H-AREA TANK FARM

TYPE III/IIIA WASTE TANK INPUTS

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Prepared by: SRR Closure & Waste Disposal Authority
Aiken, SC 29808

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1.0 TYPE III AND TYPE IIIA WASTE TANK CONCEPTUAL MODELS

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 designs (sections 2 through 10) and present the initial conceptual design of the waste tanks for transport modeling. Modeling parameters outside of the tank boundary are included in other input packages (e. g., hydrogeology, 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 decisions guidelines were followed for the initial design:

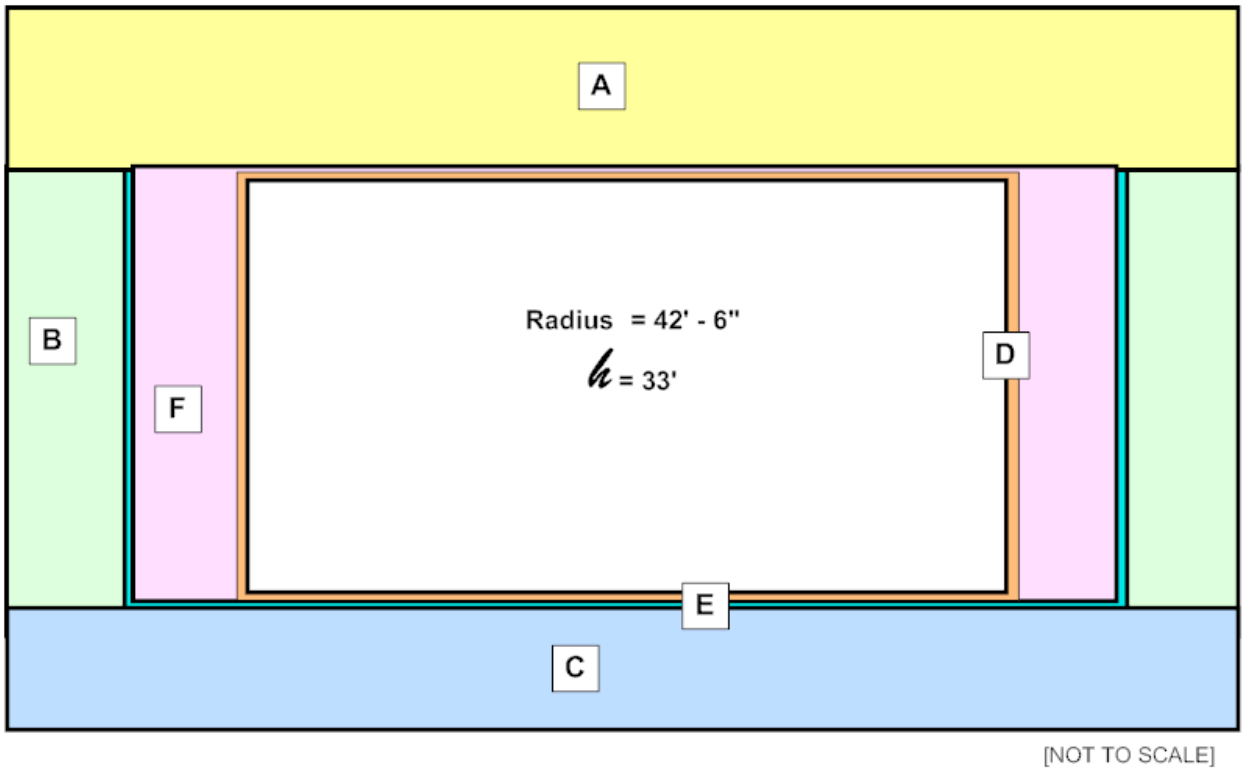
- The intent of the initial conceptual model is to capture tank dimensions and relative material differences for each discrete tank segment.
- Each discrete tank segment/area is represented as homogeneous, ignoring interior elements (e.g., rebar, cooling coils) and/or penetrations through the area (e.g., 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, cooling coils) is assumed to have occurred as planned.

The HTF Type III and Type IIIA waste tank dimensions detailed in Figures 1.0-1 and 1.0-2, respectively, will be used in the modeling as a simplification of the actual physical infrastructure of the waste tanks. Specific areas where these modeling decisions are implemented for the Type III/IIIA waste tanks are highlighted below:

- The tank basemat segment is based on the minimum basemat thickness and ignores the thicker concrete drop panel below the tank center column and other material layers below the tank (i.e., concrete working slab, grout layers). Type IIIA basemat thickness has 2 inches subtracted to reflect the 2 inch leak detection slots cut into the basemat. [W701336, W707253]
- Thermocouple piping running through the tank walls and basemat is not modeled discretely.
- The tank primary liner is assumed to be filled with grout and is treated as a discrete area. The tank center column, center annulus, ventilation ductwork, and cooling coils are not modeled discretely.
- The tank secondary liner is assumed to be filled with grout and is treated as a discrete area.
- The primary liner and secondary liner assumed thicknesses are based on the minimum thicknesses only (e.g., extra thickness at knuckle not modeled).
- Penetrations through the tank wall and tank liner (i.e., transfer lines) are not modeled discretely.
- The tank roof penetrations (i.e., risers) are not modeled discretely.

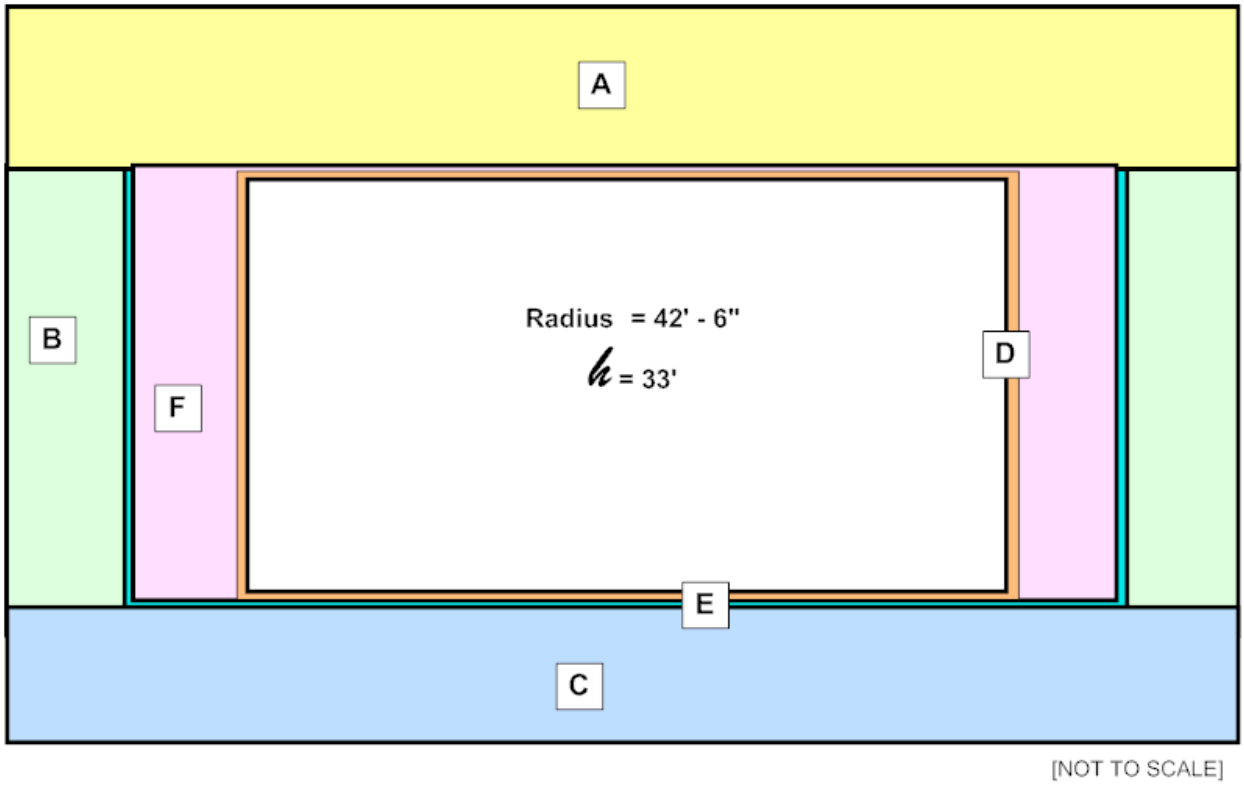
- Concrete rebar in the tank top, tank walls, and tank basemat is not modeled discretely, such that concrete is considered a homogenous material.
- The waste tank underliner sump is not modeled discretely.

Figure 1.0-1: Typical Type III Waste Tank Modeling Dimensions



LABEL	THICKNESS	MATERIAL
A Concrete Roof	48"	Concrete
B Concrete Wall	30"	Concrete
C Concrete Basemat	42"	Concrete
D Primary Liner	0.5"	Carbon Steel
E Secondary Liner	0.375"	Carbon Steel
F Grouted Annulus	30"	Tank Fill Grout

Figure 1.0-2: Typical Type IIIA Waste Tank Modeling Dimensions



LABEL	THICKNESS	MATERIAL
A Concrete Roof	48"	Concrete
B Concrete Wall	30"	Concrete
C Concrete Basemat	41" (Typical) (43" - Tanks 35 - 37)	Concrete
D Primary Liner	0.5"	Carbon Steel
E Secondary Liner	0.375"	Carbon Steel
F Grouted Annulus	30"	Tank Fill Grout

2.0 TYPE III/IIIA WASTE TANK DIMENSIONS

There are four Type III waste tanks (Tanks 29-32) and 13 Type IIIA waste tanks (Tanks 35-37, 38-43 and 48-51) in the HTF. The Type III tanks were constructed between 1967 and 1970. The Type IIIA tanks were constructed between 1974 and 1981. These tanks are 85 feet in diameter and 33 feet high, with a nominal operating capacity of 1,300,000 gallons. [W236519] Typical Type III and Type IIIA tanks are shown in Figures 2.0-1 and 2.0-2, respectively. Note that Tanks 35, 36, and 37 have been designated as Type IIIA tanks but they differ from Figure 2.0-2 in that these tanks have a flat roof with a uniform 4 foot concrete thickness, similar to the Type III tanks. Additionally, Tank 35 has deployable cooling coils rather than permanently installed cooling coils.

Figure 2.0-1: Typical Type III Waste Tank (Cross-sectional View)

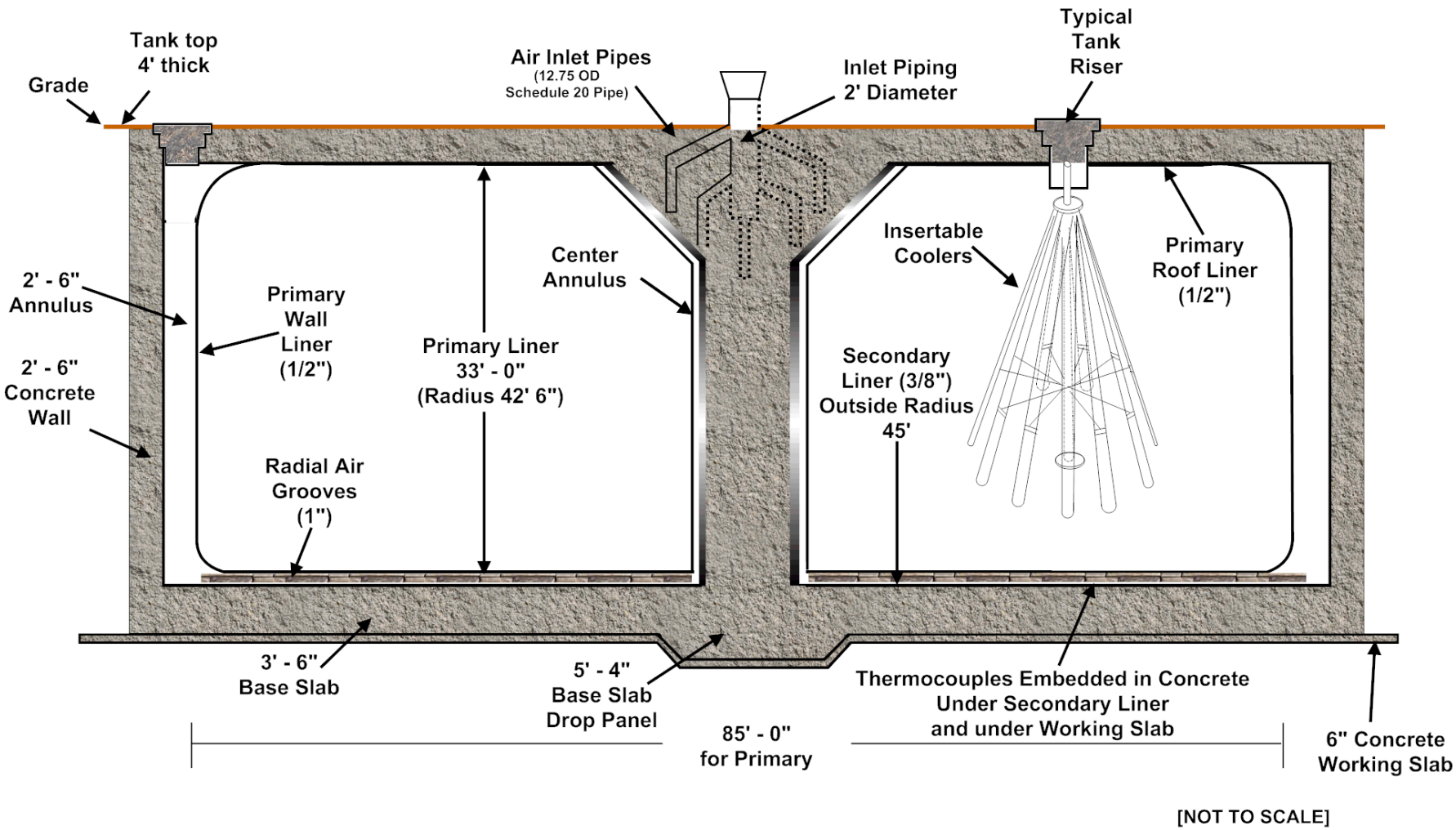
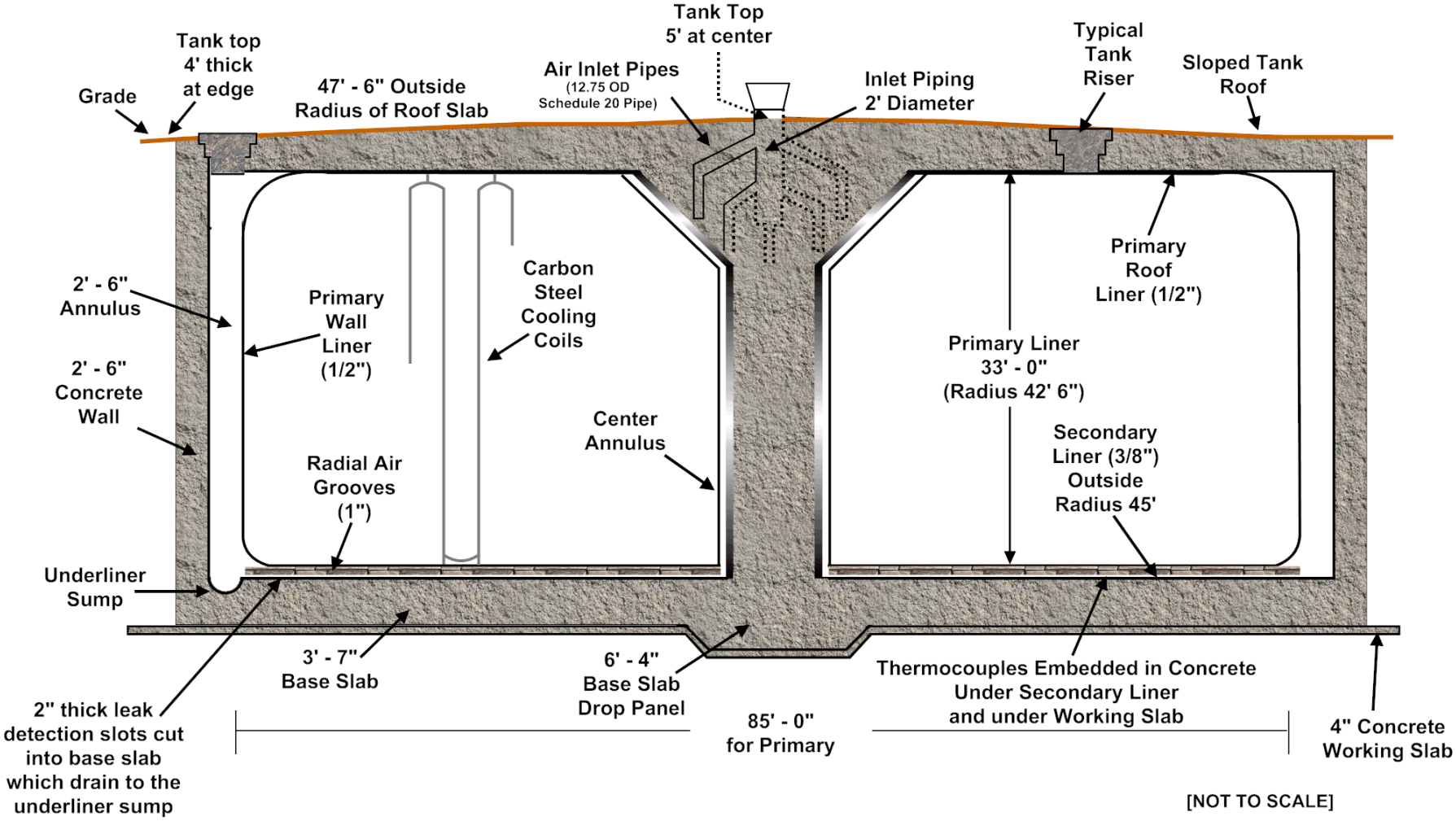


Figure 2.0-2: Typical Type IIIA Waste Tank (Cross-sectional View)



3.0 TYPE III/IIIA WASTE TANK LOCATIONS

The location and elevation in feet above mean sea level (MSL) for the Type III and Type IIIA waste tanks are provided in Table 3.1-1.

Table 3.1-1: Tank Location Details

Tank	North Location	East Location	References	Elevation of Tank Top (ft above MSL)	Elevation of top of working slab (ft above MSL)	References
Type III						
29	71778.5	61636	W236439	324.87	283.5	W236439 W231220
30	71778.5	61520	W236439	323.85	282.5	W236439 W231220
31	71778.5	61404	W236439	322.88	281.5	W236439 W231220
32	71662.5	61462	W236439	321.23	280	W236439 W231220
Type IIIA						
35	71865	61220	W700242_OUO	324.04	282.67	W449843_OUO W700242_OUO
36	71990	61075	W700242_OUO	325.04	283.67	W449843_OUO W700242_OUO
37	72052	61175	W700242_OUO	325.04	283.67	W449843_OUO W700242_OUO
38	71290	62490	W700825_OUO	332.45	291.09	W700825_OUO W700834
39	71290	62610	W700825_OUO	333.45	292.09	W700825_OUO W700834
40	71290	62730	W700825_OUO	333.45	292.09	W700825_OUO W700834
41	71290	62850	W700825_OUO	332.45	291.09	W700825_OUO W700834
42	71170	62590	W700825_OUO	334.45	293.09	W700825_OUO W700834
43	71170	62800	W700825_OUO	334.45	293.09	W700825_OUO W700834
48	70956	62610	W706301	329.5	288.14	W706301 W704285_OUO
49	70956	62735	W706301	329.5	288.14	W706301 W704285_OUO
50	70820	62610	W706301	327	285.64	W706301 W704285_OUO
51	70820	62735	W706301	327	285,64	W706301 W704285_OUO

4.0 TYPE III/IIIA WASTE TANK BASEMATS AND WORKING SLABS

4.1 Type III Waste Tank Basemat

The secondary liner rests on the concrete basemat which connects with concrete walls and roof to form a vault. The basemat is 3 - foot 6 inches thick (5 foot - 4 inches at drop panel at tank center) with a radius of 45 feet (not including the 2 foot - 6 inch wall radius). [W236562] The concrete basemat does not have leak detection slots cut into it. [W236495]

There are two thermocouples, each having a 1 inch grout layer (surrounding 1 inch thermocouple tubing) between the secondary liner and the concrete basemat. There are also thermocouples located 10 feet below the working slab. [D139029] Type III tanks also have a pipe-encased thermocouple that travels through the vault wall down to the basemat and working slab.

The concrete basemat rests on a minimum 6 inch thick construction working slab. The construction working slab is under all four tanks (Tanks 29 through 32). [W236495] Figure 4.1-1 shows the early construction of a typical Type III/IIIA basemat.

Figure 4.1-1: Early Construction of a Type III/IIIA Tank Basemat

The basemat concrete was installed with reinforcing bars placed throughout, with the length and type of bar varying depending upon the location. The basemat also includes a water stop embedded in the circumference. [W236495, W236562]

4.2 Type IIIA Waste Tank Basemat

The secondary liner rests on the concrete basemat which is connected with the concrete walls and roof to form a vault. The basemat is 3 foot - 7 inches thick with a 6 foot - 4 inch drop panel at the tank center and a radius of 45 feet (not including the 2 foot 6 inch wall radius). The basemat rests on a minimum 4 inch thick construction working slab. The working slab rests on undisturbed soil. [W448847, W700855, W707138]

The working slab slopes away from the tanks, and extends at least 25 feet from the tanks. [W448847, W700855, W707138] Prior to the placement of backfill, the working slab was broken up or perforated with 4 inch diameter holes spaced 18 inches apart, center to center between the tanks to prevent perched water (Figure 4.1-2). The basemat has reinforcing bars placed throughout, with the length and type of bar varying depending upon the location. A water stop is provided at the basemat to vault wall joint. [W448847, W700505_OUO, W707138]

Figure 4.1-2: Drilled Working Slab Around a Type IIIA Tank

Tanks 38-43 and 48-51 have an underliner sump located between the secondary containment bottom and basemat. A grid of nominal 2 inch deep by 4 inch wide interconnected radial channels is grooved into the basemat with a finish per specification SB 10 U. The secondary liner rests on top of the concrete basemat. Figure 4.1-3 shows the leak detection channel grid in a typical Type IIIA basemat. The channels are sloped to drain through a center collection pipe to a sump located inside the vault wall. A 1.5 inch stainless steel access pipe rises to grade from the sump to allow for liquid measurement, sampling, and the pumping out of collected liquid. [W701336, W707253]

Figure 4.1-3: Typical Leak Detection Channel Grid in Type IIIA Tank Basemat

If both the primary liner and the secondary liner develop a leak, liquid will collect in the channels then drain to the sump. The sump can be monitored by conductivity probes that alarm when liquid contacts the probes.

Tanks 35-37 had a total of 56 thermocouples installed on the outside of the primary liner of each tank. [W449815] Tank 38 has a total of 34 thermocouples that were installed on the outside of the primary liner. [W700715] Each of the remaining Type IIIA tanks (39-43 and 48-51) has a total of 22 thermocouples that were installed on the outside of the primary liner of each tank. [W707031] Thermocouples were also installed outside of the secondary liner via piping encased within the vault wall. All Type IIIA tanks have a thermocouple located on the top of the basemat and another thermocouple located just below the working slab. [W702019] Tanks 35-37 have an additional thermocouple was installed approximately 10 feet below the working slab. [W449931]

5.0 TYPE III/IIIA WASTE TANK CENTER COLUMNS

5.1. Type III Tank Center Column

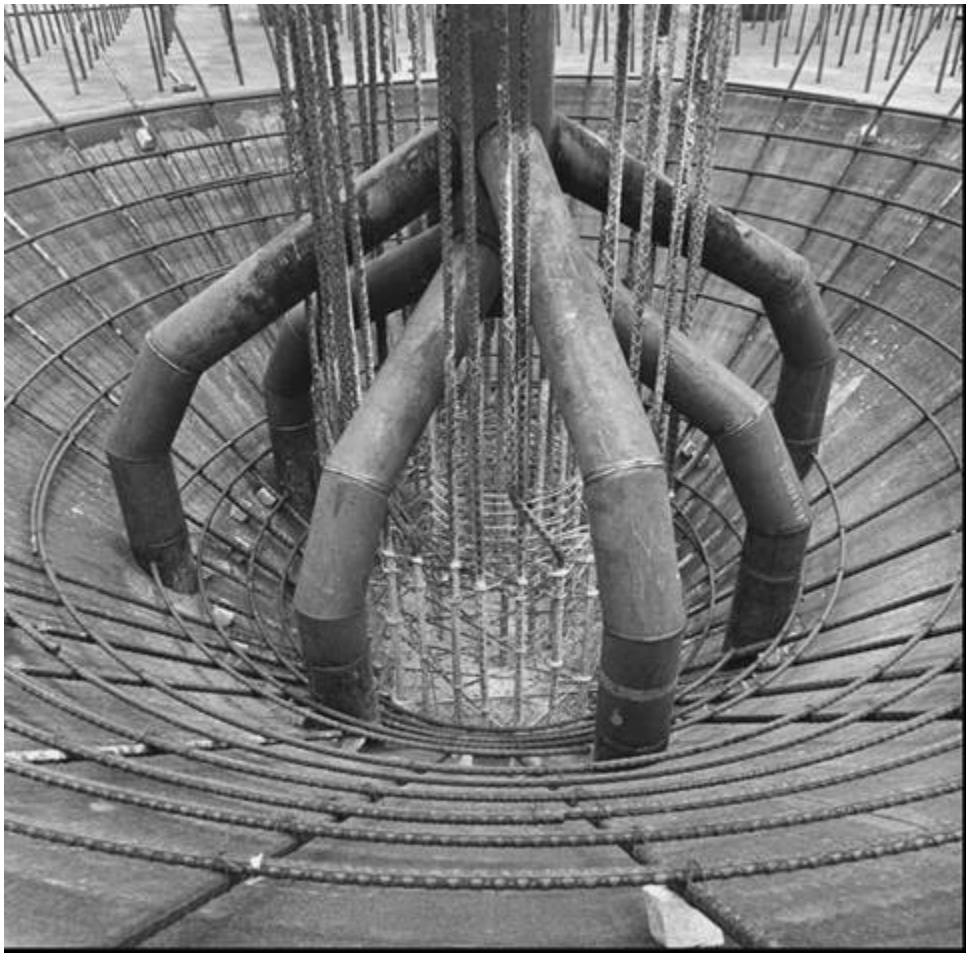
The Type III primary liner roof is supported by a steel-lined concrete center support column which was made as an integral part of the basemat. As a result of this design, the tank bottom does not support the weight of the roof support column, as it does in the Type I and II tanks, thereby reducing stress on the primary tank bottom (Figure 5.1-1). At the center column, the secondary liner is 6 foot - 6 inches in diameter and the primary liner is 6 foot - 9 inches in diameter. [W236562]

For the Type III Tanks, there is a ventilation/cooling system embedded in the center support column (Figure 5.1-2). [W236499]

The center column concrete is Class C, 1.5 inch maximum aggregate. The column was installed with a 3000 psi compressive strength at 28 days. [W236562] Reinforcing bars were placed throughout the center support column with the length and type of bar varying depending upon the location. [W236499]

Figure 5.1-1: Center Column Roof Support in a Type III/IIIA Tank

Figure 5.1-2: Type III/IIIA Vent Ductwork Construction Photo



5.2 Type IIIA Tank Center Column

The Type IIIA tank roof support for the primary liner is provided by a steel-lined concrete center support column, 6 foot 2 inches in diameter. The center support column is made as an integral part of the concrete basemat; therefore, the tank bottom does not support the weight of the roof support column, as does the Type I and II tanks, thus reducing stress on the primary tank bottom (Figures 5.1-1). At the center column, the secondary liner is 6 foot 2 inches in diameter (6 foot 1 inch for Tanks 48-51) and the primary liner is 6 foot 9 inches in diameter. [W448842, W700856, W707114]

For the Type IIIA tanks, there is a ventilation/cooling system embedded in the center support column (Figure 5.1-2). [W448844, W704339, W707111]

The center support column concrete was installed with a 3000 psi compressive strength at 28 days. [W448847, W700855, W707138] Reinforcing bars were placed throughout the center support column with the length and type of bar varying depending upon the location. [W448844, W704340, W707138]

6.0 TYPE III/IIIA TANK PRIMARY AND SECONDARY LINER DESCRIPTIONS

The Type III/IIIA tank primary liner has a 42 feet - 6 inches (inside) radius and is 33 feet high. The Type III/IIIA liners are made of two concentric cylinders joined to washer shaped top and bottom plates by curved knuckle plates. The minimum plate thicknesses for the Type III and IIIA tanks are provided in Table 6.0-1. Drawing W236562 identifies the type of steel plates for the primary liners and specifications, including material and welding information for Tanks 29 through 32, W448849 these details for Tanks 35 through 37, W700856 provides this detail for Tanks 38 through 43, and the material information for Tanks 48 through 51 can be found in W707114.

Table 6.0-1: Minimum Primary Liner Plate Thicknesses for Type III/IIIA Tanks

Location	Tanks 29-32 Thickness (inch) [W236519]	Tanks 35-37 Thickness (inch) W448842]	Tanks 38-43 Thickness (inch) [W700853]	Tanks 48-51 Thickness (inch) [W706806]
Top and bottom	0.5	0.5	0.5	0.5
Upper knuckle	0.5	0.5	0.5	0.5
Outer liner				
Upper band	0.5	0.5	0.5	0.5
Middle band	0.5	0.625	0.625	0.625
Lower band	0.5	0.5	0.875	0.75
Column liner				
Upper band	0.5	0.625	0.5	0.5
Lower band	0.5	0.875	0.625	0.625
Lower Knuckle				
Outer	1.0	0.875	0.875	0.875
Inner (at column)	0.625	0.625	0.625	0.625

The primary liner sits on a bed of insulating material grooved to channel air flow to the secondary annulus liner. [W236993, W702700] The insulating bed has radial grooves so that ventilating air can flow through the slots, and any leakage from the tank bottom or center annulus would flow to the outer annulus. The Type III tanks have a 6 inch thick layer of insulating material with 1 inch deep by 2 inch wide slots. [W236993] The Type IIIA tanks have an 8 inch thick layer of insulating material with 2 inch deep by 5 inch wide slots. [W702700] Figure 6.0-1 shows the grooved radial air slots for a typical Type IIIA tank and Figure 6.0-2 shows the grooved radial air slots emerging from below the primary liner.

Figure 6.0-1: Grooved Radial Air Slots for a Typical Type IIIA Tank

Figure 6.0-2: Typical Type IIIA Tank Primary and Secondary Liner - Early Construction

The secondary liner for the Type III/IIIA tanks is 0.375 inch thick carbon steel. [W236562] The secondary liner is the full height of the primary liner and 90 feet in outside diameter forming a 2 foot - 6 inch annular region between the sides of the primary liner and the secondary liner. Figures 6.0-2 and 6.0-3, respectively, show the erection of the primary and secondary liners for a typical Type IIIA tank during early and late construction.

Figure 6.0-3: Typical Type IIIA Tank Primary and Secondary Liner - Late Construction

Type III Tanks 29 through 32, have a number of penetrations through the primary and/or secondary liner at the tank top ranging in size from approximately 9 inches to 36 inches in diameter. Two pairs of stainless steel lines penetrate the primary liner at the upper knuckle. One pair is the main waste inlet lines that are 3 inches in diameter and enter the primary tank via a 10 inch diameter carbon steel sleeve that is welded to the primary liner. The 10 inch sleeve traverses the annular space and mates into a 12 inch carbon steel sleeve that is welded to the secondary liner and penetrates through the vault wall. The second pair is the spare waste inlet lines that are 2 inches in diameter and enter the primary tank via a 6 inch diameter steel sleeve that is welded to the primary liner. The 6 inch sleeve traverses the annular space and mates into an 8 inch carbon steel sleeve that is welded to the secondary liner and penetrates through the vault wall. Both pairs have asbestos wicking packed within the annular space between the larger and smaller sleeves. [W236519]

Similar to the Type III tanks, the Type IIIA tanks have a number of penetrations through the primary and/or secondary liner at the tank top ranging in size from approximately 9 inches to 52 inches in diameter. In addition, the Type IIIA tanks (except Tank 35) have multiple penetrations to accommodate the valve house on the tank top for the permanently installed cooling coils. Penetrations on the side of the Type IIIA tanks also exist at various locations along the upper knuckle and are designed similarly as described above for the side penetrations on the Type III tanks. [W449795, W449796, W449797]

7.0 TYPE III/IIIA WASTE TANK SOIL WORKING SLAB AND BACKFILL DESCRIPTIONS

7.1 Type III Tanks

Tanks 29-32 were built on a working slab that extends a minimum of 30 feet beyond the edge of the tank and slopes away from the tank. [W236439]

7.2 Type IIIA Tanks

Tanks 35-37, 38-43, and 48-51 were built on a single working slab that extends out beneath all waste tanks. [W449843_OUO, W700834, W706301]

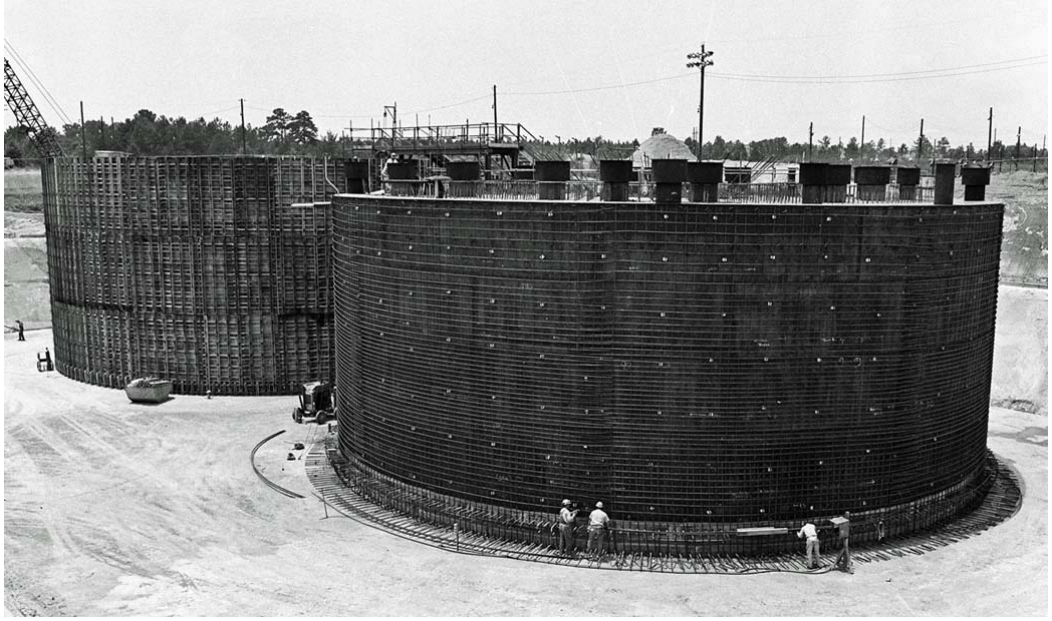
All areas receiving backfill (including sloped areas) were prepared per specification SC 5 E. Prior to placing backfill, the working slab was either broken up or 4 inch holes 18 inches on centers were punched in the slab. In other areas receiving backfill, the soil cover (e.g., vegetation, top soil, soil erosion protection layer) was removed and the ground scarified to a depth of 4 inches. Backfill used was per specification SC 5 E, with the amount (percent) of water most favorable to achieve not less than 95% of the maximum dry density. [W701036_OUO]. Backfill was placed to within 1 foot of the elevation of the top of the Type III/IIIA tanks. [W231220, W700242_OUO, W701036_OUO, W704700] Figure 7.2-1 shows a typical Type III/IIIA tank after completion of backfill placement.

Figure 7.2-1: Typical Type III/IIIA Tank After Backfill Complete

8.0 TYPE III/IIIA WASTE TANK VAULTS

The Type III/IIIA tanks are completely enclosed in a concrete vault. The vault roof is at least 48 inches thick, and the walls are 30 inches thick. Because of this thick enclosure, no earthen cover is required for shielding on top of the Type III/IIIA tanks. The Type III tanks and the Type IIIA Tanks 35-37 have a flat roof, but the roof on the Type IIIA Tanks 38-43 and 48-51 is sloped with the roof being 5 foot thick at the tank center and 4 foot thick at the tank edge. The vault wall and the roof have reinforcing bars placed throughout, with the length and type of bar varying depending upon the location of the bar (Figure 8.0-1). There is a 24 ounce water stop at the basemat/wall joint with all seams brazed watertight. [W236562, W448847, W704339, W707138] The concrete and reinforcing bar, the walls, the basemat, and the top roof slab was installed per the construction drawing specifications. [W236577, W706690, W236499, W448844]

Figure 8.0-1: Typical Type III/IIIA Tank Side Wall Rebar



The Type III/IIIA tanks have both a center and outer annulus. The center annulus is formed between the primary liner and the roof support column. The center annulus allows for ventilation airflow to the tank bottom and then out to the outer annulus through the radial air grooves. Figure 8.0-2 shows placement of the tank top reinforcing bars and center annulus ventilation ductwork in preparation for concrete pouring. The Type IIIA tanks have conductivity probes that cross through the tank top concrete into the center annulus. [W236562] Multiple conductivity probes are also installed in the outer annulus to provide redundant leak detection capability. No primary tank leakage has been detected in the Type III/IIIA secondary liners or concrete vaults. A completed Type IIIA tank (prior to receiving backfill) is shown in Figure 8.0-3.

Figure 8.0-2: Type III/IIIA Tank Top Preparation for Concrete Pour

Figure 8.0-3: Final Construction of a Type III/IIIA Tank

9.0 TYPE III/IIIA WASTE TANK COOLING COIL DESCRIPTIONS

9.1 Type III Tanks

The Type III Tanks 29-32 have deployable cooling coils that were installed after the tank was completed. Tank 35 is the only Type IIIA tank that was not designed with permanent cooling coils. Like the Type III tanks, Tank 35 had deployable cooling coils installed after construction. The deployable coils are installed through the tank risers and supported by the tank roof. Figure 9.1-1 depicts the various designs used for the deployable coolers in Tanks 29-32 and 35. Figure 9.1-2 shows a deployable cooling coil installed inside a Type III tank. Figures 9.1-3 and 9.1-4 show the typical conical and cylindrical type of deployable cooling coils used in the Type III tanks and Tank 35, respectively. Tank 29 has nine deployable coils, Tank 31 has seven deployable coils, and Tanks 30, 32, and 35 each have five deployable coils. Type III waste tanks do not have horizontal cooling coils along the tank bottom. Type III waste tank bottoms are cooled by forced air that passes through grooved channels in the concrete insulating slab between the primary liner and secondary liner. [W236993]

Figure 9.1-1: Deployable Coolers Used in Type III Tanks and Tank 35

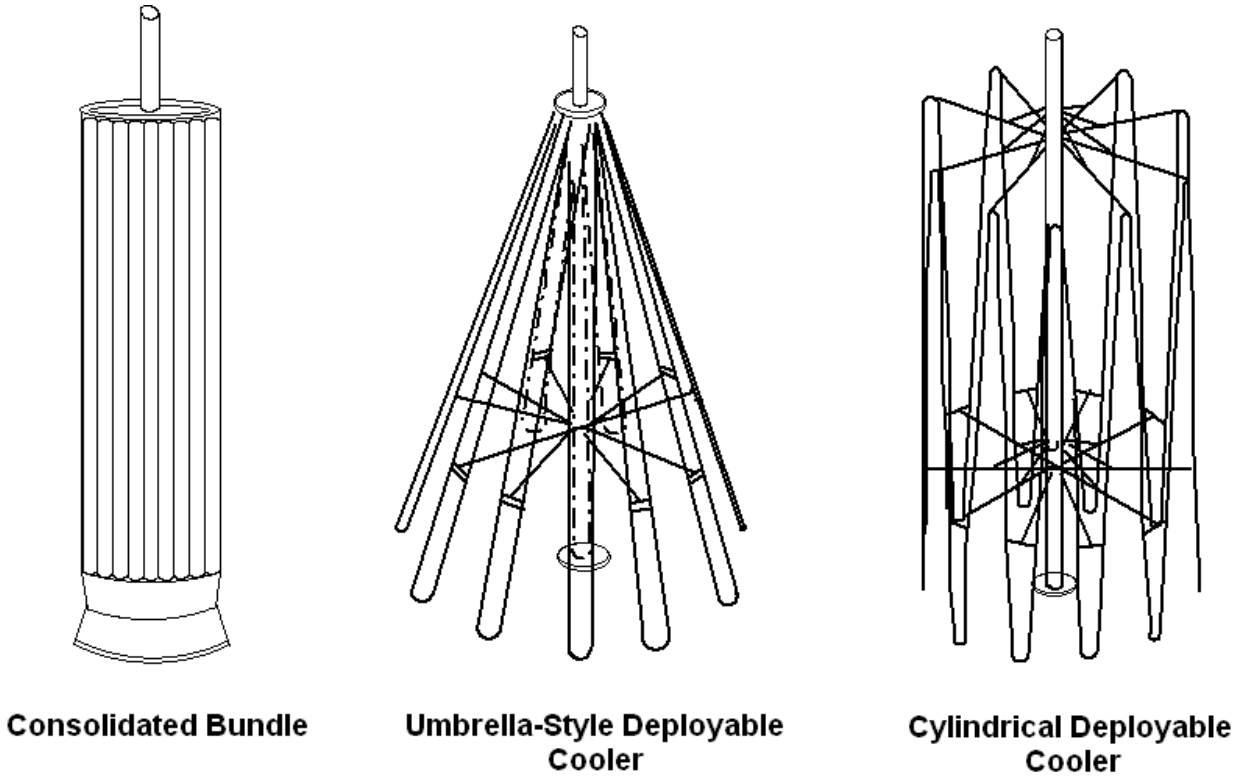


Figure 9.1-2: Typical Consolidated Bundle Type of Deployable Cooling Coil

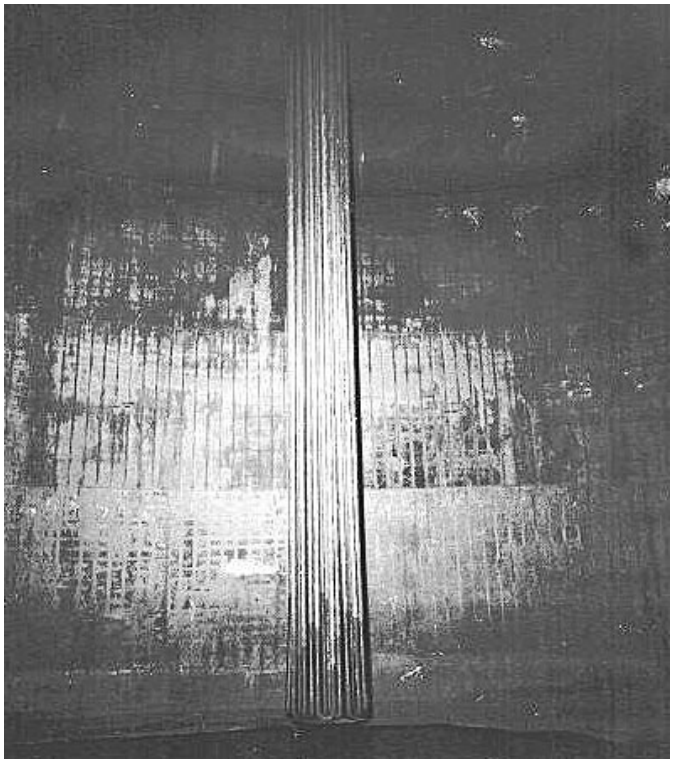


Figure 9.1-3: Typical Conical (Umbrella) Type of Deployable Cooling Coil

Figure 9.1-4: Typical Cylindrical Type of Deployable Cooling Coil

9.2 Type IIIA Tanks

Type IIIA waste tanks have permanently installed cooling coils similar to those in the Type I and II waste tanks (Figure 9.1-5). The Type IIIA waste tanks have top and bottom supported vertical coils on 3 foot triangular centers. The cooling coils supports are welded to the bottom of the primary liner. There are 246 vertical coils mounted 9 inches off the bottom of the tank and spaced on 3 foot centers. The coils are made of 2 inch carbon steel pipe. [W449710, W700286, W701130, W708852]

Type IIIA waste tank bottoms are cooled by forced air that passes through grooved channels in the concrete insulating slab between the primary liner and secondary liner to supplement the vertical cooling coils. [W448840, W449824, W702700, W707288]

Figure 9.1-5: Cooling Coils in a Type IIIA Tank

10.0 REFERENCES

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