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Acronyms and Abbreviations

AEA	Atomic Energy Act of 1954
DOE	US Department of Energy
ETF	effluent treatment facility
FRP	feed receipt process
HLP	HLW lag storage and feed blending process
HLW	high-level waste
LAW	low-activity waste
LERF	liquid effluent retention facility
PT	pretreatment
PWD	plant wash and disposal
RLD	radioactive liquid waste disposal
WAC	Washington Administrative Code

1 Introduction

The Washington Administrative Code, WAC 173-303-640(4)(e), addresses tank systems containing dangerous waste. This code requires that secondary containment systems be designed to contain 100 % of the capacity of the largest tank within its boundary. Because the tank system addressed in this document is in an outdoor uncovered area, also included is the containment of the rainfall.

Flooding scenarios for rooms within the PT facility have been addressed in prior issued documents. This report specifically addresses flooding scenarios for Room P-0150, a tank containment area located outside the PT building, which contains the Radioactive Liquid Waste Disposal (RLD) tanks RLD-TK-00006A and RLD-TK-00006B. The flooding scenario addressed in this document establishes the minimum requirements for secondary containment in Room P-0150.

2 Applicable Documents

WAC 173-303, *Dangerous Waste Regulations*, Washington Administrative Code

3 Description

3.1 Background

The PT facility receives low-activity waste (LAW) feed and high-level waste (HLW) feed from the Double-Shell Tank System. This mixed waste feed is pumped through double-walled underground transfer lines to the PT facility.

The purpose of the PT facility is to pretreat the waste received from the Double-Shell Tank System and to transfer it to the LAW and the HLW vitrification facilities. Within the LAW and HLW vitrification facilities, the waste is formed into glass logs suitable for long-term disposal.

Within the PT facility, the LAW feed is transferred to the waste feed receipt process (FRP) vessels (FRP-VSL-00002A/B/C/D), while the HLW feed is sent to the HLW feed receipt vessel (HLP-VSL-00022). These wastes are temporarily stored in the vessels before being pumped and treated by the PT processing equipment.

These vessels are located in black cells and are not accessible. The black cells are arranged in a "U" shape around a central hot cell in the PT facility, where major processing equipment is located.

The hot cell is remotely maintainable with the use of a crane system. Below the center of the hot cell are two adjacent rooms in the deep pit at the -45 ft elevation. This is the low point for the PT facility. Within these rooms are the plant wash and disposal (PWD) ultimate overflow vessel (PWD-VSL-00033) and the HLW effluent transfer vessel (PWD-VSL-00043).

The FRP vessels are the largest in the PT facility. The flood scenario at 0 ft elevation addressed a postulated failure of one FRP vessel and the movement of its fluid from a black cell to the hot cell, and then to the -45 ft elevation pit in *Flooding Volume for Below Grade and 0 Ft Elevation in PT Facility*

(24590-PTF-PER-M-02-005). The flooding scenario also addressed the fire water pit at the -19 ft elevation.

The RLD tanks RLD-TK-00006A and RLD-TK-00006B, located in Room P-0150 (a concrete containment area) outside of the PT building, receive, sample, and discharge low activity effluent. The majority of the inventory contained in these tanks is process condensate generated in the PT facility evaporators, but these tanks also receive and store alkaline scrubber and other low activity liquids routed from RLD-VSL-00017A/B located in the PT facility. Liquid effluents stored in RLD-TK-00006A/B are pumped to the Liquid Effluent Retention Facility (LERF) and Effluent Treatment Facility (ETF) for further treatment prior to disposal.

3.2 Room P-0150 Flooding Volume

Room P-0150 is a concrete containment area located outside the PT building on the northeast side of the building. It provides secondary containment for tanks RLD-TK-00006A/B, which are the only tanks within this containment area. The room is completely enclosed by the walls and there is no overhead covering or roof.

Each tank sits on a pedestal that is octagonal in shape. Also located in this room are six pumps on individual pedestals, with associated piping. There are 12 concrete posts in the room. The secondary containment includes a low point sump (RLD-SUMP-00003). The floor of the containment area also includes a covered trench between each tank and a sump. The floor and the trench are sloped towards the sump. The room's concrete walls and floor are provided with a special protective coating to contain liquid in case of leakage. For simplicity, these walls and the floor will be referred to as the "secondary containment".

The minimum height for the secondary containment is based on the flooding volume. The basic methodology used to calculate the minimum secondary containment height is to divide resulting volume by the available room area. The available room area is reduced by the area of the tank and pump pedestals. The height of the secondary containment is determined from the top of the floor but for conservatism, no credit is taken for the volume created by the slope of the floor.

3.3 Calculation of the Minimum Height of the Secondary Containment Wall

For calculating the minimum height of the secondary containment walls, the following scenario is considered.

The total volume of the fluid contained in one of the two tanks is discharged by leakage or spillage into the secondary containment. Added to this volume of fluid is the maximum accumulation of rainwater for duration of 24 hours. Refer to Appendix A for basis of rainwater. Therefore, the secondary containment wall is sized to handle the volume of rainwater in addition to the 100 % capacity of the tank.

The secondary containment is calculated in three parts:

Part 1 Determination of Flooding Volume

a) Determine the volume of the tank (V_{tank}) by adding the sum of the volumes of the cylindrical section and the cone roof section. The volume of the entire conical section is included with the cylindrical section volume for conservatism.

b) Determine the volume of the rainwater (V_w) for the area of the room.

c) Determine the total flooding volume (V_{flood}) by adding V_{tank} and V_w.

Part 2 Allowance for Other Components

a) To account for space that is unavailable due to other auxiliary components (piping and structural posts) in the room, a design allowance of 5 % is added to V_{flood}.

b) The volume of sump RLD-SUMP-00003 (78 cu ft) is considered negligible compared to V_{flood} (calculated in Appendix A).

c) The liquid in the failed tank empties or leaks down to the secondary containment height, as the liquid level equalizes. This assumption also applies to a failed nozzle or pipe connected to the bottom of the tank. The flood volume will occupy the area of the failed tank.

Part 3 Determination of Containment Height

The minimum height of the secondary containment wall is calculated incrementally, taking into account the tank pedestals, the pumps, and the results from Parts 1 and 2 above.

Step 1. Calculate the area of available secondary containment up to the thickest part of the tank pedestal, 1 ft 4 in. This step subtracts the tank pedestals and the six pumps from the available area. The tank pedestals are conservatively assumed flat (not sloped) and with an area assumed 25 % larger than the tank footprint. The pumps are conservatively considered rectangular shapes, using the cross-sectional area of the largest concrete pump pedestal. The area determined by this step can be multiplied by 1 ft 4 in to get the volume of liquid contained by the 1 ft 4 in high containment wall section.

Step 2. The available area of the room in this step is the (area of the room) minus (area of remaining intact tank) minus (area of the six pumps).

Calculate the additional height of the secondary containment wall (above the first 1 ft 4 in) required to accommodate the remaining V_{flood} by: subtracting the volume calculated in Step 1, from V_{flood}, and dividing by the available area of the room (in this step above).

Step 3: To determine the minimum secondary containment wall height, add the heights from Step 1 and Step 2 above.

3.4 Results

The minimum secondary containment height required is 7.27 ft above the top of the concrete floor.

Appendix A

Evaluation of Flooding Volume for Room P-0150

Appendix A
Evaluation of Flooding Volume for Room P-0150

Description

Room P-0150 is a concrete containment area located outside the PT building on the northeast side of the building. It provides secondary containment for tanks RLD-TK-00006A/B, which are the only tanks within this containment area. The secondary containment includes low point sump (RLD-SUMP-00003). The floor of the containment area also includes a covered trench between each tank and RLD-SUMP-00003. The floor and interior walls of the containment area including the trench are treated with a special protective coating. The floor and the trench are sloped towards the sump.

This evaluation determines the flooding volume for Room P-0150 and determines the minimum height for the secondary containment structure.

Basis and Assumptions

- The dimensions of Room P-0150 are 113 ft by 77 ft (inside dimensions).
- The dimensions of both RLD-TK-00006A and -00006B are 42 ft inside diameter by 32 ft tall (cylindrical section).
- The thickness of each tank wall is assumed to be 1 inch, therefore the outside diameter will be 42 ft 2 in or 42.17 ft.
- The tanks are flat bottom and each tank contains a cone roof with a center height of 42 inches measured from the top of the cylindrical section.
- The tank pedestals are octagonal and are assumed 25 % larger than the footprint of the tank.
- The volume of RLD-SUMP-00003 is 583 gallons (78 cu ft) and is considered negligible.
- The trenches in the concrete floor are not credited in this flooding volume for conservative purposes.
- The six pump pedestals are conservatively considered rectangular, each with a cross-sectional area equal to that of the largest pump pedestal and the height equal to the containment wall.
- The 24 hour rainfall is 1.27 inches (a 24-hour, 25 year storm, i.e. the storm that occurs once in 25 years.) Rainfall data is derived from Table 7.3 of PNNL 14242, *Hanford Site Climatological Data Summary, 2002 with Historical Data.* The volume of rain for 24 hrs is conservatively estimated.
- To account for room area that is unavailable due to other auxiliary components (piping and structural posts) in the room, a design allowance of 5 % is added to total flood volume.
- The liquid level of the failed tank empties or leaks down to a wall height, where the liquid level equalizes between the outside and inside of the tank. The area of the failed tank is included in the available area of the room. This assumption also applies to a failed nozzle or pipe connected to the bottom of the tank.
- Numbers in excess of 4 significant figures were rounded to the nearest integer.

Determination of Flood Volume

From the dimensions of RLD-TK-00006A/B (both tanks are the same size), the tank volume contribution to flooding volume, V_{tank}, is the sum of the volume of the straight cylindrical section V_{cyl} plus the volume of the cone roof, V_{cone}:

$$V_{tank} = V_{cyl} + V_{cone}$$

$$V_{cyl} = \pi/4 \text{ x } D_{tank}^2 \text{ x } H_{cyl}$$

Where:

D_{tank} = Tank diameter, feet = 42 ft

H_{cyl} = Tank cylindrical height, feet = 32 ft

Then

$$V_{cyl} = \pi/4 \text{ x } (42 \text{ ft})^2 \text{ x } (32 \text{ ft}) = 44{,}334 \text{ cu ft}$$

$$V_{cone} = \pi/12 \text{ x } D_{tank}^2 \text{ x } H_{cone}$$

Where H_{cone} = height of the conical section measured in the tank center from the top of the cylindrical section = 42 inches

Then

$$V_{cone} = \pi/12 \text{ x } (42)^2 \text{ sq ft x } (42 \text{ in}/12 \text{ in/ft})$$

$$V_{cone} = 1616 \text{ cu ft}$$

$$V_{tank} = 44{,}334 \text{ cu ft} + 1616 \text{ cu ft} = 45{,}950 \text{ cu ft}$$

To determine the volume of rainwater, the total room area, A_t, is determined from:

$$A_t = L_r \text{ x } W_r$$

Where:

L_r = room length, ft = 113 ft

W_r = room width, ft = 77 ft

A_t = 113 ft x 77 ft = **8701 sq ft**

Then, the volume of rainwater, V_w, is given by:

$$V_w = (1.27 \text{ inches}/12 \text{ inches/ft}) \text{ x } 8701 \text{ sq ft}$$

$$V_w = 921 \text{ cu ft}$$

The flooding volume, V_{flood}, is the sum of these quantities plus 5 % to allow for auxiliary components (such as piping and posts):

$$V_{flood} = (V_{tank} + V_w) \times 1.05$$

$$V_{flood} = (45{,}950 \text{ cu ft} + 921 \text{ cu ft}) \times 1.05$$

$$V_{flood} = (46{,}871 \text{ cu ft}) \times 1.05 = \mathbf{49{,}215 \text{ cu ft}}$$

Determination of Containment Height

As stated in the method section, for conservatism, the volume created within the sloped area of the floor is neglected.

The pump pedestal dimensions, six each, are as follows: 3.5 ft by 7 ft.

The pumps are conservatively considered to occupy the space above the pump pedestals to the height of the secondary containment wall.

The room dimensions are 113 ft by 77 ft.

Step 1: Secondary Containment Volume (Vc_1) from floor level (0 ft) to top of tank pedestal (1.33 ft).

The secondary containment area has two tank pedestals that are 1.33 ft high. The area of each pedestal is assumed to be 25 % larger than the footprint of the tank.

Cross sectional area of octagonal tank pedestal is conservatively assumed as:

$$A_{ped} = A_{tank,\ out} \times 1.25 \text{ where}$$

$$A_{tank,\ out} = (\pi/4 \times D_{tank,\ out}^{2})$$

$$A_{tank,\ out} = \pi/4 \times (42.17 \text{ ft})^2 = 1397 \text{ sq ft}$$

$$A_{ped} = 1397 \text{ sq ft} \times 1.25 = 1746 \text{ sq ft}$$

Total cross sectional area of the room is the length of the room times the width of the room:

$$A_t = L_r \times W_r$$

$$A_t = 113 \text{ ft} \times 77 \text{ ft} = 8701 \text{ sq ft}$$

Cross sectional area of pumps:

$$A_{pump} = 3.5 \text{ ft} \times 7 \text{ ft} = 24.5 \text{ sq ft}$$

Area of the room available for secondary containment up to 1.33 ft height is:

$Ac_1 = [A_t - 2A_{ped} - 6A_{pump}]$

$Ac_1 = [8701 \text{ sq ft} - 2(1746 \text{ sq ft}) - 6(24.5 \text{ sq ft})]$

$Ac_1 = 8701 \text{ sq ft} - 3492 \text{ sq ft} - 147 \text{ sq ft} = 5062 \text{ sq ft}$

Volume of liquid contained by 1.33 ft high secondary containment wall is:

$Vc_1 = Ac_1 \times H_1$

$Vc_1 = 5062 \text{ sq ft} \times 1.33 \text{ ft} = \mathbf{6732\ cu\ ft}$

Step 2: The height of the secondary containment wall required to accommodate the remaining total tank volume (above the first 1.33 ft).

This wall height (H_2) is determined by subtracting the volume contained in the first 1.33 ft from the total flooding volume and dividing by the available cross sectional area of this space.

$Vc_2 = V_{flood} - Vc_1$

$Vc_2 = 49{,}215 \text{ cu ft} - 6732 \text{ cu ft} = 42{,}483 \text{ cu ft}$

The available cross sectional area for this space is:

$Ac_2 = A_t - A_{tank,\ out} - 6(A_{pump})$

$Ac_2 = 8701 \text{ sq ft} - 1397 \text{ sq ft} - 6(24.5 \text{ sq ft})$

$Ac_2 = 8701 \text{ sq ft} - 1397 \text{ sq ft} - 147 \text{ sq ft} = 7157 \text{ sq ft}$

Therefore:

$H_2 = Vc_2 / Ac_2$

$H_2 = 42{,}483 \text{ cu ft} / 7157 \text{ sq ft} = 5.94 \text{ ft}$

Step 3: Minimum secondary containment wall height H_{min}.

Secondary containment wall required to accommodate the total flooding volume is 1.33 ft plus the height calculated in step 2.

$H_{min} = 1.33 \text{ ft} + H_2$

$H_{min} = 1.33 \text{ ft} + 5.94 \text{ ft} = \mathbf{7.27\ ft}$

Attachment 2
05-ED-100

Bechtel National, Inc. and U.S. Department of Energy,
Office of River Protection Certification Statements

Bechtel National, Inc. Certification

The following certification statement is provided consistent with Contract No. DE-AC27-01RV14136, Section H.26, Environmental Permits, paragraph (g) for Dangerous Waste Permit package PTF-065, Rev. 0, "Tank Secondary Containment for PTF Facility RLD System."

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

J. P. Henschel
Project Director

11/30/05
Date

U.S. Department of Energy, Richland Operations Office Certification

The following certification statement is provided for the Hanford Tank Waste Treatment and Immobilization Plant for Dangerous Waste Permit package PTF-065, Rev. 0, "Tank Secondary Containment for PTF Facility RLD System."

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

R. J. Schepens, Manager
U.S. Department of Energy,
Office of River Protection

11/30/05
Date