



# Waste Removal Capability for the Direct Feed LAW Effluent Management Facility (EMF)

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**24590-BOF-PER-M-16-002, Rev 0  
Waste Removal Capability for the Direct Feed LAW  
Effluent Management Facility (EMF)  
Issued for Permitting Use**

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## Notice

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## History Sheet

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## Acronyms

AEA	Atomic Energy Act of 1954
DOE	Department of Energy
DFLAW	Direct Feed Low Activity Waste
EMF	Effluent Management Facility
WAC	Washington Administrative Code

# 1 Summary

The Effluent Management Facility (EMF) must satisfy the waste removal criteria of Washington Administrative Code (WAC) 173-303-640(4) (Ref. 8.1) and of Dangerous Waste Permit Number WA7890008967 (Ref. 8.2) Permit Condition III.10.E.9.e.iii for EMF tank and miscellaneous unit system secondary containment systems. This report evaluates the capability for removing, within 24 hours, bounding volumes of leaked waste from the secondary containment areas. For outdoor vessel areas, the bounding volume includes rainfall from a twenty-five-year, twenty-four-hour rainfall event. For indoor areas, the bounding volume includes 20 minutes of sprinkler fire water that may accumulate within the regulated secondary containment areas of EMF.

The secondary containment areas with sump(s) are located at the (-) 39 feet and 0 feet elevations of EMF. The secondary containment areas are lined with a stainless steel liner or a special protective coating. The liners are sloped to direct liquids to dry sump(s) in the area. All sumps contain level detection instrumentation, which indicate increases in fluid levels in the sump. When liquid is initially detected in the sumps, an alarm will alert the operators to take action. The sump(s) within the EMF process building as well as the Drain Tank building are emptied by sump pumps that can transfer accumulated liquids to process vessels for storage and subsequent processing.

Total accumulated liquid volumes from dangerous waste, rainfall, and fire water are calculated for the containment areas listed below, as appropriate:

1. Room ED-B001, Low Point Drain Vessel Area, (-) 39 ft. elevation. The Low Point Drain Vessel Area contains the Low Point Drain Vessel (DEP-VSL-00001). The total accumulated volume (21,456 gallons) in this area includes the total vessel volume (18,000 gallons) and the volume (3,456 gallons) of accumulated fire water.
2. Room E-0105, Evaporator Feed Vessel Area, 0 ft. elevation. The Evaporator Feed Vessel Area contains the Evaporator Feed Vessel (DEP-VSL-00002) as well as three Evaporator Concentrate Vessels (DEP-VSL-00003A/B/C). The total accumulated volume (44,028 gallons) in this area includes the total vessel volume (42,300 gallons) of the single largest vessel in the area, the Evaporator Feed Vessel, and the volume (1,728 gallons) of accumulated rainfall.
3. Room E-0106, Process Condensate Lag Storage Vessel Area, 0 ft. elevation. The Process Condensate Lag Storage Area contains two Overhead Sampling Vessels (DEP-VSL-00004A/B) and two Process Condensate Lag Storage Vessels (DEP-VSL-00005A/B). The total accumulated volume (130,993 gallons) in this area includes the total vessel volume (127,260 gallons) of the single largest vessel in the area, one of the Process Condensate Lag Storage Vessels (DEP-VSL-00005A/B), and the volume (3,733 gallons) of accumulated rainfall.
4. Room E-0103, West Evaporator Process Area, 0 ft. elevation. The West Evaporator Process Area contains the Evaporator Feed Vessel discharge pumps (DEP-PMP-00002A/B and DEP-PMP-00012A/B/C), the Evaporator Concentrate Vessel discharge pumps (DEP-PMP-00003A/B), the Evaporator Separator Vessel (DEP-EVAP-00001), the Evaporator Reboiler (DEP-RBLR-00001), and the Evaporator Concentrate/Feed LAW Effluent Cooler (DEP-HX-00001). The total accumulated volume (55,401 gallons) in this area includes the total vessel volume (42,300 gallons) of the single largest vessel connected to the pumps in the area, the Evaporator Feed Vessel (DEP-VSL-00002), and the volume (13,101 gallons) of accumulated fire water.

5. Room E-0102, East Evaporator Process Area, 0 ft. elevation. The East Evaporator Process Area contains the Overhead Sampling Vessel discharge pumps (DEP-PMP-00004A/B/C), the Process Condensate Lag Storage Vessel discharge pumps (DEP-PMP-00005A/B and DEP-PMP-00015A/B/C), three Evaporator Condensers (DEP-COND-00001/2/3), the Reboiler Condensate Collection Vessel (DEP-VSL-00008), and the Steam Condensate Water Blowdown Vessel (SCW-VSL-00054). The total accumulated volume (149,173 gallons) in this area includes the total vessel volume (127,260 gallons) of the single largest vessel connected to the pumps in the area, one of the Process Condensate Lag Storage Vessels (DEP-VSL-00005A/B), and the volume (21,913 gallons) of accumulated fire water.
6. Rooms E-0102 and E-0103, East and West Evaporator Process Areas Combined, 0 ft. elevation. Doors between the areas cannot be credited for isolating spills; therefore, liquid from one room has the potential to spill into the adjacent room. The East and West Evaporator Process Areas contain the Overhead Sampling Vessel discharge pumps (DEP-PMP-00004A/B/C), the Process Condensate Lag Storage Vessel discharge pumps (DEP-PMP-00005A/B and DEP-PMP-00015A/B/C), three Evaporator Condensers (DEP-COND-00001/2/3), the Reboiler Condensate Collection Vessel (DEP-VSL-00008), the Steam Condensate Water Blowdown Vessel (SCW-VSL-00054), Evaporator Feed Vessel discharge pumps (DEP-PMP-00002A/B and DEP-PMP-00012A/B/C), the Evaporator Concentrate Vessel discharge pumps (DEP-PMP-00003A/B), the Evaporator Separator Vessel (DEP-EVAP-00001), the Evaporator Reboiler (DEP-RBLR-00001), and the Evaporator Concentrate/Feed LAW Effluent Cooler (DEP-HX-00001). The total accumulated volume (162,274 gallons) in this area includes the total vessel volume (127,260 gallons) of the single largest vessel connected to the pumps in the area, one of the Process Condensate Lag Storage Vessels (DEP-VSL-00005A/B), and the volume (35,014 gallons) of accumulated fire water.

The capability to remove the total accumulated volume for each of the containment areas is summarized below:

1. Room ED-B001 – Liquid removal is achieved by operation of one sump pump at a flow rate of 45 gal/min. Approximate time to remove the accumulated liquid volume is 8.0 hours.
2. Room E-0105 – Liquid removal is achieved by operation of one sump pump at a flow rate of 120 gal/min. Approximate time to remove the accumulated liquid volume is 6.2 hours.
3. Room E-0106 – Liquid removal is achieved by operation of one sump pump at a flow rate of 120 gal/min. Approximate time to remove the accumulated liquid volume is 18.2 hours.
4. Room E-0103 – Liquid removal is achieved by operation of one sump pump at a flow rate of 120 gal/min. Approximate time to remove the accumulated liquid volume is 7.7 hours.
5. Room E-0102 – Liquid removal is achieved by operation of one sump pump at a flow rate of 120 gal/min. Approximate time to remove the accumulated liquid volume is 20.7 hours.
6. Rooms E-0102 & E-0103 Combined – Liquid removal is achieved by operation of one sump pump in each room at a total flow rate of 240 gal/min (120 gal/min per pump). Approximate time to remove the accumulated liquid volume is 11.2 hours.

These values are within the 24-hour period required by WAC 173-303-640(4) (Ref. 8.1) and stipulated by Permit Condition III.10.E.9.e.iii (Ref. 8.2). These values are based on consideration of 100% of the total volume of the single largest vessel in each containment area, anticipated fire water, and rainfall, as applicable, that is postulated to accumulate in each area.

The process for ensuring the sumps are dry are described for each area below:

1. Room ED-B001 – The Low Point Drain Vessel Area is an indoor moderate radiation area. Since there will be no rain in the building, sampling of the accumulated liquid is not required. After the maximum volume of accumulated liquid has been transferred by the sump pump, manual entry is required to rinse and flush the room. The rinse/flush water is then transferred by the sump pump. A small amount of residual rinse/flush liquid will remain due to pumping capability and backflow from piping. The residual rinse/flush liquid will be removed through means determined appropriate by operations.
2. Room E-0105 – The Evaporator Feed Vessel Area is an outdoor high radiation classification area. Due to the possibility of frequent rain accumulation, sampling is required to determine whether sump accumulation is rain water or a process leak. To minimize operator entry once a sump high level alarm is tripped, dedicated sampling pumps within this area will pump samples of liquid to a sampling container within the fume hood located in the East Evaporator Process Area (E-0102) to determine the contents of the sump and the destination of the sump pump transfers. If the liquid is a process leak, manual entry is required to rinse and flush the room after the maximum volume of accumulated liquid has been transferred by one of the sump pumps. The rinse/flush water is then transferred by the sump pump. Residual rinse/flush liquid will remain due to pumping capability and backflow from piping. The residual rinse/flush liquid will be removed through means determined appropriate by operations, which may include the usage of the sampling pumps. If the liquid is rainwater, after the maximum volume of accumulated liquid has been transferred, manual entry may be required to remove the residual liquid unless it is left to evaporate.
3. Room E-0106 – The Process Condensate Lag Storage Area is an outdoor low radiation classification area. Although there is possibility of frequent rain accumulation, the accumulation will be transferred to a non-leaking Process Condensate Lag Storage Vessel (DEP-VSL-00005A/B) regardless of whether the liquid is rain water or a process leak, therefore, sampling is not required. After the maximum volume of accumulated liquid has been transferred by one of the sump pumps, manual entry is required to rinse and flush the room if the accumulated liquid is a process leak. Residual rinse/flush liquid will remain due to pumping capability and backflow from piping. The residual rinse/flush liquid will be removed through means determined appropriate by operations. If the liquid is rainwater, after the maximum volume of accumulated liquid has been transferred, manual entry may be required to remove the residual liquid unless it is left to evaporate.
4. Room E-0103 – The West Evaporator Process Area is an indoor moderately high radiation area. Since there will be no rain in the building, sampling is not required. After the maximum volume of accumulated liquid has been transferred by one of the sump pumps, manual entry is required to rinse and flush the room. The rinse and flush water is then transferred out by one of the sump pumps. Residual rinse/flush liquid will remain due to pumping capability and backflow from piping. The residual rinse/flush liquid will be removed through means determined appropriate by operations.

5. Room E-0102 – The East Evaporator Process Area is an indoor moderate radiation area. Since there will be no rain in the building, sampling is not required. After the maximum volume of accumulated liquid has been transferred by one of the sump pumps, manual entry is required to rinse and flush the room. The rinse and flush water is then transferred out by one of the sump pumps. Residual rinse/flush liquid will remain due to pumping capability and backflow from piping. The residual rinse/flush liquid will be removed through means determined appropriate by operations.
6. Rooms E-0102 & E-0103 Combined – The East and West Evaporator Process Area is an indoor moderately high radiation area. Since there will be no rain in the building, sampling is not required. After the maximum volume of accumulated liquid has been transferred by one sump pump in each room, manual entry is required to rinse and flush the rooms. The rinse and flush water is then transferred out by one sump pump in each room. Residual rinse/flush liquid will remain due to pumping capability and backflow from piping. The residual rinse/flush liquid will be removed through means determined appropriate by operations.

## 2 Objective

The objective of this report is to estimate and document the capability of removing spills, leaked waste, and accumulated liquids in the secondary containment systems of EMF within twenty-four hours as required by Washington Administrative Code (WAC) 173-303-640(4) (Ref. 8.1) and Dangerous Waste Permit WA7890008967 Condition III.10.E.9.e.iii (Ref. 8.2).

## 3 Description

The regulatory requirements for the secondary containment areas are contained in WAC 173-303-640(4), (Ref. 8.1). The regulatory requirement states that secondary containment systems must be:

“Sloped or otherwise designed or operated to drain and remove liquids resulting from leaks, spills, or precipitation. Spilled or leaked waste and accumulated precipitation must be removed from the secondary containment system within twenty-four hours...” [WAC 173-303-640(4)(c)(iv)]

The Waste Treatment Plant Dangerous Waste Permit (Ref. 8.2), Permit Condition III.10.E.9.e.iii requires submittal of:

“Detailed operational plans and descriptions, demonstrating that spilled or leaked waste and accumulated liquids can be removed from the secondary containment system within twenty-four (24) hours” [WAC 173-303-806(4)(c)(vii)]

The total accumulated volume in each secondary containment area that is required to be removed will be the volume that must be contained by the external liners, which is composed of the following:

1. “... one hundred percent of the capacity of the largest tank within its boundary” [WAC 173-303-640(4)(e)(i)(A)] (Ref. 8.1)

2. "... precipitation from a twenty-five-year, twenty-four-hour rainfall event" [WAC 173-303-640(4)(e)(i)(B)] (Ref. 8.1), as applicable.
3. "... fire-protection water from the fire protection system over the minimum design area for a period of 20 minutes..." [Basis of Design Section 14.10.1.2.1] (Ref. 8.6), as applicable.

## 4 Assumptions

4.1 Design flow rates, the bounding flow requirement, for sump pumps are used to estimate approximate time to remove accumulated volume. Purchased equipment will have capacities equal to or exceeding the design flow rate. If the purchased equipment has a higher capacity, the time required to remove the accumulated volume will decrease. Therefore, this assumption is conservative.

4.2 Specific operator response times are omitted for the purposes of this calculation. This includes time required:

- To respond after a leak has been detected
- To manually align valves
- To activate sump pumps
- For subsequent operator responses.

It is assumed that there will be sufficient operator response time provided outside of the required sump pump operation time.

4.3 Waste removal is achieved by operation of one sump pump within a containment area at a time.

4.4 Only one area in the facility accumulates liquid at a time. However, the leaking and spilling from accumulated liquids of one area is expected to have the potential of spilling into its adjacent area since doors are not credited to isolate the accumulated liquids.

4.5 The Evaporator Separator (DEP-EVAP-00001), Evaporator Condensers' (DEP-COND-00001/2/3), Evaporator Reboiler (DEP-RBLR-00001), Reboiler Condensate Collection Vessel (DEP-VSL-00008), Steam Condensate Water Blowdown Vessel (SCW-VSL-00054), and Evaporator Concentrate/Feed LAW Effluent Cooler (DEP-HX-00001) volumes are not considered in determination of accumulated liquid volumes because their capacities are smaller than the process vessel volumes considered.

4.6 All inside areas are assumed to have a fire sprinkler system. All outside areas are assumed not to have a fire sprinkler system.

4.7 The containment areas are assumed to be either indoor or outdoor as shown in the following table per the EMF General Arrangement Drawing (Ref. 8.3):

Room	Area	Indoor/Outdoor
ED-B001	Low Point Drain Vessel Area	Indoor

E-0105	Evaporator Feed Vessel Area	Outdoor
E-0106	Process Condensate Lag Storage Vessel Area	Outdoor
E-0103	West Evaporator Process Area	Indoor
E-0102	East Evaporator Process Area	Indoor

## 5 Analysis

The secondary containment areas located at the (-) 39 feet and 0 feet elevations of EMF are provided with sump(s). The liners are sloped to direct liquids to dry sump(s) in the secondary containment areas. The containment areas and sump(s) are shown on the Balance of Facilities LAW Effluent Process Building and LAW Effluent Drain Tank Building General Arrangement Plan (Ref. 8.3). The total accumulated volume of an indoor area is the total vessel volume of the single largest vessel in the containment area and the volume of accumulated fire water. The total accumulated volume of an outdoor area is the total vessel volume of the single largest vessel in the containment area and the volume of accumulated rainfall. The sump pump design flow rates are taken from the DEP Sump, Sump Pump and Pipeline Sizing mechanical calculation (Ref. 8.4) and the vessel, fire water, and rainfall volumes are calculated in and taken and rounded up to the nearest whole number from the Dangerous Waste Permit (DWP) Liner Heights in the Effluent Management Facility (EMF) report (Ref. 8.5).

### 5.1 Room ED-B001, Low Point Drain Vessel Area

Room ED-B001, the Low Point Drain Vessel Area, is located below grade in the Drain Tank Building at the (-) 39 ft. elevation. It contains the Low Point Drain Vessel (DEP-VSL-00001), which has a total vessel volume of 18,000 gal.

A stainless steel liner provides secondary containment to accommodate the total volume (18,000 gal) of the Low Point Drain Vessel (DEP-VSL-00001) and 3,456 gallons of fire water for a total accumulated liquid volume of 21,456 gallons.

The floor liner is sloped towards the low-point sump (DEP-SUMP-00001), which is provided with level detection instrumentation and a sump pump (DEP-PMP-00031) to send the process leak to the Evaporator Feed Vessel (DEP-VSL-00002). After the maximum volume that can be pumped by the sump pump has been transferred, the area is manually rinsed and flushed. The rinse/flush water is then transferred. The pump has a design flow rate of 45 gal/min. Residual rinse/flush liquid will remain due to pumping capability and backflow from piping. The residual rinse/flush liquid will be removed through means determined appropriate by operations.

### 5.2 Room E-0105, Evaporator Feed Vessel Area

Room E-0105, Evaporator Feed Vessel Area, is located in the northwest part of EMF at the 0 ft. elevation. It contains the following four vessels:

- Evaporator Concentrate Vessel DEP-VSL-00003A (Total Volume: 14,805 gal)
- Evaporator Concentrate Vessel DEP-VSL-00003B (Total Volume: 14,805 gal)
- Evaporator Concentrate Vessel DEP-VSL-00003C (Total Volume: 14,805 gal)
- Evaporator Feed Vessel DEP-VSL-00002 (Total Volume: 42,300 gal)

A stainless steel liner provides secondary containment to accommodate the total volume (42,300 gal) of the largest vessel in the area, the Evaporator Feed Vessel (DEP-VSL-00002), and 1,728 gallons of rainfall for a total accumulated volume of 44,028 gallons.

The floor liner is sloped towards the low-point sumps (DEP-SUMP-00004A and DEP-SUMP-00004B), which are provided with level detection instrumentation and sump pumps (DEP-PMP-00034A and DEP-PMP-00034B). The sump pumps send rainwater to one of the Overhead Sampling Vessels (DEP-VSL-00004A or DEP-VSL-00004B), small process leaks to the Low Point Drain Vessel (DEP-VSL-00001), and large process leaks to one of the Overhead Sampling Vessels (DEP-VSL-00004A or DEP-VSL-00004B). The sump pumps have a design flow rate of 120 gal/min. The fluid is determined to be rainwater or a process leak through the use of separate sampling pumps (DEP-PMP-00042A/B) which pump samples of the accumulated liquid to a sampling container in the fume hood (DEP-HOOD-00001) located in the East Evaporator Process Area (Room E-0102). The size of a process leak is determined by sump level detection. When the sump is overflowing, vessel level indications for the Evaporator Feed Vessel (DEP-VSL-00002) and the Evaporator Concentrate Vessels (DEP-VSL-00003A/B/C) are monitored. If a measurable drop in vessel level is indicated, the leak size can be estimated. After the maximum volume that can be pumped by the sump pumps has been transferred to their appropriate destinations, the area is manually rinsed and flushed, as needed. The rinse/flush water is then transferred. Residual rinse/flush liquid will remain due to pumping capability and backflow from piping. The residual rinse/flush liquid will be removed through means determined appropriate by operations, which may include the usage of the sampling pumps. If the liquid is rainwater, after the maximum volume of accumulated liquid has been transferred, manual entry may be required to remove the residual liquid unless being left to evaporate.

### **5.3 Room E-0106, Process Condensate Lag Storage Vessel Area**

Room E-0106, Process Condensate Lag Storage Vessel Area, is located in the north part of EMF at the 0 ft. elevation. It contains the following four vessels:

- Overhead Sampling Vessel DEP-VSL-00004A (Total Volume: 40,800 gal)
- Overhead Sampling Vessel DEP-VSL-00004B (Total Volume: 40,800 gal)
- Process Condensate Lag Storage Vessel DEP-VSL-00005A (Total Volume: 127,260 gal)
- Process Condensate Lag Storage Vessel DEP-VSL-00005B (Total Volume: 127,260 gal)

A special protective coating liner with water stops provides secondary containment to accommodate the total volume (127,260 gal) of the largest vessel in the area, the Process Condensate Lag Storage Vessel (DEP-VSL-00005A/B), and 3,733 gallons of rainfall for a total accumulated volume of 130,993 gallons.

The floor liner is sloped towards the low-point sumps (DEP-SUMP-00005A and DEP-SUMP-00005B), which are provided with level detection instrumentation and sump pumps (DEP-PMP-00035A and DEP-PMP-00035B) to send the process leak to a non-leaking Process Condensate Lag Storage Vessels (DEP-VSL-00005A or DEP-VSL-00005B). The pumps have a design flow rate of 120 gal/min. The non-leaking vessel is determined by monitoring the vessel level indications in both Process Condensate Lag Storage Vessels and/or by following operational procedures to visually inspect the area. After the maximum volume that can be pumped by the sump pumps has been transferred, the area is manually rinsed and flushed, as needed. The rinse/flush water is then transferred. The residual rinse/flush liquid will be removed through means determined appropriate by operations. If the liquid is rainwater, after the

maximum volume of accumulated liquid has been transferred, manual entry may be required to remove the residual liquid unless being left to evaporate.

#### **5.4 Room E-0103, West Evaporator Process Area**

Room E-0103, West Evaporator Process Area, is located in the southwest part of EMF at 0 ft. elevation. It contains the Evaporator Separator (DEP-EVAP-00001), the Evaporator Reboiler (DEP-RBLR-00001), the Evaporator Concentrate/Feed LAW Effluent Cooler (DEP-HX-00001), the Evaporator Feed Vessel discharge pumps (DEP-PMP-00002A/B and DEP-PMP-00012A/B/C), and the Evaporator Concentrate Vessels' discharge pumps (DEP-PMP-00003A/B/C).

A special protective coating liner with water stops provides secondary containment to accommodate the total volume (42,300 gal) of the largest vessel connected to the pumps in the area, the Evaporator Feed Vessel (DEP-VSL-00002), and 13,101 gallons of fire water for a total accumulated volume of 55,401 gallons.

The floor liner is sloped towards the low-point sumps (DEP-SUMP-00002A and DEP-SUMP-00002B), which are provided with level detection instrumentation and sump pumps (DEP-PMP-00032A and DEP-PMP-00032B) to send small process leaks to the Low Point Drain Vessel (DEP-VSL-00001) and large process leaks to one of the Overhead Sampling Vessels (DEP-VSL-00004A or DEP-VSL-00004B). The pumps have a design flow rate of 120 gal/min. The size of the leak is determined by sump level detection until it overflows from the sump. When the sump is overflowing, vessel level indications for the Evaporator Feed Vessel (DEP-VSL-00002) and the Evaporator Concentrate Vessels (DEP-VSL-00003A/B/C) are monitored. If a measurable drop in vessel level is indicated, the leak size can be determined. If there is no measurable change in vessel level, operational procedures are followed to perform a visual inspection of this area to determine the source and size of leak. After the maximum volume that can be pumped by the sump pumps has been transferred, the area is manually rinsed and flushed. The rinse/flush water is then transferred. Residual rinse/flush liquid will remain due to pumping capability and backflow from piping. The residual rinse/flush liquid will be removed through means determined appropriate by operations.

#### **5.5 Room E-0102, East Evaporator Process Area**

Room E-0102, East Evaporator Process Area, is located in the southeast part of EMF at 0 ft. elevation. It contains the Evaporator Condensers (DEP-COND-00001/2/3), the Reboiler Condensate Collection Vessel (DEP-VSL-00008), the Steam Condensate Water Blowdown Vessel (SCW-VSL-00054), the Overhead Sampling Vessels' discharge pumps (DEP-PMP-00004A/B/C), and the Process Condensate Lag Storage Vessels' discharge pumps (DEP-PMP-00005A/B and DEP-PMP-00015A/B/C).

A special protective coating liner with water stops provides secondary containment to accommodate the total volume (127,260 gal) of the largest vessel connected to the pumps in the area, the Process Condensate Lag Storage Vessel (DEP-VSL-00005A/B), and 21,913 gallons of fire water for a total accumulated liquid volume of 149,173 gallons.

The floor liner is sloped towards the low-point sumps (DEP-SUMP-00003A and DEP-SUMP-00003B), which are provided with level detection instrumentation and sump pumps (DEP-PMP-00033A and DEP-PMP-00033B) to send the process leak to a non-leaking Process Condensate Lag Storage Vessels (DEP-VSL-00005A or DEP-VSL-00005B). The pumps have a design flow rate of 120 gal/min. The non-

leaking vessel is determined by monitoring the vessel level indications in both Process Condensate Lag Storage Vessels and/or by following operational procedures to visually inspect the Process Condensate Lag Storage Vessel Area. After the maximum volume that can be pumped by the sump pumps has been transferred, the area is manually rinsed and flushed. The rinse/flush water is then transferred. Residual rinse/flush liquid will remain due to pumping capability and backflow from piping. The residual rinse/flush liquid will be removed through means determined appropriate by operations.

## 5.6 Rooms E-0102 and E-0103, East and West Evaporator Process Areas Combined

In the event that a pump suction line breaks in Room E-0102 or E-0103, there is the potential for liquid to spill into the adjacent room as doors cannot be credited for isolating spills.

A special protective coating liner with water stops provides secondary containment to accommodate the total volume (127,260 gal) of the largest vessel connected to the pumps in either area, the Process Condensate Lag Storage Vessel (DEP-VSL-00005A/B), and 35,014 gallons of fire water across both process areas for a total accumulated liquid volume of 162,274 gallons.

In this scenario, one sump pump (DEP-PMP-00032A/B in the West Evaporator Process Area and DEP-PMP-00033A/B in the East Evaporator Process Area) is operating in each room to remove the contained liquid. The pumps have a design flow rate of 120 gal/min. The fluid in the West Evaporator Process Area sumps are pumped to one of the Overhead Sampling Vessels (DEP-VSL-00004A or DEP-VSL-00004B) and the fluid in the East Evaporator Process Area sumps are pumped to a non-leaking Process Condensate Lag Storage Vessels (DEP-VSP-00005A or DEP-VSL-00005B). The non-leaking vessel is determined by monitoring the vessel level indications in both of the Process Condensate Lag Storage Vessels and/or by following operational procedures to visually inspect the Process Condensate Lag Storage Vessel Area. After the maximum volume that can be pumped by the sump pumps has been transferred, the area is manually rinsed and flushed. The rinse/flush water is then transferred. Residual rinse/flush liquid will remain due to pumping capability and backflow from piping. The residual rinse/flush liquid will be removed through means determined appropriate by operations.

## 6 Calculations

Waste removal capability is calculated for the containment areas based on information presented in Section 5 using the following equations:

$$\text{Flow Rate (gal/hr)} = \text{Flow Rate (gal/min)} \times (60 \text{ min/hr}) \quad (\text{Equation 1})$$

$$\text{Time Required to Remove Liquid (hr)} = \frac{\text{Volume}}{\text{Pump Flow Rate}} \quad (\text{Equation 2})$$

### 6.1 Pump Flow Rate Conversion

$$\text{Flow Rate (gal/hr)} = \text{Flow Rate (gal/min)} \times (60 \text{ min/hr}) \quad (\text{Equation 1})$$

$$\text{DEP-PMP-00031 flow rate} = 45 \frac{\text{gal}}{\text{min}} \times \frac{60 \text{ min}}{\text{hr}} = 2700 \frac{\text{gal}}{\text{hr}}$$

$$\text{All other pump flow rate} = 120 \frac{\text{gal}}{\text{min}} \times \frac{60 \text{ min}}{\text{hr}} = 7200 \frac{\text{gal}}{\text{hr}}$$

### 6.2 Room ED-B001, Low Point Drain Vessel Area

Liquid Source	Total Volume (Section 5)	DEP-PMP-00031 Flow Rate (Section 6.1)	Time Required to Remove Liquid (Equation 2)
DEP-VSL-00001	18,000 gal	2,700 gal/hr	6.7 hours
Fire Water	3,456 gal	2,700 gal/hr	1.3 hours
Rainfall	Not Applicable		
<b>Accumulated Liquid</b>	<b>21,456 gal</b>	<b>2,700 gal/hr</b>	<b>8.0 hours</b>

The requirement for removing accumulated liquid within twenty-four hours is met considering 8.0 hours is required for the sump pump to remove the total accumulated liquid and operator response time (Assumption 4.2) is not anticipated to require more than the remaining time.

### 6.3 Room E-0105, Evaporator Feed Vessel Area

Liquid Source	Total Volume (Section 5)	DEP-PMP-00034A/B Flow Rate (Section 6.1)	Time Required to Remove Liquid (Equation 2)
DEP-VSL-00002	42,300 gal	7,200 gal/hr	5.9 hours
Fire Water	Not Applicable		
Rainfall	1,728 gal	7,200 gal/hr	0.3 hours
<b>Accumulated Liquid</b>	<b>44,028 gal</b>	<b>7,200 gal/hr</b>	<b>6.2 hours</b>

The requirement for removing accumulated liquid within twenty-four hours is met considering 17.8 hours is required for the sump pump to remove the total accumulated liquid and operator response time (Assumption 4.2) is not anticipated to require more than the remaining time.

### 6.4 Room E-0106, Process Condensate Lag Storage Vessel Area

Liquid Source	Total Volume (Section 5)	DEP-PMP-00035A/B Flow Rate (Section 6.1)	Time Required to Remove Liquid (Equation 2)
DEP-VSL-00005A/B	127,260 gal	7,200 gal/hr	17.7 hours
Fire Water	Not Applicable		
Rainfall	3,733 gal	7,200 gal/hr	0.5 hours
<b>Accumulated Liquid</b>	<b>130,993 gal</b>	<b>7,200 gal/hr</b>	<b>18.2 hours</b>

The requirement for removing accumulated liquid within twenty-four hours is met considering 5.8 hours is required for the sump pump to remove the total accumulated liquid and operator response time (Assumption 4.2) is not anticipated to require more than the remaining time.

### 6.5 Room E-0103, West Evaporator Process Vessel Area

Liquid Source	Total Volume (Section 5)	DEP-PMP-00032A/B Flow Rate (Section 6.1)	Time Required to Remove Liquid (Equation 2)
DEP-VSL-00002	42,300 gal	7,200 gal/hr	5.9 hours
Fire Water	13,101 gal	7,200 gal/hr	1.8 hours
Rainfall	Not Applicable		
<b>Accumulated Liquid</b>	<b>55,401 gal</b>	<b>7,200 gal/hr</b>	<b>7.7 hours</b>

The requirement for removing accumulated liquid within twenty-four hours is met considering only 16.3 hours is required for the sump pump to remove the total accumulated liquid and operator response time (Assumption 4.2) is not anticipated to require more than the remaining time.

### 6.6 Room E-0102, East Evaporator Process Vessel Area

Liquid Source	Total Volume (Section 5)	DEP-PMP-00033A/B Flow Rate (Section 6.1)	Time Required to Remove Liquid (Equation 2)
DEP-VSL-00005A/B	127,260 gal	7,200 gal/hr	17.7 hours
Fire Water	21,913 gal	7,200 gal/hr	3.0 hours
Rainfall	Not Applicable		
<b>Accumulated Liquid</b>	<b>149,173 gal</b>	<b>7,200 gal/hr</b>	<b>20.7 hours</b>

The requirement for removing accumulated liquid within twenty-four hours is met considering 3.3 hours is required for the sump pump to remove the total accumulated liquid and operator response time (Assumption 4.2) is not anticipated to require more than the remaining time.

### 6.7 Rooms E-0102 and E-0103, East and West Evaporator Process Areas Combined

Liquid Source	Total Volume (Section 5)	DEP-PMP-00032A/B and DEP-PM-00033A/B Flow Rate Combined (Section 6.1)	Time Required to Remove Liquid (Equation 2)
DEP-VSL-00005A/B	127,260 gal	14,400 gal/hr	8.8 hours
Fire Water	35,014 gal	14,400 gal/hr	2.4 hours
Rainfall	Not Applicable		
<b>Accumulated Liquid</b>	<b>162,274 gal</b>	<b>14,400 gal/hr</b>	<b>11.2 hours</b>

The requirement for removing accumulated liquid within twenty-four hours is not challenged considering only 12.8 hours is required for the sump pump to remove the total accumulated liquid and operator response time is not anticipated to require more than the remaining time (Assumption 4.2).

## 7 Waste and Accumulated Liquid Removal Rates

Containment Area Elevation (ft)	Containment Area Room Number	Sump(s)	Sump Pump(s)	Sump Pump Flow Rate (gal/min)	Sump Pump Flow Rate (gal/hr)	Largest Vessel in Containment Area (Vessel Number)	Total Vessel Volume (gal)	Time Required to Remove Vessel Volume (hr)	Fire Water Volume (gal)	Time Required to Remove Fire Water (hr)	Rainfall Volume (gal)	Time Required to Remove Rainfall (hr)	Total Accumulated Volume (gal)	Time Required to Remove Total Accumulated Volume (hr)
-39	ED-B001 (Low Point Drain Vessel Area)	DEP-SUMP-00001	DEP-PMP-00031	45	2,700	DEP-VSL-00001	18,000	6.7	3,456	1.3	Not Applicable. Rainfall is not accumulated in indoor areas.		21,456	8.0
0	E-0105 (Evaporator Feed Vessel Area)	DEP-SUMP-00004A/B	DEP-PMP-00034A/B	120	7,200	DEP-VSL-00002	42,300	5.9	Not Applicable. Fire water is not accumulated in outdoor areas.		1,728	0.3	44,028	6.2
0	E-0106 (Process Condensate Lag Storage Vessel Area)	DEP-SUMP-00005A/B	DEP-PMP-00035A/B	120	7,200	DEP-VSL-00005A/B	127,260	17.7			3,733	0.6	130,993	18.2
0	E-0103 (West Evaporator Process Area)	DEP-SUMP-00002A/B	DEP-PMP-00032A/B	120	7,200	DEP-VSL-00002	42,300	5.9	13,101	1.9	Not Applicable. Rainfall is not accumulated in indoor areas.		55,401	7.7
0	E-0102 (East Evaporator Process Area)	DEP-SUMP-00003A/B	DEP-PMP-00033A/B	120	7,200	DEP-VSL-00005A/B	127,260	17.7	21,913	3.1			149,173	20.7
0	E-0102/E-0103 (East and West Evaporator Process Areas)	DEP-SUMP-00002A/B and DEP-SUMP-00003A/B	DEP-PMP-00032A/B and DEP-PMP-00033A/B	120 x 2	14,400	DEP-VSL-00005A/B	127,260	8.9	35,014	2.5			162,274	11.2

## 8 References

- 8.1 Washington Administrative Code, December 18, 2014, Title 173 Chapter 303
- 8.2 WA 7890008967, Waste Treatment & Immobilization Plant Operating Unit Group 10 (OUG-10), Part III
- 8.3 24590-BOF-P1-25-00001, Rev. 0, Balance of Facilities LAW Effluent Process Bldg & LAW Effluent Drain Tank Bldg General Arrangement Plan at Elev. 0'-0".
- 8.4 24590-BOF-M6C-DEP-00001, Rev. A, DEP Sump, Sump Pump and Pipeline Sizing
- 8.5 24590-BOF-PER-M-16-003, Rev. 0, Dangerous Waste Permit (DWP) Liner Heights in the Effluent Management Facility (EMF)
- 8.6 24590-WTP-DB-ENG-01-001, Rev. 3, Basis of Design