H-AREA TANK FARM

TYPE IV WASTE TANK INPUTS

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1.0 TYPE IV WASTE TANK CONCEPTUAL MODEL

Waste tank design data is necessary to perform groundwater modeling supporting the Savannah River Site (SRS) H-Area Tank Farm (HTF) Performance Assessment (PA). The purpose of this input package is to compile relevant background information regarding the actual waste tank design (Sections 2 through 7) and present the initial conceptual design of the waste tank for transport modeling. Modeling parameters outside of the tank boundary are included in other input packages (e.g., vadose zone, compiled conceptual model).

The initial conceptual design is an aphysical simplification of the actual waste tank design, which is required for analytical modeling. Certain tank features and design elements have by necessity been omitted in the initial conceptual model. Tank design features not included in the initial conceptual design will be addressed in subsequent conceptual models (e.g., cooling coils and rebar as fast flow paths). A number of general modeling decision guidelines were followed for the initial design:

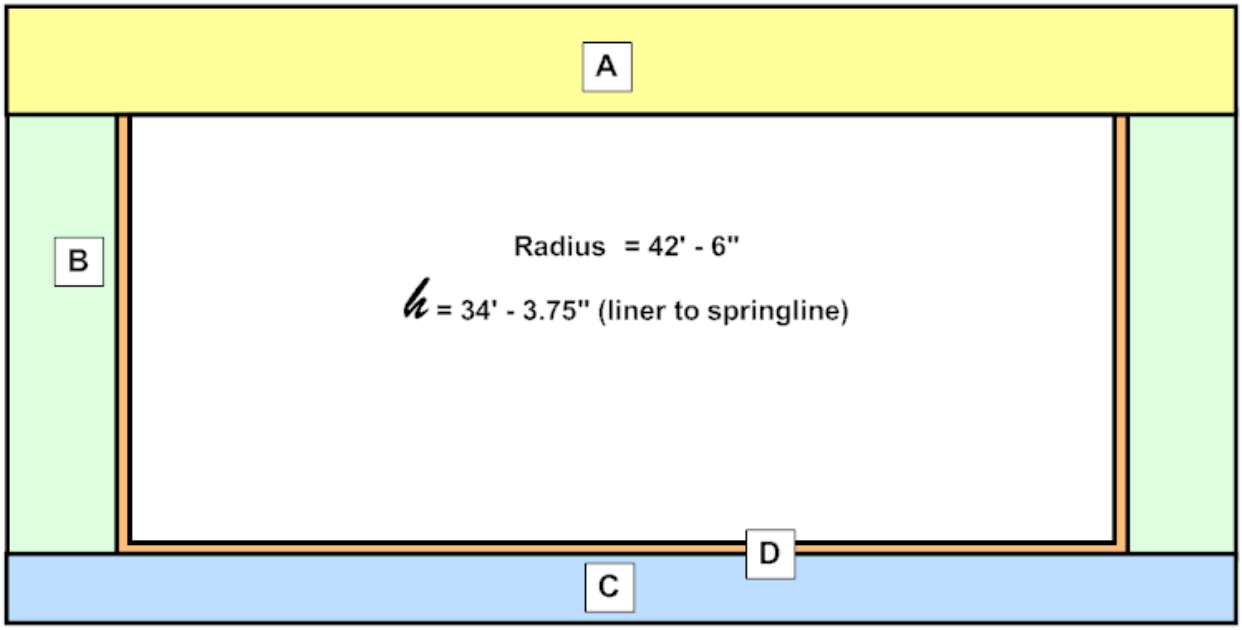
- The intent of the initial conceptual model is to capture tank dimensions and relative material differences for each discrete tank segment.
- Each discrete tank segment/area is represented as homogeneous, ignoring interior elements (e.g., rebar, cooling coils) and/or penetrations through the area (e.g., tank risers, transfer lines).
- Minimum segment thicknesses are used where an area had variable thickness (e.g., tank walls, tank tops).
- Grouting of tank void areas (e.g., tank primary, tank annulus) is assumed to have occurred as planned.

The Type IV waste tank dimensions detailed in Figure 1.0-1 to be used in the modeling are a simplification of the actual physical infrastructure of a Type IV waste tank. Specific areas where these modeling decisions are implemented for the Type IV waste tanks are highlighted below:

- The waste tank basemat segment was based on the basemat thickness and the cement topping placed over the basemat. Approximately 0.1 inch thickness was subtracted to account for the drainage grooves cut into the cement topping. The effective 0.1 inch groove thickness is based grooves being 1.625 inch deep and covering less than 6% of the waste tank footprint. The waste tank wall footing and the grouted segment between the wall footing and the tank basemat were not modeled discretely.
- The tank primary cavity or liner is assumed to be filled with grout and is treated as a discrete modeled area.
- The tank primary liner assumed thickness is based on the minimum thicknesses only (e.g., extra thickness at knuckle not modeled).
- The tank wall and tank liner penetrations (i.e., transfer lines) are not modeled discretely.
- The tank wall thickness is the minimum wall thickness and does not reflect the variable thickness of the wall.

- The tank roof thickness is the minimum thickness of the dome, and does not reflect the variable thickness of the roof.
- The tank roof penetrations (i.e., risers) are not modeled discretely.
- Concrete rebar in the tank top, tank wall, and tank basemat is not modeled discretely, such that concrete is considered a homogenous material.
- The waste tank underliner sump is not modeled discretely.

Figure 1.0-1: Typical Tank IV Modeling Dimensions



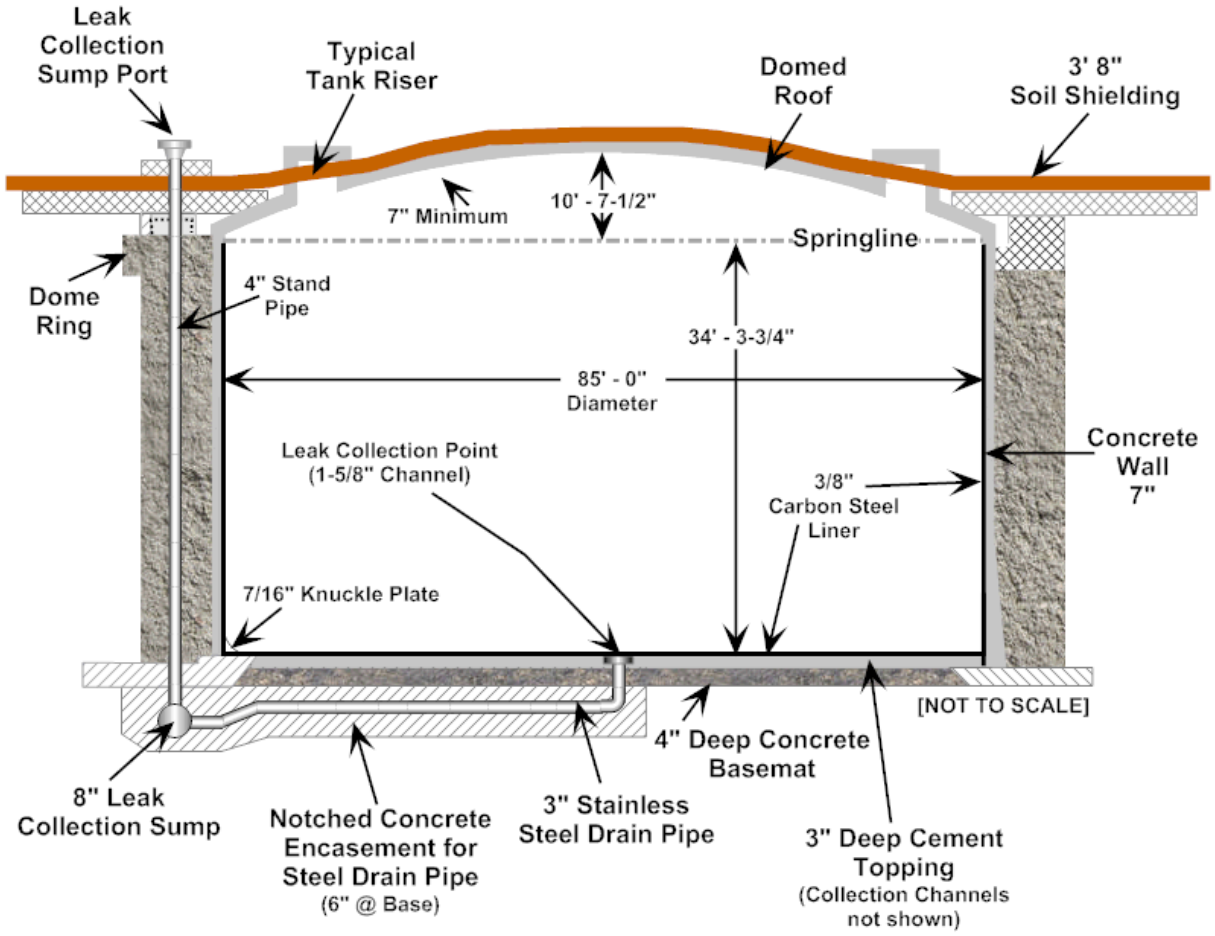
[NOT TO SCALE]

MATERIAL ZONE LABEL	THICKNESS	MATERIAL
A Concrete Roof	7"	Concrete
B Concrete Wall	7"	Concrete
C Concrete Basemat	6.9025"	Concrete
D Primary Liner	0.375"	Carbon Steel

2.0 TYPE IV WASTE TANK DIMENSIONS

There are four Type IV waste tanks in the HTF (Tanks 21 through 24). The Type IV waste tanks were constructed between 1958 and 1962. A typical Type IV waste tank configuration is shown in Figure 2.0-1. These waste tanks have a single liner with a spherical, reinforced concrete, domed roof that supports itself. Type IV tanks are 85 feet in diameter and approximately 34 feet high at the side wall, with a nominal operating capacity of 1,300,000 gallons. [DP-478]

Figure 2.0-1: Typical Type IV Waste Tank Configuration



[W230907, W230945, W231023]

3.0 TYPE IV WASTE TANK LOCATIONS

The locations and elevations for the Type IV waste tanks are provided in Table 3.0-1.

Table 3.0-1: HTF Type IV Waste Tank Locations and Elevations

Tank	North Location	East Location	Elevation of Basemat (MSL)	References
21	71465.0	61772.0	281.42 [(a)]	W230826 W230945
22	71465.0	61660.0	281.42 [(a)]	W230826 W230945
23	71577.0	61772.0	281.42 [(a)]	W230826 W230945
24	71577.0	61660.0	281.42 [(a)]	W230826 W230945

a The elevation shown for the Type IV tanks is at the bottom of the basemat, there is no working slab under the Type IV tanks.

MSL = Mean Sea Level

4.0 TYPE IV TANK FLOOR (BASEMAT & CEMENT TOPPING)

A 4 inch thick reinforced basemat forms the bottom layer of the Type IV tank. The basemat is installed with a tolerance of plus 0.5 inch and minus 0.25 inch, and reinforced bars throughout per Spec-3583. The testing of concrete and concrete materials was in accordance with specification SB-5-A. [W230945]

The basemat is covered with a wire mesh which has a 3 inch cement topping covering the mesh. The 4 inch basemat and 3 inch cement topping together comprise a nominal 7 inch modeling basemat. Figure 4.0-1 shows the placement of the cement topping over the basemat. Drainage channels (1.625 inches deep and approximately 3.5 inches wide, 3.625 inches at the top and 3.125 inches at the bottom) used for leak detection were formed in the 3 inch deep cement topping (Figure 4.0-2). The channels coincide with the locations of welds and backup strips. [W230945]

A 3 inch stainless steel drainpipe to collect any leakage is located at the center of the basemat and runs to a collection chamber below the footing at the edge of the waste tank wall. The drainpipe was placed below the 4 inch basemat and runs to an 8 inch diameter x 8 inch long collection chamber below the footing at the edge of the waste tank wall. A 4 inch diameter pipe connects the leak collection chamber to the surface so that a leak collection probe might be placed in the chamber (Figure 2.0-1). [W230945]

Figure 4.0-1: Placement of Cement Topping on Basemat

Figure 4.0-2: Basemat Cement Topping Showing Geometry of Drainage Channels

5.0 TYPE IV WASTE TANK SOIL & BACKFILL DESCRIPTION

Earth was excavated from the Tanks 21-24 area, to a nominal depth of 17 feet below existing grade. [W230826] Since no annulus exists for the tanks, a three-layer backfilling system is used to surround the sidewalls of the concrete vault. [W231221] The backfill consists of a vermiculite fill layer, a special manually compacted fill of soil, and a test controlled compacted fill of soil. The vermiculite fill, with a minimum 8 inch thickness added in bags, provides a cushion layer for expansion of the primary tank with temperature variations of the tank and tank contents from the foundation to the underside of the dome ring. As each bag layer was placed, voids behind and between bags were filled with earth backfill. When the fill came up to the top of a course of vermiculite bags, additional bags were placed against the tank. [DP-478, Section 8] Standard compaction of excavated soil (sandy clay) was performed around and over tanks per Spec-3583. [W230976, W231023, W231221] The final test-controlled compacted fill was packed and rolled with heavy equipment. Figure 5.0-1 shows the placement of the vermiculite bags along the tank wall with backfilling operations approximately 50% complete. The tanks were finally covered with a minimum of 3 feet 8 inches of compacted soil (Figure 5.0-2). [W231023]

Figure 5.0-1: Backfilling Around Type IV Tanks with Vermiculite Bags Shown

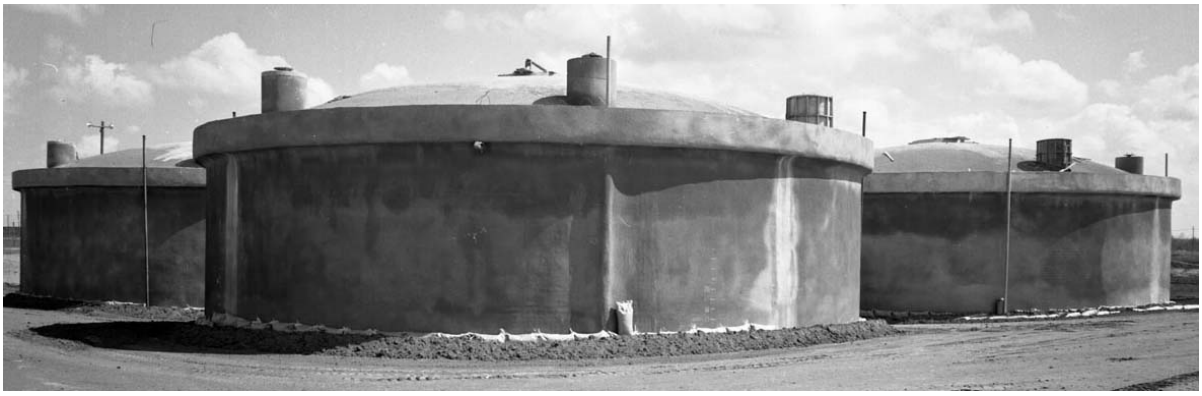


Figure 5.0-2: Backfilling Over Type IV Tanks Complete

6.0 TYPE IV WASTE TANK VAULT

The Type IV tank is completely enclosed in a concrete vault. [W230976] The waste tank wall foundation and 4 inch basemat are per Spec-3583. After the wall foundation and basemat had been set and cured the annular space between them was filled with metallic non-shrink grout with a compressive strength at least equal to that of the basemat. [Spec-3583 Part 40, Section 11] The wall footing is 4 foot - 10 inches wide in total, with 2 feet of the wall footing extending underneath the primary tank liner. The wall footing and wall contain vertical and horizontal reinforcing steel bars as detailed in drawings W230945 and W230976.

The tank roof consists of a spherical reinforced concrete dome made of 7 to 10 inch thick concrete (the dome concrete is thicker near the risers). The concrete dome is reinforced throughout with steel bars. Figure 6.0-1 shows the reinforced steel bars prior to the placement of the concrete. The dome has an internal radius of curvature of 90 feet - 4 inches and a rise of 10 feet - 7.5 inches above the springline. The dome shape of the roof provides its own structural support; therefore, the concrete roof is not lined with carbon steel on the inside. The dome was constructed of Class A concrete which developed 5,000 psi at 28 days. [W231023] Each tank has six peripheral risers, each providing a 2 foot diameter opening into the tank interior. The riser locations are detailed in drawing W231206. Figure 6.0-2 shows the concrete vault for the Type IV tanks and the peripheral risers on the tank dome.

There is no secondary steel liner for the Type IV waste tanks. The concrete vault for the Type IV tank was built around the primary steel liner with the wall and the dome ring formed by shotcrete and reinforcing bars. [W230976] The walls were shot in vertical strips to avoid any horizontal joints around the tank and vertical joints were staggered in subsequent layers. The shotcrete was applied in successive layers from 0.75 inches to a maximum of 2 inches to provide the buildup thickness required per Spec-3583. Figure 6.0-3 shows the application of shotcrete on the wall of the Type IV tank.

Figure 6.0-1: Dome Construction of Type IV Tanks

Figure 6.0-2: Concrete Vault and Dome of Type IV Tanks

Figure 6.0-3: Application of Shotcrete on the Type IV Tank Vault Wall

The walls (concrete and liner) form a cylinder 85 feet inner diameter and 34 feet 3.375 inches high at the springline surmounted by the dome ring. The core wall is 7 inches thick at the top and 11 inches at the bottom. The dome ring and wall were made monolithic by shooting the layers continually from bottom to top of the wall. The vertical reinforcing in the wall was also carried up into the dome ring. The dome ring and wall act as a unit with a joint between dome ring and dome slab and a joint between the wall and floor. [W230976]

The dome ring was prestressed with forty-one, 1 inch round bands installed per DP-478. The wall was prestressed circumferentially by one hundred sixty-three, 0.875 inch round bands, roll threaded with a minimum area no smaller than the 0.875 inch rod. The turnbuckles, placed 45° apart on each band, were designed to be stronger than the rods.

7.0 TYPE IV WASTE TANK PRIMARY LINER DESCRIPTION

The Type IV tank primary liner is a cylinder (open at the top) made of 0.375 inch carbon steel plates and 0.4375 inch knuckle plates. [W230907] The knuckle plates at the junction between the tank bottom and sidewalls rest on a concrete tank ring. The primary tank liner is reinforced internally with four circumferential carbon steel stiffener angles and is anchored externally to the concrete wall. The primary carbon steel liner material is specified and installed per specification DP-478. Figure 7.0-1 shows the erection of the primary liner during Type IV tank construction.

Penetrations through the primary liner and the side concrete wall exist to accommodate processing needs. The process lines penetrate the tank liner and concrete wall through sleeved penetrations. The size and material type for the process lines and the penetration sleeves are identified in Table 7.0-1.

Table 7.0-1: Side Penetrations in Primary Liner of Type IV Tanks

Tank No.	Process Line	Sleeve Welded to Primary Liner	Reference Drawings
21 - 24	3 inch schedule 40 stainless steel core pipe with 6 inch schedule 20 stainless steel jacket	10 inch schedule 40 carbon steel	W231244 W234134
21 - 24	3 inch schedule 40 stainless steel (2 per tank)	10 inch schedule 40 carbon steel	W231244
21	4 inch stainless steel	6 inch schedule 40 carbon steel	W231210 W231244

Figure 7.0-1: Construction of the Primary Liners in Type IV Tanks

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