Appendix A

Detailed INTEC Facility Description

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This appendix provides a detailed description of the Idaho Nuclear Technology and Engineering Center (INTEC) Tank Farm Facility (TFF) to provide information to further support the closure plan. The facilities within the TFF and associated equipment and processes are described.

A-1. INTEC AND TANK FARM FACILITY DESCRIPTION

INTEC, formerly known as the Idaho Chemical Processing Plant, is located in the south-central portion of the Idaho National Engineering and Environmental Laboratory (INEEL). INTEC began operations in 1953 and was historically a fuel reprocessing facility for defense projects, research, and storage of spent nuclear fuel. The high-level radioactive liquid wastes (HLLW) generated from fuel reprocessing operations were stored in stainless-steel storage tanks contained in concrete vaults at the TFF. In 1992, the Department of Energy (DOE) decided to end the fuel reprocessing mission at INTEC. This decision led to the phase-out of fuel dissolution, solvent extraction, product denitration, and other processes. The current mission of INTEC is to receive and store spent nuclear fuels and radioactive wastes, treat and convert wastes, and develop new technologies for waste and waste management for DOE. Employees are to do this in a cost-effective manner that protects the safety of INEEL employees, the public, and the environment.

The INTEC facility is situated on 210 acres that lie within a perimeter fence. Located outside the INTEC perimeter fence are parking areas, a helicopter landing pad, the waste water treatment lagoon, various pits and percolation ponds, and the Tank Farm Project Support Facility. These areas occupy approximately 55 acres.

A-2. TFF TANK CONTENTS AND CONSTRUCTION INFORMATION

The TFF is comprised of

- Nine 300,000-gallon and two 318,000-gallon active stainless steel tanks (hereafter referred to as 300,000-gallon tanks), each of which is contained within a concrete vault
- Four inactive 30,000-gallon stainless steel tanks
- Valve boxes, encasements, and various process and instrumentation piping associated with the tanks (INEEL 2000).

The physical layout of INTEC and the TFF is depicted in Figure A-1. A conceptual view of the TFF is depicted in Figure A-2.

A-2.1 300,000-Gallon Tanks

The 300,000-gallon storage tanks, WM-180 through WM-190, are contained in belowground, 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 A-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 285,000 gallons of liquid waste. The inside tank diameter and wall

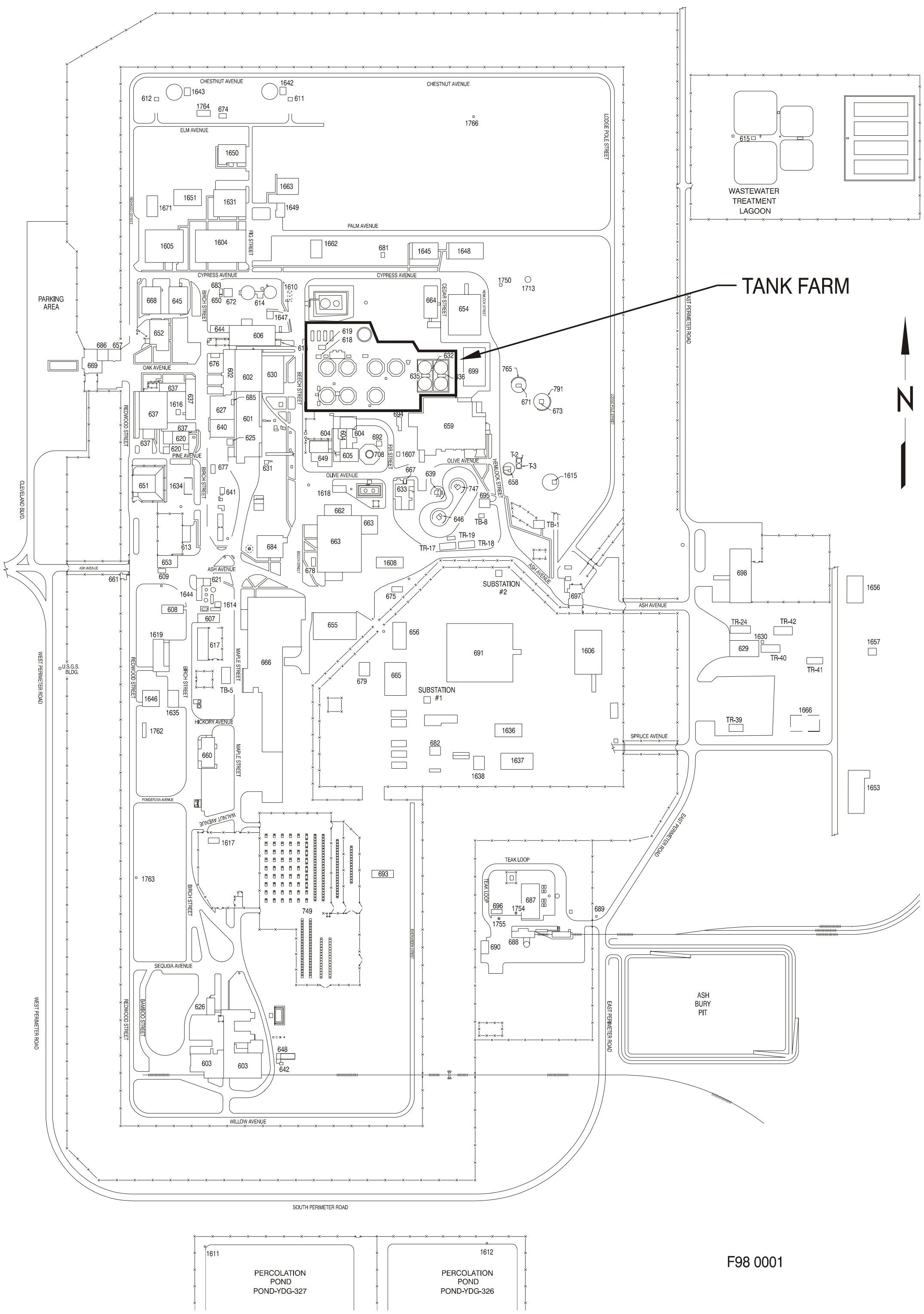

Figure A-1. Location of the TFF at the Idaho Nuclear Technology and Engineering Center.

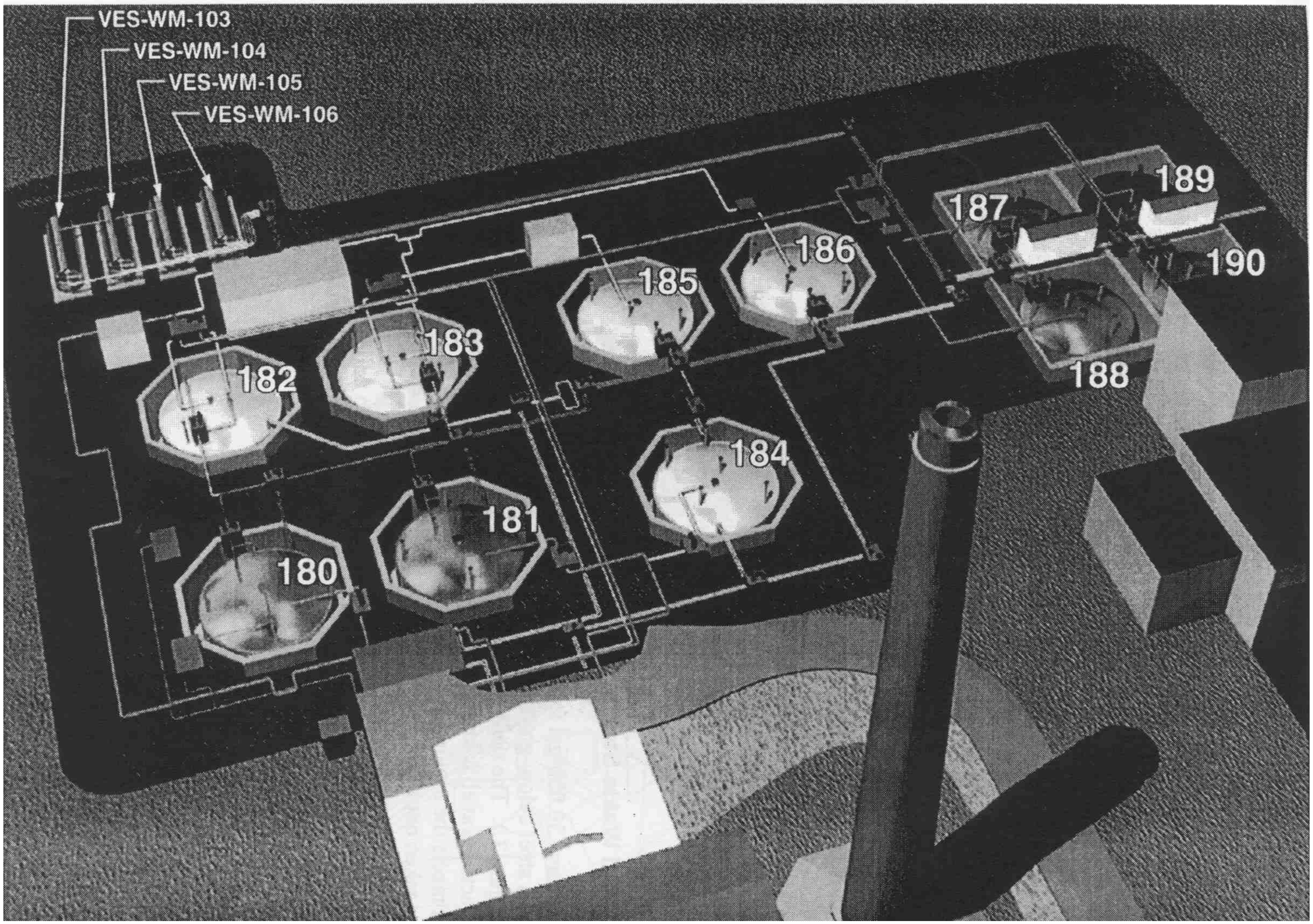

Figure A-2. Conceptual overview of the TFF.

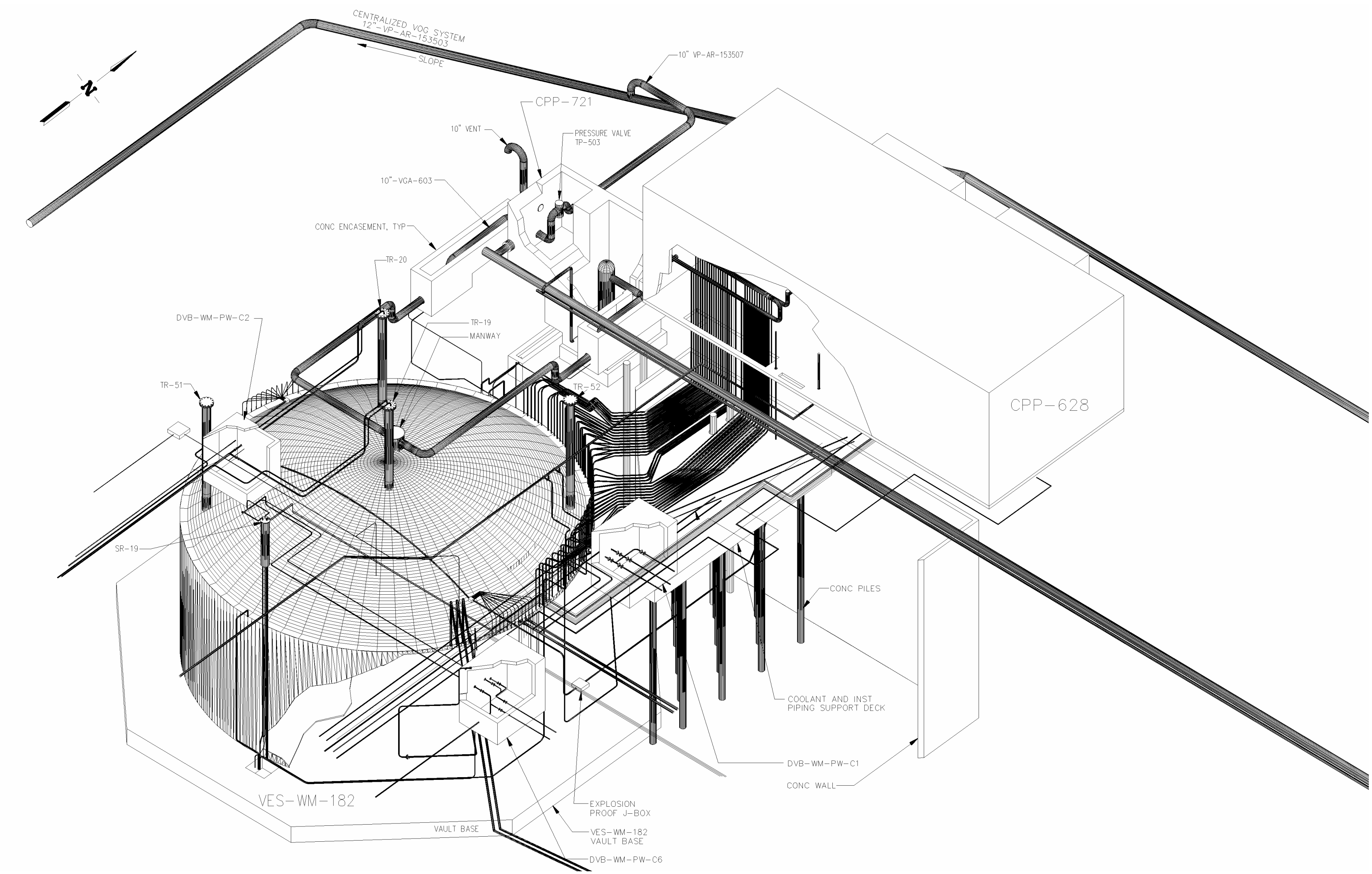

Figure A-3. Cutaway view of Tank WM-182.

height are 50 ft and 21 ft, respectively, with the exception of the 23-ft high 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 (all except WM-181, -184, and –186). The cooling coils maintain the liquid waste temperature below 95°F for fluoride-containing waste and below 131°F 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 waste transfer equipment (steam jets and airlifts). Two steam jets are located inside each tank, with the exception of WM-189 and WM-190; these two tanks have one steam jet and one air lift pump. A single steam jet can transfer waste out of a tank at approximately 50 gal/min. An airlift can transfer waste out of a tank at approximately 35 gal/min. Table A-1 provides general construction information on the 300,000-gallon tanks.

A-2.2 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, -104, -105, and -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) (1983)/Resource Conservation and Recovery Act (RCRA) (1976) 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 ft long × 17 ft wide × 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 gal. 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 A-2.

Underground pillars anchored to bedrock support the concrete pipe encasements associated with the 30,000-gallon tanks. The base slabs, which the tanks rest on, sit on undisturbed soil.

All four tanks contain stainless steel, closed loop, re-circulating cooling coils to control liquid waste temperature, evaporation rate, and condensation accumulation. Base slab sump access is provided by a 2-ft diameter concrete riser that extends to grade level. A permanently installed sump jet pump obstructs the sump access riser interior.

Table A-1. Design information summary for the 300,000-gallon tanks at the TFF.[a]

	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	Chicago Bridge and Iron	Chicago Bridge and Iron	Chicago Bridge and Iron	Chicago Bridge and Iron	Chicago Bridge and Iron	Chicago Bridge and Iron	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 WM-181)[b]				8.5 ft (WM-182 through WM-190)[b]					
Approximate total tank volume		2,000 yd^3 (WM-180 and WM-181)[b,c]				1,825 yd^3 (WM-182 through WM-190)[b,c]					
Approximate dome volume		330 yd^3 (WM-180 and WM-181)[b,d]				300 yd^3 (WM-182 through WM-190)[b,d]					

a. Data taken from *Idaho Nuclear Technology and Engineering Center Tank Farm Facility Conceptual DOE and HWMA/RCRA Closure Approach* (INEEL 2000).

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

c. Estimated volume is based on the physical tank volume, not the tank capacity.

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

Table A-2. Design information summary for the 30,000 gallon tanks at the TFF.

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 (gal)	30,750	30,750	30,750	30,750
Tank cylindrical length (ft)	38	38	38	38
Spherical heads (two per column)	ASME standard flanged and dished heads (≈2 ft deep)	ASME standard flanged and dished heads (≈2 ft deep)	ASME standard flanged and dished heads (≈2 ft deep)	ASME standard flanged and dished heads (≈2 ft deep)
Total tank length (ft)	42	42	42	42
Tank inner diameter (ft)	11.5	11.5	11.5	11.5
Tank wall thickness (in.)	11/16	11/16	11/16	11/16
Tank supporting base slab size (ft)	47.5 × 17 × 1.25 thick	47.5 × 17 × 1.25 ft thick	47.5 × 17 × 1.25 thick	47.5 × 17 × 1.25 ft thick
Liquid containment perimeter curb size (in.)	12 high × 9 wide	12 high × 9 wide	12 high × 9 wide	12 high × 9 wide
Tank access risers	Three 6-in. diameter	Three 6-in. diameter	Three 6-in. diameter	Three 6-in. diameter
	One 3-in. diameter	One 3-in. diameter	One 3-in. diameter	One 3-in. diameter
Sump riser (concrete pipe)	24-in. diameter	24-in. diameter	24-in. diameter	24-in. diameter
	Pipe wall is 3 in. thick	Pipe wall is 3 in. thick	Pipe wall is 3 in. thick	Pipe wall is 3 in. thick
Sump dimensions (ft)	2 × 2 × 2	2 × 2 × 2	2 × 2 × 2	2 × 2 × 2
Buried tank depths (dimensions to tank bottom) (ft)	28.5	28.5	28.5	28.5

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.

A-2.3 Vaults

The vault floors are approximately 45 ft belowground. The vaults containing the tanks are of three basic designs: monolithic octagonal, pillar and panel octagonal, or 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 A-3.

A-2.3.1 Monolithic Octagonal Vaults

The two oldest tanks at TFF, Tanks WM-180 and WM-181, were constructed from 1950 to 1952 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.

A-2.3.2 Pillar and Panel Octagonal Vaults

The five tanks contained in vaults of pillar and panel octagonal construction, Tanks WM-182 through WM-186, were constructed from 1954 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.[a] A diagram of the pillar and panel vault design is presented in Figure A-4. 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 A-4. The roofs are constructed of similar materials.

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a. M.C. Swenson, INEEL, e-mail to P.A. Tucker, INEEL, “Seismic Qualification of 300,000-gal Tanks,” April 1999.

Table A-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	56	58.9	58.9	58.9	58.8	58.8	56	56	56	56
Wall thickness (ft)	2.33 or 1.75	2.33 or 1.75	0.5	0.5	0.5	0.542	0.542	N = 3.5 S = 3.5 W = 1.5 E = 3.5	N = 3.5 S = 3.5 W = 1.5 E = 3.5	N = 3.5 S = 3.5 W = 3.5 E = 1.5	N = 3.5 S = 3.5 W = 3.5 E = 1.5
Inside vault wall height (ft)	27.33	27.33	32	32	32	29.5	29.5	32.6	32.6	32.6	32.6
No. of vault risers and sumps	1	1	2	2	2	2	2	2	2	2	2
Maximum roof thickness (ft)	5.75	5.75	3.66	3.66	3.66	3.5	3.5	4.5	4.5	4.0	4.0
Minimum roof thickness (ft)	1.25	1.25	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Vault top to grade (ft)	6.75	6.75	8.5 to 9	9 to 9.5	9	9	9	9	9	9	9
Total vault volume (yd^3)	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)	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.

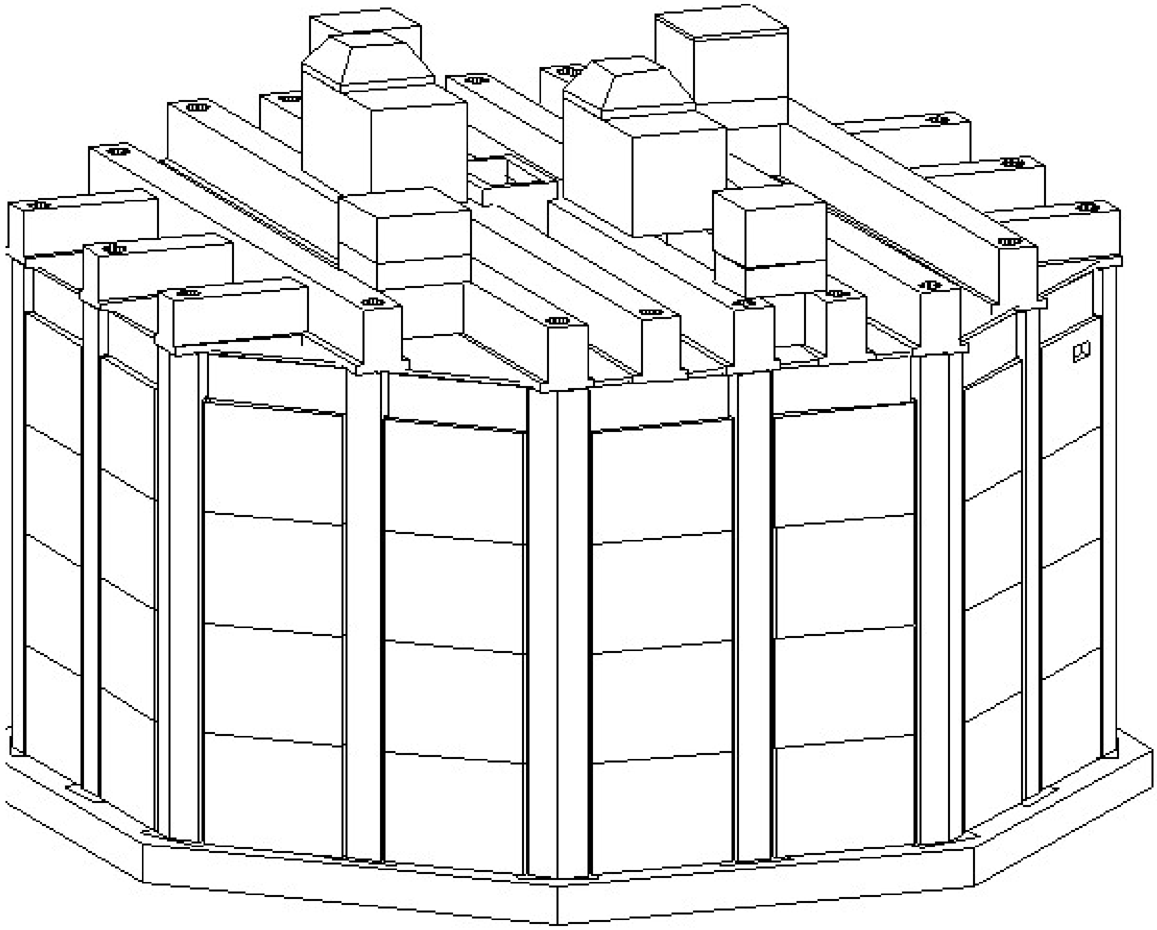

Figure A-4. Pillar and panel vault design at the INTEC Tank Farm Facility.

A-2.3.3 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 1958 to 1964. The vaults of these tanks are believed to meet PC-4 criteria, but the analysis for qualification was not performed (Palmer et al. 1998; footnote a, page 9). 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 × 12 × 12 in., 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.

A-2.4 Transfer Equipment

Waste transfer, cooling, decontamination, instrumentation, and vessel off-gas 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 aboveground energizes 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 TFF Control House (CPP-628). Double contained process waste lines are routed underground from the jet pumps to the main transfer/filling system.

All lines that transport waste within the TFF are buried and enclosed in pipe encasements known as secondary containment. The four main types of TFF secondary containment are

1. Split tile (ceramic cast pipe with concrete joints)

2. Stainless-steel-lined concrete troughs

3. Direct-buried pipes in concrete

4. Double-walled stainless-steel pipe.

During recent TFF upgrades, most pipe sections encased in ceramic tile were replaced or abandoned in place. Short sections of ceramic pipe still remain on the active line list that serves WM-180 and WM-181. These lines cannot be used unless authorized by upper management. Any fluid leaking from a process line drains into an encasement and then into a valve box or vault sump. Leaking fluid is detected by radiation and/or level detection instrumentation. A leaking line is immediately taken out of service and is not reused until it has been repaired. Waste collected in the valve box or vault sumps is jetted to Tank WL-133 or drained to Valve Box C12. Wastes collected in Valve Box C12 also are jetted to WL-133. All wastes are then transferred to the process equipment waste (PEW) evaporator for processing.

A-2.4.1 Transfer Equipment for Tanks WM-187 through WM-190

Waste transfer, cooling, decontamination, instrumentation, and vessel off-gas 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.

A-2.4.2 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 lines 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.

A-2.4.3 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 attached drain lines to transfer liquid waste to vault sumps or PEW evaporator in the event 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 × 6.5 ft high with a wall thickness of 6 in. Typically, valve boxes extend approximately 1 ft aboveground.

A-2.4.4 Process Waste Pipelines

During recent TFF upgrades, most pipe sections encased in split tile were either replaced or abandoned in place (footnote a, page A-2). 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 PEW evaporator for processing.

A-3. REFERENCES

42 USC 6901 et seq., 1976, "Resource Conservation and Recovery Act of 1976."

INEEL, 2000, *Idaho Nuclear Technology and Engineering Center Tank Farm Facility Conceptual DOE HWMA/RCRA Closure Approach*, INEEL/EXT-99-01066, Idaho National Engineering and Environmental Laboratory, June.

Palmer, W. B., C. B. Millet, M. D. Staiger, and F. S. Ward, 1998, *ICPP Tank Farm Planning through 2012*, INEEL/EXT-98-00339, Idaho National Engineering and Environmental Laboratory, April.

State of Idaho, 1983, "Hazardous Waste Management," Idaho Statute, Title 39, "Health and Safety," Chapter 44, "Hazardous Waste Management," (also known as the Hazardous Waste Management Act of 1983).