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Releases From Failed HEPA Filters Due to an Overpressurization Event

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Abstract: This document supports the development and presentation of the following accident scenario in the TWRS Final Safety Analysis Report:

HEPA Filter Failure - Exposure to High Temperature or Pressure.

The calculations needed to quantify the risk associated with this accident scenario are included within.

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Karen A. Toland 9/19/96
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RELEASES FROM FAILED HEPA FILTERS DUE TO AN OVERPRESSURIZATION EVENT

REVISION 1

**Tank Waste Remediation System Final Safety Analysis Report Project
Safety Analysis & Nuclear Engineering**

NOTE: ACCORDING TO SECTION WP-6.7, REV. 0 OF WHC-CM-6-32, *SAFETY ANALYSIS AND NUCLEAR ENGINEERING WORK PROCEDURES*, CALCULATION NOTES ARE USED TO DOCUMENT THE ORIGINATOR'S ANALYSIS BUT ARE NOT TO BE USED TO AUTHORIZE ACTIVITIES OR JUSTIFY FACILITY MODIFICATIONS, OR CHANGES TO AN AUTHORIZATION BASIS, SAFETY BASIS, OR DESIGN BASIS.

September 1996

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LIST OF TERMS

AWF	aging waste facility
DST	double-shell tank
FSAR	final safety analysis report
HEDOP	Hanford Environmental Dose Overview Panel
HEPA	high efficiency particulate air (filter)
PF	partition fraction
rem	radiation effective man
RF	respirable fraction
SST	single-shell tank
Sv	sievert
TWRS	Tank Waste Remediation System
ULD	unit liter dose
WHC	Westinghouse Hanford Company

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RELEASES FROM FAILED HEPA FILTERS DUE TO AN OVERPRESSURIZATION EVENT**1.0 INTRODUCTION AND PURPOSE**

This document supports the development and presentation of the following accident scenario in the TWRS Final Safety Analysis Report (FSAR):

HEPA Filter Failure - Exposure to High Temperature or Pressure.

Passive or active ventilation is maintained across single-shell and double-shell waste tanks, double-contained receiver tanks (DCRTs), the 204-AR Waste Unloading Facility, the 244-AR Receiver Vault, the compactor building, and catch tanks 241-A-417 and 241-AX-152.

ACCIDENT SCENARIO DEVELOPMENT AND DESCRIPTION

It is postulated that a pressure differential as little as 0.36 lb/in^2 (10 inches water gauge) will fail HEPA filters¹ in a ventilation system (either active or passive) and create a sudden, unfiltered release of radiological and toxicological contaminants. Subsequent to the HEPA filter release, a continuous, unfiltered release of headspace air is assumed to occur. Doses associated with the continuous, unfiltered release have been calculated in WHC-SD-WM-CN-062, Rev. 0, and are considered appropriate to be added to the results of the analysis for the initial HEPA filter release as presented in this calculation note.

Unlike the evaluation performed in WHC-SD-WM-CN-062, *HEPA Filter Fire (and Subsequent Unfiltered Release)*, a headspace pressurization cannot occur independent of an additional accident initiator. There are many initiators that could lead to a pressurization resulting in a HEPA filter release. These include steam intrusions, an in-tank fuel fire/deflagration, or an organic salt-nitrate reaction. These accident scenarios are evaluated separately (and include where appropriate, the dose associated with a HEPA filter breach and the continuous, unfiltered release following the breach) for the TWRS FSAR.

The intent of this document is to provide the radiological dose and toxicological exposure consequences associated with a HEPA filter rupture by pressurization and the subsequent unfiltered, continuous release following the pressurization.

ACCIDENT FREQUENCY DEVELOPMENT

Since the frequency associated with a specific accident scenario may vary, this document presents the radiological dose for comparison with all accident frequencies (*anticipated, unlikely, and extremely unlikely*). Since toxicological exposure consequences are calculated differently, only the values for an anticipated accident frequency are presented here. Using the method presented in this document, a user can calculate similar exposure

¹HEPA filter release amounts, as calculated in WHC-SD-WM-CN-054, *Waste Tank Ventilation System Waste Material Accumulations*, include the quantities from pre-filters, HEPA filters, and ductwork accumulation.

consequences for the other accident frequencies (*unlikely and extremely unlikely*). The radiological risk acceptance guidelines are referenced from WHC-CM-4-46, Rev. 1, whereas the toxicological risk acceptance guidelines are built-in to the calculational methodology of WHC-SD-WM-SARR-011.

2.0 ANALYSIS INPUT

1. Amount of Material Released (Q)

The material release amounts for a rapid pressurization from the various ventilation systems are calculated in WHC-SD-WM-CN-054, *Waste Tank Ventilation System Waste Material Accumulations*, and summarized in Table 1. The release amounts from a contaminated filter are calculated using a release fraction of 1×10^{-2} . This conservative release fraction is given in Section 5.4.4.2 of DOE-HDBK-3010-94 and corresponds to the material that would be released from crushing a filter in an unconfined space.

Table 1. HEPA Filter Release Amounts (Q) from Various TWRS Ventilation Systems.

Facility/Vent System	Type of Waste Released	Amount Released (L)
241-SX/241-C-106 (SSTs with active ventilation)	SST Solids	6.13 E-03
SSTs with Passive Breather Filters (SSTs with Passive Ventilation 1 and 2)	SST Solids (24x24x12 Filter)	1.27 E-04
	SST Solids (12x12x12 Filter)	4.72 E-05
DCRTs	SST Liquids	2.28 E-03
241-SY/241-AN/241-AP 241-AW (DSTs)	DST Liquids	9.79 E-04
241-AY/241-AZ (DSTs using AWF Liquid)	AWF Liquids	5.62 E-03
204-AR Waste Unloading Facility	DST Liquids	2.37 E-03
244-AR Receiver Vault	DST Liquids	2.37 E-03
Compactor Building ¹	DST Liquids	9.79 E-04
Catch Tanks ¹	DST Liquids	9.79 E-04

¹ The values for the amount released are taken from WHC-SD-WM-CN-062.

2. Unit Liter Doses (ULDs)

The ULDs for this analysis are taken from WHC-SD-WM-SARR-037, Rev. 0, *Development of Radiological Concentrations and Unit Liter Doses for TWRS FSAR Radiological Consequence Calculations*. Table 2 provides the ULD's used in this analysis:

Table 2. Unit Liter Doses Used in This Analysis.

Composite	Inhalation ULD _i (Sv/L)	Ingestion ULD _i (Sv-m ³ /s-L)
SST Liquids	1.1 E+04	0.052
SST Solids	2.2 E+05	4.1
DST Liquids	6.1 E+03	0.068
AWF Liquids	1.4 E+03	0.092

The use of these ULDs is consistent with the calculations performed in WHC-SD-WM-CN-062.

3. Dispersion Coefficients (χ/Q 's)

Onsite - $3.41 \times 10^{-2} \text{ s/m}^3$ (WHC-SD-WM-SARR-016).

Offsite - $2.83 \times 10^{-5} \text{ s/m}^3$ (WHC-SD-WM-SARR-016).

4. Breathing Rate (R)

$3.3 \times 10^{-4} \text{ m}^3/\text{s}$ light activity breathing rate is used to calculate consequences to both the onsite and offsite receptors (WHC-SD-WM-SARR-016).

5. Unmitigated Continuous, Unfiltered Radiological Dose and Toxicological Exposure Consequences

In WHC-SD-WM-CN-062, Rev. 0, the unfiltered release was calculated for 12 hours (onsite), 24 hours (offsite) and a year (onsite and offsite). For the one year unfiltered release to the onsite receptor, the dose is adjusted by an occupancy factor of 0.286 to account for the actual time spent at work. A partition fraction (PF) of $1.0 \text{ E-}10$ was used for SSTs with active and passive ventilation, DCRTs, the 204-AR, 244-AR, and a partition fraction of $1.0 \text{ E-}08$ was used for the DST tanks (including AWF tanks)[see Appendix A]. It was assumed that the Compactor Building and Catch Tanks have no liquid therefore, there is no unfiltered release from these facilities. The unmitigated radiological doses and toxicological exposures associated with an unmitigated continuous, unfiltered vent system release calculated in WHC-SD-WM-CN-062 are summarized in Tables 3 and 4, respectively. The values in Tables 3 and 4 do not include the amount released from the burned HEPA filter (WHC-SD-WM-CN-062).

Table 3. Unmitigated Radiological Dose Consequences from Continuous, Unfiltered Releases (from WHC-SD-WM-CN-062, Rev. 0).

Facility/Vent System	Onsite Dose Consequences (Sv)		Offsite Dose Consequences (Sv)	
	12 hr	Annual (8760 hr)	24 hr	Annual (8760 hr)
241-SX/241-C-106 (SSTs with active ventilation)	1.37 E-02	7.12 E-02	1.02 E-05	8.19 E-05
SSTs with Passive Breather Filters (SSTs with Passive Ventilation 1 and 2)	2.82 E-06	1.47 E-05	2.11 E-09	1.69 E-08
DCRTs	4.10 E-04	2.14 E-03	2.93 E-07	2.34 E-06
241-SY/241-AN/241-AP 241-AW (DSTs)	6.31 E-03	3.29 E-02	4.61 E-06	3.69 E-05
241-AY/241-AZ (DSTs using AWF Liquid)	4.98 E-03	2.60 E-02	4.34 E-06	3.47 E-05
204-AR Waste Unloading Facility	1.08 E-04	5.65 E-04	7.92 E-08	6.33 E-07
244-AR Receiver Vault	8.13 E-04	4.24 E-03	5.94 E-07	4.75 E-06
Compactor Building	N/A	N/A	N/A	N/A
Catch Tanks	N/A	N/A	N/A	N/A

Table 4. Unmitigated Toxicological Exposure Consequences from Continuous, Unfiltered Releases (from WHC-SD-WM-CN-062, Rev. 0).

Facility/Vent System	Onsite Exposure Consequences	Offsite Exposure Consequences
241-SX/241-C-106 (SSTs with active ventilation)	1.32 E-02	3.10 E-05
SSTs with Passive Breather Filters (SSTs with Passive Ventilation 1 and 2)	1.43 E-06	2.24 E-09
DCRTs	1.90 E-03	1.58 E-06
241-SY/241-AN/241-AP 241-AW (DSTs)	5.28 E-02	4.40 E-05
241-AY/241-AZ (DSTs using AWF Liquid)	1.89 E-01	1.59 E-04
204-AR Waste Unloading Facility	9.44 E-04	7.93 E-07
244-AR Receiver Vault	6.80 E-03	5.66 E-06
Compactor Building	N/A	N/A
Catch Tanks	N/A	N/A

* Unmitigated continuous toxicological exposure consequences are calculated using a L/s release rate and the final calculation is not duration sensitive for this accident evaluation.

3.0 ASSUMPTIONS

No assumptions have been made in this analysis.

4.0 ANALYTICAL METHODS

The methodology that is used to calculate radiological dose consequences is documented in WHC-SD-WM-SARR-016, Rev. 2, *Tank Waste Compositions and Atmospheric Dispersion Coefficients for use in ASA Consequence Assessments* and WHC-SD-WM-SARR-037, Rev. 0, *Development of Radiological Concentrations and Unit Liter Doses for TWRS FSAR Radiological Consequence Calculations*.

The methodology that is used to calculate toxicological exposure consequences is documented in WHC-SD-WM-SARR-011, Rev. 2, *Toxic Chemical Considerations for Tank Farm Releases*.

5.0 RADIOLOGICAL DOSE CONSEQUENCE ANALYSIS

Using the formula presented on page 4-4 of WHC-SD-WM-SARR-016, Rev. 2 and modifications for a 24 hour ingestion dose to the offsite receptor from WHC-SD-WM-SARR-037, Rev. 0, the radiological dose consequences can be calculated.

Onsite Consequences:

$$D \text{ (Sv)} = Q \text{ (L)} \times \frac{X}{Q'} \text{ (s/m}^3\text{)} \times R \text{ [m}^3\text{/s]} \times \text{ULD}_H \text{ [Sv/L]}$$

SSTs with Active Ventilation -

$$D \text{ (Sv)} = (6.13 \times 10^{-3} \text{ L})(3.41 \times 10^{-2} \text{ s/m}^3)(3.3 \times 10^{-4} \text{ m}^3\text{/s})(2.2 \times 10^5 \text{ Sv/L})$$

$$D \text{ (Sv)} = 1.5 \times 10^{-2} \text{ Sv}$$

SSTs with Passive Ventilation 1 -

$$D \text{ (Sv)} = (1.27 \times 10^{-4} \text{ L})(3.41 \times 10^{-2} \text{ s/m}^3)(3.3 \times 10^{-4} \text{ m}^3\text{/s})(2.2 \times 10^5 \text{ Sv/L})$$

$$D \text{ (Sv)} = 3.1 \times 10^{-4} \text{ Sv}$$

SSTs with Passive Ventilation 2 -

$$D \text{ (Sv)} = (4.72 \times 10^{-5} \text{ L})(3.41 \times 10^{-2} \text{ s/m}^3)(3.3 \times 10^{-4} \text{ m}^3\text{/s})(2.2 \times 10^5 \text{ Sv/L})$$

$$D \text{ (Sv)} = 1.2 \times 10^{-4} \text{ Sv}$$

DCRTs -

$$D \text{ (Sv)} = (2.28 \times 10^{-3} \text{ L})(3.41 \times 10^{-2} \text{ s/m}^3)(3.3 \times 10^{-4} \text{ m}^3\text{/s})(1.1 \times 10^6 \text{ Sv/L})$$

$$D \text{ (Sv)} = 2.8 \times 10^{-4} \text{ Sv}$$

DSTs -

$$D \text{ (Sv)} = (9.79 \times 10^{-4} \text{ L})(3.41 \times 10^{-2} \text{ s/m}^3)(3.3 \times 10^{-4} \text{ m}^3\text{/s})(6.1 \times 10^3 \text{ Sv/L})$$

$$D \text{ (Sv)} = 6.7 \times 10^{-5} \text{ Sv}$$

DSTs (using AWF Liquids) -

$$D \text{ (Sv)} = (5.62 \times 10^{-3} \text{ L})(3.41 \times 10^{-2} \text{ s/m}^3)(3.3 \times 10^{-4} \text{ m}^3\text{/s})(1.4 \times 10^3 \text{ Sv/L})$$

$$D \text{ (Sv)} = 8.9 \times 10^{-5} \text{ Sv}$$

204-AR Waste Unloading Facility -

$$D \text{ (Sv)} = (2.37 \times 10^{-3} \text{ L})(3.41 \times 10^{-2} \text{ s/m}^3)(3.3 \times 10^{-4} \text{ m}^3/\text{s})(6.1 \times 10^3 \text{ Sv/L})$$

$$D \text{ (Sv)} = 1.6 \times 10^{-4} \text{ Sv}$$

244-AR Receiver Vault -

$$D \text{ (Sv)} = (2.37 \times 10^{-3} \text{ L})(3.41 \times 10^{-2} \text{ s/m}^3)(3.3 \times 10^{-4} \text{ m}^3/\text{s})(6.1 \times 10^3 \text{ Sv/L})$$

$$D \text{ (Sv)} = 1.6 \times 10^{-4} \text{ Sv}$$

Compactor Building -

$$D \text{ (Sv)} = (9.79 \times 10^{-4} \text{ L})(3.41 \times 10^{-2} \text{ s/m}^3)(3.3 \times 10^{-4} \text{ m}^3/\text{s})(6.1 \times 10^3 \text{ Sv/L})$$

$$D \text{ (Sv)} = 6.7 \times 10^{-5} \text{ Sv}$$

Catch Tanks -

$$D \text{ (Sv)} = (9.79 \times 10^{-4} \text{ L})(3.41 \times 10^{-2} \text{ s/m}^3)(3.3 \times 10^{-4} \text{ m}^3/\text{s})(6.1 \times 10^3 \text{ Sv/L})$$

$$D \text{ (Sv)} = 6.7 \times 10^{-5} \text{ Sv}$$

Offsite Consequences:

$$D \text{ (Sv)} = Q \text{ (L)} \times \frac{X}{Q'} \text{ (s/m}^3) \times ((R \text{ [m}^3/\text{s}] \times \text{ULD}_H \text{ [Sv/L]}) + \text{ULD}_I \text{ [Sv-m}^3/\text{s-L]})$$

SSTs with Active Ventilation -

$$D \text{ (Sv)} = (6.13 \times 10^{-3} \text{ L})(2.83 \times 10^{-5} \text{ s/m}^3)[(3.3 \times 10^{-4} \text{ m}^3/\text{s})(2.2 \times 10^5 \text{ Sv/L}) + 4.1 \text{ Sv-m}^3/\text{s-L}]$$

$$D \text{ (Sv)} = 1.3 \times 10^{-5} \text{ Sv}$$

SSTs with Passive Ventilation 1 -

$$D \text{ (Sv)} = (1.27 \times 10^{-4} \text{ L})(2.83 \times 10^{-5} \text{ s/m}^3)[(3.3 \times 10^{-4} \text{ m}^3/\text{s})(2.2 \times 10^5 \text{ Sv/L}) + 4.1 \text{ Sv-m}^3/\text{s-L}]$$

$$D \text{ (Sv)} = 2.8 \times 10^{-7} \text{ Sv}$$

SSTs with Passive Ventilation 2 -

$$D \text{ (Sv)} = (4.72 \times 10^{-5} \text{ L})(2.83 \times 10^{-5} \text{ s/m}^3)[(3.3 \times 10^{-4} \text{ m}^3/\text{s})(2.2 \times 10^5 \text{ Sv/L}) + 4.1 \text{ Sv-m}^3/\text{s-L}]$$

$$D \text{ (Sv)} = 1.0 \times 10^{-7} \text{ Sv}$$

DCRTs -

$$D \text{ (Sv)} = \left(\frac{2.28 \times 10^{-3} \text{ L}}{+ 0.052 \text{ Sv-m}^3/\text{s-L}} \right) (2.83 \times 10^{-5} \text{ s/m}^3) [(3.3 \times 10^{-4} \text{ m}^3/\text{s}) (1.1 \times 10^4 \text{ Sv/L})]$$

$$D \text{ (Sv)} = 2.4 \times 10^{-7} \text{ Sv}$$

DSTs -

$$D \text{ (Sv)} = \left(\frac{9.79 \times 10^{-4} \text{ L}}{+ 0.068 \text{ Sv-m}^3/\text{s-L}} \right) (2.83 \times 10^{-5} \text{ s/m}^3) [(3.3 \times 10^{-4} \text{ m}^3/\text{s}) (6.1 \times 10^3 \text{ Sv/L})]$$

$$D \text{ (Sv)} = 5.8 \times 10^{-8} \text{ Sv}$$

DSTs (using AWF Liquids) -

$$D \text{ (Sv)} = \left(\frac{5.62 \times 10^{-3} \text{ L}}{+ 0.092 \text{ Sv-m}^3/\text{s-L}} \right) (2.83 \times 10^{-5} \text{ s/m}^3) [(3.3 \times 10^{-4} \text{ m}^3/\text{s}) (1.4 \times 10^3 \text{ Sv/L})]$$

$$D \text{ (Sv)} = 8.8 \times 10^{-8} \text{ Sv}$$

204-AR Waste Unloading Facility -

$$D \text{ (Sv)} = \left(\frac{2.37 \times 10^{-3} \text{ L}}{+ 0.068 \text{ Sv-m}^3/\text{s-L}} \right) (2.83 \times 10^{-5} \text{ s/m}^3) [(3.3 \times 10^{-4} \text{ m}^3/\text{s}) (6.1 \times 10^3 \text{ Sv/L})]$$

$$D \text{ (Sv)} = 1.4 \times 10^{-7} \text{ Sv}$$

244-AR Receiver Vault -

$$D \text{ (Sv)} = \left(\frac{2.37 \times 10^{-3} \text{ L}}{+ 0.068 \text{ Sv-m}^3/\text{s-L}} \right) (2.83 \times 10^{-5} \text{ s/m}^3) [(3.3 \times 10^{-4} \text{ m}^3/\text{s}) (6.1 \times 10^3 \text{ Sv/L})]$$

$$D \text{ (Sv)} = 1.4 \times 10^{-7} \text{ Sv}$$

Compactor Building -

$$D \text{ (Sv)} = \left(\frac{9.79 \times 10^{-4} \text{ L}}{+ 0.068 \text{ Sv-m}^3/\text{s-L}} \right) (2.83 \times 10^{-5} \text{ s/m}^3) [(3.3 \times 10^{-4} \text{ m}^3/\text{s}) (6.1 \times 10^3 \text{ Sv/L})]$$

$$D \text{ (Sv)} = 5.8 \times 10^{-8} \text{ Sv}$$

Catch Tanks -

$$D \text{ (Sv)} = \left(\frac{9.79 \times 10^{-4} \text{ L}}{+ 0.068 \text{ Sv-m}^3/\text{s-L}} \right) (2.83 \times 10^{-5} \text{ s/m}^3) [(3.3 \times 10^{-4} \text{ m}^3/\text{s}) (6.1 \times 10^3 \text{ Sv/L})]$$

$$D \text{ (Sv)} = 5.8 \times 10^{-8} \text{ Sv}$$

6.0 TOXICOLOGICAL EXPOSURE CONSEQUENCE ANALYSIS

The following equation is used to calculate the peak concentration for a puff-type release from the release of HEPA filter contents as a result of a pressurization event:

$$\text{Toxicological Exposure Consequences (D)} = Q \cdot \text{SOF}$$

Where Q is equivalent to the amount (L) shown in Table 1 for each TWRS ventilation system and,

SOF is the sum-of-fraction (1/L) as defined in Table 3-8 of WHC-SD-WM-SARR-011, Rev. 2 for the different waste types and is a function of accident frequency.

The toxicological exposure consequence values are calculated for the *anticipated* frequency category as follows.

Onsite Exposure Consequences (for an Accident Frequency of *Anticipated*):

SSTs with Active Ventilation -

$$D = (6.13 \times 10^{-3} \text{ L})(1.2 \times 10^4 \text{ 1/L})$$

$$D = 7.4 \times 10^1$$

SSTs with Passive Ventilation 1 -

$$D = (1.27 \times 10^{-4} \text{ L})(1.2 \times 10^4 \text{ 1/L})$$

$$D = 1.5$$

SSTs with Passive Ventilation 2 -

$$D = (4.72 \times 10^{-5} \text{ L})(1.2 \times 10^4 \text{ 1/L})$$

$$D = 5.7 \times 10^{-1}$$

DCRTs -

$$D = (2.28 \times 10^{-3} \text{ L})(2.8 \times 10^3 \text{ 1/L})$$

$$D = 6.4$$

DSTs -

$$D = (9.79 \times 10^{-4} \text{ L})(2.9 \times 10^3 \text{ 1/L})$$

$$D = 2.8$$

DSTs (using AWF Liquids) -

$$D = (5.62 \times 10^{-3} \text{ L})(2.9 \times 10^3 \text{ 1/L})$$

$$D = 1.6 \times 10^1$$

204-AR Waste Unloading Facility -

$$D = (2.37 \times 10^{-3} \text{ L})(2.9 \times 10^3 \text{ 1/L})$$

$$D = 6.9$$

244-AR Receiver Vault -

$$D = (2.37 \times 10^{-3} \text{ L})(2.9 \times 10^3 \text{ 1/L})$$

$$D = 6.9$$

Compactor Building -

$$D = (9.79 \times 10^{-4} \text{ L})(2.9 \times 10^3 \text{ 1/L})$$

$$D = 2.8$$

Catch Tanks -

$$D = (9.79 \times 10^{-4} \text{ L})(2.9 \times 10^3 \text{ 1/L})$$

$$D = 2.8$$

Offsite Exposure Consequences (for an Accident Frequency of *Anticipated*):

SSTs with Active Ventilation -

$$D = (6.13 \times 10^{-3} \text{ L})(3.8 \times 10^{-1} \text{ 1/L})$$

$$D = 2.3 \times 10^{-3}$$

SSTs with Passive Ventilation 1 -

$$D = (1.27 \times 10^{-4} \text{ L})(3.8 \times 10^{-1} \text{ 1/L})$$

$$D = 4.8 \times 10^{-5}$$

SSTs with Passive Ventilation 2 -

$$D = (4.72 \times 10^{-5} \text{ L})(3.8 \times 10^{-1} \text{ 1/L})$$

$$D = 1.8 \times 10^{-5}$$

DCRTs -

$$D = (2.28 \times 10^{-3} \text{ L})(3.2 \times 10^{-2} \text{ 1/L})$$

$$D = 7.3 \times 10^{-5}$$

DSTs -

$$D = (9.79 \times 10^{-4} \text{ L})(3.4 \times 10^{-2} \text{ 1/L})$$

$$D = 3.3 \times 10^{-5}$$

DSTs (using AWF Liquids) -

$$D = (5.62 \times 10^{-3} \text{ L})(3.4 \times 10^{-2} \text{ 1/L})$$

$$D = 1.9 \times 10^{-4}$$

204-AR Waste Unloading Facility -

$$D = (2.37 \times 10^{-3} \text{ L})(3.4 \times 10^{-2} \text{ 1/L})$$

$$D = 8.1 \times 10^{-5}$$

244-AR Receiver Vault -

$$D = (2.37 \times 10^{-3} \text{ L})(3.4 \times 10^{-2} \text{ 1/L})$$

$$D = 8.1 \times 10^{-5}$$

Compactor Building -

$$D = (9.79 \times 10^{-4} \text{ L})(3.4 \times 10^{-2} \text{ 1/L})$$

$$D = 3.3 \times 10^{-5}$$

Catch Tanks -

$$D = (9.79 \times 10^{-4} \text{ L})(3.4 \times 10^{-2} \text{ 1/L})$$

$$D = 3.3 \times 10^{-5}$$

7.0 ANALYSIS RESULTS

The results of this analysis is summarized in Tables 5 through 8.

Table 5. Total Unmitigated Radiological Dose Consequences from a Pressurized HEPA Release Event and a Continuous, Unfiltered Release (2 sheets).

Facility/Vent System	Release Mechanism*	Onsite Dose Consequences (Sv)		Offsite Dose Consequences (Sv)	
		12 hr	Annual (8760 hr)	24 hr	Annual (8760 hr)
241-SX/241-C-106 (SSTs with active ventilation)	HEPA Release	1.5 E-02	1.5 E-02	1.3 E-05	1.3 E-05
	Continuous	1.37 E-02	7.12 E-02	1.02 E-05	8.19 E-05
	Total	2.87 E-02	8.62 E-02	2.32 E-05	9.49 E-05
SSTs with Passive Breather Filters (SSTs with Passive Ventilation 1)	HEPA Release	3.1 E-04	3.1 E-04	2.8 E-07	2.8 E-07
	Continuous	2.82 E-06	1.47 E-05	2.11 E-09	1.69 E-08
	Total	3.13 E-04	3.25 E-04	2.82 E-07	2.97 E-07
SSTs with Passive Breather Filters (SSTs with Passive Ventilation 2)	HEPA Release	1.2 E-04	1.2 E-04	1.0 E-07	1.0 E-07
	Continuous	2.82 E-06	1.47 E-05	2.11 E-09	1.69 E-08
	Total	1.23 E-04	1.35 E-04	1.02 E-07	1.17 E-07
DCRTs	HEPA Release	2.8 E-04	2.8 E-04	2.4 E-07	2.4 E-07
	Continuous	4.10 E-04	2.14 E-03	2.93 E-07	2.34 E-06
	Total	6.90 E-04	2.42 E-03	5.33 E-07	2.58 E-06
241-SY/241-AN/241-AP 241-AW (DSTs)	HEPA Release	6.7 E-05	6.7 E-05	5.8 E-08	5.8 E-08
	Continuous	6.31 E-03	3.29 E-02	4.61 E-06	3.69 E-05
	Total	6.38 E-03	3.30 E-02	4.67 E-06	3.70 E-05
241-AY/241-AZ (DSTs using AWF Liquid)	HEPA Release	8.9 E-05	8.9 E-05	8.8 E-08	8.8 E-08
	Continuous	4.98 E-03	2.60 E-02	4.34 E-06	3.47 E-05
	Total	5.07 E-03	2.61 E-02	4.43 E-06	3.48 E-05

Table 5. Total Unmitigated Radiological Dose Consequences from a Pressurized HEPA Release Event and a Continuous, Unfiltered Release (2 sheets).

Facility/Vent System	Release Mechanism*	Onsite Dose Consequences (Sv)		Offsite Dose Consequences (Sv)	
		12 hr	Annual (8760 hr)	24 hr	Annual (8760 hr)
204-AR Waste Unloading Facility	HEPA Release	1.6 E-04	1.6 E-04	1.4 E-07	1.4 E-07
	Continuous	1.08 E-04	5.65 E-04	7.92 E-08	6.33 E-07
	Total	2.68 E-04	7.25 E-04	2.19 E-07	7.73 E-07
244-AR Receiver Vault	HEPA Release	1.6 E-04	1.6 E-04	1.4 E-07	1.4 E-07
	Continuous	8.13 E-04	4.24 E-03	5.94 E-07	4.75 E-06
	Total	9.73 E-04	4.40 E-03	7.34 E-07	4.89 E-06
Compactor Building	HEPA Release	6.7 E-05	6.7 E-05	5.8 E-08	5.8 E-08
	Continuous	N/A	N/A	N/A	N/A
	Total	6.7 E-05	6.7 E-05	5.8 E-08	5.8 E-08
Catch Tanks	HEPA Release	6.7 E-05	6.7 E-05	5.8 E-08	5.8 E-08
	Continuous	N/A	N/A	N/A	N/A
	Total	6.7 E-05	6.7 E-05	5.8 E-08	5.8 E-08

* The HEPA Release values are calculated in Section 5.0 and the Continuous values are taken from Table 3.

rem = 100 x Sv

Table 6. Total Unmitigated Toxicological Exposure Consequences from a Pressurized HEPA Release Event and a Continuous, Unfiltered Release for an Accident Frequency of *Anticipated* (2 sheets).

Facility/Vent System	Release Mechanism*	Onsite Exposure Consequences	Offsite Exposure Consequences
241-SX/241-C-106 (SSTs with active ventilation)	HEPA Release	7.4 E+01	2.3 E-03
	Continuous	1.32 E-02	3.10 E-05
	Total	7.40 E+01	2.33 E-03
SSTs with Passive Breather Filters (SSTs with Passive Ventilation 1)	HEPA Release	1.5 E+00	4.8 E-05
	Continuous ¹	1.43 E-06	2.24 E-09
	Total	1.50 E+00	4.80 E-05
SSTs with Passive Breather Filters (SSTs with Passive Ventilation 2)	HEPA Release	5.7 E-01	1.8 E-05
	Continuous ¹	1.43 E-06	2.24 E-09
	Total	5.70 E-01	1.80 E-05
DCRTs	HEPA Release	6.4 E+00	7.3 E-05
	Continuous	1.90 E-03	1.58 E-06
	Total	6.40 E+00	7.46 E-05
241-SY/241-AN/241-AP 241-AW (DSTs)	HEPA Release	2.8 E+00	3.3 E-05
	Continuous	5.28 E-02	4.40 E-05
	Total	2.85 E+00	7.70 E-05
241-AY/241-AZ (DSTs using AWF Liquid)	HEPA Release	1.6 E+01	1.9 E-04
	Continuous	1.89 E-01	1.59 E-04
	Total	1.62 E+01	3.49 E-04
204-AR Waste Unloading Facility	HEPA Release	6.9 E+00	8.1 E-05
	Continuous	9.44 E-04	7.93 E-07
	Total	6.90 E+00	8.18 E-05
244-AR Receiver Vault	HEPA Release	6.9 E+00	8.1 E-05
	Continuous	6.80 E-03	5.66 E-06
	Total	6.90 E+00	8.67 E-05
Compactor Building	HEPA Release	2.8 E+00	3.3 E-05
	Continuous	N/A	N/A
	Total	2.8 E+00	3.3 E-05

Table 6. Total Unmitigated Toxicological Exposure Consequences from a Pressurized HEPA Release Event and a Continuous, Unfiltered Release for an Accident Frequency of *Anticipated* (2 sheets).

Facility/Vent System	Release Mechanism*	Onsite Exposure Consequences	Offsite Exposure Consequences
Catch Tanks	HEPA Release	2.8 E+00	3.3 E-05
	Continuous	N/A	N/A
	Total	2.8 E+00	3.3 E-05

* The HEPA Release values are calculated in Section 6.0 and the Continuous values are taken from Table 4.

¹ The continuous toxicological consequence values, as shown here are calculated in WHC-SD-WM-CN-062, using a frequency of *unlikely*.

rem = 100 x Sv

The risk guidelines for radiological dose and toxicological exposure consequences are provided in Table 7.

Table 7. Risk Guidelines for Radiological Dose and Toxicological Exposure Consequences.

Unmitigated Accident Frequencies: See Section 1.0 for frequency discussion.				
Total Consequences: See Tables 5 and 6.				
Receptor/ Hazard	Calculated Dose/Exposure	Risk Guidelines		
		Anticipated	Unlikely	Extremely Unlikely
Offsite/ Radiological	See Table 5.	1.0 E-03 Sv	5.0 E-03 Sv	4.0 E-02 Sv
Onsite/ Radiological	See Table 5.	5.0 E-03 Sv	5.0 E-02 Sv	1.0 E-01 Sv
Offsite/ Toxicological	See Table 6.	1	1	1
Onsite/ Toxicological	See Table 6.	1	1	1

8.0 CONCLUSIONS

The total unmitigated radiological consequences from unfiltered releases due to pressurization for single-shell tanks with active ventilation and the double-shell tanks (including AWF tanks), as shown in Table 5 are above the risk evaluation guidelines for an *anticipated* event (5.0×10^{-3} Sv). Total unmitigated radiological doses to the offsite receptor are below the risk guidelines in all cases.

The total unmitigated toxicological exposure consequences from unfiltered releases due to pressurization exceed the onsite risk guidelines in all cases except for the single-shell tanks with passive breather filters (SSTs with passive ventilation 1 and 2) as shown in Table 6. Total unmitigated toxicological exposure consequences to the offsite receptor are below the risk guidelines in all cases.

Controls to either mitigate or prevent the risk associated with accident scenario are not developed or proposed in this document. This is due to the fact, as discussed in Section 1.0, that a pressurization does not occur independent of an additional accident initiator. The appropriate controls are left to the specific accident scenario that may include a tank headspace pressurization resulting in a release similar to the ones calculated here.

9.0 REFERENCES

- DOE-HDBK-3010-94, 1994, *DOE Handbook Airborne Release Fractions/Rates and Restorable Fraction for Nonreactor Nuclear Facilities*, U.S. Department of Energy, Richland, Washington.
- WHC-SD-WM-SARR-011, Rev. 2, *Toxicological Chemical Considerations for Tank Farm Releases*, Westinghouse Hanford Company, Richland, Washington.
- WHC-SD-WM-SARR-016, Rev. 2, *Tank Waste Compositions and Atmospheric Dispersion Coefficients for use in ASA Consequence Assessments*, Westinghouse Hanford Company, Richland, Washington.
- WHC-SD-WM-SARR-037, Rev. 0, *Development of Radiological Concentrations and Unit Liter Doses for TWRS FSAR Radiological Consequence Calculations*, Westinghouse Hanford Company, Richland, Washington.
- WHC-SD-WM-CN-054, Rev. 0, *Waste Tank Ventilation System Waste Material Accumulations*, Westinghouse Hanford Company, Richland, Washington.
- WHC-SD-WM-CN-062, Rev. 0, *HEPA Filter Fire (and Subsequent Unfiltered Release)*, Westinghouse Hanford Company, Richland, Washington.
- WHC-CM-4-46, Rev. 1, *Safety Analysis Manual*, Section 4.0, Westinghouse Hanford Company, Richland, Washington.

APPENDIX A
PARTITION FRACTION DISCUSSION

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Development of Headspace Partition Fraction

Radioactive material is carried from the tank waste material into the tank headspace atmosphere through several physical processes. Only a fraction (the partition fraction) of the waste constituents in a tank will migrate to the headspace atmosphere. The partition fraction is the ratio of tank headspace radioactivity concentration to the concentration in that tank's solid or liquid waste, whichever is used as the basis.

Kimura and Lindsey (1987) report on the ratio of activity concentration in tank headspace samples to activity concentration in tank liquid waste material samples taken from DSTs during ALC operation, during waste transfer operations, and during static conditions. The characterization effort focused on cesium because it is prevalent in nearly all of the tank waste analyzed, producing the largest numbers, and is therefore considered bounding. The sample analyses indicated the following:

- ALC operations — Observed ^{137}Cs partition fractions ranged from 1.02×10^{-9} to 2.49×10^{-9}
- Tank waste transfer operations — Observed ^{137}Cs partition fractions ranged from 1.02×10^{-12} to 5.25×10^{-10}
- Static tank waste conditions — Observed ^{137}Cs partition fractions ranged from about 1.00×10^{-13} to 6.9×10^{-11} .

The results indicate the partition fraction for DST and AWF tanks during operations that result in worst-case liquid waste agitation conditions would be bounded by a partition fraction of 10^{-8} , which is the number used in this accident analysis.

For an unagitated tank liquid waste scenario (i.e., long-term passive ventilation), static waste conditions, the above information indicates a partition fraction of about 1×10^{-10} .

References

Kimura and Lindsey, 1987, *Characterization of Airborne Radionuclide Particulates in Ventilated Liquid Waste Tanks*, RHO-RE-SA-216P, Rockwell Hanford Operations, Richland, Washington.

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APPENDIX B
PEER REVIEW AND HEDOP REVIEW CHECKLISTS

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CHECKLIST FOR PEER REVIEW

Document Reviewed: "Releases From Failed HEPA Filters Due to ann Overpressurization Event," WHC-SD-WM-CN-063, Rev. 1, 9/96, by Grant Ryan.

Scope of Review: Entire Document.

Yes No NA

☒	☐	☐	Previous reviews complete and cover analysis, up to scope of this review, with no gaps.
☒	☐	☐	Problem completely defined.
☒	☐	☐	Accident scenarios developed in a clear and logical manner.
☒	☐	☐	Necessary assumptions explicitly stated and supported.
☐	☐	☒	Computer codes and data files documented.
☒	☐	☐	Data used in calculations explicitly stated in document.
☒	☐	☐	Data checked for consistency with original source information as applicable.
☒	☐	☐	Mathematical derivations checked including dimensional consistency of results.
☒	☐	☐	Models appropriate and used within range of validity or use outside range of established validity justified.
☒	☐	☐	Hand calculations checked for errors. Spreadsheet results should be treated exactly the same as hand calculations.
☐	☐	☒	Software input correct and consistent with document reviewed.
☐	☐	☒	Software output consistent with input and with results reported in document reviewed.
☒	☐	☐	Limits/criteria/guidelines applied to analysis results are appropriate and referenced. Limits/criteria/guidelines checked against references.
☒	☐	☐	Safety margins consistent with good engineering practices.
☒	☐	☐	Conclusions consistent with analytical results and applicable limits.
☒	☐	☐	Results and conclusions address all points required in the problem statement.
☐	☐	☒	Format consistent with appropriate NRC Regulatory Guide or other standards
☐	☐	☒	Review calculations, comments, and/or notes are attached.
☒	☐	☐	Document approved.

Anthony V. Savino *Anthony V. Savino*
Reviewer (Printed Name and Signature)

9/18/96
Date

HEDOP REVIEW CHECKLIST
for
Radiological and Nonradiological Release Calculations

Document reviewed (include title or description of calculation, document number, author, and date, as applicable):

WHC-SD-WM-CN-063, Rev. 1, *Unfiltered HEPA Filter Release Due to Pressurization*

Submitted by: Grant W. Ryan

Date Submitted: 9/6/96

Scope of Review: Radiological Dose and Toxicological Exposure Calculations.

YES NO* N/A

☒	☐	☐	1. A detailed technical review and approval of the environmental transport and dose calculation portion of the analysis has been performed and documented.
☒	☐	☐	2. Detailed technical review(s) and approval(s) of scenario and release determinations have been performed and documented.
☐	☐	☒	3. HEDOP-approved code(s) were used.
☐	☐	☒	4. Receptor locations were selected according to HEDOP recommendations.
☒	☐	☐	5. All applicable environmental pathways and code options were included and are appropriate for the calculations.
☒	☐	☐	6. Hanford site data were used.
☐	☐	☒	7. Model adjustments external to the computer program were justified and performed correctly.
☒	☐	☐	8. The analysis is consistent with HEDOP recommendations.
☐	☐	☒	9. Supporting notes, calculations, comments, comment resolutions, or other information is attached. (Use the "Page 1 of X" page numbering format and sign and date each added page.)
☒	☐		10. Approval is granted on behalf of the Hanford Environmental Dose Overview Panel.

* All "NO" responses must be explained and use of nonstandard methods justified.

David A. Himes 8/27/96
HEDOP-Approved Reviewer (Printed Name and Signature) Date

COMMENTS (add additional signed and dated pages if necessary):