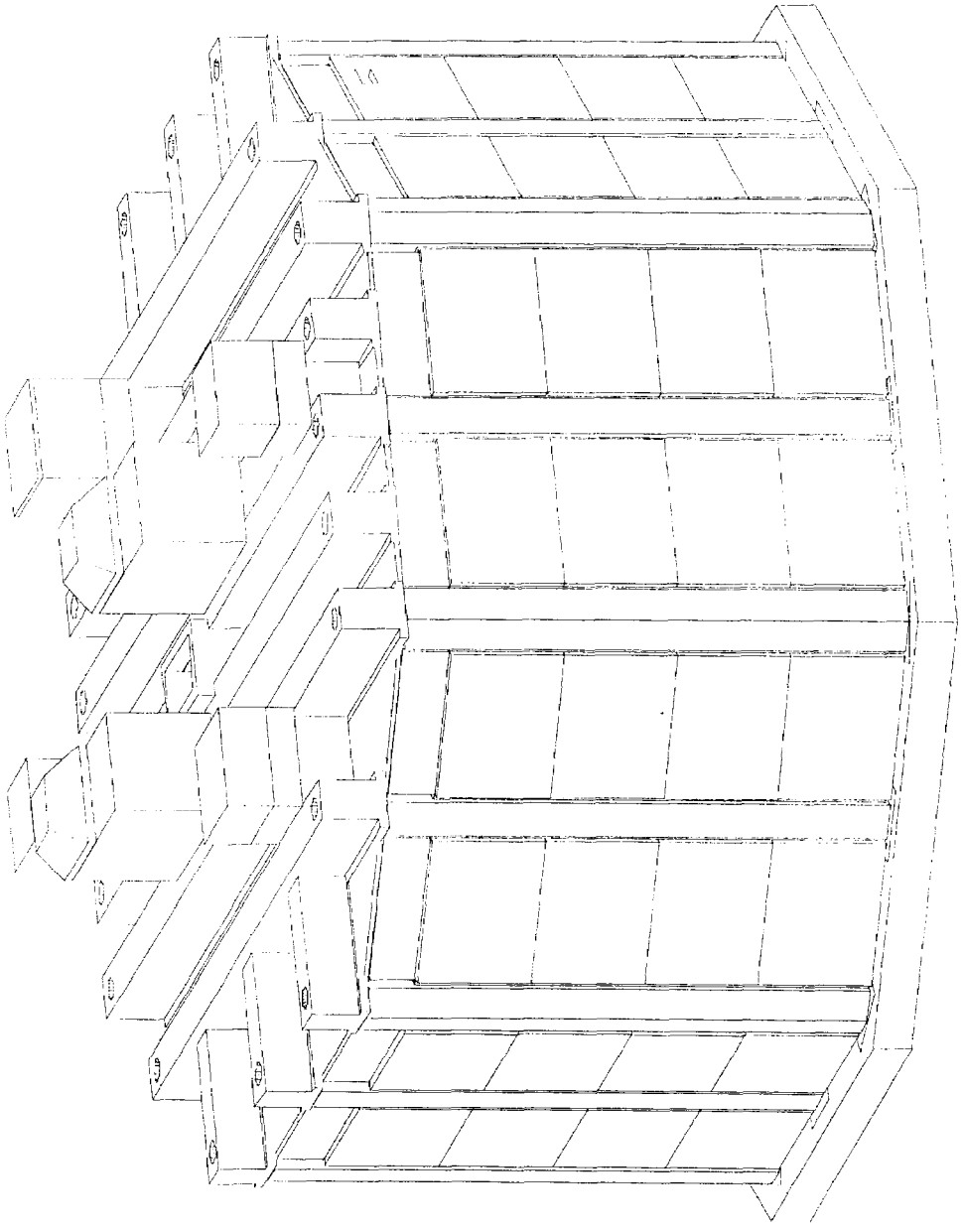


Figure B-4. Pillar and Panel Vault Design.

B.1.4 Transfer Equipment

B.1.4.1 Tanks WM-180 and WM-181. Waste transfer, cooling (WM-180 only), decontamination, instrumentation, and vessel off-gas (VOG) pipelines are plumbed to individual tanks and vaults. Split tile piping (ceramic pipe sealed together with cement mortar) was used as secondary containment. The secondary encasement drains into CPP-604. Sump jet pumps are installed to remove liquid from the respective vaults. These pumps operate on steam power and pump from the vault sumps into the tanks. Jet pumps are installed to remove liquid from the tanks. These jet pumps are located 3 to 9.5 in. above the tank floor. Permanent steam lines are connected to each jet pump and routed through underground piping to steam sources within the Piping Control House (CPP-628). Double-contained process waste lines (either double wall piping or single wall piping inside encasements) are routed underground from the jet pumps to the main transfer/filling system.

B.1.4.2 Tanks WM-182 Through WM-186. Waste transfer, cooling, decontamination, instrumentation, and VOG pipelines are plumbed to individual tanks and vaults. The waste transfer pipe running from the valve boxes to just outside the vault walls is encased in concrete enclosures with stainless steel liners to prevent radioactive waste from escaping. The concrete enclosures do not penetrate the vault. Pipes penetrate the vault via a pipe-in-pipe sleeve. Drains in each concrete encasement allow liquid from a leaking pipe or water infiltration to flow back to the nearest tank vault. Sump jets are installed in the sumps on the north and south sides of each tank. A portable high-pressure steam hose connected above ground will energize these pumps. The sump jets transfer liquid from the vaults to the respective tanks. Jet pumps are installed to remove liquid from the tanks. These jet pumps are located 3 to 9.5 in. above the tank floor. Permanent steam lines are connected to each jet pump and routed through underground piping to steam sources within the Piping Control House (CPP-628). Double contained process waste lines are routed underground from the jet pumps to the main transfer/filling system.

B.1.4.3 Tanks WM-187 Through WM-190. Waste transfer, cooling, decontamination, instrumentation, and VOG pipelines are plumbed to individual tanks and vaults. The waste transfer pipe running from the valve boxes to just outside the vault walls are encased in stainless steel pipe enclosures to prevent escape of radioactive waste. Process line leaks are routed to the nearest valve box sump. Sump jets with permanently attached steam source and transfer lines are installed into each vault sump to allow liquid removal. Liquid transfer jets are permanently installed inside the storage tanks through the tank risers to allow liquid waste removal.

B.1.4.4 30,000 Gallon Tank Liquid Transfer Equipment. There are permanent sump jet pumps installed in each of the four sumps associated with these tanks. Liquid removal jet pumps are installed in each tank with line penetrating through the tank personnel access. The inlets to these tanks are currently disconnected but the outlets are still tied to the TFF piping system.

B.1.4.5 C Series Valve Boxes. Valve boxes, located where pipe runs change directions, were constructed to provide protection for pipe joints, improve valve access, increase protection to workers from contaminated soils, and reduce valve repair costs by minimizing ground excavation. Valve boxes were installed with sumps and attaching drain lines to transfer liquid waste to vault sumps or the Process Equipment Waste Evaporator (PEWE) in the even pipe encasement draining or process valve leaking occurs.

Each concrete valve box is reinforced and lined with stainless steel. The interior surfaces of C-series valve boxes are painted. Americoat 33, an enamel based paint, was used to paint C-series valve boxes. Bitumastic #50, a material similar to tar thatch, was used as filler around pipe sleeves or on carbon

steel piping. The approximate valve box dimensions are 6 ft long, 6 ft wide, and 6.5 ft high, with a wall thickness of 6 in. Typically, valve boxes extend approximately 1 ft above grade.

B.1.4.6 Process Waste Pipelines. All lines that transport waste within TFF are buried and enclosed in pipe encasements known as secondary containment. The four main types of TFF secondary containment include the following:

- Split tile (ceramic cast pipe)
- Concrete troughs line with stainless steel
- Directly buried pipes encased in concrete
- Double-walled stainless steel pipe.

During recent TFF upgrades, most pipe sections encased in split tile were either replaced or abandoned in place (Swenson 1990). Process waste lines and respective secondary containment are generally covered with 10 to 15 ft of soil.

Any fluid leaking from a process line drains into an encasement and then into a valve box or vault sump. Leaking liquid is detected by radiation and level detection instrumentation. Waste collected in a valve box or vault sump is jetted to Tank WL-133 (located in building CPP-604) or drained to Valve Box C12. Waste collected in Valve Box C12 is also jetted to Tank WL-133. Waste from WL-133 is sent to the PEWE for processing.

B.2 Process Details

Essentially all of the high-level waste (HLW) at the INEEL exists at INTEC (Palmer et al. 1998). Liquid HLW from first-cycle extraction was produced in liquid form from 1953 to 1988 and intermediate-level waste was produced from second- and third-cycle extractions until 1994 from the reprocessing of many different types of spent nuclear fuel (SNF). Most of the liquid waste generated at INTEC has been stored temporarily at TFF. Two types of liquid waste were stored at TFF.

- HLW, generated from reprocessing SNF during first-cycle extraction (Wichmann, Brooks, and Heiser 1996)
- Sodium bearing waste, or nonHLW, generated from second- and third-cycle extraction and incidental activities, such as decontamination associated with operation of INTEC (Palmer et al. 1998; Wichmann, Brooks, and Heiser 1996). Sodium-bearing waste typically contains no more than about 10% of the radioactivity of HLW.

The liquid sodium-bearing waste at TFF is stored and treated in the same manner as the HLLW, but it is actually mixed transuranic (TRU) waste. TRU waste is defined as material containing any alpha-emitting radionuclides with an atomic number greater than 92, a half-life longer than 20 years, and a concentration greater than 100 nCi/g at the end of an assumed 10-year period of institutional control (DOE-ID 1999).

With the end of the Cold War and the diminishing need to recover and recycle SNF, DOE discontinued the reprocessing mission at INTEC in April 1992. The final second- and third-cycle processes for decontamination and decommissioning were completed in 1994. Since the discontinuation, no more HLW has been generated at INTEC and its focus has shifted to continued management and disposition of waste accumulated from previous reprocessing activities.

B.2.1 Past Process Description

B.2.1.1 INTEC Operational History Overview. TFF provided interim storage for highly radioactive liquid waste generated during fuel reprocessing operations. These operations are summarized below. A more detailed discussion of historic operations at INTEC can be found in Chapter 2 of the Operable Unit (OU) 3-14 Work Plan (DOE-ID 1999) or from an inactive INTEC manual, the Idaho Chemical Processing Plant Integrated Plan Manual (WINCO 1986).

B.2.1.1.1 Fuel Reprocessing—INTEC facilities were designed to reprocess SNF from test and research reactors in the United State and foreign countries and from U.S. Navy ship propulsion reactors. Fission products would build up in the fuel elements used in the reactors. The elements would sometimes require replacement when only 25 to 35% of the original U-235 was consumed in the reactor. TFF provided interim storage for highly radioactive liquid waste generated while recovering U-235 during fuel reprocessing operation.

The majority of liquid waste stored in TFF was generated during progressively more refined processes performed at CPP-601 to extract uranium: the first-, second-, and third-cycle extractions. The extraction processes typically would extract nearly all of the fission products from the uranium.

B.2.1.1.1.1 Fuel Dissolution—Prior to reprocessing SNF, the fuel was dissolved to form a uranyl nitrate solution suitable for solvent extraction. The fuel dissolution process varied, depending on the type of fuel to be reprocessed. Generally, five types of dissolution processes were used: aluminum, zirconium, stainless steel, graphite, and custom.

In the aluminum dissolution process, aluminum-based fuels were dissolved in a nitric acid solution in the presence of a mercuric nitrate catalyst. Aluminum dissolves very slowly in nitric acid because a passive oxide surface forms on the aluminum metal. Mercuric nitrate was added to the nitric acid to promote rapid dissolution by reducing mercuric ions to metallic mercury. The metallic mercury amalgamates with the aluminum and provides a more reactive surface for dissolution (WINCO 1986, p. II-9).

Zirconium-based fuels were dissolved using the fluorinel dissolution process. This process used hydrofluoric and nitric acids, aluminum nitrate, and the soluble nuclear points of cadmium and boron. After the fuel was digested, water, nitric acid, and aluminum nitrate that contained cadmium nuclear poison were added to complex the fluoride ions, dissolve tin in Zircaloy, oxidize uranium tetrafluoride to uranyl nitrate, and prevent criticality (WINCO, 1986, p II-19).

Stainless steel fuels were dissolved in nitric acid while a direct electrical current passed through the fuel in the electrolytic dissolution process. Anodic corrosion is accelerated by the application of an electrical current at voltages well above the electromotive potentials of the ionic reactions involved. The ionic reactions are the oxidation reactions of all the elemental metal components of fuel, fission products, and fuel can materials (WINCO, 1986, p. II-26).

The ROVER dissolution process was used to dissolve graphite fuels. ROVER fuels were composed of either an uncoated or pyrolytic carbon-coated graphite matrix that contained uranium dispersed throughout as uranium dicarbide fuel particles. These fuels were first burned in oxygen to remove the graphite. The uranium materials were then dissolved in hydrofluoric and nitric acids (WINCO 1986, p. OV-4, II-34).

Custom processing in specially designed pilot plant-type equipment with material-specific dissolvents was used for nuclear material that was incompatible with established dissolution processes. For example, those fuels with nontraditional cladding materials, material impurities, excessively high radiation levels, or small amounts of recoverable fissile material required custom fuel processing methods (WINCO 1986, p. II-38).

The liquid, uranium-bearing, product stream from these fuel dissolution processes were further prepared for the solvent extraction processes. This feed preparation consisted of a combination of the following steps: clarification by centrifuge to remove particulates, adjustment of chemical composition by adding nitric acid to improve uranium extractability, and suppression of emulsions by adding gelatin. Following feed preparation, each batch was sampled to determine uranium input to the plant. After confirming the consistency of the batch, the solution was transferred to interim storage in the dissolution facility prior to uranium recovery by solvent extraction (WINCO 1986, p. OV-4).

B.2.1.1.1.1.1 First-Cycle Fuel Extraction—The separation of uranium from the uranyl nitrate solution resulting from fuel dissolution began with the first-cycle extraction process. In the first-cycle extraction process, uranium was extracted from the uranyl nitrate solution into a solution of tributyl phosphate in dodecane. The aqueous raffinate stream from this extraction, which included the fission products, was sent to the TFF waste tanks unless the uranium concentration remained high enough for further extraction (WINCO 1986, p. III-1, 2, 3). Additional fission products and nitric acid were removed from the uranium-bearing organic solution with ammonium hydroxide and aluminum nitrate (Campaign 38 report, p.1). The uranium was then transferred from the organic to the aqueous phase by contacting the uranium-bearing organic solution with a nitrate-deficient aqueous solution. Traces of tributyl phosphate in the aqueous uranium stream were removed by a stream of pure hydrocarbon diluent. The uranium product was concentrated in the evaporator and then sent to intercycle storage for further purification in the hexone extraction process (WINCO 1986, p. III-6, 7).

All first-cycle raffinates were acidic with a hydrogen-ion concentration between 1 and 3 molar (M). Nuclides in the first-cycle raffinates produced a typical radioactivity level in the stored wastes from 5 to 40 Ci/gallon depending on burnup in the reactor, time since removal from the discharge, and the nature of the fuel. The raffinates from zirconium dissolution and coprocessed zirconium and aluminum dissolution were fluoride-bearing wastes. The first cycle raffinates from the dissolution of aluminum and stainless steel fuel were nonfluoride bearing (WINCO 1986, p. IX-2).

B.2.1.1.1.2 Second- and Third-Cycle Reprocessing Wastes—The second- and third-cycle extraction processes used the hexone extraction process to purify the uranium product from the first-cycle extraction. The process used the solvent methyl isobutyl ketone (hexone) to separate the uranium from residual fission products and TRU elements such as neptunium and plutonium to recover greater than 99.9% of the uranium as product. A solution of 2 M aluminum nitrate containing 0.55 M ammonium hydroxide to make the solution acid-deficient and 0.08-M ferrous sulfamate was used to scrub plutonium, neptunium, and fission products from the hexone. The waste material containing the transuranics and fission products was evaporated to reduce its volume and then sent to TFF for future calcining (WINCO, 1986, p. IV-1-7). The second-cycle raffinate was less radioactive and was blended

with concentrated sodium-bearing wastes from the PEWE prior to being sent to TFF (WINCO 1986, IX-1, 4, 6).

B.2.1.1.2 Waste from Other Sources. Additional low-level waste (LLW) was sent to the PEWE and the PEWE bottoms before being sent to TFF for storage. The waste from PEWE that was stored in TFF included the following:

- Fluoride- and cadmium-bearing waste from the fluorinel process (from the Flourinel Dissolution Process and Fuel Storage (FAST) facility at CPP-666 through the Fuel Processing Facility CPP-601)

- Waste from the Fuel Storage Basins (in FAST and the Fuel Storage Facility in CPP-603)

- Decontamination waste containing fluoride from the waste calcining process [from the Waste Calcining Facility (WCF) at CPP-633 and later the New Waste Calcining Faciltiy (NWCF) at CPP-659]

- Occasional transfers from Tanks WL-104 and WL-105 (in the West Side Holdup Facility in CPP-641), the Pilot Plant in CPP-637, and the Head End Process Plant in CPP-640)

- Nonchlorinated organic waste shipped to the PEWE from the analytical laboratories (the Remote Analytical Laboratory in CPP-684, the Remote Analytical Facility (RAF) in CPP-627, and the Analytical Laboratory in CPP-602)

- Non-INTEC waste such as from Test Area North or Test Reactor Area (from the Truck Unloading Station in CPP-1619)

Decontamination and other incidental waste (from the Liquid Effluent Treatment and Disposal Facility in CPP-1618).

B.2.1.2 300,000 Gallon Tank Usage History. The eleven 300,000-gallon tanks contained in concrete vaults provided primary storage of high- and intermediate-level liquid waste except Tank WM-190, which was designated as an emergency spare. Each 300,000-gallon tank in TFF has a different waste storage history that will impact the closure of the tank. Compiled from two 1998 reports (Palmer 1998; Palmer et al. 1998), is a brief summary of each tank's usage:

- Tank WM-180 has been used only for storing sodium-bearing waste since 1972. The HLW in the tank was calcined during 1966 and 1967. Tanks WM-180 and WM-181 are the two oldest tanks at TFF. Tank WM-180 was put into service in 1954 and stored HLW from reprocessing aluminum-class SNF.

- Tank WM-181 has been used to store sodium-bearing waste since becoming operational in 1953 and has never contained HLW

- Tank WM-182 became operational in 1956 to store HLW from reprocessing aluminum- and zirconium-clad SNF. It was emptied to heel level in 1993

- Tank WM-183 became operational in 1958 and has stored HLW from reprocessing aluminum- and stainless steel- clad SNF, high-fluoride decontamination solutions, and process equipment waste and high-level liquid waste (HLLW) Evaporator bottoms from the WCF. HLW was transferred from the tank in 1981, after which the tank was filled with sodium-bearing waste. WM-183 has contained the greatest variety of waste of all the tanks at TFF.

- Tank WM-184 has contained only sodium-bearing waste composed of PEWE bottoms since becoming operational in 1958

- Tank WM-185 became operational in 1959 and has stored aluminum and zirconium fuel reprocessing waste as well as high-fluoride decontamination waste and PEWE bottoms

- Tank WM-186 contained HLW from reprocessing aluminum-clad SNF from 1959, when the tank was put into service, until 1967, when the HLW was transferred out of the tank

- Tank WM-187 was put into service in 1959 and stored HLW from reprocessing of aluminum- and zirconium-clad SNF, high fluoride decontamination waste, and PEWE bottoms.

- Tank WM-188 became operational in 1963. This tank has contained zirconium fuel reprocessing waste as well as high-fluoride decontamination waste and PEWE bottoms.

- Tank WM-189 became operational in 1964. From this point until 1996, the tank contained HLW from reprocessing zirconium-clad SNF and waste from decontamination and bed dissolutions at the WCF and NWCF.

- Tank WM-190 was never put into service. It was retained as the designated spare tank for use in emergencies. The only waste tank WM-190 contained was liquid waste that had leaked through closed valves and collected in the tank. This waste mixed with accumulated rainwater and snowmelt. The waste was removed from the tank in 1982 using a sump pump that emptied the tank as much as possible without personnel entry.

A detailed analysis of tank process history for Tank WM-182 is presented in Table B-4. The process history for WM-183 is presented in Table B-5. Past process details for WM-182 and WM-183 are provided because these are the first of the tanks to be closed. Similar information exists for each of the other tanks and will be included in the 1st Tier DOE Closure Plan for TFF.

B.2.1.3 Calcination Campaigns. Since 1963, the liquid waste stored at TFF has been solidified using a calcination process. This process results in reduced wastewater volumes and a granular solid that is then stored in Calcined Solids Storage Facilities (Palmer et al. 1998). Liquid waste at TFF is reduced using this method. The principal reactions during calcination are evaporation and thermal decomposition of the solutions to metallic oxides/fluorides, water vapor, and nitrogen oxides. Waste was removed from various TFF tanks during 13 calcination campaigns between 1963 and 1999. The volume of waste removed from each tank during the calcining campaigns is presented in Table B-6. Over 7.5 million gallons of waste have been removed from TFF tanks and treated since 1963. This includes over 1.5 million from WM-182 and over 400,000 gallons from WM-183.

Table B-4. Fuel reprocessing history for Tank WM-182.

Run	Beginning Date	Ending Date	Fuel	Cladding	Uranium Recovered (kg)	Unit
			First Cycle Waste Storage Use			
5	Dec-55	Mar-56	Hanford C Slugs	Aluminum	0.00	G-Cell
5	Dec-55	Mar-56	Chem Dev Test SRP Reject Slugs		0.13	G-Cell
5	Dec-55	Mar-56	Hanford J Slugs	Aluminum	581.00	G-Cell
6	Mar-56	May-56	Chalk River		0.82	C-Cell
6	Mar-56	May-56	Low Intensity Test Reactor	Aluminum	1.89	C-Cell
6	Mar-56	May-56	Boiling Reactor Experiment		1.90	C-Cell
6	Mar-56	May-56	Argonne Research Reactor (Prior to Rebuild)	Aluminum	4.15	C-Cell
6	Mar-56	May-56	Materials Testing Reactor	Aluminum	22.07	C-Cell
7	May-56	Mar-57	Chalk River		0.15	C-Cell
7	May-56	Mar-57	RalaMaterial Testing Reactor		2.61	L-Cell
7	May-56	Mar-57	Hanford C Slugs	Aluminum	93.90	C-Cell
7	May-56	Mar-57	Hanford J Slugs	Aluminum	125.10	C-Cell
7	Aug-57	Sep-57	CPM Cold Start w/SRP Slugs	Aluminum	222.00	G-Cell
8	Oct-57	Dec-57	Rala Material Testing Reactor		0.20	L-Cell
8	Oct-57	Dec-57	SRP Slugs	Aluminum	467.00	G-Cell
10	Jan-58	Feb-58	Rala Material Testing Reactor		0.70	L-Cell
10	Jan-58	Feb-58	Hanford C Slugs	Aluminum	68.10	G-Cell
10	Jan-58	Feb-58	SRP LM Slugs	Aluminum	208.40	G-Cell
11	May-58	Nov-58	Chalk River		0.45	C-Cell
11	May-58	Nov-58	SRP Tube		10.00	C-Cell
11	May-58	Nov-58	SRP LM Slugs	Aluminum	229.30	G-Cell
11	May-58	Nov-58	SRP Tube		857.00	G-Cell
28	Jun-72	Aug-72	Engineering Test Reactor	Aluminum	75.00	G-Cell
28	Jun-72	Aug-72	Navy (Zr)	Zirconium	103.00	E-Cell
29	Jan-73	May-73	Navy (Zr) Cold	Zirconium	0.00	E-Cell
30	Feb-74	May-74	Materials Testing Reactor	Aluminum	0.35	G-Cell
30	Feb-74	May-74	Test Reactor Area Scrap	Aluminum	0.40	G-Cell
30	Feb-74	May-74	University of Missouri	Aluminum	0.40	G-Cell
30	Feb-74	May-74	Materials Testing Reactor 20%	Aluminum	0.50	G-Cell
30	Feb-74	May-74	Juggernaut Argonne Low Power Research Reactor		2.20	G-Cell
30	Feb-74	May-74	Sandia Engineering Reactor?	Aluminum	3.90	G-Cell
30	Feb-74	May-74	JMTR		4.10	G-Cell
30	Feb-74	May-74	Livermore Pool Type Reactor	Aluminum	4.75	G-Cell
30	Feb-74	May-74	KUR		4.90	G-Cell
30	Feb-74	May-74	Japanese Research Reactor	Aluminum	5.45	G-Cell
30	Feb-74	May-74	Argonne Research Reactor (After Rebuild)	Aluminum	5.55	G-Cell
30	Feb-74	May-74	Omega West Reactor		10.45	G-Cell
30	Feb-74	May-74	General Electric Test Reactor	Aluminum	43.50	G-Cell
30	Feb-74	May-74	Engineering Test Reactor	Aluminum	175.75	G-Cell
30	Feb-74	May-74	Advanced Test Reactor	Aluminum	254.05	G-Cell
30	Feb-74	May-74	Navy (Zr)	Zirconium	318.60	E-Cell
36	Sep-80	Mar-81	Navy (Zr)	Zirconium	171.97	E-Cell
40	Aug-85	Jan-86	Livermore Pool Type Reactor	Aluminum	0.62	G-Cell
40	Aug-85	Jan-86	BSR		2.34	G-Cell
40	Aug-85	Jan-86	JANUS		2.73	G-Cell

Table B-4. (continued).

Run	Beginning Date	Ending Date	Fuel	Cladding	Uranium Recovered (kg)	Unit
			First Cycle Waste Storage Use			
40	Aug-85	Jan-86	McMaster University	Aluminum	3.30	G-Cell
40	Aug-85	Jan-86	JUNTA		3.31	G-Cell
40	Aug-85	Jan-86	Aerospace Systems Test Reactor	Aluminum	3.64	G-Cell
40	Aug-85	Jan-86	UCLA		3.80	G-Cell
40	Aug-85	Jan-86	Leital Netherlands	Aluminum	3.90	G-Cell
40	Aug-85	Jan-86	Turkey		4.64	G-Cell
40	Aug-85	Jan-86	HMI		5.41	G-Cell
40	Aug-85	Jan-86	Omega West Reactor	Aluminum	6.69	G-Cell
40	Aug-85	Jan-86	Sterling Forest Reactor		9.07	G-Cell
40	Aug-85	Jan-86	BR-2		9.53	G-Cell
40	Aug-85	Jan-86	TRITON French Reactor Design	Aluminum	10.29	G-Cell
40	Aug-85	Jan-86	Japanese Research Reactor II	Aluminum	11.30	G-Cell
40	Aug-85	Jan-86	ORPHEE French Reactor Design	Aluminum	14.90	G-Cell
40	Aug-85	Jan-86	Research Reactor Geesthacht		15.04	G-Cell
40	Aug-85	Jan-86	DR-3		16.53	G-Cell
40	Aug-85	Jan-86	Oak Ridge Research Reactor		33.74	G-Cell
40	Aug-85	Jan-86	Research Reactor Juelich-2		34.70	G-Cell
40	Aug-85	Jan-86	Savannah River		39.40	G-Cell
40	Aug-85	Jan-86	High Flux Reactor		42.75	G-Cell
40	Aug-85	Jan-86	Missouri University Research Reactor		43.17	G-Cell
40	Aug-85	Jan-86	R-2		45.83	G-Cell
40	Aug-85	Jan-86	JMTR		54.37	G-Cell
40	Aug-85	Jan-86	HFBR		137.97	G-Cell
40	Aug-85	Jan-86	Advanced Test Reactor	Aluminum	162.64	G-Cell
			Second Cycle Waste Storage Use			
27	Feb-71	Jul-71	Japanese Research Reactor II	Aluminum	1.95	D-Cell
28	Jun-72	Aug-72	Navy (Zr)	Zirconium	103.00	E-Cell
40	Aug-85	Jan-86	Livermore Pool Type Reactor	Aluminum	0.62	G-Cell
40	Aug-85	Jan-86	BSR		2.34	G-Cell
40	Aug-85	Jan-86	JANUS		2.73	G-Cell
40	Aug-85	Jan-86	McMaster University	Aluminum	3.30	G-Cell
40	Aug-85	Jan-86	JUNTA		3.31	G-Cell
40	Aug-85	Jan-86	Aerospace Systems Test Reactor	Aluminum	3.64	G-Cell
40	Aug-85	Jan-86	UCLA		3.80	G-Cell
40	Aug-85	Jan-86	Leital Netherlands	Aluminum	3.90	G-Cell
40	Aug-85	Jan-86	Turkey		4.64	G-Cell
40	Aug-85	Jan-86	HMI		5.41	G-Cell
40	Aug-85	Jan-86	Omega West Reactor	Aluminum	6.69	G-Cell
40	Aug-85	Jan-86	Sterling Forest Reactor		9.07	G-Cell
40	Aug-85	Jan-86	BR-2		9.53	G-Cell
40	Aug-85	Jan-86	TRITON French Reactor Design	Aluminum	10.29	G-Cell
40	Aug-85	Jan-86	Japanese Research Reactor II	Aluminum	11.30	G-Cell
40	Aug-85	Jan-86	ORPHEE French Reactor Design	Aluminum	14.90	G-Cell
40	Aug-85	Jan-86	Research Reactor Geesthacht		15.04	G-Cell
40	Aug-85	Jan-86	DR-3		16.53	G-Cell

Table B-4. (continued).

Run	Beginning Date	Ending Date	Fuel	Cladding	Uranium Recovered (kg)	Unit
			Second Cycle Waste Storage Use			
40	Aug-85	Jan-86	Oak Ridge Research Reactor		33.74	G-Cell
40	Aug-85	Jan-86	Research Reactor Juelich-2		34.70	G-Cell
40	Aug-85	Jan-86	Savannah River		39.40	G-Cell
40	Aug-85	Jan-86	High Flux Reactor		42.75	G-Cell
40	Aug-85	Jan-86	Missouri University Research Reactor		43.17	G-Cell
40	Aug-85	Jan-86	R-2		45.83	G-Cell
40	Aug-85	Jan-86	JMTR		54.37	G-Cell
40	Aug-85	Jan-86	HFBR		137.97	G-Cell
40	Aug-85	Jan-86	Advanced Test Reactor	Aluminum	162.64	G-Cell
41	Oct-86	Oct-87	FLUORINEL	Zirconium	404.85	FDP
41	Oct-86	Oct-87	FLUORINEL	Zirconium	404.85	FDP
42	Dec-87	Jul-88	FLUORINEL	Zirconium	335.35	FDP
42	Dec-87	Jul-88	FLUORINEL	Zirconium	335.35	FDP
			Third Cycle Waste Storage Use			
40	Aug-85	Jan-86	Livermore Pool Type Reactor	Aluminum	0.62	G-Cell
40	Aug-85	Jan-86	BSR		2.34	G-Cell
40	Aug-85	Jan-86	JANUS		2.73	G-Cell
40	Aug-85	Jan-86	McMaster University	Aluminum	3.30	G-Cell
40	Aug-85	Jan-86	JUNTA		3.31	G-Cell
40	Aug-85	Jan-86	Aerospace Systems Test Reactor	Aluminum	3.64	G-Cell
40	Aug-85	Jan-86	UCLA		3.80	G-Cell
40	Aug-85	Jan-86	Leital Netherlands	Aluminum	3.90	G-Cell
40	Aug-85	Jan-86	Turkey		4.64	G-Cell
40	Aug-85	Jan-86	HMI		5.41	G-Cell
40	Aug-85	Jan-86	Omega West Reactor	Aluminum	6.69	G-Cell
40	Aug-85	Jan-86	Sterling Forest Reactor		9.07	G-Cell
40	Aug-85	Jan-86	BR-2		9.53	G-Cell
40	Aug-85	Jan-86	TRITON French Reactor Design	Aluminum	10.29	G-Cell
40	Aug-85	Jan-86	Japanese Research Reactor II	Aluminum	11.30	G-Cell
40	Aug-85	Jan-86	ORPHEE French Reactor Design	Aluminum	14.90	G-Cell
40	Aug-85	Jan-86	Research Reactor Geesthacht		15.04	G-Cell
40	Aug-85	Jan-86	DR-3		16.53	G-Cell
40	Aug-85	Jan-86	Oak Ridge Research Reactor		33.74	G-Cell
40	Aug-85	Jan-86	Research Reactor Juelich-2		34.70	G-Cell
40	Aug-85	Jan-86	Savannah River		39.40	G-Cell
40	Aug-85	Jan-86	High Flux Reactor		42.75	G-Cell
40	Aug-85	Jan-86	Missouri University Research Reactor		43.17	G-Cell
40	Aug-85	Jan-86	R-2		45.83	G-Cell
40	Aug-85	Jan-86	JMTR		54.37	G-Cell
40	Aug-85	Jan-86	HFBR		137.97	G-Cell
40	Aug-85	Jan-86	Advanced Test Reactor	Aluminum	162.64	G-Cell
41	Oct-86	Oct-87	FLUORINEL	Zirconium	404.85	FDP
41	Oct-86	Oct-87	FLUORINEL	Zirconium	404.85	FDP
42	Dec-87	Jul-88	FLUORINEL	Zirconium	335.35	FDP
42	Dec-87	Jul-88	FLUORINEL	Zirconium	335.35	FDP

Table B-5. Fuel reprocessing history for WM-183.

Run	Beginning Date	Ending Date	Fuel	Cladding	Uranium Recovered (kg)	Unit
			First Cycle Waste Storage Use			
11	May-58	Nov-58	Chalk River		0.45	C-Cell
11	May-58	Nov-58	Rala Material Testing Reactor		2.17	L-Cell
11	May-58	Nov-58	Materials Testing Reactor	Aluminum	42.60	L&C-Cell
11	May-58	Nov-58	SRP LM Slugs	Aluminum	229.30	G-Cell
11	May-58	Nov-58	SRP Tube		857.00	G-Cell
12	Dec-58	Apr-59	Rala Material Testing Reactor		0.42	L-Cell
12	Dec-58	Apr-59	Chalk River (NRX)	Aluminum	0.48	D-Cell
12	Dec-58	Apr-59	SRP Slugs	Aluminum	46.55	C&D-Cell
12	Dec-58	Apr-59	SRP Tube		279.55	C&D-Cell
24	Mar-67	Sep-67	Experimental Breeder Reactor II, Vycor Gas	Stainless Steel	9.56	Multi-Curie
24	Mar-67	Sep-67	Japanese Research Reactor II Core 1	Aluminum	10.81	D-Cell
25	Apr-68	Jun-68	Sandia Engineering Reactor	Aluminum	1.76	G-Cell
25	Apr-68	Jun-68	Ground Test Reactor	Aluminum	3.20	G-Cell
25	Apr-68	Jun-68	Industrial Radiation Laboratories	Aluminum	3.37	G-Cell
25	Apr-68	Jun-68	NRL	Aluminum	3.98	G-Cell
25	Apr-68	Jun-68	Livermore Pool Type Reactor	Aluminum	5.37	G-Cell
25	Apr-68	Jun-68	Argonne Research Reactor (After Rebuild)	Aluminum	6.54	G-Cell
25	Apr-68	Jun-68	Graphite Leaching		9.95	Pilot Plant
25	Apr-68	Jun-68	Omega West Reactor	Aluminum	10.08	G-Cell
25	Apr-68	Jun-68	Low Intensity Test Reactor	Aluminum	53.39	G-Cell
25	Apr-68	Jun-68	General Electric Test Reactor	Aluminum	85.89	G-Cell
25	Apr-68	Jun-68	WSU Materials Testing Reactor		110.70	G-Cell
25	Apr-68	Jun-68	Engineering Test Reactor	Aluminum	385.54	G-Cell
26	Aug-69	Oct-69	Sandia Engineering Reactor	Aluminum	12.00	G-Cell
26	Aug-69	Oct-69	Korean	Aluminum	16.00	G-Cell
26	Aug-69	Oct-69	AFNETR		28.00	G-Cell
26	Aug-69	Oct-69	KUR		28.00	G-Cell
26	Aug-69	Oct-69	Livermore Pool Type Reactor	Aluminum	40.00	G-Cell
26	Aug-69	Oct-69	Omega West Reactor	Aluminum	60.00	G-Cell
26	Aug-69	Oct-69	Japanese Research Reactor II	Aluminum	71.00	G-Cell
26	Aug-69	Oct-69	General Electric Test Reactor	Aluminum	140.00	G-Cell
26	Aug-69	Oct-69	Engineering Test Reactor	Aluminum	227.00	G-Cell
26	Aug-69	Oct-69	Low Intensity Test Reactor	Aluminum	267.00	G-Cell
26	Aug-69	Oct-69	Materials Testing Reactor	Aluminum	420.00	G-Cell
26	Aug-69	Oct-69	Advanced Test Reactor	Aluminum		G-Cell
26	Aug-69	Oct-69	Special Power Excursion Reactor Test	Stainless Steel		G-Cell
27	Feb-71	Jul-71	WADCO		0.60	Multi-Curie
27	Feb-71	Jul-71	Experimental Breeder Reactor II, Scrap	Stainless Steel	32.20	Multi-Curie
28	Jun-72	Aug-72	Engineering Test Reactor	Aluminum	75.00	G-Cell
28	Jun-72	Aug-72	Navy (Zr)	Zirconium	103.00	E-Cell
29	Jan-73	May-73	Experimental Breeder Reactor II	Stainless Steel	514.53	HPP Cell 5
29	Jan-73	May-73	Experimental Breeder Reactor II	Stainless Steel	514.53	HPP Cell 5
29	Jan-73	May-73	Experimental Breeder Reactor II	Stainless Steel	514.53	HPP Cell 5
31	Feb-75	May-76	Experimental Breeder Reactor II	Stainless Steel	1046.60	HPP Cell 5

Table B-5. (continued).

Run	Beginning Date	Ending Date	Fuel	Cladding	Uranium Recovered (kg)	Unit
			First Cycle Waste Storage Use			
38	Sep-82	Nov-82	BSR		0.62	G-Cell
38	Sep-82	Nov-82	Sterling Forest Reactor		2.94	G-Cell
38	Sep-82	Nov-82	Omega West Reactor	Aluminum	5.49	G-Cell
38	Sep-82	Nov-82	SAPHIR		6.79	G-Cell
38	Sep-82	Nov-82	Research Reactor Juelich/Muenchen		9.49	G-Cell
38	Sep-82	Nov-82	Oak Ridge Research Reactor		9.94	G-Cell
38	Sep-82	Nov-82	Research Reactor Geesthacht		11.85	G-Cell
38	Sep-82	Nov-82	High Flux Reactor		20.65	G-Cell
38	Sep-82	Nov-82	General Electric Test Reactor	Aluminum	71.50	G-Cell
38	Sep-82	Nov-82	Advanced Test Reactor	Aluminum	99.37	G-Cell
38	Sep-82	Nov-82	Engineering Test Reactor	Aluminum	177.63	G-Cell
			Second Cycle Waste Storage Use			
28	Jun-72	Aug-72	Engineering Test Reactor	Aluminum	75.00	G-Cell
28	Jun-72	Aug-72	Engineering Test Reactor	Aluminum	75.00	G-Cell
29	Jan-73	May-73	Experimental Breeder Reactor II	Stainless Steel	514.53	HPP Cell 5
29	Jan-73	May-73	Experimental Breeder Reactor II	Stainless Steel	514.53	HPP Cell 5
29	Jan-73	May-73	Experimental Breeder Reactor II	Stainless Steel	514.53	HPP Cell 5
30	Feb-74	May-74	Materials Testing Reactor	Aluminum	0.35	G-Cell
30	Feb-74	May-74	Materials Testing Reactor	Aluminum	0.35	G-Cell
30	Feb-74	May-74	Test Reactor Area Scrap	Aluminum	0.40	G-Cell
30	Feb-74	May-74	Test Reactor Area Scrap	Aluminum	0.40	G-Cell
30	Feb-74	May-74	University of Missouri	Aluminum	0.40	G-Cell
30	Feb-74	May-74	University of Missouri	Aluminum	0.40	G-Cell
30	Feb-74	May-74	Materials Testing Reactor 20%	Aluminum	0.50	G-Cell
30	Feb-74	May-74	Materials Testing Reactor 20%	Aluminum	0.50	G-Cell
30	Feb-74	May-74	Juggernaut Argonne Low Power Research Reactor		2.20	G-Cell
30	Feb-74	May-74	Juggernaut Argonne Low Power Research Reactor		2.20	G-Cell
30	Feb-74	May-74	Sandia Engineering Reactor	Aluminum	3.90	G-Cell
30	Feb-74	May-74	Sandia Engineering Reactor	Aluminum	3.90	G-Cell
30	Feb-74	May-74	JMTR		4.10	G-Cell
30	Feb-74	May-74	JMTR		4.10	G-Cell
30	Feb-74	May-74	Livermore Pool Type Reactor	Aluminum	4.75	G-Cell
30	Feb-74	May-74	Livermore Pool Type Reactor	Aluminum	4.75	G-Cell
30	Feb-74	May-74	KUR		4.90	G-Cell
30	Feb-74	May-74	KUR		4.90	G-Cell
30	Feb-74	May-74	Japanese Research Reactor	Aluminum	5.45	G-Cell
30	Feb-74	May-74	Japanese Research Reactor	Aluminum	5.45	G-Cell
30	Feb-74	May-74	Argonne Research Reactor (After Rebuild)	Aluminum	5.55	G-Cell
30	Feb-74	May-74	Argonne Research Reactor (After Rebuild)	Aluminum	5.55	G-Cell
30	Feb-74	May-74	Omega West Reactor		10.45	G-Cell
30	Feb-74	May-74	Omega West Reactor		10.45	G-Cell
30	Feb-74	May-74	General Electric Test Reactor	Aluminum	43.50	G-Cell
30	Feb-74	May-74	General Electric Test Reactor	Aluminum	43.50	G-Cell
30	Feb-74	May-74	Engineering Test Reactor	Aluminum	175.75	G-Cell

Table B-5. (continued).

Run	Beginning Date	Ending Date	Fuel	Cladding	Uranium Recovered (kg)	Unit
			Second Cycle Waste Storage Use			
30	Feb-74	May-74	Engineering Test Reactor	Aluminum	175.75	G-Cell
30	Feb-74	May-74	Advanced Test Reactor	Aluminum	254.05	G-Cell
30	Feb-74	May-74	Advanced Test Reactor	Aluminum	254.05	G-Cell
30	Feb-74	May-74	Navy (Zr)	Zirconium	318.60	E-Cell
30	Feb-74	May-74	Navy (Zr)	Zirconium	318.60	G-Cell
31	Feb-75	May-76	Experimental Breeder Reactor II	Stainless Steel	1046.60	HPP Cell 5
31	Feb-75	May-76	Experimental Breeder Reactor II	Stainless Steel	1046.60	HPP Cell 5
31	Feb-75	May-76	Experimental Breeder Reactor II	Stainless Steel	1046.60	HPP Cell 5
37	Aug-81	Nov-81	Experimental Breeder Reactor II	Stainless Steel	275.33	HPP Cell 5
37	Aug-81	Nov-81	Experimental Breeder Reactor II	Stainless Steel	275.33	HPP Cell 5
38	Sep-82	Nov-82	BSR		0.62	G-Cell
38	Sep-82	Nov-82	Sterling Forest Reactor		2.94	G-Cell
38	Sep-82	Nov-82	Omega West Reactor	Aluminum	5.49	G-Cell
38	Sep-82	Nov-82	SAPHIR		6.79	G-Cell
38	Sep-82	Nov-82	Research Reactor Juelich/Muenchen		9.49	G-Cell
38	Sep-82	Nov-82	Oak Ridge Research Reactor		9.94	G-Cell
38	Sep-82	Nov-82	Research Reactor Geesthacht		11.85	G-Cell
38	Sep-82	Nov-82	High Flux Reactor		20.65	G-Cell
38	Sep-82	Nov-82	General Electric Test Reactor	Aluminum	71.50	G-Cell
38	Sep-82	Nov-82	Advanced Test Reactor	Aluminum	99.37	G-Cell
38	Sep-82	Nov-82	Engineering Test Reactor	Aluminum	177.63	G-Cell
39	Apr-83	Jun-84	Space Nuclear Propulsion Program (ROVER)	Graphite	1009.20	HPP
39	Apr-83	Jun-84	Space Nuclear Propulsion Program (ROVER)	Graphite	1009.20	HPP
39	Apr-83	Jun-84	Space Nuclear Propulsion Program (ROVER)	Graphite	1009.20	HPP
			Third Cycle Waste Storage Use			
30	Feb-74	May-74	Navy (Zr)	Zirconium	318.60	G-Cell
31	Feb-75	May-76	Experimental Breeder Reactor II	Stainless Steel	1046.60	HPP Cell 5
31	Feb-75	May-76	Experimental Breeder Reactor II	Stainless Steel	1046.60	HPP Cell 5
31	Feb-75	May-76	Experimental Breeder Reactor II	Stainless Steel	1046.60	HPP Cell 5
37	Aug-81	Nov-81	Experimental Breeder Reactor II	Stainless Steel	275.33	HPP Cell 5
38	Sep-82	Nov-82	BSR		0.62	G-Cell
38	Sep-82	Nov-82	Sterling Forest Reactor		2.94	G-Cell
38	Sep-82	Nov-82	Omega West Reactor	Aluminum	5.49	G-Cell
38	Sep-82	Nov-82	SAPHIR		6.79	G-Cell
38	Sep-82	Nov-82	Research Reactor Juelich/Muenchen		9.49	G-Cell
38	Sep-82	Nov-82	Oak Ridge Research Reactor		9.94	G-Cell
38	Sep-82	Nov-82	Research Reactor Geesthacht		11.85	G-Cell
38	Sep-82	Nov-82	High Flux Reactor		20.65	G-Cell
38	Sep-82	Nov-82	General Electric Test Reactor	Aluminum	71.50	G-Cell
38	Sep-82	Nov-82	Advanced Test Reactor	Aluminum	99.37	G-Cell
38	Sep-82	Nov-82	Engineering Test Reactor	Aluminum	177.63	G-Cell
39	Apr-83	Jun-84	Space Nuclear Propulsion Program (ROVER)	Graphite	1009.20	HPP
39	Apr-83	Jun-84	Space Nuclear Propulsion Program (ROVER)	Graphite	1009.20	HPP
39	Apr-83	Jun-84	Space Nuclear Propulsion Program (ROVER)	Graphite	1009.20	HPP

Table B-6. Calcining-campaign history and waste-treatment history for each tank.

		Gallons Processed												
		Tank												
Campaign	Date	WM-180	WM-181	WM-182	WM-183	WM-184	WM-185	WM-186	WM-187	WM-188	WM-189	WM-190	WM-102	WM-106
WCF1	Nov 1963-Oct 1964	5,500	–	–	145,900	–	188,000	–	209,200	600	–	–	–	–
WCF2	Mar 1966-Mar 1968	284,400	–	652,500	101,300	–	25,300	–	–	109,400	–	–	–	–
WCF3	Aug 1968-Jun 1969	–	–	–	–	–	19,300	–	3,600	181,100	115,000	–	–	–
WCF4	May 1970-Jan 1971	–	–	–	7,400	–	–	–	207,700	–	6,600	–	–	–
WCF5	Sep 1971-Apr 1972	–	–	–	65,500	–	–	–	–	–	219,600	–	–	5,500
WCF6	May 1973-May 1974	–	–	–	109,600	–	–	–	–	111,400	179,200	–	–	4,200
WCF7	May 1975-Jan 1977	2,300	–	–	–	–	63,500	–	262,000	–	43,950	–	–	–
WCF8	Sep 1977-Sep 1978	28,400	–	275,600	–	–	204,200	–	–	600	700	–	–	–
WCF9	Jun 1979-Mar 1981	23,100	–	94,700	–	–	171,200	–	–	40,000	96,600	–	–	–
NWCF1	Aug 1982-Jun 1984	–	4,300	301,700	–	3,500	283,700	–	124,900	261,300	303,400	–	234,300	–
NWCF2	Sep 1987-Dec 1988	–	–	–	–	–	–	120,400	69,500	194,600	448,800	–	–	–
NWCF3	Dec 1990-Nov 1993	–	–	279,600	–	–	98,600	6,300	169,100	180,800	–	–	26,000	–
NWCF4	May 1997-Apr 1999	–	–	–	–	–	71,480	–	–	270,900	47,708	–	–	–
Total For Each Tank		343,700	4,300	1,604,100	429,700	3,500	1,125,280	126,700	1,046,000	1,350,700	1,461,558	–	260,300	9,700
Total For All Tanks														7,765,538

B.2.2 Present Process Description

The current Department of Energy (DOE) mission for INTEC includes management and storage of SNF, treatment and storage of HLW generated during past SNF reprocessing, and LLW generated from primarily decontamination and other ongoing and future operations and activities. In February 1998, calcination of all HLLW at TFF was completed.

The production of sodium-bearing waste is dependent on the quantity and type of work done at INTEC and is generated primarily from decontamination and decommissioning and from the off-gas produced during the waste calcination process.

Of the facilitates that generated waste, other than fuel reprocessing waste, FAST (CPP-666), the Fuel Processing Facility (CPP-601), the WCF (CPP-633), the Pilot Plant (CPP-637), the Head End Process Plant (CPP-640), the RAF (CPP-627) and the Hot Shop (CPP-663) are inactive and have been decontaminated and dismantled.

B.2.3 TFF Future Use

TFF will continue to be used as a storage facility for sodium-bearing waste. The production of this waste will depend upon future activities at INTEC as discussed above. Despite the age of the tanks, corrosion monitoring has shown they are expected to continue reliable service for the additional 20 to 40 years required (Palmer et al. 1998; LMITCO 1998; Palmer et al. 1999).

B.3 Tank Waste Data

The closure procedure will require that decontamination be performed to achieve acceptable concentrations of contaminants associated with the heels of the tanks. It is vital to understand the nature and extent of the contamination present at the beginning of decontamination to assess the effectiveness of the procedures.

A key issue in TFF closure will be the development of usable, sampling methodologies to develop statistically defendable contaminant concentrations in the tank. Concentrations of contaminants present in the 30,000 gallon tanks (which are out of service) and the tank vault sumps are also needed. To date, data that is available concerning contaminant concentration in any of these locations is sporadic and nonrepresentative. Data currently available on constituent concentrations in the tanks is presented below.

B.3.1 Existing 300,000 Gallon Tank Content Data

Nature and extent of contamination is defined by the volume or mass of contaminated media, along with the concentration of contaminant within that media. Together, this information will yield the mass of contaminant available for transport to potential receptors. The discussion of the 300,000 gallon tanks will focus on Tanks WM-182 and WM-183. These tanks constitute the first phase of the closure process. Similar data is available for the other 300,000 gallon tanks and will eventually be summarized in the 1st Tier DOE Closure Plan.

B.3.1.1 Volume of Tank Contents. Each 300,000 gallon tank in TFF currently has unique contents that may impact the closure plan for each tank. A brief summary of the contents of each tank is

provided below. This information was compiled from two 1998 reports (Palmer 1998; Palmer et al. 1998).

- Tank WM-180 currently contains 278,600 gallons of sodium-bearing waste
- Tank WM-181 currently contains 275,900 gallons of sodium-bearing waste
- Tank WM-182 contains 10,300 gallons of sodium bearing waste. This volume is the final flush of the 3,600 gallon tank heel.
- Tank WM-183 contains a 23,000-gallon heel consisting of sodium-bearing waste. Due to the diverse nature of the contents of this tank, it will most likely have the highest concentration of precipitated solids.
- Tank WM-184 currently contains 262,000 gallons of sodium-bearing waste
- Tank WM-185 currently contains about 74,800 gallons of sodium-bearing waste
- Tank WM-186 currently contains 281,500 gallons of dilute sodium-bearing waste
- Tank WM-187 currently contains 24,300 gallons of dilute sodium-bearing waste
- Tank WM-188 contains an approximately 9,000-gallon heel that has not been flushed (Patterson 1999)
- Tank WM-189 contains about 141,100 gallons of sodium-bearing waste and a heel of about 5,000 gallons
- Tank WM-190 currently contains a heel of about 500 gallons consisting of waste leakage and rainwater.

All of the heels have been flushed, with the exception of the 9,000-gallon heel in Tank WM-188 (Palmer et al. 1998; Patterson 1999). These heels now consist of sodium-bearing waste (Palmer 1999). In November 1998, approximately 1.4 million gallons of waste was stored in TFF. The liquid waste stored in TFF has been maintained in an acid condition. Therefore, precipitation of solids has not occurred and the waste is a clear (though colored) liquid.

B.3.1.2 Constituent Concentration in the Tanks. HWMA/RCRA hazardous waste codes applicable to TFF are based on analysis of waste streams which entered TFF. Table B-7, below, lists those hazardous waste codes currently believed to be applicable to TFF. Listed waste codes identified in Table B-7 are based on recently completed analyses (Gilbert 1999) while the applicable characteristic waste codes (D-codes) are those listed in INEEL's Part A HWMA/RCRA Permit. The waste codes applicable to TFF are the subject of continuing (or planned) analyses of past operating history at INTEC and are therefore subject to change.

Table B-7. Hazardous waste codes and compounds applicable to INTEC TFF.

Chemical Name	CAS #	EPA Waste Code
Corrosive		(underlying) D002
Fluoride	7782-41-4	(underlying) D002
Nickel	7440-02-0	(underlying) D002
Arsenic	7440-38-2	D004
Barium	7440-39-3	D005
Cadmium	7440-43-9	D006
Chromium	7440-47-3	D007
Lead	7439-92-1	D008
Mercury	7439-97-6	D009
Selenium	7782-49-2	D010
Silver	7440-22-4	D011
Trichloroethylene	79-01-6	F001
Benzene	71-43-2	F005
Carbon disulfide	75-15-0	F005
Hydrogen fluoride	7664-39-3	U134
Toluene	108-88-3	F005
1,1,1-Trichloroethane	71-55-6	F001, F002

Data, available in January of 1999, on the chemical and radionuclide concentrations of the wastes in TFF are summarized in Tables B-8 and B-9, respectively (Schindler 1999). All samples were taken at NWCF and include dilution resulting from transfer from TFF.

Extensive sample data for material which has passed through the tanks and vaults exists, but it contains little information on the material's HWMA/RCRA constituent content. Testing for contaminants in TFF has gone on sporadically since at least 1960. It is unlikely that the sampling methodology is consistent enough to justify performing any statistical analyses of the data. Nonetheless, some statistical analysis is presented in this report, simply to develop an understanding for the scope of contamination within the tanks. The statistical summaries for the contaminants detected in Tanks WM-182 and WM-183 are presented in Tables B-10 and B-11 respectively. This data is presented for information only and does not reflect constituent concentrations in material remaining in TFF tanks at the completion of closure actions.

B.3.2 30,000-Gallon Tank Content Data

In 1990, the 30,000-gallon tank heels were sampled and analyzed for radionuclides and RCRA hazardous materials. The testing results indicated contaminant concentrations of organic levels that were below RCRA limits for hazardous waste and a small amount of radioactivity (Matule 1990). To date, this is the only information available concerning potential hazardous and radioactive contamination in the 30,000-gallon tanks. Table B-12 lists analytical results for metals from 1990 water samples taken from the 30,000-gallon tanks described previously. The metals analyzed coincide with the characteristic waste-code (D-code) metals listed in Table B-7 above.

Table B-8. Chemical compositions of wastes in TFF, October 1998.

Waste tank	WM-180	WM-181	WM-182	WM-183	WM-184	WM-185	WM-186	WM-187	WM-188	WM-189	WM-190
Sample date	2/93	2/93	estimate	6/96	7/98	3/98	7/98	6/98	2/97	11/98	8/80
Sp. Grav.	1.262	1.156	1.2	1.216	1.219	1.25	1.158	1.134	1.306	1.307	–
Acid, N	1.14	1.8	1.07	1.69	1.67	1.58	1.36	1.78	2.65	2.57	0.023
NO3, M	4.56	3.68	3.77	4.34	3.99	4.93	2.945	3.04	5.85	6.23	0.018
F, M	0.042	0.089	0.042	0.046	0.0232	0.16	0.040	0.119	0.302	0.222	0.0074
Cl, M	0.031	0.012	0.019	0.0109	0.0275	0.028	0.0180	0.0035	0.0148	0.024	3.4E-4
SO4, M	0.032	0.024	0.025	0.025	0.0274	0.036	0.029	0.010	0.0348	0.0067	–
P, M		0.0061	3E-5	1E-4	0.0105	0.0026	0.0005	–	3.5E-4	2.9E-4	–
Al, M	0.63	0.22	0.604	0.59	0.507	0.74	0.264	0.323	0.828	0.915	–
Na, M	2.0	0.9	1.113	0.695	1.284	1.313	0.841	0.118	0.738	0.901	–
K, M	0.18	0.14	0.108	0.093	0.085	0.184	0.139	0.0137	0.142	0.114	–
Ca, M	0.034	0.044	0.025	0.0366	0.016	0.070	0.050	0.046	0.148	0.084	–
B, M	0.01	0.015	0.009	0.013	<0.014	0.0195	<0.014	0.014	0.037	0.025	–
Fe, M	0.018	0.012	0.024	0.052	0.0146	0.0248	0.0156	0.0126	0.0535	0.025	–
Zr, M	<0.0011	0.0046	0.006	<0.0163	<0.0121	0.011	<0.0121	0.015	0.0255	0.0357	–
Ag, mg/l	0.48	3.66	–	–	–	<0.8 to 10	–	–	5.1	–	–
As, mg/l	3.5	< 3	–	–	–	0.11 to 23	–	–	46	–	–
Ba, mg/l	7.1	5.1	–	–	–	9	–	–	13.5	–	–
Cd, mg/l	90	584	105	135	< 530	172	< 530	< 530	1210	540	–
Cr, mg/l	198	151	260	675	< 210	255	215	< 210	750	225	–
Hg, mg/l	195	90	200	580	138	782	181	540	1500	1024	–
Pb, mg/l	290	207	–	–	59	190	87	–	200	216	–
Ni, mg/l	94	70	–	–	< 243	88	< 243	–	270	< 117	–
Se, mg/l	0.82	< 1	–	–	–	< 1	–	–	–	–	–
U, mg/l	78	76	63	89	43	76	91	11	120	54	–
UDS, g/l	0.63	0.17	–	–	–	4.8	–	–	–	1.1	–

Table B-9. Radionuclide concentrations of wastes in TFF, January 1999.

Waste tank	WM-180	WM-181	WM-182	WM-183	WM-184	WM-185	WM-186	WM-187	WM-188	WM-189	WM-190
Sample date	2/93	2/93	estimate	6/96	7/98	3/98	7/98	6/98	2/97	11/98	8/80
H-3 mCi/l	0.028	0.033	0.37	0.24	–	0.024	–	–	–	0.023	–
Co-60 mCi/l		0.19	0.038	0.15	0.027	0.06	0.037	–	0.32	–	–
Ni-63 mCi/l)	0.026	0.046	–	–	–	–	–	–	–	–	–
Sr mCi/l	–	–	–	–	13.6	–	20.7	–	260	111	–
Sr-90[a] mCi/l	25	29	143	191	–	119	–	–	–	–	–
Cs-134 mCi/l	0.12	1.1	5.73	0.42	0.011	0.45	0.077	–	1.04	0.21	0.34
Cs-137 mCi/l	30	30	155	212	17.0	119	25.4	49	335	122	16
Eu-154 mCi/l	7.8E-04	0.38	1.44	0.97	0.034	0.4	0.114	–	1.7	0.41	0.12
Np-237 mCi/l	2.8E-03	2.4E-03	0.003	<0.008	–	0.0039	–	–	8.9E-4	–	–
Pu-238 mCi/l	0.66	0.52	0.407	0.39	0.336	0.54	–	–	1.45	–	–
Pu-239 mCi/l	0.095	0.021	0.08	0.14	0.063	0.065	–	–	0.16	–	–
Am-241 mCi/l	0.063	0.017	0.045	0.062	0.076	0.079	–	–	0.071	–	–
U-234 wt. %	–	–	–	–	0.400	–	0.0996	–	0.109	–	–
U-235 wt. %	–	–	–	–	30.22	–	7.237	–	10.28	–	–
U-236 wt. %	–	–	–	–	1.979	–	0.700	–	0.37	–	–
U-238 wt. %	–	–	–	–	67.4	–	91.96	–	89.24	–	–

a. Some of the analyses reported as Sr-90 are really total Sr analyses.

Table B-10. Summary statistics for contaminant-concentration data for Tank WM-182.

Analyte	Units	Number of Samples	Sample for Analyte?	Sampling Frequency	Minimum	Maximum	Arithmetic Mean	Standard Deviation	Lognormal 95% UCL
Nonradiological Constituents									
Ag	mg/l	50	4	8%	6.80E-01	2.15E+01	6.55E+00	1.00E+01	1.63E+01
Al	mg/l	50	49	98%	3.24E+03	4.69E+04	3.30E+04	1.41E+04	3.70E+04
As	mg/l	50	1	2%	3.18E+01	3.18E+01	3.18E+01	NA	NA
B	mg/l	50	22	44%	6.80E+01	2.82E+04	4.11E+03	8.00E+03	7.45E+03
Ba	mg/l	50	4	8%	1.24E+01	2.87E+01	1.77E+01	7.48E+00	2.50E+01
Ca	mg/l	50	13	26%	1.00E+03	1.87E+05	4.04E+04	5.44E+04	7.00E+04
Cd	mg/l	50	15	30%	1.05E+02	1.03E+03	3.59E+02	2.45E+02	4.83E+02
Cl	mg/l	50	12	24%	5.00E+00	6.74E+02	1.50E+02	2.07E+02	2.67E+02
Cr	mg/l	50	8	16%	3.00E-01	2.60E+02	5.79E+01	8.29E+01	1.15E+02
F	mg/l	50	18	36%	6.50E+01	5.70E+04	4.89E+03	1.31E+04	1.09E+04
Fe	mg/l	50	24	48%	1.60E+02	1.34E+03	9.55E+02	3.14E+02	1.08E+03
Hg	mg/l	50	27	54%	2.00E+02	4.21E+03	3.21E+03	1.56E+03	3.80E+03
K	mg/l	50	23	46%	7.40E-02	4.22E+03	5.58E+02	9.52E+02	9.47E+02
Mn	mg/l	50	1	2%	1.68E+02	1.68E+02	1.68E+02	NA	NA
Mo	mg/l	50	1	2%	6.70E+01	6.70E+01	6.70E+01	NA	NA
Na	mg/l	50	32	64%	2.74E+02	2.58E+04	5.30E+03	7.13E+03	7.77E+03
NH4	mg/l	50	1	2%	9.02E+02	9.02E+02	9.02E+02	NA	NA
Ni	mg/l	50	1	2%	1.74E+01	1.74E+01	1.74E+01	NA	NA
NO3	mg/l	50	19	38%	5.83E+04	4.09E+05	2.40E+05	6.57E+04	2.70E+05
P	mg/l	50	1	2%	9.29E-01	9.29E-01	9.29E-01	NA	NA
Pb	mg/l	50	4	8%	4.68E+00	6.62E+00	6.01E+00	9.09E-01	6.90E+00
PO4	mg/l	50	2	4%	1.17E+02	1.85E+03	9.84E+02	1.23E+03	2.68E+03
Ru	mg/l	50	1	2%	2.70E+01	2.70E+01	2.70E+01	NA	NA
Se	mg/l	50	4	8%	5.75E-01	1.36E+01	4.10E+00	6.34E+00	1.03E+01
Si	mg/l	50	1	2%	7.60E+02	7.60E+02	7.60E+02	NA	NA
Sn	mg/l	50	10	20%	4.11E+02	3.61E+03	1.79E+03	1.20E+03	2.54E+03
SO4	mg/l	50	17	34%	1.82E+02	4.35E+03	2.57E+03	1.27E+03	3.17E+03
Tc	mg/l	50	1	2%	7.40E+00	7.40E+00	7.40E+00	NA	NA
Te	mg/l	50	1	2%	6.10E+00	6.10E+00	6.10E+00	NA	NA
Undissolved solids	mg/l	50	14	28%	0.00E+00	9.39E+04	2.27E+04	2.98E+04	3.84E+04
Zr	mg/l	50	27	54%	3.56E+02	2.74E+05	3.00E+04	6.37E+04	5.40E+04

Table B-10. (continued).

Analyte	Units	Number of Samples	Sample for Analyte?	Sampling Frequency	Minimum	Maximum	Arithmetic Mean	Standard Deviation	Lognormal 95% UCL
Organic Constituents (continued)									
1,1,1-trichloroethane	mg/l	4	1	25%	9.65E-03	9.65E-03	9.65E-03	NA	NA
Hexone	mg/l	4	2	50%	5.06E-02	2.12E-01	1.31E-01	1.14E-01	2.89E-01
acetone	mg/l	4	4	100%	3.19E-02	3.68E-01	1.22E-01	1.64E-01	2.83E-01
benzene	mg/l	4	4	100%	1.16E-02	7.81E-02	2.89E-02	3.28E-02	6.11E-02
carbon tetrachloride	mg/l	4	1	25%	2.71E-03	2.71E-03	2.71E-03	NA	NA
chloroform	mg/l	4	1	25%	9.42E-01	9.42E-01	9.42E-01	NA	NA
tetrachloroethylene	mg/l	4	1	25%	1.29E-03	1.29E-03	1.29E-03	NA	NA
toluene	mg/l	4	1	25%	8.84E-02	8.84E-02	8.84E-02	NA	NA
trichloroethylene	mg/l	4	1	25%	2.81E-03	2.81E-03	2.81E-03	NA	NA
dichlroromethane	mg/l	4	1	25%	1.75E-01	1.75E-01	1.75E-01	NA	NA
Radionuclides									
Am-241	µCi/ml	33	2	6%	4.50E-02	5.02E-01	2.74E-01	3.23E-01	7.21E-01
Ce-144	µCi/ml	33	11	33%	2.01E-02	7.61E+03	7.11E+02	2.29E+03	2.06E+03
Co-60	µCi/ml	33	5	15%	4.36E-04	6.04E-01	2.07E-01	2.45E-01	4.21E-01
Cs-134	µCi/ml	33	11	33%	2.22E+00	4.30E+01	2.79E+01	1.48E+01	3.67E+01
Cs-137	µCi/ml	33	26	79%	2.78E-04	4.45E+03	1.18E+03	1.16E+03	1.62E+03
Eu-154	µCi/ml	33	12	36%	9.65E-02	9.92E+00	6.57E+00	3.07E+00	8.30E+00
Eu-155	µCi/ml	33	5	15%	1.14E+00	3.95E+00	3.09E+00	1.16E+00	4.11E+00
H-3	µCi/ml	33	12	36%	3.70E-01	5.30E+01	7.19E+00	1.50E+01	1.57E+01
Np-237	µCi/ml	33	3	9%	6.94E-04	3.00E-03	1.95E-03	1.17E-03	3.27E-03
Pr-144	µCi/ml	33	1	3%	5.19E+01	5.19E+01	5.19E+01	NA	NA
Pu - total	mg/l	33	1	3%	7.94E-02	7.94E-02	7.94E-02	NA	NA
Pu - total	µCi/ml	33	11	33%	3.11E-01	1.08E+01	2.85E+00	2.77E+00	4.49E+00
Pu-238	µCi/ml	33	2	6%	4.07E-01	2.57E+00	1.49E+00	1.53E+00	3.61E+00
Pu-239	µCi/ml	33	2	6%	8.00E-02	2.85E-01	1.83E-01	1.45E-01	3.83E-01
Pu-240	µCi/ml	33	1	3%	1.64E-02	1.64E-02	1.64E-02	NA	NA
Pu-241	µCi/ml	33	1	3%	6.10E-01	6.10E-01	6.10E-01	NA	NA
Pu-242	µCi/ml	33	1	3%	1.94E-05	1.94E-05	1.94E-05	NA	NA
Ru-106	µCi/ml	33	6	18%	2.81E-02	4.27E+02	7.69E+01	1.72E+02	2.14E+02
Sb-125	µCi/ml	33	1	3%	7.80E-01	7.80E-01	7.80E-01	NA	NA
Sr-total	µCi/ml	33	13	39%	5.59E+02	2.58E+03	7.77E+02	5.42E+02	1.07E+03
Sr-90	µCi/ml	33	4	12%	1.43E+02	1.34E+03	6.64E+02	4.99E+02	1.15E+03

Table B-10. (continued).

Analyte	Units	Number of Samples	Sample for Analyte?	Sampling Frequency	Minimum	Maximum	Arithmetic Mean	Standard Deviation	Lognormal 95% UCL
Radionuclides (continued)									
U - total	mg/l	33	11	33%	2.83E+01	6.30E+01	3.97E+01	1.17E+01	4.66E+01
U-234	µCi/ml	33	1	3%	1.98E-03	1.98E-03	1.98E-03	NA	NA
U-235	µCi/ml	33	1	3%	5.73E-05	5.73E-05	5.73E-05	NA	NA
U-236	µCi/ml	33	1	3%	2.13E-04	2.13E-04	2.13E-04	NA	NA
U-238	µCi/ml	33	1	3%	1.08E-06	1.08E-06	1.08E-06	NA	NA
Zr-95	µCi/ml	33	5	15%	7.27E-01	1.92E+03	3.85E+02	8.60E+02	1.14E+03

Table B-11. Summary statistics for contaminant concentration data for TFF Tank WM-183.

Analyte	Units	Number of Samples	Sample for Analyte?	Sampling Frequency	Minimum	Maximum	Arithmetic Mean	Standard Deviation	Lognormal 95% UCL
Nonradiological Constituents									
Al	mg/l	8	6	75%	2.56E+03	4.05E+04	1.73E+04	1.27E+04	2.74E+04
Al(NO3)3	mg/l	8	1	13%	3.17E+05	3.17E+05	3.17E+05	NA	NA
B	mg/l	8	3	38%	1.41E+02	1.51E+02	1.44E+02	6.24E+00	1.51E+02
Ca	mg/l	8	4	50%	1.47E+03	5.92E+03	2.71E+03	2.14E+03	4.81E+03
Cd	mg/l	8	3	38%	1.35E+02	1.69E+02	1.54E+02	1.71E+01	1.73E+02
Cl	mg/l	8	4	50%	5.00E+00	4.11E+02	2.98E+02	1.96E+02	4.90E+02
Cr	mg/l	8	4	50%	4.90E+02	8.84E+02	7.20E+02	1.77E+02	8.94E+02
F	mg/l	8	5	63%	8.74E+02	3.42E+03	1.47E+03	1.09E+03	2.43E+03
Fe	mg/l	8	5	63%	2.90E+02	7.97E+03	3.56E+03	2.77E+03	5.99E+03
H3BO3	mg/l	8	1	13%	6.18E+02	6.18E+02	6.18E+02	NA	NA
Hg	mg/l	8	5	63%	1.87E-03	4.11E+03	1.16E+03	1.67E+03	2.62E+03
Hg(NO3)2	mg/l	8	1	13%	3.90E+03	3.90E+03	3.90E+03	NA	NA
K	mg/l	8	4	50%	3.64E+03	5.20E+03	4.12E+03	7.23E+02	4.83E+03
Mn	mg/l	8	3	38%	3.18E+02	7.69E+02	6.00E+02	2.46E+02	8.79E+02
Mo	mg/l	8	3	38%	6.62E+01	7.90E+01	7.08E+01	7.13E+00	7.89E+01
Na	mg/l	8	5	63%	1.15E+03	2.48E+04	1.56E+04	8.76E+03	2.33E+04
NaNO3	mg/l	8	1	13%	4.25E+03	4.25E+03	4.25E+03	NA	NA
Nb	mg/l	8	1	13%	1.19E+03	1.19E+03	1.19E+03	NA	NA
NH4	mg/l	8	1	13%	9.02E+02	9.02E+02	9.02E+02	NA	NA
NH4NO3	mg/l	8	1	13%	4.00E+03	4.00E+03	4.00E+03	NA	NA
Ni	mg/l	8	3	38%	3.92E+02	4.23E+02	4.05E+02	1.58E+01	4.23E+02
NO3	mg/l	8	4	50%	2.69E+05	3.42E+05	3.19E+05	3.44E+04	3.53E+05
P	mg/l	8	1	13%	3.10E+00	3.10E+00	3.10E+00	NA	NA
Pb	mg/l	8	2	25%	3.11E+02	3.32E+02	3.21E+02	1.47E+01	3.41E+02
PO4	mg/l	8	1	13%	9.70E+02	9.70E+02	9.70E+02	NA	NA
Pu	mg/l	8	1	13%	3.28E-01	3.28E-01	3.28E-01	NA	NA
Ru	mg/l	8	1	13%	3.40E+01	3.40E+01	3.40E+01	NA	NA
Si	mg/l	8	1	13%	5.00E+01	5.00E+01	5.00E+01	NA	NA
SO4	mg/l	8	4	50%	1.24E+03	6.63E+03	4.15E+03	2.74E+03	6.83E+03
Tc	mg/l	8	1	13%	1.00E+01	1.00E+01	1.00E+01	NA	NA
Te	mg/l	8	1	13%	8.00E+00	8.00E+00	8.00E+00	NA	NA
Undissolved solids	mg/l	8	1	13%	2.34E+03	2.34E+03	2.34E+03	NA	NA
Zr	mg/l	8	4	50%	1.37E+02	3.18E+04	8.39E+03	1.56E+04	2.37E+04

Table B-11. (continued).

Analyte	Units	Number of Samples	Sample for Analyte?	Sampling Frequency	Minimum	Maximum	Arithmetic Mean	Standard Deviation	Lognormal 95% UCL
Radiolonuclides									
Am-241	µCi/ml	8	4	50%	6.20E-02	7.48E-01	2.39E-01	3.39E-01	5.72E-01
Ce-144	µCi/ml	8	5	63%	9.26E-04	2.90E+02	1.27E+02	1.40E+02	2.49E+02
Co-60	µCi/ml	8	5	63%	1.41E-01	2.50E-01	1.69E-01	4.58E-02	2.09E-01
Cs-134	µCi/ml	8	3	38%	3.43E-01	1.40E+00	7.21E-01	5.89E-01	1.39E+00
Cs-137	µCi/ml	8	7	88%	6.97E+01	1.64E+03	5.34E+02	5.42E+02	9.36E+02
Eu-154	µCi/ml	8	4	50%	9.26E-01	1.40E+00	1.07E+00	2.20E-01	1.29E+00
Eu-155	µCi/ml	8	2	25%	4.29E-01	1.70E+00	1.06E+00	8.99E-01	2.31E+00
H-3	µCi/ml	8	3	38%	2.30E-04	4.82E-01	2.41E-01	2.41E-01	5.13E-01
I-129	µCi/ml	8	2	25%	1.20E-02	1.20E-02	1.20E-02	0.00E+00	NA
Nb-95	µCi/ml	8	2	25%	4.16E-01	5.72E-01	4.94E-01	1.10E-01	6.47E-01
Np-237	µCi/ml	8	4	50%	1.35E-04	8.00E-03	4.23E-03	4.36E-03	8.50E-03
Pm-147	µCi/ml	8	1	13%	9.60E+02	9.60E+02	9.60E+02	NA	NA
Pu-238	µCi/ml	8	4	50%	2.10E-01	2.41E+00	9.18E-01	1.01E+00	1.91E+00
Pu-239	µCi/ml	8	4	50%	7.40E-02	7.44E-01	3.00E-01	3.04E-01	5.98E-01
Pu-240	µCi/ml	8	1	13%	1.88E-02	1.88E-02	1.88E-02	NA	NA
Pu-241	µCi/ml	8	1	13%	5.61E-01	5.61E-01	5.61E-01	NA	NA
Pu-242	µCi/ml	8	1	13%	5.53E-05	5.53E-05	5.53E-05	NA	NA
Ru-106	µCi/ml	8	3	38%	1.09E+01	3.07E+01	2.22E+01	1.02E+01	3.37E+01
Sb-125	µCi/ml	8	1	13%	8.29E+00	8.29E+00	8.29E+00	NA	NA
Sr - total	µCi/ml	8	1	13%	1.20E+02	1.20E+02	1.20E+02	NA	NA
Sr-90	µCi/ml	8	5	63%	1.75E+02	1.47E+03	5.41E+02	5.52E+02	1.03E+03
Tc-99	µCi/ml	8	1	13%	1.70E-02	1.70E-02	1.70E-02	NA	NA
U - total	mg/l	8	2	25%	8.90E+01	1.30E+02	1.10E+02	2.90E+01	1.50E+02
U-234	µCi/ml	8	1	13%	6.28E-04	6.28E-04	6.28E-04	NA	NA
U-235	mg/l	8	1	13%	2.35E+01	2.35E+01	2.35E+01	NA	NA
U-235	µCi/ml	8	1	13%	2.65E-05	2.65E-05	2.65E-05	NA	NA
U-236	µCi/ml	8	1	13%	2.57E-05	2.57E-05	2.57E-05	NA	NA
U-238	mg/l	8	1	13%	8.34E+01	8.34E+01	8.34E+01	NA	NA
U-238	µCi/ml	8	1	13%	3.00E-05	3.00E-05	3.00E-05	NA	NA
Zr-95	µCi/ml	8	2	25%	3.16E-01	3.05E+00	1.69E+00	1.94E+00	4.37E+00

Table B-12. 1990 metals-analysis results for water samples from TFF 30,000-gallon tanks.

Analyte	HWMA/RCRA Hazardous Waste Limit (mg/l)	Tank WM-103 Concentration (mg/l)	Tank WM-104 Concentration (mg/l)	Tank WM-105 Concentration (mg/l)	Tank WM-106 Concentration (mg/l)
pH (unitless)	2-12	3.4	3.4	6.0	7.9
Arsenic	5.0	ND[a]	ND	ND	ND
Barium	100.	0.46	0.11	0.11	0.27
Cadmium	1.0	ND	ND	ND	ND
Chromium	5.0	0.24	0.84	0.04	0.05
Lead	5.0	ND	ND	ND	ND
Mercury	0.2	0.005	0.004	0.007	0.003
Selenium	1.0	ND	ND	ND	ND
Silver	5.0	ND	0.005	0.006	ND

a. ND = not detected

B.4 Vault Content Data

Though liquid-waste leaks have occasionally occurred in associated valves and piping, no leaks from the tanks have been documented (Palmer et al. 1998). There are a very few samples that have been drawn from vault sumps over the years. The samples drawn from the vaults show concentrations of contaminants that were, when tested and detected, several orders of magnitude lower than in the tanks, which supports the assertion made by Palmer et al. Further characterization of potential vault contamination will be part of the closure.

Samples of liquid in various tank vault sumps were collected and analyzed on an irregular basis in the early 1970s. Samples were variously analyzed for radionuclides, pH, and ions affecting water quality and treatment of the liquid (e.g., calcium, sodium, phosphate, nitrate, chloride). Some samples collected were analyzed for chromium (total Cr, Cr^{+3}, or Cr^{+6}). The majority of the samples contained detectable levels of radioactivity. Of the 17 samples analyzed for Cr, the highest detected concentration was 0.4 mg/l (Cr was not detected in most samples). Five samples were analyzed for pH (four from the WM-190 sump and one from the WM-187 sump), with results ranging from a pH of 7.9 to 8.9.

Appendix C

Conceptual Design Outline

C. CONCEPTUAL DESIGN OUTLINE

The Tank Farm Facility (TFF) closure design is an integral part of developing information needed to complete required planning documentation and ultimate closure of TFF. The conceptual design is the first phase of TFF closure design and is currently underway. This section provides a description of the scope of work for the Conceptual Design of the Idaho Nuclear Technology and Engineering Center (INTEC) TFF Closure Project.

C.1 Tank Closure Sequence Development

Establish the sequence required to safely close the eleven 300,000-gallon and four 30,000-gallon waste tanks located in TFF without impacting ongoing INTEC operations. This work includes:

- Develop general pipeline and enclosure filling/grouting criteria
- Develop a closure sequence for each of the 300,000 and 30,000-gallon tanks
- Closure sequence includes addressing VOG system management, abandoned piping assessment, valve box isolation, system components that must remain operational during and after each tank closure, and pipeline closure sequence
- Cross-reference the tanks identified in the "LMITCO Tank Inventory" database to the main 15 tanks being closed
- Validate proposed closure information with INTEC operations and HLW project personnel
- Incorporate any changes required by operations, HLW project personnel or the conceptual design.

C.2 MECHANICAL SYSTEMS

C.2.1 Water Supply for Remote Washing

Provide a brief write-up of how the water supply for remote washing should function, for example, a system description including any unique features. Describe the method for providing an adequate amount of deionized water at the required pressure for remote washing of the inside of the tank. Provide a block diagram and/or a piping & instrumentation diagram (P&ID) of the basic parts of the system.

C.2.2 Grout Supply Station

Provide a brief write-up of how the grout supply system should function, for example, a system description including any unique features. Describe the grout supply system required to grout the tank/vault system. Provide a block diagram and/or a P&ID of the basic parts of the system.

C.2.3 Liquid Filter/Pump Station To PEWE

Provide a brief write-up of how the liquid-filter/pump to PEWE system should function, for example, a system description including any unique features. The existing INTEC facilities and sampling systems shall be utilized to the extent possible. Design a method for pumping and sampling the liquids removed during tank washing. Liquids shall be pumped to PEWE for processing.

C.2.4 Mechanical Utilities (Support)

Provide a brief write-up of how the mechanical utilities should function, for example, a system description including any unique features. Describe the support mechanical utilities (compressed air, steam, hot water, deionized water, etc.) required for closing the tank/vault system. Provide a block diagram and/or a P&ID of the basic parts of the system.

C.2.5 Tank Water Removal System

Provide a brief write-up of how the tank water removal system should function, for example, a system description including any unique features. Describe the method for removing liquids from the bottom of the tank, including water used to wash down the inside of the tank. Provide a block diagram and/or a P&ID of the basic parts of the system.

C.2.6 Tank/Vault Supply Air System

Provide a brief write-up of how the tank/vault supply air system should function, for example, a system description including any unique features. Describe the method for supplying ventilation air to the tank/vault system during closure activities. Provide a block diagram and/or a P&ID of the basic parts of the system.

C.2.7 Temporary Ventilation Treatment System

Provide a brief write-up of how the temporary ventilation treatment system should function, for example, a system description including any unique features. Describe the method for providing exhaust ventilation during the closure of the tank/vault system. Provide a block diagram and/or a P&ID of the basic parts of the system.

C.2.8 Ventilation for Valve Box Secondary Confinement

Provide a brief write-up of how the ventilation system should function, for example, a system description including any unique features. Describe the method for providing ventilation during the closure of valve boxes. Provide a block diagram and/or a P&ID of the basic parts of the system.

C.2.9 Ventilation for Secondary Confinement System

Provide a brief write-up of how the ventilation system should function, for example, a system description including any unique features. Describe the method for supplying and exhausting air from the secondary confinement system located over the tank/vault system during closure activities. Provide a block diagram and/or a P&ID of the basic parts of the system.

C.2.10 Dry Grout Supply Station

Provide a brief write-up of how the dry grout supply system should function, for example, a system description including any unique features. Describe the method for supplying dry grout mixture to the remotely operated system that is used to apply dry grout mixture inside the tank for solidifying free liquids on the bottom of the tank. Provide a block diagram and/or a P&ID of the basic parts of the system.

C.2.11 Pipeline Decontamination

Conceptualize and design a contamination removal system that will decontaminate process waste and cooling coil pipelines.

C.2.12 Pipeline Isolation

Develop information for individual pipelines that connect to the eleven 300,000-gallon and four 30,000-gallon underground storage tanks and vaults, including corresponding isolation points.

C.2.13 Pipeline Tooling

Conceptualize and design the following pipeline- and encasement-isolation and closure items:

- Split flow cartridge. Remotely isolates pipelines from active pipelines using vacant valve housings
- Pipe-encasement grout-filling devices. Allows grout placement into pipeline encasements
- Pipe-cutting devices. Isolates pipelines from active tank farm systems and provides capability to remove existing pipelines and valves
- Grout source pipeline attachment. Provides connection from a grout source to an isolated pipeline

C.2.14 Pipeline Capping

Establish a basic criteria for permanently capping lines in accordance with the regulatory drivers.

Conceptualize and design temporary and permanent pipe capping devices.

C.3 REMOTE SYSTEMS

C.3.1 Remote Washing/Pumping

Provide a brief write-up of how the remote washing/pumping system should function, for example, a system description including any unique features. Describe a method for entering the tanks to perform the actual washing operation, along with a proposed plan for retrieval of the washing equipment will be provided. Provide a block diagram and/or a P&ID of the basic parts of the system.

C.3.2 Remote Connections for Line-Opening/Filling/Capping Design

Provide a brief write-up of what type of system(s) will be required for remote line-opening, filling, and capping operations. Provide a description of the equipment required to perform these operations, along with any supporting equipment necessary to successfully complete these operations. Preferred methods for completing these operations will be discussed. Where feasible, current remote connector technology will be used in descriptions. No diagrams or sketches are assumed to be required for this scope.

C.3.3 Remote Video and Lighting Design

A description of the remote video and lighting design will be provided, along with equipment descriptions where applicable. Existing video camera and lighting technology equipment will described. Methods for placing and retrieving equipment in the tanks and valve boxes will be discussed.

C.3.4 Gloveboxes-Sampling

Provide a brief description of how the glovebox sampling system should function, for example, a system description including any unique features. A description of the basic requirements for sampling, using glove box technology, will be provided.

C.3.5 Decontamination Systems for Tank Equipment

Provide a brief write-up of how the decontamination system(s) should function, for example, a system description including any unique features. A spray-wash-down system was developed for removing contamination from the LDUA, when retrieving samples from INTEC tank WM-189 using water. This will be the proposed system for this activity and will be discussed as such. A one-line block diagram may be provided, if needed, to adequately describe the system(s). More than one size or one type of spray-wash-down system may be required to adequately accommodate this activity.

C.3.6 LDUA Compatibility – Engineering Design File

For purposes of the TFF Closure Project, the LDUA may provide a suitable means to accomplish several activities to support successful completion. Activities include surveillance with video camera(s), inspections, observations during tank washing, and obtaining solids samples from tank heel residual. The LDUA has potential drawbacks, such as the weight of trailer/arm-mast assembly (for use on top of a given tank) and the required foot print over the tanks. The LDUA will be evaluated for supporting TFF closure activities.

C.3.7 Grout Placement and Dry Grout Supply (Into Tank)

Provide a brief description of how the grout placement and dry grout supply systems should function, for example, a system description including any unique features. Describe the method to disperse liquid grout near the tank bottom (above the heel) and to disperse dry grout near the inside top of the tanks. A block diagram and/or a P&ID as part of the grout supply system will be provided.

C.4 STRUCTURAL SYSTEMS

C.4.1 Secondary Confinement Structures

Temporary secondary confinement structures will be designed to enclose the tank riser(s) or the valve box being closed. The structures will physically cover the area being worked on and will be designed to allow closure processes to operate whether via remote or hands-on, as required. Closure processes may include decontamination, monitoring, pumping, ventilation, grouting, etc. Tank riser secondary confinement structures will be sized to support closure processes. Valve box secondary confinement structures will cover the valve box and an area large enough to allow closure work to operate.

C.4.2 Support Structures

Temporary secondary structures will be designed to support the closure process. The structures will be designed to house control, liquid processing, and personnel support functions. Control functions may include process control equipment, video control equipment, and database collection equipment. Liquid process functions may include liquid filtering and pumping and sampling for liquid characteristics. Personnel support functions may include personnel change rooms, decontamination areas, and shower/eyewash stations. The structures will be designed to be temporary and moveable between locations at TFF to support closure processes at a number of locations. Different types of construction materials will be reviewed for functionality and transportability.

C.4.3 Tank and Vault Grouting Analysis

All the vaults are to be filled with grout. A review will be preformed of the existing vault-filling analysis for the WM-182 and WM-183 Closure Study (Spaulding et al. 1998) to determine if it is applicable to the other vaults. Additional analysis will be recommended, as required, on the other vaults. A vault grout mix with adequate strength to comply with the conclusion of the filling analysis will be recommended.

C.4.4 Tank Farm Mockups

As planned, a list of target mock-ups are to be developed as the conceptual design progresses. These potential mock-ups, listed below, are in addition to the tank/grout mock-up which has been completed.

- Test/determine suitable methods/materials to absorb/fix free liquids in the tanks
- Develop/test articulated grout placement arm

- Procure/test large bore-pipe/pipe-trench washing systems
- Test/determine the effect of the LDUA sample system on RCRA volatile organic compound analysis
- Test jet-pump back-flushing to clear clogs
- Test split-flow cartridge installation/removal in valve boxes
- Test pipeline cutting/capping/tooling
- Test the tank washing/mixing system
- Verify access/penetration of equipment through tank riser
- Verify/test grout mixtures to qualify for RCRA/DOE criteria
- Verify grout placement through vault jet-suction leg.

Mockup testing for grouting the TFF vessels will be performed under a separate project. Structural design personnel will need to coordinate with other disciplines prior to and after the testing is completed to verify tests to be performed, review the results, and to develop grouting components. TFF grouting mock-up results will be incorporated into this conceptual design. The system for grout placement into the tanks or vaults will be outlined. Recommended grout mix design for pipe filling (pipe grout mix), tank filling (tank grout mix), and vault filling (vault grout mix) will be developed using the mock-up results.

C.4.5 Additional Structural Design

Provide conceptual designs for the structural portions of the grout pumping station; temporary enclosures, as required for isolation and grouting of piping; and for temporary enclosures for the other processes as determined. Conceptual structural design analysis may also be required for support efforts such as TFF weight restrictions and grout pump placement. For the structural design portion, provide design criteria, design descriptions, sketches, or other documentation necessary to estimate the project cost. Assist in determining tasks and deliverables for the Title I and Title II design effort. Estimate hours and schedule related to the structural design for the Title design effort.

C.4.6 Tank and Vault Seismic Analysis

Perform a PC-2 seismic evaluation of each of the three types of tank vaults (if funding permits, otherwise evaluate WM-183 only). The vaults will be filled with grout and the tanks will be empty, except for a 24-in. layer of grout in the bottom. Verify that a seismic event will not cause a failure of the tank or vault.

C.5 CIVIL SYSTEMS

C.5.1 Utility Routing

Piping will be required for several water systems in the decontamination process and closure of the storage tanks. Several types of piping will be required. Some new duct banks will be required to accommodate the electrical requirements.

C.5.1.1 Demineralized Water

CPP-628 is located in TFF and has the capability of supplying deionized water for the decontamination of the tank risers, piping and interior of the tanks. The piping and pumping systems will need to be evaluated to determine what maintenance or improvements would be required to accommodate the closure of TFF. Deionized water from the CPP-603 storage basins will be evaluated as a second source for the decontamination of the tank risers, piping, and interior of the tanks. Determine the feasibility of using this source of water at TFF through existing piping.

C.5.1.2 Wash Water

Wash water from cleaning the tanks will be piped to the PEWE for evaporation. Determine the feasibility of piping the wash water from the tanks to the PEWE through existing piping. If this is not possible, provide new underground piping, overhead piping, or a combination of both. Excavation is not allowed in TFF. In TFF, pipe will be supported above ground. Outside TFF, the pipe can be buried.

C.5.1.3 Potable Water

Potable water for construction personnel will be obtained from the closest available source through the INTEC water system. The need for a potable water source will be evaluated. If necessary, it will be brought underground to the TFF perimeter. In TFF, piping will be supported on concrete blocks and anchored to avoid earth excavation.

C.5.1.4 Sanitary Sewer

Portable toilets, wash room facilities, and showers for construction personnel will be used. Wastewater will be piped underground into the INTEC sanitary collections system and disposed in the INTEC Wastewater Treatment Plant. These portable facilities will be located outside the fenced perimeter to avoid excavation within TFF.

C.5.1.5 Plant Air

Plant air will be supplied from CPP-628 to the various locations within TFF. Existing airlines will be used. Provide an evaluation of existing air supply to determine air supply requirements and the capacity of the facilities in CPP-628. Also, determine what maintenance or improvements may be required to accommodate the decontamination. Any additional lines, which may be required, will be supported above grade within TFF to avoid excavation of soils. Evaluate the use of portable air compressors in place of air from CPP-628.

C.5.1.6 Steam

Steam is available from CPP-628. Evaluate the piping and distribution systems maintenance or improvements, which may be required to support the closure project.

C.5.1.7 Underground Duct Bank for Electrical Supply

Underground duct bank will be provided to the fence bordering TFF from either the nearest power supply at CPP-654 or the new electrical utilities system upgrade distribution system on the east. Drag cables or above ground conduit supported on concrete blocks will be used in TFF.

C.5.1.8 Excavation (Soils Disposition)

There is to be no excavation of soils within TFF except where absolutely necessary. Identify areas outside TFF where excavation will be required to accommodate utilities for the construction work inside TFF. Using available data, estimate the amount of excavation required to accommodate utilities for construction work inside TFF. Using available data, identify Environmentally Controlled Areas (ECAs) and areas where there may be contaminated soil in line with the proposed excavation. Evaluate alternate utility routes to avoid excavation through ECAs and contaminated areas.

C.5.1.9 Trailer and Structure Pads – Location and Placement

Using the siting plan, develop a layout and plan to place pads for equipment and utility trailers that will be used in the TFF closure. Review concepts with INTEC operations personnel to avoid interference with the INTEC day-to-day operations. Develop methods to accommodate the interface with the closure project and INTEC operations. Review options for driving support trailers to the required location in lieu of placing trailers with cranes. Work with the other engineering disciplines to located pads for closure equipment. Develop concept for disposing pads after construction.

C.5.2 Siting Plan – Sequences and Locations

Review siting requirements with each of the major players in the design of the TFF Closure, including, but not limited to, operators, utilities, engineers and designers. Develop two conceptual siting plans for major components required to accommodate the Closure of TFF. Develop concepts where modifications of the siting can be made without major changes or large costs.

C.5.3 TFF Membrane Ground Cover

Review "as-built" drawings of the membrane cover and details of its construction. Review vendor data of the membrane. Consult with membrane suppliers for penetrating the membrane and membrane repair procedures. Develop conceptual procedures for penetrating and repairing the membrane.

C.5.4 Construction Sequence

Develop a list of major tasks to be performed. Involve primary TFF users including TFF operators, plant operators, design engineers among others. Determine the proper sequence of operations

and work items. Use existing schedules as a basis for planning. Interview several potential contractors for their interpretation and ideas regarding the project and interfacing critical tasks.

C.6 ELECTRICAL SYSTEMS

C.6.1 Instrument and Control

Monitoring the tank and the processes associated with tank closure will be necessary to maintain the integrity of the tank, as well as safety and health requirements. Records of the important parameters relevant to the closure will be maintained, and parameters that are monitored will be backed up daily. Monitored parameters include grout flow, tank level, static pressure of the tank, video monitor inside tank/vault, video monitor in secondary containment, vent gas monitor, PEWE liquid monitor, radiation, criticality, and others that will be identified as the processes for the closure are developed.

C.6.2 Electrical Power

Electrical power will be required for items such as enclosures, temporary VOG system, grouting equipment, mixing pumps, submersible pumps, and auxiliary equipment, such as lighting and power tools.

C.7 CHEMICAL PROCESS

C.7.1 Assess Suitability of CPP 603 Basin Water for Tank Washing

This task will evaluate the composition of the CPP-603 basin water to determine if it can be used for decontaminating the TFF tanks. An important issue regarding contaminated water is whether it will be acceptable at the PEWE after use. The volume and composition of the water will be evaluated relative to project needs.

C.7.2 Define "Solids" for Mockup Tanks

This task will define the surrogate suspended solids used in grout tests in the mock-up tanks. The solids will be defined in terms of chemical composition, particle size distribution, moisture content, and total volume required. In addition, an approach for procuring the material will be provided, along with an estimate of the cost to prepare and deliver the solids to INTEC.

C.7.3 Define Decontamination Solution Chemistry, Water/Slurry Chemistry, Prepare Material Balances

This task has two specific goals: (a) identify the chemical composition of the tank decontamination solution to be used and (b) generate material balances, including chemical composition estimates, for all materials that will enter and leave the tanks during the closure process. The methodologies used in achieving these goals will be documented.

C.7.4 Designer

C.7.4.1 Line List, Lines Less than One Inch

Prepare smaller than 1-in. line list for TFF that encompasses tanks WM-180 through WM-190 (excluding tanks WM-182 and WM-183) and tanks WM-103 through WM-106. The list will be incorporated into the previous list of those tanks, which includes the larger lines. The line list is generated in Microsoft Word format.

C.7.4.2 3D Model and Tank Drawings

Prepare 3-D drawings of tanks WM-180 through WM-190, WM-103 through WM-106. The 3-D drawings will include all piping lines and instrumentation associated with these tanks. The 3-D drawings will also include inside piping of the valve boxes associated with the before-mentioned tanks.

C.8 PROJECT PLANNING AND COORDINATION

C.8.1 Justification Document

Assemble and develop information to produce a "Justification Document" for the current conceptual design, as specified in the Technical Functional Requirements. Explain technical and economic practical limits of solids removal. Explain why solids should stay in tanks and discuss the associated risk numbers. Explain conservatism with the associated risk numbers. Address the leachability and transport mechanisms of solids. Explain the risk associated with removing solids. Develop a cost-benefit analysis break point for economic practicability. Discuss the criticality ALARA concerns with solids removal. Address risk using recent State of Idaho and DOE meeting minutes.

C.8.2 Verification and Method Development

Because of the complex nature of the TFF area, there are areas in which methods need to be developed and refined. Because of the highly radioactive nature of the contamination, extraordinary methods will have to be employed in all activities to protect the safety of the workers. Sampling methods must be developed to collect representative data of the concentration or activity of the contaminants in the residual waste. Waste removal methods need to be developed to allow the maximum possible removal of the waste. Decontamination methods must be tested to determine proper decontamination solutions and methods. Finally, testing must be conducted to determine the appropriate methods for stabilizing the waste.

C.8.2.1 Sampling Techniques. Due to the design of TFF, sampling and analysis performed to demonstrate that closure standards have been met may not always follow normal sampling and analysis protocols. In addition to difficulties resulting from the presence of radiation fields and requirements to keep TFF operational, there are distinct physical limitations. As part of the sampling and analysis activities, methods need to be proposed, developed, and tested to ensure that representative, defensible data are generated, from which conclusions can be drawn with respect to the characteristics of the residual waste prior to, during, and following decontamination.

Options currently under consideration for alternative sampling techniques include:

- Collection of residual waste or decontamination rinsate downstream of liquid removal jets at the PEWE, HLW Evaporator, or NWCF

- Collection of residual waste or decontamination rinsate at the discharge of the pump/jet used for heel reduction

- Collection of liquid samples through risers with the LDUA or other grab sampling techniques.

C.8.2.2 Waste Removal Techniques. Waste removal is difficult for the same reasons that sampling is difficult. The physical limitations of the equipment and radiation fields prevent many removal techniques from being applicable. It is possible to remove the waste "down to the heels" using the existing jets that are used to transfer waste from the tanks when they are in operation. However, this has the potential to leave a significant amount of residual waste in the tanks. A detailed discussion of tank and jet construction is provided in Section 4, Site Description. It may be possible to remove additional waste prior to decontamination using alternative pumping techniques, such as a submersible pump or by lowering the jets further into the tanks. These techniques must be developed and tested to determine if they are applicable, while continuing to protect the safety of the workers and the environment.

C.8.2.3 Decontamination Techniques. Difficulties presented in decontamination are similar to those for waste removal and sampling. Access to the tanks is limited. It is desirable to use some mechanism to not only flush water or decontamination solution through the tank, but to wash the walls of the tanks. Methods that must be assessed and tested to determine their feasibility are low-pressure water washing and steam washing. The effectiveness of these methods in terms of contamination removal, cost, and protection of worker safety must be assessed. It is also possible that video equipment may be installed through tank risers to assist in tank washing operations. It has previously been shown that residues on tank walls and cooling coils was easily removed by low-pressure water sprays (LMITCO 1998)

There is a myriad of options available for decontamination solutions. The most effective solution for decontamination needs to be determined for each tank. It may be necessary to perform decontamination solution testing throughout the closure process to determine the best decontamination solution for each tank. In that case, the results of these tests would be included in 2nd Tier DOE closure plans for each tank group. These solutions for decontamination need to be tested for effectiveness at decontamination and safety with respect to human health and the environment.

C.8.2.4 Stabilization Techniques. It is expected that residual contamination will stabilized by placing grout in the tank and vault spaces. Stabilization of residual contamination in the tanks requires a grout mixture that will both flow and display high strength characteristics. Preliminary testing involves developing a grout that meets these criteria by varying key ingredients.

The grout specifications are different for tank and vault stabilization. Because the walls of the vaults have many sharp angles and areas in which grout will have to flow around corners, it is necessary to develop a grout mixture that will flow to all areas of the vault and self-level. This grout still needs to maintain high strength to assure stabilization of any contamination to ensure protection of human health and the environment. The tank grout will be used as a mechanism to remove the last of the residual liquid contamination in the tank. In this instance, the grout will be pumped into the tank through a riser on the opposite side of the tank from the riser in which the submersible pump or jet is located. The grout must

be of a consistency that will allow it to accumulate on the side of the tank it is placed and force the tank liquid towards the removal pump. A discussion of the physical characteristics of both the vault and the tank is included in Section 4 of this report. A description of grouting methodology for waste stabilization is included in Section 5.

Verification of the grout characteristics is tested using mock-ups. This project is currently in progress. Tank and vault mock-ups will be built, and the grouting stabilization process will be tested. Grout properties that are to be evaluated are discussed below.

- Grout elevation at various points in the form will be measured. This will allow determination of the flowability of the grout, which is of particular importance for the vault grout, given the irregular shape of the pillar and panel vaults (see Section 4).

- The ability of the tank grout to form a front to force water away from the grout placement point and toward a removal point will be evaluated

- The heat of hydrolysis generated by the grout curing process will be measured. This will ensure that the grout curing process will not introduce undesirable energy to the residual waste. There is potential presence of volatile organic chemicals in the residual waste. The introduction of heat from the grout curing process could cause these organics to volatilize and not be stabilized in the grouting process.

- Grout shrinkage will be determined. If the grout were to shrink substantially as it cures, it would pull away from the vault and tank walls, creating pathways for water infiltration and potentially increasing the leach potential of the waste constituents.

- The residual strength of the cured grout will be assessed to determine if the stabilized waste form meets requirements to ensure that no residual contamination is available to leach to the environment

- It is possible that video equipment might be used to facilitate the tank and vault grouting effort. The video equipment would be used to view inside the tank and vault to make sure that the grout is added at the correct rate to force water toward the submersible pump or, in the case of the vault, that the grout is added rapidly enough to force the grout to flow to all corners of the vault. Another complexity of the grouting procedure is that it is likely that the vault and tank will have to be filled concurrently, or in stages, to ensure that the tank does not collapse under the weight of the grout. The video system would also aid in this effort. As with the decontamination use of the video system, this portion of the methodology needs to be evaluated and verified.