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HEPA Filter Failure by Fire or Heater Overtemperature and Subsequent Unfiltered Release

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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. Noland 12/27/96
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**HEPA FILTER FAILURE BY FIRE OR HEATER OVERTEMPERATURE AND SUBSEQUENT
UNFILTERED RELEASE**

REVISION 2

**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.

December 1996

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LIST OF TERMS

ARF	airborne release fraction
AWF	aging waste facility
CEDE	committed effective dose equivalent
DOE	U. S. Department of Energy
DST	double-shell tank
FSAR	final safety analysis report
HEDOP	Hanford Environmental Dose Overview Panel
IVF	information validation form
rem	radiation effective man
RF	respirable fraction
SST	single-shell tank
Sv	sievert
TEDE	total effective dose equivalent
TWRS	Tank Waste Remediation System
ULD	unit liter dose
WHC	Westinghouse Hanford Company

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HEPA FILTER FAILURE BY FIRE OR HEATER OVERTEMPERATURE AND SUBSEQUENT UNFILTERED RELEASE

1.0 INTRODUCTION AND PURPOSE

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.

ACCIDENT SCENARIO DEVELOPMENT AND DESCRIPTION

Passive or active high-efficiency particulate air (HEPA)-filtered ventilation is maintained for single-shell tanks (SSTs) and double-shell waste tanks (DSTs), double-contained receiver tanks (DCRTs), the 204-AR Waste Unloading Facility, the 244-AR Vault, the 213-W Dry Waste Compactor Facility, and 7 of 12 catch tanks, as applicable. A description of these ventilation systems and facilities is provided in Chapter 2.0 of the TWRS FSAR.

The hazard analysis identified two potential hazardous conditions associated with HEPA filter systems. The first is a fire associated with a ventilation system that releases the inventory on the filters and results in an unfiltered pathway. High temperatures associated with an external fire (occurring in close proximity to a HEPA filter system) or the failure of an in-line heater (present in some HEPA filter systems) could degrade the ventilation system filters. The second is an unfiltered release due to seal failure, a defective or deteriorated HEPA filter, or improper installation of HEPA filter. The fire scenario is selected for analysis as its consequences are bounding due to the additional release associated with the filter inventory.

An accident scenario (assuming no controls) was developed for each of the tank farm HEPA filter system configurations shown in Table 1. The total consequences of this event are calculated by (1) adding the consequences due to the amount of respirable material released during the HEPA filter failure and (2) the amount of respirable material released during the subsequent continuous, unfiltered release following the filter failure. The scenario assumes that a fire occurs in or around a ventilation system and the heat from the fire degrades the filters. Degradation of the filters is assumed to result in the release of a fraction of the inventory of tank waste accumulated on prefilters (if present) and HEPA filters and to result in an unfiltered release pathway.

Heat from the fire is also assumed to release a fraction of the inventory of tank waste accumulated on ventilation system ductwork. The amount of accumulated material is assumed equal to the loading on one stage of HEPA filtration.

The material at risk on the HEPA and pre-filters was assumed to have a contact dose rate of less than or equal to 200 mrem/h (2.0 E-03 Sv/h). Since this is an assumption for filter loading it requires a Technical Safety Requirement (TSR) level control (see Section 8.0). The contact dose rate is based on operational history and bounds the contact dose rates observed in the

tank farms. WHC-SD-WM-CN-033, *Microshield* Dose Rate Calculations for HEPA Filters and Prefilters*, uses the contact dose rate to back calculate the inventory on the filters.

Consequences resulting from the unfiltered release pathway were calculated for 12 hours (onsite receptor), 24 hours (offsite receptor), and one year (onsite and offsite receptors). 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. For actively ventilated systems, it is assumed that the exhaust fans continue to run at the ventilation flowrate given in Table 1. The passively ventilated SSTs (both filter configurations) are assumed to vent vapor space particulates to the atmosphere at a flow rate equal to that shown in Table 1.

ACCIDENT FREQUENCY DEVELOPMENT

The event frequency for this overtemperature accident scenario is anticipated ($>10^{-2}$ to $\leq 10^0$) based on the initiating event frequency for either a heater failure or an external fire. Heaters in the ventilation system have failed in the past resulting in high temperatures in the exhaust air and some degradation of the filters has been observed. The failure of the heater to shut-off could create an overtemperature situation and cause the failure of the filters in the ventilation system. An external fire around the ventilation system would likely cause a filter degradation, as analyzed here. This event frequency is consistent with the analysis presented in Section 3.3.2.3.2.2.3 of the TWRS FSAR and the accompanying calculation note, WHC-SD-WM-CN-056, *Fire in a Contaminated Area*, that evaluates the consequences of a fire in a contaminated area.

The consequences associated with this accident scenario are compared to the risk acceptance guidelines for *anticipated* accidents as provided in WHC-CM-4-46, Rev. 1.

*Microshield is a registered trademark of Grove Engineering, Inc., Rockville, MD.

2.0 ANALYSIS INPUT

The input data shown in Table 1 is used in this document to develop the radiological and toxicological consequence analyses.

Additionally, to supplement the information in Table 1, the unit liter doses (ULD) for the different tank waste types cited are taken from WHC-SD-WM-SARR-016. Table 2 contains the ULDs utilized in the analysis of each ventilation system.

The following dispersion coefficients are developed for use in this accident analysis:

Onsite:

The χ/Q' for the acute release from the HEPA filter is $3.41 \times 10^{-2} \text{ s/m}^3$ (Table 4, WHC-SD-WM-SARR-016).

To determine the χ/Q' for the 12 hour release, the logarithmic interpolation procedure described in WHC-SD-WM-SARR-016 is used to correctly identify the proper χ/Q' 's to be used. The χ/Q' used for the 2 hour release is $1.13 \times 10^{-2} \text{ s/m}^3$ to account for plume meander (Table 4, WHC-SD-WM-SARR-016). Using the equation from WHC-SD-WM-SARR-016 yields:

$$\frac{\log(1.13 \times 10^{-2}) - \log(\chi/Q' \text{ 12 hr})}{\log(1.13 \times 10^{-2}) - \log(4.03 \times 10^{-4})} = \frac{\log(2 \text{ hr}) - \log(12 \text{ hr})}{\log(2 \text{ hr}) - \log(8,760 \text{ hr})}$$

The onsite χ/Q' (12 hr) is $5.54 \times 10^{-3} \text{ s/m}^3$.

The annual onsite χ/Q' (8760 hr) is $4.03 \times 10^{-4} \text{ s/m}^3$ (Table 9, WHC-SD-WM-SARR-016).

Offsite:

The χ/Q' for the acute release from the HEPA filter is $2.83 \times 10^{-5} \text{ s/m}^3$ (Table 5, WHC-SD-WM-SARR-016).

To determine the χ/Q' for the 24 hour release, the logarithmic interpolation procedure described in WHC-SD-WM-SARR-016 is used to correctly identify the proper χ/Q' 's to be used. The χ/Q' used for the 2 hour release is $2.12 \times 10^{-5} \text{ s/m}^3$ to account for plume meander (Table 5, WHC-SD-WM-SARR-016). Using the equation from WHC-SD-WM-SARR-016 yields:

$$\frac{\log(2.12 \times 10^{-5}) - \log(\chi/Q' \text{ 24 hr})}{\log(2.12 \times 10^{-5}) - \log(1.24 \times 10^{-7})} = \frac{\log(2 \text{ hr}) - \log(24 \text{ hr})}{\log(2 \text{ hr}) - \log(8,760 \text{ hr})}$$

The offsite χ/Q' (24 hr) is $4.62 \text{ E-}06 \text{ s/m}^3$.

The annual offsite χ/Q' (8760 hr) is $1.24 \times 10^{-7} \text{ s/m}^3$ (Table 9, WHC-SD-WM-SARR-016).

Table 1. Input Data Used to Develop the Consequence Analyses. (2 Sheets)

Facility/vent system	Filter dimension (in.) and configuration	Flow rate ^f (m ³ /s)	Type of waste released	Amount released (L)
241-SX/241-C (SSTs with active ventilation)	24 x 24 x 12 ^a	3.30	SST solids	6.13 E-05
SSTs with passive breather filters (SSTs with passive ventilation configuration 1)	24 x 24 x 12 ^b	6.80 E-04	SST solids	1.27 E-06
SSTs with passive breather filters (SSTs with passive ventilation configuration 2)	12 x 12 x 12 ^b	6.80 E-04	SST solids	4.72 E-07
Double-contained receiver tank	12 x 12 x 12 ^a	1.98	SST liquids	2.28 E-05
241-SY/241-AN/241-AP, 241-AW (DSTs)	24 x 24 x 12 ^a	0.55	DST liquids	9.79 E-06
241-AY/241-AZ (AWF tanks)	24 x 24 x 12 ^c	1.89	AWF liquids	5.62 E-05
204-AR Waste Unloading Facility	24 x 24 x 12 ^d	0.94	DST liquids	2.37 E-05
244-AR Vault	24 x 24 x 12 ^d	7.08 ^e	DST liquids	2.37 E-05
213-W Dry Waste Compactor Facility	24 x 24 x 12 ^a	0.94	DST liquids	9.79 E-06
Catch tanks	24 x 24 x 12 ^a	NA ^g	DST liquids	9.79 E-06

NOTE: a, b, c, d descriptions consistent with information presented in Appendix A.

^aTwo HEPA's, a prefilter, and another volume equal to the prefilter for material coming out of the ventilation ducting: 2 HEPA Volumes + 2 Prefilter Volumes.

^bPassive breather HEPA, no prefilter, no second HEPA, and no appreciable material in the ventilation ducting: 1 HEPA Volume.

^cTwo (2) HEPA's, no prefilter but there are two (2) de-entrainers and material in the ventilation ducting (1): 5 HEPA Volumes.

^dTwo HEPA's, a prefilter, a low efficiency filter (treated as a prefilter), and another volume equal to the prefilter for material coming out of the ventilation ducting: 2 HEPA Volumes + 2 Prefilter Volumes.

^eFlow rate for Canyon Exhaust System. The canyon exhaust system is inactive, with no plans for future use. Future activities in the facility are expected to rely on the vessel ventilation system which has a much lower flow rate when operating at full capacity. Calculating the consequences using the ventilation flow rate for the canyon exhaust system ensure conservative values.

^fIn general, the referenced ventilation flow rates are taken from the information presented in Chapter 2.0 (Facility and Process Description) of the Tank Waste Remediation System Final Safety Analysis Report (WHC-SD-WM-SAR-067). One exception to this is the ventilation flow rate for the 213-W Dry Waste Compactor Facility which is taken from WHC-SD-WM-SAR-009, Dry Waste Compactor Hazard Identification and Evaluation.

SEE ADDITIONAL NOTES ON NEXT SHEET.

Table 1. Input Data Used to Develop the Consequence Analyses. (2 Sheets)

Facility/vent system	Filter dimension (in.) and configuration	Flow rate ^f (m ³ /s)	Type of waste released	Amount released (L)
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gCatch tanks do not possess dedicated active ventilation systems. Two catch tanks have shared ventilation systems. The 241-A-417 and 241-AX-152 are connected to the 702-A ventilation system via a ventilation line. The ventilation systems for the following catch tanks and DCRTs consist of a breather filter similar to the breather filter assemblies on SSTs:

241-A-350, 241-A-417, 241-EW-151, 241-S-304, 241-AZ-151, 241-AZ-154. The following catch tanks have no HEPA filtration systems: 241-A-302-A, 241-TX-302-C, 241-U-301-B, 241-UX-302-A, and 241-ER-311.

AWF = aging waste facility.

DST = double-shell tank.

HEPA = high-efficiency particulate air (filter)

NA = not applicable.

SST = single-shell tank.

Table 2. Unit Liter Doses for Tank Waste Composites.

Composite	Inhalation ULD (Sv/L)	Ingestion ULD* (Sv-m ³ /s-L)
Single-shell tank liquids	1.1 E+04	0.052
Single-shell tank solids	2.2 E+05	4.1
Double-shell tank liquids	6.1 E+03	0.068
Aging waste facility tank liquids	1.4 E+03	0.092

*Includes 24 hours ingestion of fruits and vegetables, ground shine, inadvertent soil ingestion, and inhalation of material resuspended from the ground.

ULD = unit liter doses.

For the unfiltered release following the failure of the HEPA filters, Table 3 presents the particulate release rate for each facility or ventilation system.

Table 3. Particulate Release Rates.

Facility/vent system	Flow rate ^a		Partition Fraction Applied	Particulate Release Rate ^c (L/s)
	(m ³ /s)	(L/s)		
241-SX/241-C (SSTs with active ventilation)	3.30	3,300	1.0 E-10	3.3 E-07
SSTs with passive breather filters (SSTs with passive ventilation configuration 1)	6.80 E-04	0.68	1.0 E-10	6.8 E-11
SSTs with passive breather filters (SSTs with passive ventilation configuration 2)	6.80 E-04	0.68	1.0 E-10	6.8 E-11
Double-contained receiver tank	1.98	1,980	1.0 E-10	2.0 E-07
241-SY/241-AN/241-AP, 241-AW (DSTs)	0.55	550	1.0 E-08	5.5 E-06
241-AY/241-AZ (AWF tanks)	1.89	1,890	1.0 E-08	1.9 E-05
204-AR Waste Unloading Facility	0.94	940	1.0 E-10	9.4 E-08
244-AR Vault	7.08	7,080	1.0 E-10	7.1 E-07
213-W Dry Waste Compactor Facility	0.94	940	NA ^b	NA
Catch tanks	NA	NA	NA ^b	NA

NOTES:

^aSee Table 1 for description of ventilation system flow rates.^bIt is assumed that there is no unfiltered release (following the fire or overtemperature event) from the 213-W Dry Waste Compactor Facility or the ventilated catch tanks.^cThe particulate release rate (L/s) is calculated by multiplying the ventilation flow rate (L/s) by the partition fraction.

AWF = aging waste facility.

DST = double-shell tank.

HEPA = high-efficiency particulate air (filter)

NA = not applicable.

SST = single-shell tank.

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3.0 ASSUMPTIONS

The following assumptions were used in this analysis (in no particular order):

- The dose rate "on contact" from pre-filters and HEPA filters is ≤ 200 mR/hr. According to the approved Information Validation Form (IVF) provided in Appendix B, Tank Farm Operations personnel confirm that HEPA filters are changed when the contact dose rate is less than 200 mR/hr (i.e., 160 mR/hr). The location for calculating contact dose rate on pre-filters and HEPA filters is defined in WHC-SD-WM-CN-033.
- All of the HEPA filters are assumed to be compromised and release a fraction of their contents during a fire in or around the ventilation system.
- The filter media making up the HEPA filters is made of fiberglass (or other non-combustible material). There is no paper (or other highly combustible) filter media used in the Tank Farm ventilation systems HEPA filters.
- The ventilation system remains in operation (i.e., fan running) during and following the fire (or overtemperature) event that fails the HEPA filters.
- Continuous air monitor (CAM) interlock detects and shuts off the ventilation system within 10 minutes on the SSTs (active ventilation only) and DSTs (including aging waste facility tanks) following the fire (or overtemperature) event. This assumption is used for mitigated analysis only (see Section 7.0).

The only combustion products that could conceivably impact the function of the continuous air monitor interlock/alarm would be from the degradation of the HEPA filter media and frame. The HEPA filter media is fiberglass, the frames are fire retardant and the combustion products would be minimal. In addition, the continuous air monitor interlock/alarm is located some distance downstream of the filter location and is expected to be outside the fire zone.

- An additional amount of contamination equal to the loading on the pre-filter or HEPA filter is used in order to account for accumulation in the ventilation duct work.
- The occupancy factor (OF) for the maximum onsite individual is assumed to be 1.0 and 0.286 for a 12-hour and a 1 year release, respectively (WHC-SD-WM-SARR-016) to account for the actual time spent at work. The OF for a maximum offsite individual is 1.0.
- The respirable fraction (RF) for the unfiltered release is assumed to be 1.0 in all cases.
- The unfiltered release amounts, based on the ventilation system flow rates shown in Table 1, were calculated utilizing a partition fraction to determine the amount of contamination in the headspace air. A partition fraction of 1.0×10^{-10} was used for SSTs (with active and passive ventilation), DCRTs, the 204-AR Waste Unloading Facility, and

the 244-AR Vault and a partition fraction of 1.0×10^{-8} was used for all DST tanks. It was assumed in the analysis that the 213-W Dry Waste Compactor Facility and the catch tanks evaluated contained no liquid waste and therefore, there is no unfiltered release from these facilities. The partition fractions cited here are based on experimental results published in RHO-RE-SA-216, *Characterization of Airborne Radionuclide Particulates in Ventilated Liquid Waste Tanks* for agitated (1.0×10^{-8}) and unagitated (1.0×10^{-10}) tanks under both active and passive ventilation.

- The airborne release fraction (ARF) used to determine the amount of respirable material released from the HEPA filter as a result of exposure to high temperature or fire is 1.0×10^{-4} . This bounding value, for fiberglass filters, is based on information presented in Section 5.4.1 of DOE-HDBK-3010-94, *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities*, for HEPA filters subjected to thermal stress. This value is considered applicable and conservative for use in this analysis since the filters used in tank farm ventilation systems are fiberglass and similar to those empirically evaluated in DOE-HDBK-3010-94. The values for HEPA filter release amounts (including prefilters and ductwork accumulation) are summarized in Table 1. The release amounts shown in Table 1 are developed in the discussion and worksheets of Appendix A.
- There is no unfiltered release (following the fire or overtemperature event) from the 213-W Dry Waste Compactor Facility or the ventilated catch tanks. The assumption of no unfiltered release from the catch tanks may appear to be an odd assumption, since they normally contain at the very least, small amounts of condensate or tank waste. It is justified with the following discussion: passive breathing (with no filters) would be the worst case accident condition for a catch tank following a fire or overtemperature event that destroys the integrity of the filtration system. Given that the volume of these tanks is small (compared to either SSTs or DSTs), the amount of particulate material in the vapor space that would be vented as a result of long-term, passive breathing would be very, very low. Passive breathing is considered to be 0.45% of available headspace per day (WHC-SD-WM-SARR-015).
- A breathing rate of $2.7 \times 10^{-4} \text{ m}^3/\text{s}$ for a 24-hour release offsite and 1 year release onsite and offsite, and $3.3 \times 10^{-4} \text{ m}^3/\text{s}$ is used for a 12-hour release onsite (WHC-SD-WM-SARR-016, page 4-4).

4.0 ANALYTICAL METHODS AND CALCULATIONS

The total consequences of this event are calculated by adding the consequences due to the amount of respirable material released during the HEPA filter failure and the amount of respirable material released during the subsequent continuous, unfiltered release following the filter failure. Consequences resulting from the unfiltered release pathway were calculated for 12 hours (onsite receptor), 24 hours (offsite receptor), and one year (onsite and offsite receptors). 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.

Overall, the methodology used to calculate the radiological and toxicological consequences is presented and discussed in WHC-SD-WM-SARR-016 and WHC-SD-WM-SARR-011, respectively.

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5.0 RADIOLOGICAL DOSE CONSEQUENCE ANALYSIS

Given an airborne source term, the doses from the inhalation and ingestion pathways are calculated by the following formulas:

Inhalation:

$$D_{inh}(Sv) = Q(L) \times \frac{X}{Q'} \left(\frac{s}{m^3} \right) \times R \left(\frac{m^3}{s} \right) \times ULD_{inh} \left(\frac{Sv}{L} \right)$$

Ingestion:

$$D_{ing}(Sv) = Q(L) \times \frac{X}{Q'} \left(\frac{s}{m^3} \right) \times ULD_{ing} \left(\frac{Sv \cdot m^3}{s \cdot L} \right)$$

where

D_{inh} = dose due to inhalation (Sv)

D_{ing} = dose due to ingestion (Sv)

Q = respirable source term (L)

X/Q' = appropriate atmospheric dispersion coefficient (s/m^3)

R = breathing rate (for values, see assumptions in Section 3.0)

ULD_{inh} = inhalation unit liter dose (Sv/L, see Table 2)

ULD_{ing} = ingestion unit liter dose ($Sv \cdot m^3/s \cdot L$, see Table 2).

For the inhalation pathway, the dose calculated is the 50-year committed effective dose equivalent (CEDE) defined as the dose received by the individual during a 50-year period following the uptake. For the maximum onsite individual, this dose must be combined with that due to external exposure (if any) to yield the TEDE. For the ingestion pathway, the dose calculated is the CEDE from ingestion plus the dose due to external exposure (e.g., ground shine) during the first 24 hours after the release. Combining the ingestion dose with the inhalation dose yields the TEDE for the maximum offsite individual.

To demonstrate the way the radiological consequences are calculated, a sample calculation of the onsite and offsite consequences are presented for the SSTs with Active Ventilation.

ONSITE RADIOLOGICAL CONSEQUENCESConsequences from the HEPA Filter Failure (D_{filter}):

$$D_{\text{inh}}(\text{Sv}) = Q(L) \times \frac{X}{Q'} \left[\frac{s}{m^3} \right] \times R \left[\frac{m^3}{s} \right] \times ULD_{\text{inh}} \left[\frac{\text{Sv}}{L} \right]$$

where

 D_{inh} = dose due to inhalation (Sv) $Q = 6.13 \times 10^{-5} \text{ L}$ (see Table 1) $X/Q' = 3.41 \times 10^{-2} \text{ s/m}^3$ (see Section 2.0) $R = 3.3 \times 10^{-4} \text{ m}^3/\text{s}$ (see Section 3.0) $ULD_{\text{inh}} = 2.2 \times 10^5 \text{ Sv/L}$ (see Table 2)

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

$$D_{\text{filter}} = 1.52 \times 10^{-4} \text{ Sv}$$

Consequences from the 12 hour Unfiltered Release ($D_{12 \text{ hour}}$):

$$D_{\text{inh}}(\text{Sv}) = Q(L/s) \times \frac{X}{Q'} \left[\frac{s}{m^3} \right] \times R \left[\frac{m^3}{s} \right] \times ULD_{\text{inh}} \left[\frac{\text{Sv}}{L} \right] \times t(s)$$

where

 D_{inh} = dose due to inhalation (Sv) $Q = 3.3 \times 10^{-7} \text{ L/s}$ (see Table 3) $X/Q' = 5.54 \times 10^{-3} \text{ s/m}^3$ (see Section 2.0) $R = 3.3 \times 10^{-4} \text{ m}^3/\text{s}$ (see Section 3.0) $ULD_{\text{inh}} = 2.2 \times 10^5 \text{ Sv/L}$ (see Table 2) $t = 43,200 \text{ s}$ (12 h)

$$D_{12 \text{ hour}} = (3.3 \times 10^{-7} \text{ L/s})(5.54 \times 10^{-3} \text{ s/m}^3)(3.3 \times 10^{-4} \text{ m}^3/\text{s}) \times (2.2 \times 10^5 \text{ Sv/L})(43,200 \text{ s})$$

$$D_{12 \text{ hour}} = 5.73 \times 10^{-3} \text{ Sv}$$

Consequences from an Annual (8,760 h) Unfiltered Release (D_{annual}):

$$D_{\text{inh}} (\text{Sv}) = Q (\text{L/s}) \times \frac{X}{Q'} \left[\frac{\text{s}}{\text{m}^3} \right] \times R \left[\frac{\text{m}^3}{\text{s}} \right] \times \text{ULD}_{\text{inh}} \left[\frac{\text{Sv}}{\text{L}} \right] \times t (\text{s}) \times \text{OF}$$

where

D_{inh} = dose due to inhalation (Sv)

$Q = 3.3 \times 10^{-7}$ L/s (see Table 3)

$X/Q' = 4.03 \times 10^{-4}$ s/m³ (see Section 2.0)

$R = 2.7 \times 10^{-4}$ m³/s (see Section 3.0)

$\text{ULD}_{\text{inh}} = 2.2 \times 10^5$ Sv/L (see Table 2)

$t = 3.1536 \times 10^7$ s (8,760 h) [additional significant figures included to reduce error in final answer]

$\text{OF} = 0.286$ (see Section 3.0)

$$D_{\text{annual}} = (3.3 \times 10^{-7} \text{ L/s})(4.03 \times 10^{-4} \text{ s/m}^3)(2.7 \times 10^{-4} \text{ m}^3/\text{s})(2.2 \times 10^5 \text{ Sv/L}) \times (3.1536 \times 10^7 \text{ s})(0.286)$$

$$D_{\text{annual}} = 7.12 \times 10^{-2} \text{ Sv}$$

Total onsite consequences (12 hour release):

$$\begin{aligned} D_{\text{onsite (12 h)}} &= D_{\text{filter}} + D_{\text{12 hour}} \\ &= 1.52 \times 10^{-4} \text{ Sv} + 5.73 \times 10^{-3} \text{ Sv} \\ D_{\text{onsite (12 h)}} &= 5.88 \times 10^{-3} \text{ Sv} \end{aligned}$$

Total onsite consequences (Annual release):

$$\begin{aligned} D_{\text{onsite (annual)}} &= D_{\text{filter}} + D_{\text{annual}} \\ &= 1.52 \times 10^{-4} \text{ Sv} + 7.12 \times 10^{-2} \text{ Sv} \\ D_{\text{onsite (annual)}} &= 7.14 \times 10^{-2} \text{ Sv} \end{aligned}$$

By the same method, onsite radiological consequences are calculated for each facility or ventilation system. Worksheets detailing the calculations are included in Appendix C with summary results presented in Section 7.0.

OFFSITE RADIOLOGICAL CONSEQUENCES

Consequences from the HEPA Filter Failure ($D_{\text{filter-inhalation}}$ and $D_{\text{filter-ingestion}}$):

$$D_{\text{inh}} (\text{Sv}) = Q (\text{L}) \times \frac{X}{Q'} \left[\frac{\text{S}}{\text{m}^3} \right] \times R \left[\frac{\text{m}^3}{\text{S}} \right] \times \text{ULD}_{\text{inh}} \left[\frac{\text{Sv}}{\text{L}} \right]$$

where

D_{inh} = dose due to inhalation (Sv)

$Q = 6.13 \times 10^{-5} \text{ L}$ (see Table 1)

$X/Q' = 2.83 \times 10^{-5} \text{ s/m}^3$ (see Section 2.0)

$R = 3.3 \times 10^{-4} \text{ m}^3/\text{s}$ (see Section 3.0)

$\text{ULD}_{\text{inh}} = 2.2 \times 10^5 \text{ Sv/L}$ (see Table 2)

$$D_{\text{filter-inhalation}} = (6.13 \times 10^{-5} \text{ L})(2.83 \times 10^{-5} \text{ s/m}^3)(3.3 \times 10^{-4} \text{ m}^3/\text{s}) \times (2.2 \times 10^5 \text{ Sv/L})$$

$$D_{\text{filter-inhalation}} \approx 1.26 \times 10^{-7} \text{ Sv}$$

$$D_{\text{ing}} (\text{Sv}) = Q (\text{L}) \times \frac{X}{Q'} \left[\frac{\text{S}}{\text{m}^3} \right] \times \text{ULD}_{\text{ing}} \left[\frac{\text{Sv-m}^3}{\text{s-L}} \right]$$

where

D_{ing} = dose due to inhalation (Sv)

$Q = 6.13 \times 10^{-5} \text{ L}$ (see Table 1)

$X/Q' = 2.83 \times 10^{-5} \text{ s/m}^3$ (see Section 2.0)

$\text{ULD}_{\text{ing}} = 4.1 \text{ Sv-m}^3/\text{s-L}$ (see Table 2)

$$D_{\text{filter-ingestion}} = (6.13 \times 10^{-5} \text{ L})(2.83 \times 10^{-5} \text{ s/m}^3)(4.1 \text{ Sv-m}^3/\text{s-L})$$

$$D_{\text{filter-ingestion}} \approx 7.11 \times 10^{-9} \text{ Sv}$$

Consequences from the 24 hour Unfiltered Release ($D_{24 \text{ h-inhalation}}$ and $D_{24 \text{ h-ingestion}}$):

$$D_{\text{inh}} (\text{Sv}) = Q (\text{L/s}) \times \frac{X}{Q'} \left[\frac{\text{s}}{\text{m}^3} \right] \times R \left[\frac{\text{m}^3}{\text{s}} \right] \times ULD_{\text{inh}} \left[\frac{\text{Sv}}{\text{L}} \right] \times t (\text{s})$$

where

$$D_{\text{inh}} = \text{dose due to inhalation (Sv)}$$

$$Q = 3.3 \times 10^{-7} \text{ L/s (see Table 3)}$$

$$X/Q' = 4.62 \times 10^{-6} \text{ s/m}^3 \text{ (see Section 2.0)}$$

$$R = 2.7 \times 10^{-4} \text{ m}^3/\text{s} \text{ (see Section 3.0)}$$

$$ULD_{\text{inh}} = 2.2 \times 10^5 \text{ Sv/L (see Table 2)}$$

$$t = 86,400 \text{ s (24 h)}$$

$$D_{24 \text{ h-inhalation}} = (3.3 \times 10^{-7} \text{ L/s})(4.62 \times 10^{-6} \text{ s/m}^3)(2.7 \times 10^{-4} \text{ m}^3/\text{s}) \times (2.2 \times 10^5 \text{ Sv/L}) \times (86,400 \text{ s})$$

$$D_{24 \text{ h-inhalation}} = 7.82 \times 10^{-6} \text{ Sv}$$

$$D_{\text{ing}} (\text{Sv}) = Q (\text{L/s}) \times \frac{X}{Q'} \left[\frac{\text{s}}{\text{m}^3} \right] \times ULD_{\text{ing}} \left[\frac{\text{Sv-m}^3}{\text{s-L}} \right] \times t (\text{s})$$

where

$$D_{\text{ing}} = \text{dose due to inhalation (Sv)}$$

$$Q = 3.3 \times 10^{-7} \text{ L/s (see Table 3)}$$

$$X/Q' = 4.62 \times 10^{-6} \text{ s/m}^3 \text{ (see Section 2.0)}$$

$$ULD_{\text{ing}} = 4.1 \text{ Sv-m}^3/\text{s-L (see Table 2)}$$

$$t = 86,400 \text{ s (24 h)}$$

$$D_{24 \text{ h-ingestion}} = (3.3 \times 10^{-7} \text{ L/s})(4.62 \times 10^{-6} \text{ s/m}^3)(4.1 \text{ Sv-m}^3/\text{s-L})(86,400 \text{ s})$$

$$D_{24 \text{ h-ingestion}} = 5.40 \times 10^{-7} \text{ Sv}$$

Consequences from an Annual (8,760 h) Unfiltered Release
($D_{\text{annual-inhalation}}$ and $D_{\text{annual-ingestion}}$):

$$D_{\text{inh}}(\text{Sv}) = Q(\text{L/s}) \times \frac{X}{Q'} \left[\frac{\text{s}}{\text{m}^3} \right] \times R \left[\frac{\text{m}^3}{\text{s}} \right] \times \text{ULD}_{\text{inh}} \left[\frac{\text{Sv}}{\text{L}} \right] \times t(\text{s})$$

where

D_{inh} = dose due to inhalation (Sv)

$Q = 3.3 \times 10^{-7}$ L/s (see Table 3)

$X/Q' = 1.24 \times 10^{-7}$ s/m³ (see Section 2.0)

$R = 2.7 \times 10^{-4}$ m³/s (see Section 3.0)

$\text{ULD}_{\text{inh}} = 2.2 \times 10^5$ Sv/L (see Table 2)

$t = 3.1536 \times 10^7$ s (8,760 h) [additional significant figures included to reduce error in final answer]

$$D_{\text{annual-inhalation}} = (3.3 \times 10^{-7} \text{ L/s})(1.24 \times 10^{-7} \text{ s/m}^3)(2.7 \times 10^{-4} \text{ m}^3/\text{s}) \times (2.2 \times 10^5 \text{ Sv/L})(3.1536 \times 10^7 \text{ s})$$

$$D_{\text{annual-inhalation}} = 7.66 \times 10^{-5} \text{ Sv}$$

$$D_{\text{ing}}(\text{Sv}) = Q(\text{L/s}) \times \frac{X}{Q'} \left[\frac{\text{s}}{\text{m}^3} \right] \times \text{ULD}_{\text{ing}} \left[\frac{\text{Sv-m}^3}{\text{s-L}} \right] \times t(\text{s})$$

where

D_{ing} = dose due to ingestion (Sv)

$Q = 3.3 \times 10^{-7}$ L/s (see Table 3)

$X/Q' = 1.24 \times 10^{-7}$ s/m³ (see Section 2.0)

$\text{ULD}_{\text{ing}} = 4.1 \text{ Sv-m}^3/\text{s-L}$ (see Table 2)

$t = 3.1536 \times 10^7$ s (8,760 h) [additional significant figures included to reduce error in final answer]

$$D_{\text{annual-ingestion}} = (3.3 \times 10^{-7} \text{ L/s})(1.24 \times 10^{-7} \text{ s/m}^3)(4.1 \text{ Sv-m}^3/\text{s-L}) \times (3.1536 \times 10^7 \text{ s})$$

$$D_{\text{annual-ingestion}} = 5.29 \times 10^{-6} \text{ Sv}$$

Total offsite consequences (24 hour release):

$$\begin{aligned}
 D_{24\text{ h}} &= (D_{\text{filter-inhalation}}) + D_{\text{filter-ingestion}} + D_{24\text{ h-inhalation}} + D_{24\text{ h-ingestion}} \\
 &= 1.26 \times 10^{-7} \text{ Sv} + 7.11 \times 10^{-9} \text{ Sv} + 7.82 \times 10^{-6} \text{ Sv} + 5.40 \times 10^{-7} \text{ Sv} \\
 D_{24\text{ h}} &= 8.49 \times 10^{-6} \text{ Sv}
 \end{aligned}$$

Total offsite consequences (Annual release):

$$\begin{aligned}
 D_{\text{annual}} &= (D_{\text{filter-inhalation}}) + D_{\text{filter-ingestion}} + D_{\text{annual-inhalation}} + D_{\text{annual-ingestion}} \\
 &= 1.26 \times 10^{-7} \text{ Sv} + 7.11 \times 10^{-9} \text{ Sv} + 7.66 \times 10^{-5} \text{ Sv} + 5.29 \times 10^{-6} \text{ Sv} \\
 D_{\text{annual}} &= 8.20 \times 10^{-5} \text{ Sv}
 \end{aligned}$$

By the same method, offsite radiological consequences are calculated for each facility or ventilation system. Worksheets detailing the calculations are included in Appendix C with summary results presented in Section 7.0.

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6.0 TOXICOLOGICAL EXPOSURE CONSEQUENCE ANALYSIS

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*. In this method, the released quantity (or release rate) is multiplied by the appropriate sum-of-fraction (SOF) value from Table 3-8 of WHC-SD-WM-SARR-011. Sum-of-fraction (SOF) values are dependent on the type of release (puff-type or continuous), the waste material released, and the event frequency. All scenarios in this document are evaluated at a frequency of *anticipated* (see Section 1.0).

$$D = Q \cdot \text{SOF}$$

Where

- D = the variable D is used to denote the toxicological exposure consequences and should not be confused with dose (in the radiological sense).
- Q = the quantity released, in units of L or L/s
- SOF = the appropriate sum-of-fraction value, in units of L⁻¹ or s/L

To demonstrate the way the toxicological consequences are calculated, a sample calculation of the onsite and offsite consequences are presented for the SSTs with Active Ventilation.

ONSITE TOXICOLOGICAL CONSEQUENCES

Consequences from the HEPA Filter Failure (D_{filter}):

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

Where

$$Q = 6.13 \times 10^{-5} \text{ L}$$

$$\text{SOF} = 1.2 \times 10^4 \text{ L}^{-1}$$

$$D_{\text{filter}} = (6.13 \times 10^{-5} \text{ L})(1.2 \times 10^4 \text{ L}^{-1})$$

$$D_{\text{filter}} = 7.36 \times 10^{-1}$$

Consequences from the Unfiltered Release ($D_{unfiltered}$): [Note that since the release rate is constant with respect to time (i.e., linear), the evaluated time period of the release (i.e., 12 h, 24 h, or annually) is not relevant to the calculation.]

$$D = Q \cdot SOF$$

Where

$$Q = 3.3 \times 10^{-7} \text{ L/s}$$

$$SOF = 4.0 \times 10^4 \text{ s/L}$$

$$D_{unfiltered} = (3.3 \times 10^{-7} \text{ L/s})(4.0 \times 10^4 \text{ s/L})$$

$$D_{unfiltered} = 1.32 \times 10^{-2}$$

Total onsite consequences:

$$\begin{aligned} D_{onsite} &= D_{filter} + D_{unfiltered} \\ &= 7.36 \times 10^{-1} + 1.32 \times 10^{-2} \\ D_{onsite} &= 7.49 \times 10^{-1} \end{aligned}$$

These consequences are identical for either the 12 h or annual release.

By the same method, onsite toxicological consequences are calculated for each facility or ventilation system. Worksheets detailing the calculations are included in Appendix C with summary results presented in Section 7.0.

OFFSITE TOXICOLOGICAL CONSEQUENCES

Consequences from the HEPA Filter Failure (D_{filter}):

$$D = Q \cdot SOF$$

Where

$$Q = 6.13 \times 10^{-5} \text{ L}$$

$$SOF = 3.8 \times 10^{-1} \text{ L}^{-1}$$

$$D_{filter} = (6.13 \times 10^{-5} \text{ L})(3.8 \times 10^{-1} \text{ L}^{-1})$$

$$D_{filter} = 2.33 \times 10^{-5}$$

Consequences from the Unfiltered Release ($D_{unfiltered}$): [Note that since the release rate is constant with respect to time (i.e., linear), the evaluated time period of the release (i.e., 12 h, 24 h, or annually) is not relevant to the calculation.]

$$D = Q \cdot SOF$$

Where

$$Q = 3.3 \times 10^{-7} \text{ L/s}$$

$$SOF = 9.4 \times 10^1 \text{ s/L}$$

$$D_{unfiltered} = (3.3 \times 10^{-7} \text{ L/s})(9.4 \times 10^1 \text{ s/L})$$

$$D_{unfiltered} = 3.10 \times 10^{-5}$$

Total offsite consequences:

$$D_{offsite} = D_{filter} + D_{unfiltered}$$

$$= 2.33 \times 10^{-5} + 3.10 \times 10^{-5}$$

$$D_{offsite} = 5.43 \times 10^{-5}$$

These consequences are identical for either the 24 h or annual release.

By the same method, offsite toxicological consequences are calculated for each facility or ventilation system. Worksheets detailing the calculations are included in Appendix C with summary results presented in Section 7.0.

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7.0 ANALYSIS RESULTS

7.1 RADIOLOGICAL CONSEQUENCES

The onsite and offsite radiological consequences of this scenario are summarized in Tables 4 and 5, respectively for comparison with the risk guidelines.

The onsite and offsite radiological consequences for SSTs with passive ventilation (both configurations), DCRTs, 204-AR Waste Unloading Facility, 244-AR Vault, the 213-W Dry Waste Compactor Facility, and the catch tanks are below the risk guidelines. As such, no controls are required for these systems.

The offsite radiological consequences for the accident scenario without controls, shown in Table 5, for SSTs (with active ventilation) and DSTs (including aging waste facility tanks) are below the risk guidelines. However, the onsite consequences for SSTs (with active ventilation) and DSTs (including aging waste facility tanks) shown in Table 4 are above the onsite risk guidelines. Therefore, controls have been developed for SSTs (with active ventilation) and DSTs (including aging waste facility tanks).

The following safety-significant SSC was selected to prevent the releases from exceeding the onsite risk guidelines:

- Continuous air monitor interlock that detects and shuts off the ventilation system within 10 minutes on the SSTs (active ventilation only) and DSTs (including aging waste facility tanks).

The accident scenario with controls assumes that a fire occurs in or around the ventilation system and that the HEPA filters fail. Within 10 minutes of the HEPA failure, a continuous air monitor interlock detects and shuts off the ventilation system for the active-ventilation SSTs and DSTs (including aging waste facility tanks). The only combustion products that could conceivably impact the function of the continuous air monitor interlock/ alarm would be from the degradation of the HEPA filter media and frame. The HEPA filter media is fiberglass, the frames are fire retardant and the combustion products would be minimal. In addition, the continuous air monitor interlock/alarm is located some distance downstream of the filter location.

The control selected has no effect on the frequency. Therefore, the frequencies assuming controls are the same as frequencies assuming no controls (i.e., anticipated).

The consequence calculations for the release with controls for SSTs (active ventilation only) and DSTs (including aging waste facility tanks) are detailed in Appendix C and summarized in Table 6 and are below the risk guidelines.

It should be noted that the dose consequences for an annual unfiltered release from the 244-AR Vault approach the risk guideline. No controls have been developed for this facility since the analysis was conservatively calculated using the ventilation flow rate from the canyon exhaust system. The canyon exhaust system is inactive, with no plans for future use. Future

Table 4. Summary of Onsite Radiological Consequences Assuming No Controls.

FACILITY/VENT SYSTEM	ONSITE RADIOLOGICAL CONSEQUENCES					Risk Guideline (Sv)
	Dose from Filter Failure [D,filter] (Sv)	Dose from 12 h Unfiltered Release [D,12 hour] (Sv)	Dose from Annual Unfiltered Release [D,annual] (Sv)	Total Onsite Dose (12 h Release) [D,onsite (12 h)] (Sv)	Total Onsite Dose (Annual Release) [D,onsite (annual)] (Sv)	
	A	B	C	A + B	A + C	
SSTs with Active Ventilation	1.52 E-04	5.73 E-03	7.12 E-02	5.89 E-03	7.14 E-02	5.0 E-03
SSTs with Passive Ventilation Configuration 1	3.14 E-06	1.18 E-06	1.47 E-05	4.33 E-06	1.78 E-05	5.0 E-03
SSTs with Passive Ventilation Configuration 2	1.17 E-06	1.18 E-06	1.47 E-05	2.35 E-06	1.59 E-05	5.0 E-03
Double-Contained Receiver Tank	2.82 E-06	1.74 E-04	2.16 E-03	1.77 E-04	2.16 E-03	5.0 E-03
DSTs	6.72 E-07	2.65 E-03	3.29 E-02	2.65 E-03	3.29 E-02	5.0 E-03
AWF Tanks	8.85 E-07	2.10 E-03	2.61 E-02	2.10 E-03	2.61 E-02	5.0 E-03
204-AR Waste Unloading Facility	1.63 E-06	4.53 E-05	5.63 E-04	4.69 E-05	5.64 E-04	5.0 E-03
244-AR Vault	1.63 E-06	3.42 E-04	4.25 E-03	3.44 E-04	4.25 E-03	5.0 E-03
213-W Dry Waste Compactor Facility	6.72 E-07	0.0	0.0	6.72 E-07	6.72 E-07	5.0 E-03
Catch Tanks	6.72 E-07	0.0	0.0	6.72 E-07	6.72 E-07	5.0 E-03

rem = Sv x 100

Table 5. Summary of Offsite Radiological Consequences Assuming No Controls.

FACILITY/VENT SYSTEM	OFFSITE RADIOLOGICAL CONSEQUENCES					Risk Guideline (Sv)
	Dose from Filter Failure (Sv)	Dose from 24 h Unfiltered Release (Sv)	Dose from Annual Unfiltered Release (Sv)	Total Offsite Dose (24 h Release) [D,24 h] (Sv)	Total Offsite Dose (Annual Release) [D,annual] (Sv)	
	A	B	C	A + B	A + C	
SSTs with Active Ventilation	1.33 E-07	8.36 E-06	8.19 E-05	8.50 E-06	8.21 E-05	1.0 E-03
SSTs with Passive Ventilation Configuration 1	2.76 E-09	1.72 E-09	1.69 E-08	4.48 E-09	1.96 E-08	1.0 E-03
SSTs with Passive Ventilation Configuration 2	1.02 E-09	1.72 E-09	1.69 E-08	2.75 E-09	1.79 E-08	1.0 E-03
Double-Contained Receiver Tank	2.38 E-09	2.41 E-07	2.36 E-06	2.44 E-07	2.37 E-06	1.0 E-03
DSTs	5.77 E-10	3.77 E-06	3.69 E-05	3.77 E-06	3.69 E-05	1.0 E-03
AWF Tanks	8.81 E-10	3.56 E-06	3.49 E-05	3.57 E-06	3.49 E-05	1.0 E-03
204-AR Waste Unloading Facility	1.40 E-09	6.43 E-08	6.30 E-07	6.57 E-08	6.32 E-07	1.0 E-03
244-AR Vault	1.40 E-09	4.86 E-07	4.76 E-06	4.87 E-07	4.76 E-06	1.0 E-03
213-W Dry Waste Compactor Facility	5.77 E-10	0.00	0.00	5.77 E-10	5.77 E-10	1.0 E-03
Catch Tanks	5.77 E-10	0.00	0.00	5.77 E-10	5.77 E-10	1.0 E-03

rem = Sv x 100

activities in the facility are expected to rely on the vessel ventilation system which has a much lower flow rate when operating at full capacity.

Table 4 shows that the annual unfiltered releases from passively ventilated SSTs are significantly below the risk guidelines. Similar consequences could be extrapolated for DSTs under passive ventilation, active ventilation with degraded filters or missing ductwork, or blown seal loops. Each of these instances may provide an unfiltered pathway to the environment. Since the consequences of unfiltered releases are below the risk guidelines, no further controls are necessary.

7.2 TOXICOLOGICAL CONSEQUENCES

Similarly, the onsite and offsite toxicological consequences of this scenario are summarized in Tables 7 and 8, respectively. The onsite and offsite toxicological consequences for all configurations are below the risk guidelines.

Table 6. Summary of Onsite Radiological Consequences Assuming Controls.

FACILITY/VENT SYSTEM	ONSITE RADIOLOGICAL CONSEQUENCES			Risk Guideline (Sv)
	Dose from Filter Failure [D,filter] (Sv)	Dose from 10 min. Unfiltered Release [D,10 min] (Sv)	Total Onsite Dose (10 min. Release) [D,10 min.] (Sv)	
	A	B	A + B	
SSTs with Active Ventilation	1.52 E-04	7.96 E-05	2.31 E-05	5.0 E-03
DSTs	6.72 E-07	3.68 E-05	3.75 E-05	5.0 E-03
AWF Tanks	8.85 E-07	2.92 E-05	3.01 E-05	5.0 E-03

$$\text{rem} = \text{Sv} \times 100$$

Table 7. Summary of Onsite Toxicological Consequences Assuming No Controls.

Facility/Vent System	ONSITE TOXICOLOGICAL CONSEQUENCES			Risk Guideline
	Dose from Filter Failure [D,filter]	Dose from Unfiltered Release [D,unfiltered]	Total Onsite Dose [D,onsite]	
SSTs with Active Ventilation	7.36 E-01	1.32 E-02	7.49 E-01	1
SSTs with Passive Ventilation Configuration 1	1.52 E-02	2.72 E-06	1.52 E-02	1
SSTs with Passive Ventilation Configuration 2	5.66 E-03	2.72 E-06	5.67 E-03	1
Double-Contained Receiver Tank	6.38 E-02	1.92 E-03	6.58 E-02	1
DSTs	2.84 E-02	5.50 E-02	8.34 E-02	1
AWF Tanks	1.63 E-01	1.90 E-01	3.53 E-01	1
204-AR Waste Unloading Facility	6.87 E-02	9.40 E-04	6.97 E-02	1
244-AR Vault	6.87 E-02	7.10 E-03	7.58 E-02	1
213-W Dry Waste Compactor Facility	2.84 E-02	0.00	2.84 E-02	1
Catch Tanks	2.84 E-02	0.00	2.84 E-02	1

Table 8. Summary of Offsite Toxicological Consequences Assuming No Controls.

Facility/Vent System	OFFSITE TOXICOLOGICAL CONSEQUENCES			Risk Guideline
	Dose from Filter Failure [D,filter]	Dose from Unfiltered Release [D,unfiltered]	Total Onsite Dose [D,offsite]	
SSTs with Active Ventilation	2.33 E-05	3.10 E-05	5.43 E-05	1
SSTs with Passive Ventilation Configuration 1	4.83 E-07	6.39 E-09	4.89 E-07	1
SSTs with Passive Ventilation Configuration 2	1.79 E-07	6.39 E-09	1.86 E-07	1
Double-Contained Receiver Tank	7.30 E-07	1.60 E-06	2.33 E-06	1
DSTs	3.72 E-06	4.62 E-05	4.99 E-05	1
AWF Tanks	1.91 E-06	1.60 E-04	1.62 E-04	1
204-AR Waste Unloading Facility	8.06 E-07	7.90 E-07	1.60 E-06	1
244-AR Vault	8.06 E-07	5.96 E-06	6.77 E-06	1
213-W Dry Waste Compactor Facility	3.33 E-07	0.00	3.33 E-07	1
Catch Tanks	3.33 E-07	0.00	3.33 E-07	1

8.0 CONCLUSIONS

The onsite and offsite radiological consequences for SSTs with passive ventilation, DCRTs, 204-AR Waste Unloading Facility, 244-AR Vault, the 213-W Dry Waste Compactor Facility, and the catch tanks are below the risk guidelines. As such, no controls are required for these systems.

The offsite radiological consequences for the accident scenario without controls for SSTs (with active ventilation) and DSTs (including aging waste facility tanks) are below the risk guidelines. However, the onsite consequences for SSTs (with active ventilation) and DSTs (including aging waste facility tanks) are above the onsite risk guidelines.

Tables 9 and 10 list the safety-significant SSCs and TSRs, respectively, selected to mitigate the risk of HEPA filter failure due to a fire or heater overtemperature for SSTs (with active ventilation) and DSTs (including aging waste facility tanks). For each safety SSC and TSR, the safety function is described and additional comments are provided as appropriate. Further details regarding the development of these controls is provided in the TWRS FSAR.

The onsite and offsite toxicological consequences for all configurations are below the risk guidelines.

Table 9. Safety Structures, Systems, and
Components for High-Efficiency Particulate Air Filter
Failure-Exposure to High Temperature.

Control	Safety classification	Safety function	Comments
Continuous air monitor-interlock on ventilation system	Safety significant	Prevent the unfiltered release from occurring for more than 10 minutes	Applies to single-shell tanks with active ventilation and double-shell tanks (including aging waste facility tanks)

Table 10. Technical Safety Requirement
Controls for High-Efficiency Particulate Air Filter
Failure-Exposure to High Temperature.

Control	Safety function	Comments
CAM interlock on ventilation system	Detect the high radioactivity and shut off ventilation within 10 minutes. This prevents the potential unfiltered release from occurring for more than 10 minutes	Applies to single-shell tanks (with active ventilation only) and double-shell tanks (including aging waste facility tanks)
<p>HEPA Filter Control Program with the following key elements:</p> <ol style="list-style-type: none"> 1. Periodic radiation survey to monitor HEPA filter loading 2. HEPA filter replacement per change-out criteria, i.e., 2 mSv/h (200 mrem/h) 	Reduce consequences from a possible HEPA filter failure by limiting the inventory available	Applies to all HEPA filters and prefilters in the ventilation system

CAM = continuous air monitor.

HEPA = high-efficiency particulate air (filter).

9.0 REFERENCES

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- WHC-SD-WM-CN-056, 1996, *Fire in a Contaminated Area*, Rev. 2, Westinghouse Hanford Company, Richland, Washington.
- WHC-SD-WM-SAR-009, *Dry Waste Compactor Hazard Identification and Evaluation*, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- WHC-SD-WM-SAR-067, *Tank Waste Remediation System Final Safety Analysis Report*, Chapter 2.0, *Facility and Process Description*, Chapter 3.0, Hazard and Accident Analysis, DRAFT Rev. E (as submitted for DOE Independent Review), Westinghouse Hanford Company, Richland, Washington.
- WHC-SD-WM-SARR-011, *Toxicological Chemical Considerations for Tank Farm Releases*, Rev. 2, Westinghouse Hanford Company, Richland, Washington.
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- WHC-SD-WM-SARR-037, *Development of Radiological Concentration and Unit Liter Doses for Tank Waste Remediation System Final Safety Analysis Report Radiological Consequence Calculations*, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
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APPENDIX A
DEVELOPMENT AND DISCUSSION OF HEPA FILTER RELEASE AMOUNTS

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This appendix discusses the method used to calculate the amount of material on the filters in various tank farm facilities. To do this, WHC-SD-WM-CN-033 modeled 3.7×10^{10} Bq (Ci) of gamma emitters in different filter configurations and calculated the contact doses. Depending on the source material, the gamma emitters are different. For example, single-shell solids are dominated by ^{90}Sr , ^{90}Y , ^{137}Cs and ^{154}Eu for gamma emitters while double-shell liquids are dominated by ^{137}Cs (the other gamma emitters have much smaller concentrations). The spreadsheet tables give the relative amounts for each of the cases that were analyzed.

Different filter geometries were modeled. These include high efficiency particulate air filters and prefilters. After putting in the geometry and the loading, a dose rate (mSv/hr) was calculated.

High efficiency particulate air filters and prefilters have pre-specified operating limits. These were used, along with the calculated dose rate to form a ratio of the operating limit to the calculated dose limit. This gives the fraction of the assumed waste volume that could be loaded on the filter and give the operating limit. The amount of material released from the single bank of filters was calculated using one of the following schemes.

- The system is a standard active ventilation system with a prefilter, a first stage and second stage high efficiency particulate air filter. An additional amount, equal to another prefilter loading, was used to account for material that will come out of the ventilation duct work. That is, two prefilter volumes plus two high efficiency particulate air filter volumes will be used.
- The system is passively ventilated. The system is basically one high efficiency particulate filter sitting on a riser. There is not a prefilter and there is no ventilation ducting to speak of. That is one high efficiency particulate air filter will be used.
- The system has two de-entrainers, a first stage and second stage high efficiency particulate air filter. To account for the loading in the de-entrainers and the material that will come out of the ventilation duct work, an additional volume equivalent to total of five times the loading for one high efficiency particulate filter will be used.
- The system consists of a prefilter, a low efficiency filter (treated as another prefilter), a first stage and second stage high efficiency particulate air filter. In addition, a volume equal to the prefilter will be used to account for material from the ventilation ducting. That is, a total of three prefilter volumes and two high efficiency particulate volumes will be used.

The spreadsheet pages also identify how many filter banks are running at the same time. A total amount of material released from the filters is found by multiplying by the appropriate release fraction. For a filter fire, the release fraction is 1/10,000 of the volume is released. The volumes released are then to be used to calculate radiological and toxicological doses (see Sections 5.0 and 6.0, respectively).

WHC-SD-WM-SARR-037					SX, C-106			SSTs with Passive Breather Filters					
	SST Solids (Bq/L)	SST Liquids (Bq/L)	DST Liquids (Bq/L)	AWF Liquids (Bq/L)	SST Solids on a 3X3 Array of 24x24x12 Filters			SST Solids on a 24x24x12 Filter			SST Solids on a 12x12x12 Filter		
					(Ci)	(Bq)	(L)	(Ci)	(Bq)	(L)	(Ci)	(Bq)	(L)
Co60	4.2E+08	9.5E+06	7.0E+06	7.7E+05									
Sr90	1.6E+12	1.1E+10	4.6E+09	5.6E+09	0.4840	1.8E+10	0.011	0.4840	1.8E+10	0.011	0.4840	1.8E+10	0.011
Y 90	1.6E+12	1.1E+10	4.6E+09	5.6E+09	0.4840	1.8E+10	0.011	0.4840	1.8E+10	0.011	0.4840	1.8E+10	0.011
Cs137	1.0E+11	2.2E+10	5.9E+10	8.8E+10	0.0303	1.1E+09	0.011	0.0303	1.1E+09	0.011	0.0303	1.1E+09	0.011
Eu154	5.8E+09	2.4E+09	4.2E+07	0.0E+00	0.0017	6.3E+07	0.011	0.0017	6.3E+07	0.011	0.0017	6.3E+07	0.011
Np237	3.0E+07	0.0E+00	2.3E+05	9.2E+04									
Pu238	1.9E+08	9.2E+04	1.8E+06	2.8E+03									
Pu239	4.4E+08	3.6E+07	7.7E+06	1.2E+06									
Pu241	3.2E+09	2.6E+08	1.8E+07	3.4E+05									
Am241	2.3E+08	4.2E+07	3.4E+07	1.1E+06									
Cm244	2.3E+06	4.2E+05	1.2E+05	1.1E+04									
				TOTAL	1.00	3.7E+10	0.011	1.00	3.7E+10	0.011	1.00	3.7E+10	0.011
MicroShield Calculated Dose for HEPA (mSv/hr)							0.257			1.77			4.75
HEPA Operating Limit (mSv/hr)							2			2			2
OL/CD							7.7821			1.12994			0.42105
HEPA Loading to give OL (L)							0.08725			0.01267			0.00472
0.01% Release (L)							8.7E-06			1.3E-06			4.7E-07
MicroShield Calculated Dose for Prefilter (mSv/hr)							0.34			No Prefilter			No Prefilter
Prefilter Operating Limit (mSv/hr)							2						
OL/CD							5.88235						
Prefilter Loading to give OL (L)							0.06595						
0.01% Release (L)							6.6E-06						
Volume Released from One Filter Bank (L)						D	3.06E-05		P	1.27E-06		P	4.72E-07
umber of Parallel Banks Operating at the Same Time							2			1			1
TOTAL RELEASED (L)							6.13E-05			1.27E-06			4.72E-07
D = Two HEPA's, a Prefilter, and another volume equal to the prefilter for stuff coming out of the ventilation ducting = 2*HEPA Volume + 2* Prefilter Volume													
P = Passive breather HEPA, no prefilter, no second HEPA, and no appreciable ventilation ducting = 1*HEPA Volume													
A = Two (2) HEPA's, no prefilter but there are two (2) de-entrainers and material in the ventilation ducting (1) = 5*HEPA Volume													
C = Two HEPA's, a prefilter, a low efficiency filter (treated as a prefilter), and another volume equal to the prefilter for stuff coming out of the ventilation ducting = 2*HEPA Volume + 3*Prefilter Volume													

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APPENDIX B
APPROVED INFORMATION VALIDATION FORMS

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PF 304.3

(29)

Information Validation Form

Tracking # MKG-Chapter 3-01

Name of Originator M. K. Gupta/D. S. Leach	1	Organization or Team Chapter 3 Team for TWRS FSAR	2	Date 4/12/96	3
Statement of Problem The dose rate at 30cm from HEPA filters in the TWRS would be less than 150 mrem/hr					
4					
Alternatives			Consequences to Alternatives		
5			6		
Decision Reached			Basis for Decision		
7			8		
Date Requested 9 4/23/96	Sent To 10 Lankford Ruffin		Date Requested By 11 M. K. Gupta/D. S. Leach		
Response #1: Health Physics Technicians (HPT's) perform weekly HEPA filter radiation surveys per the attached task description. These surveys are taken "on contact" 1-2 CM from the filters. If levels were to reach 160 MR/HR, preparations would be made to change out the HEPA filters prior to reaching 200 MR/HR on contact. Dose levels at 30 CM would be at least 10 times less than on contact. Therefore, it is not expected that levels at 30 CM would ever exceed 150 MR/HR under normal conditions.					
12					
Response #2					
13					

<p>Attachments (List)</p> <p>1. Scheduled radiation survey tank description WTF-W-2.</p> <p>14</p>	<p>References (List) 15</p>
<p>Responder #1 Name and Signature</p> <p>16 <i>R.P. Tucker TWT/TH 4/23/96</i></p>	<p>Responder #2 Name and Signature</p> <p>17</p>
<p>POC: Filed: Routed:</p>	
<p>Further Action Required (i.e., RML, Senior Management Attention, etc.)</p> <p>18</p>	

Radiological Control SCHEDULED RADIATION SURVEY TASK DESCRIPTION	Task No. WTF-W-2	Frequency Weekly	RMP No. N/A
Governing Directive HSRCH 552.1.1.d	Issue Date 01/02/96 Rev. 0		

Area: West Tank Farms
Building: N/A
Location(s): Active Exhausters

Descriptions:

- Take contact radiation readings on the HEPA filters, and pre-filters of active exhausters.
- Document the survey results on a Radiological Survey Report

Special Circumstances: None

Required Instrumentation:

CP and/or RO 2 dose rate instrument.

Action Levels:

- Immediately contact Shift Operations and RC Management of readings of greater than 150 mR/hr for primary filters and 80 mR/hr for pre-filters. (These readings are 80% of OSR notification readings.)
- Any conditions inconsistent with radiological postings.

Notification or Actions (If Action Levels exceeded):

- Notify First Line Radiological Control Manager & WTF Operations Shift Manager
- Establish appropriate radiological postings and area control.
- Initiate a Radiological Problem Report.
- Document all actions and notifications in the RC Shift Log.

RC Manager (Print and Sign)	Approved By RC Section/Unit Manager (Print and Sign)
--	---

Information Validation Form

Tracking # MKG-Chapter 3-02

Name of Originator M. K. Gupta/D. S. Leach	1	Organization or Team Chapter 3 Team for THRS FSAR	2	Date August 12, 1996	3
<p>Statement of Problem</p> <p>The following dimensions and number of filters on different ventilation systems bound the all the different ventilation systems that have HEPA filters and pre-filters in them.</p> <ol style="list-style-type: none"> SSTs with active ventilation - 3 by 3 array of 24x24x12 filters - 2 HEPAs and 1 prefilter SSTs with Passive Breather Filters - 24x24x12 filter - 1 HEPA and no prefilter SSTs with Passive Breather Filters - 12x12x12 filter - 1 HEPA and no prefilter DCRTs - 12x12x12 filter - 2 HEPAs and 1 prefilter DSTs - 24x24x12 filter - 2 HEPAs and 1 prefilter AWF tanks - 24x24x12 filter - 2 HEPAs, no prefilter, and 2 de-entrainers 204-AR and 244-AR - 24x24x12 filter - 2 HEPAs, 1 prefilter, and 1 low efficiency filter 					
<p>Alternatives</p> <p>The number of filters and their dimensions are different from above.</p> <p>5</p>			<p>Consequences to Alternatives</p> <p>Change in the numbers of filters or their dimensions might impact the results of the analysis.</p> <p>6</p>		
<p>Decision Reached</p> <p>7</p>			<p>Basis for Decision</p> <p>8</p>		
<p>Date Requested</p> <p>9 August 22, 1996</p>		<p>Sent To</p> <p>10 Lankford Ruffin</p>		<p>Date Requested By</p> <p>11 M. K. Gupta/D. S. Leach</p>	
<p>Response #1 See attached dimensions information as provided by East Ventilation Cog. Eng.</p> <p>12</p>					
<p>Response #2</p> <p>13</p>					
<p>Attachments (List)</p> <p>14</p>			<p>References (List) 15</p>		

Responder #1 Name and Signature	Responder #2 Name and Signature.
16 Lankford Ruffin <i>[Signature]</i> 9-22-76	17
POC:	Filed: Routed:
Further Action Required (i.e., RML, Senior Management Attention, etc.)	
18	

East Tank Farms Emission Control Devices

Facility (Exhaust System)	Filter(s)	Size (INCHES)
DSIs		
Z41-AM Tank Primary	2 HEPA Filters in Series, 1 Pre-Filter, 1 Deentrainer	24x24x12
Z41-AY/AZ Tank Primary	12 HEPA Filters, 6 sets, 2 Filters per set, 2 Deentrainer	24x24x12
Z41-AY/AZ(Backup-4000 CFM)	8 HEPA Filters, 4 sets, 2 Filters per set, 2 Deentrainer	24x24x12
Z41-AP Tank Primary	2 HEPA Filters in Series, 1 Pre-Filter, 1 Deentrainer	24x24x12
Z41-AW Tank Primary	2 HEPA Filters in Series, 1 Pre-Filter, 1 Deentrainer	24x24x12
Z41-AY-101 Tank Annulus	2 HEPA Filters in Series	24x24x12
Z41-AY-102 Tank Annulus	2 HEPA Filters in Series	24x24x12
Z41-AZ Tank Annulus	4 HEPA Filters, 2 sets, 2 Filters per set, 1 set per Tank	24x24x12
Z41-AM Tank Annulus	4 HEPA Filters, 2 sets, 2 Filters per set, 2 Deentrainer	24x24x12
Z41-AP Tank Annulus	2 HEPA Filters in Series	24x24x12
Z41-AW Tank Annulus	4 HEPA Filters, 2 sets, 2 Filters per set, 2 Deentrainer	24x24x12
SSIs		
Z41-C-105/106 Tank(Active)	2 HEPA Filters in Series, 1 Pre-Filter, 1 Deentrainer	24x24x12
SSIs Passive B eather Filter	1 HEPA Filter	12x12x12
DCRT		
Z44-A DCRT	2 HEPA Filters in Series, 1 Pre-Filter (150 CFM)	12" Diameter (150 CFM)
Z44-BX DCRT	4 HEPA Filters, 2 sets, 2 Filters per set, 1 Pre-Filter per set	12x12x6(125 CFM)

est

others		
244-AR Vessel Vent	4 HEPA Filters, 2 sets, 2 Filters per set	24x24x12
244-AR Cell & Canyon	2 HEPA Filters in Series	24x24x12
244-CR Vault	2 HEPA Filters in Series, 1 Pre-Filter	24x24x12
204-AR Unloading Area	2 HEPA Filters, 2 sets, 1 Filter per set, 1 Pre-Filter per set	24x24x12
Series with 1 HEPA Filter, 1 Deentrainer		
209-E Critical by Lib.	2 HEPA Filters in Series, 1 Pre-Filter	24x24x12

2 filters on-line @ a given time.

244-AR Comp - 1st Bank 24 filters
 2nd Bank 27 filters
 3rd Bank 38 filters
 4th " 6 filter

24x24x12

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APPENDIX C
DETAILED CONSEQUENCE ANALYSIS RESULTS

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Facility/Vent System	ONSITE RADIOLOGICAL CONSEQUENCES (ASSUMING NO CONTROLS)						
	Amount of Waste Released from HEPA Filter (L)	Particulate Release Rate (L/s)	Dose from Filter Failure [D, filter] (Sv)	Dose from 12 h Unfiltered Release [D, 12 hour] (Sv)	Dose from Annual Unfiltered Release [D, annual] (Sv)	Total Onsite Dose (12 h Release) [D, onsite (12 h)] (Sv)	Total Onsite Dose (Annual Release) [D, onsite (annual)] (Sv)
SSTs with Active Ventilation	6.13 E-05	3.3 E-07	1.52 E-04	5.73 E-03	7.12 E-02	5.89 E-03	7.14 E-02
SSTs with Passive Ventilation Configuration 1	1.27 E-06	6.8 E-11	3.14 E-06	1.18 E-06	1.47 E-05	4.33 E-06	1.78 E-05
SSTs with Passive Ventilation Configuration 2	4.72 E-07	6.8 E-11	1.17 E-06	1.18 E-06	1.47 E-05	2.35 E-06	1.59 E-05
Double-Contained Receiver Tank	2.28 E-05	2.0 E-07	2.82 E-06	1.74 E-04	2.16 E-03	1.77 E-04	2.16 E-03
DSTs	9.79 E-06	5.5 E-06	6.72 E-07	2.65 E-03	3.29 E-02	2.65 E-03	3.29 E-02
AWF Tanks	5.62 E-05	1.9 E-05	8.85 E-07	2.10 E-03	2.61 E-02	2.10 E-03	2.61 E-02
204-AR Waste Unloading Facility	2.37 E-05	9.4 E-08	1.63 E-06	4.53 E-05	5.63 E-04	4.69 E-05	5.64 E-04
244-AR Vault	2.37 E-05	7.1 E-07	1.63 E-06	3.42 E-04	4.25 E-03	3.44 E-04	4.25 E-03
213-W Dry Waste Compactor Facility	9.79 E-06	0.0 E+00	6.72 E-07	0.0 E+00	0.0 E+00	6.72 E-07	6.72 E-07
Catch Tanks	9.79 E-06	0.0 E+00	6.72 E-07	0.0 E+00	0.0 E+00	6.72 E-07	6.72 E-07
ULDs							Standard Man Breathing Rate
		Inhalation	Ingestion				(m3/s)
		(Sv/L)	(Sv m3)/(s L)				2.70E-04
SST Liquids		1.1E+04	0.052				3.30E-04
SST Solids		2.2E+05	4.1				
DST Liquids		6.1E+03	0.068				
AWF Liquids		1.4E+03	0.092				
Dispersion Coefficients							Release Period (s)
		onsite	offsite			86400	
		(s/m3)	(s/m3)			43200	
acute		3.41E-02	2.83E-05			31536000	
12 hour		5.54E-03	NA				
24 hour		N/A	4.62E-06				
annual		4.03E-04	1.24E-07				
						Occupancy Factor	
						0.286	

[illegible]

Facility/Vent System	Amount of Waste Released from HEPA Filter (L)	Particulate Release Rate (L/s)	ONSITE TOX. CONSEQUENCES (ASSUMING NO CONTROLS)			OFFSITE TOX. CONSEQUENCES (ASSUMING NO CONTROLS)		
			Dose from Filter Failure [D, filter]	Dose from Unfiltered Release [D, unfiltered]	Total Onsite Dose [D, onsite]	Dose from Filter Failure [D, filter]	Dose from Unfiltered Release [D, unfiltered]	Total Onsite Dose [D, offsite]
SSTs with Active Ventilation	6.13 E-05	3.3 E-07	7.36 E-01	1.32 E-02	7.49 E-01	2.33 E-05	3.10 E-05	5.43 E-05
SSTs with Passive Ventilation Configuration 1	1.27 E-06	6.8 E-11	1.52 E-02	2.72 E-06	1.52 E-02	4.83 E-07	6.39 E-09	4.89 E-07
SSTs with Passive Ventilation Configuration 2	4.72 E-07	6.8 E-11	5.66 E-03	2.72 E-06	5.67 E-03	1.79 E-07	6.39 E-09	1.86 E-07
Double-Contained Receiver Tank	2.28 E-05	2.0 E-07	6.38 E-02	1.92 E-03	6.58 E-02	7.30 E-07	1.60 E-06	2.33 E-06
DSTs	9.79 E-06	5.5 E-06	2.84 E-02	5.50 E-02	8.34 E-02	3.72 E-06	4.62 E-05	4.99 E-05
AWF Tanks	5.62 E-05	1.9 E-05	1.63 E-01	1.90 E-01	3.53 E-01	1.91 E-06	1.60 E-04	1.62 E-04
204-AR Waste Unloading Facility	2.37 E-05	9.4 E-08	6.87 E-02	9.40 E-04	6.97 E-02	8.06 E-07	7.90 E-07	1.60 E-06
244-AR Vault	2.37 E-05	7.1 E-07	6.87 E-02	7.10 E-03	7.58 E-02	8.06 E-07	5.96 E-06	6.77 E-06
213-W Dry Waste Compactor Facility	9.79 E-06	0.0 E+00	2.84 E-02	0.00 E+00	2.84 E-02	3.33 E-07	0.00 E+00	3.33 E-07
Catch Tanks	9.79 E-06	0.0 E+00	2.84 E-02	0.00 E+00	2.84 E-02	3.33 E-07	0.00 E+00	3.33 E-07
Note: for toxicological calculations DST and AWF are synonymous								
Toxic Sum-of-Fractions of Risk Guidelines per Liter, 10+0 to 10-2 frequency range								
Continuous Release								
	(s/L)							
	DST Solids	DST Liquids	SST Solids	SST Liquids				
Onsite	1.8E+04	1.0E+04	4.0E+04	9.6E+03				
Offsite	1.9E+02	8.4E+00	9.4E+01	8.0E+00				
Puff Release								
	(1/L)							
	DST Solids	DST Liquids	SST Solids	SST Liquids				
Onsite	5.2E+03	2.9E+03	1.2E+04	2.8E+03				
Offsite	7.7E-01	3.4E-02	3.8E-01	3.2E-02				

ONSITE RADIOLOGICAL CONSEQUENCES (ASSUMING CONTROLS)					
Facility/Vent System	Amount of Waste Released from HEPA Filter (L)	Particulate Release Rate (L/s)	Dose from Filter Failure [D, filter] (Sv)	Dose from 10 min. Unfiltered Release [D, 10 min.] (Sv)	Total Onsite Dose (12 h Release) [D, onsite (12 h)] (Sv)
SSTs with Active Ventilation	6.13 E-05	3.3 E-07	1.52 E-04	7.96 E-05	2.31 E-04
DSTs	9.79 E-06	5.5 E-06	6.72 E-07	3.68 E-05	3.75 E-05
AWF Tanks	5.62 E-05	1.9 E-05	8.85 E-07	2.92 E-05	3.01 E-05
		ULDs	Standard Man Breathing Rate		
		Inhalation (Sv/L)	Ingestion (Sv m3)/(s L)	(m3/s)	
SST Liquids		1.1E+04	0.052	2.70E-04	
SST Solids		2.2E+05	4.1	3.30E-04	
DST Liquids		6.1E+03	0.068		
AWF Liquids		1.4E+03	0.092		
		Dispersion Coefficients	Release Period (s)		
		onsite (s/m3)	offsite (s/m3)	86400	
				43200	
acute		3.41E-02	2.83E-05	31536000	
12 hour		5.54E-03	NA		
24 hour		N/A	4.62E-06		
annual		4.03E-04	1.24E-07		

APPENDIX D
PEER REVIEW AND HEDOP REVIEW CHECKLISTS

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CHECKLIST FOR PEER REVIEW

Document Reviewed: WHC-SD-WM-CN-062, Rev. 2, HEPA Filter Failure by Fire or Heater Overtemperature and Subsequent Unfiltered Release

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.

B.D. Board *B.D. Board*
 Reviewer (Printed Name and Signature)

12/7/96

Date

* Any calculations, comments, or notes generated as part of this review should be signed, dated and attached to this checklist. Such material should be labeled and recorded in such a manner as to be intelligible to a technically qualified third party.

HEDOP REVIEW CHECKLIST
for
Radiological and Nonradiological Release Calculations

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

Document Reviewed: WHC-SD-WM-CN-062, Rev. 2, *HEPA Filter Failure by Fire or Heater Overtemperature and Subsequent Unfiltered Release.*

Submitted by: Grant W. Ryan

Date Submitted: 11/18/96

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.

DA Himes 12/7/96
HEDOP-Approved Reviewer (Printed Name and Signature) Date

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

DISTRIBUTION SHEET

To	From	Page 1 of 1			
Distribution	G. W. Ryan	Date 12/10/96			
Project Title/Work Order		EDT No. N/A			
HEPA Filter Failure by Fire or Heater Overtemperature and Subsequent Unfiltered Release		ECN No. 605037			
Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
D. S. Leach	A3-34	X			
TWRS S & L Project Files (6)	A2-26	X			
G. W. Ryan (2)	A3-37	X			
Central Files (Original + 1)	A3-88	X			