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Fire in a Contaminated Area

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

Fire in Contaminated Area

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

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FIRE IN A CONTAMINATED AREA

REVISION 0

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

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LIST OF TERMS

AED	aerodynamic equivalent diameter
ARF	airborne release fraction
AWF	aging waste facility
CEDE	committed effective dose equivalent
DR	damage ratio
DST	double-shell tank
FSAR	final safety analysis report
HEDOP	Hanford Environmental Dose Overview Panel
IVF	information validation form
LPF	leak path factor
MAR	material-at-risk
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
UNH	uranyl nitrate hexahydrate
vol%	volume percent
WHC	Westinghouse Hanford Company

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FIRE IN A CONTAMINATED AREA

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):

Fire in Contaminated Area.

ACCIDENT SCENARIO DEVELOPMENT AND DESCRIPTION

Numerous contaminated areas exist within TWRS facilities that are susceptible to releasing hazardous material in the event of a fire. A significant number of these contaminated areas are associated with the waste transfer system. Some of the contaminated areas in the waste transfer system that are routinely accessed include valve pits, pump pits, and diversion boxes. These structures, while being mainly underground, do extend above ground, presenting a hazard associated with the fuel tanks of vehicles operating within close proximity.

The hazard analysis performed for the tank farms identified numerous causes for a fire in a contaminated area. Some of the causes included human error in positioning a crane load, pump motor electrical failure, or a vehicle being driven over a pit cover that ruptures the fuel tank.

Evaluation of the hazards and associated causes allowed the identification of an unmitigated accident scenario that represents a set of hazardous conditions related to fires in contaminated areas. In the unmitigated accident scenario analyzed, a human error occurs such that a crane is positioned near a pit. The fuel tank of the crane or nearby support vehicle hits the pit curb and spills gasoline into the open pit. An ignition source is present and the gasoline in the pit catches fire. Convection from the fire sweeps the hazardous material out of the pit into the atmosphere where it is transported away from the accident location by wind and other atmospheric dispersion phenomena.

The analysis of this unmitigated accident scenario specifically bounds the release of radioactive or toxic materials from a vehicle carrying small waste samples or contaminated equipment due to a vehicle fire.

ACCIDENT FREQUENCY DEVELOPMENT

A frequency of *anticipated* was qualitatively assigned to this unmitigated accident scenario. Subsequent investigation showed the frequency of the unmitigated accident to be "beyond extremely unlikely" based on the number of miles per year travelled by a crane or support vehicle near a pit and the vehicle accident statistics involving fires compiled by the U.S. Department of Transportation (Appendix A).

Nevertheless, 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.

2.0 ANALYSIS INPUT

- Unit Liter Doses (ULD) for aging waste are given below in Table 1 (Cowley 1996).

Table 1. ULD for Aging Waste.

Waste Material	Inhalation ULD (Sv/L)	Ingestion ULD (Sv-m ³ /s-L)
AWF Solids	1.7×10^6	8.1
AWF Liquids	1.4×10^3	0.092

Integrated Atmospheric Coefficients for both onsite and offsite receptors from Van Keuren (1996a) are given in Table 2. The integrated X/Q' values are used for releases less than 2 hours in duration.

Table 2. Atmospheric Dispersion Coefficients.

Receptor	Integrated X/Q' (s/m ³)
Onsite	3.41×10^{-2}
Offsite	2.83×10^{-5}

- Dimensions of typical valve pit - The typical valve pit is 12 feet in length and 10 feet wide (inside dimension). A drain is located in one corner approximately 1 foot from the walls. The floor of the pit is sloped from the 4 walls to the drain. The elevation of the floor walls of the pit is 1.5 inches higher than at the drain (see Appendix B for a sketch of a typical valve pit). Additionally, see the approved information validation form (IVF) for this accident scenario in Appendix C.

3.0 ASSUMPTIONS

- It is assumed that the material at risk is bounded by a one inch deep layer of dried out aging waste material on the floor of a valve pit around the drain. This is based on the observation that the lip of the drain may protrude as much as one inch above the floor in some pits. A typical valve pit was chosen because it is larger than the other types of pits that may contain contaminated material.
- Waste composition is assumed to be 67 vol% Aging Waste Facility (AWF) liquids and 33 vol% AWF solids. This is bounding for all possible Hanford waste transfers (Cowley 1996).
- It is assumed that all of the hazardous material is available to be released during the fire and that the resuspension of any hazardous material left at the bottom of the pit as a result of the fire is negligible. This is a reasonable assumption since resuspension rate

from the floor of a pit several feet below ground would be several orders of magnitude below the suspension rate due to thermal stress (DOE-HDBK-3010-94).

- For purposes of calculating radiological dose consequences, the fire is assumed to last for less than two hours. This means that the more conservative acute 99.5 percentile integrated atmospheric dispersion coefficient X/Q' without plume meander is used to calculate dose consequence (Van Keuren 1996a).
- The airborne release fraction (ARF) and respirable fraction (RF) discussed in Mishima for the thermal stress of noncombustible powders was used in the analysis (DOE-HDBK-3010-94, p. 4-61). This assumption bounds the release of powders and the release from contaminated surfaces (DOE-HDBK-3010-94, pp. 4-61 and 5-21) due to thermal stress. The $ARF \times RF$ for liquid uranyl nitrate hexahydrate (UNH) under a gasoline fire with a 1 m/s wind is about a factor of three greater than the $ARF \times RF$ for powders. This accident, however, will most likely involve the release of particulate from a contaminated surface rather than from a boiling liquid. For this reason the assumed $ARF \times RF$ value for noncombustible powders is believed to be sufficiently conservative.
- Toxicological exposure consequences depend on the concentration of toxic material in the air (Van Keuren 1996b). Since the risk acceptance guidelines are stated in 15 minute averages, it was conservatively assumed that all of the combustible material was consumed and released in the first 15 minutes of the fire (although the fire is assumed to last for a longer period of time).
- A crane or a support vehicle travels no more than 150 m per day close enough to a pit for fuel from a ruptured fuel tank to flow into the pit. An assumption regarding the distance traveled by vehicles in and around pits is required in order to estimate an accident frequency.

4.0 ANALYTICAL METHODS AND CALCULATIONS

The analyzed unmitigated accident bounds the consequences for any of the hazards associated with fires in contaminated areas. The accident scenario assumes a one inch layer of dried out waste in the form of a powdery residue on the bottom of a valve pit. Fuel spills into the pit from a ruptured fuel tank and ignites. Both radioactive and toxic particulates are released to the atmosphere as influenced by the fire.

Airborne Source Term Released:

The first step in calculating the dose is to derive the airborne source term, i.e., the amount of airborne radioactive material generated by the accident that is available for transport to the maximum onsite and offsite individuals. As presented in *Airborne Release Fractions/Rates and Respirable*

Fractions for Nonreactor Nuclear Facilities (DOE-HDBK-3010-94), the airborne source term is typically estimated by the following formula:

$$\text{Source term (Q)} = \text{MAR} \times \text{DR} \times \text{ARF} \times \text{RF} \times \text{LPF}$$

where

MAR = material-at-risk

DR = damage ratio

ARF = airborne release fraction

RF = respirable fraction

LPF = leak path factor.

The MAR is the amount of material available to be acted on by accident-induced physical stresses such as temperature or pressure. The DR is the fraction of the MAR actually impacted by the accident. An interdependency exists between the MAR and the DR, i.e., if it is predetermined that certain types of material will not be affected by a given accident, that material can be excluded from the MAR. In other words, the DR can be accounted for when defining the MAR.

The ARF is the coefficient used to estimate the amount of material suspended in air by the accident as an aerosol and thus available for transport due to the physical stresses of a specific accident. For mechanisms that continuously act to suspend material (e.g., a spray release), an ARF is required to estimate the potential airborne release from postulated accident conditions.

The RF is the fraction of airborne particles that can be transported through air and inhaled into the pulmonary region of the human respiratory system, and includes particles having a 10- μm aerodynamic equivalent diameter (AED) or less (DOE-HDBK-3010-94). The AED is the diameter of sphere of density (1 g/cm³) that exhibits the same terminal velocity as the particle in question.

The LPF is the fraction of the material in the aerosol transported through some confinement deposition or filtration mechanism. Leak path factors are developed as applicable based upon (1) established relationships among the size of the particulate material, airborne transport mechanisms, and losses by deposition; or (2) specified filtration efficiencies (DOE-HDBK-3010-94).

Material at Risk (MAR) and Damage Ratio (DR)

The MAR is calculated for a 2.54 cm (1-in.) layer of aging waste on the floor of a valve pit that is 3.048 m (10 ft) wide by 3.6576 m (12 ft) long. The drain is located near the corner of the pit. The elevation of the pit at the drain is 3.81 cm (1.5-in.) lower than at the walls (see Section 2.0,

Analysis Input). Based on the above dimensions the volume of the aging waste on the pit floor is calculated using the equation for the volume of a pyramid.

$$V_{\text{pyramid}} = 1/3 \cdot (A)(h)$$

Where: A is the area of the base
h is the height of the pyramid

The area of the pyramid based formed by the waste on the pit floor is related to its height. For waste filling the pit 2/3 of the distance to the walls (i.e., 2.54 cm [1 in.] of waste in a pyramid shaped container 3.81 cm [1.5 in.] deep), the area will be:

$$A_{\text{waste}} = 2/3(L_{\text{pit}}) \cdot 2/3(W_{\text{pit}})$$

Combining with the previous equation gives:

$$V_{\text{pyramid}} = 1/3 \cdot [2/3(L_{\text{pit}}) \cdot 2/3(W_{\text{pit}})](h)$$

Calculating the volume of waste gives:

$$(1/3)[(2/3)(3.048 \text{ m}) \cdot (2/3)(3.6576 \text{ m}) \cdot (0.0254 \text{ m}) \cdot (1000 \text{ L/m}^3)] \cong 42.0 \text{ L}$$

The calculation of the MAR takes into account the fact that the floor slopes towards the drain from all 4 walls (See the sketch of the pit and floor in Appendix B) and assumes that the 4 floor segments intersect at the drain. No credit is taken for the volume occupied by the protruding drain.

Since all of the waste material in the pit is assumed to be involved (i.e., exposed to the fire), the damage ratio (DR) equals 1.

Airborne Release Fraction (ARF), Respirable Fraction (RF), and Leak Path Factor (LPF)

In the above scenario release and dispersion of airborne particles comes from the heating of waste material in a gasoline fire. The airborne release due to the fire was conservatively assumed to be sufficiently bounded by the ARF and RF for noncombustible powders under thermal stress (DOE-HDBK-3010-94, p. 4-61). These values are:

$$\begin{aligned} \text{ARF} &= 6.0 \times 10^{-3} \\ \text{RF} &= 2.0 \times 10^{-2} \end{aligned}$$

Once the waste is aerosolized by the fire it leaks directly to the atmosphere, LPF = 1.

Calculation of the Airborne Source Term Released in this Accident Scenario

$$\begin{aligned} \text{Source Term (Q)} &= \text{MAR} \times \text{DR} \times \text{ARF} \times \text{RF} \times \text{LPF} \\ &= (42.0 \text{ L}) \cdot (1) \cdot (6.0 \times 10^{-3}) \cdot (2.0 \times 10^{-2}) \cdot (1) \\ \text{Source Term (Q)} &= 5.0 \times 10^{-3} \text{ L} \end{aligned}$$

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:

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

where

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

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

Q = respirable source term (L)

X/Q' = atmospheric dispersion coefficient without plume meander (s/m^3)

R = breathing rate (for acute exposure, $3.3 \times 10^{-4} m^3/s$)

ULD_{inh} = inhalation unit liter dose (Sv/L, calculated below)

ULD_{ing} = ingestion unit liter dose (Sv/L, calculated below).

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.

Calculation of the Unit Liter Doses for Source Term in this Scenario

The source material for this accident was assumed to be AWF waste composed of 33 vol% solids and 67 vol% liquids. Therefore, using the ULDS for AWF liquids and solids given in Table 1 gives:

$$\begin{aligned}
 ULD_{\text{inhal}} &= (1.7 \times 10^6 \times 0.33 + 1.4 \times 10^3 \times 0.67) \frac{\text{Sv}}{\text{L}} \\
 &= 5.62 \times 10^5 \frac{\text{Sv}}{\text{L}}
 \end{aligned}$$

$$\begin{aligned}
 ULD_{\text{ing}} &= (8.1 \times 0.33 + 0.092 \times 0.67) \frac{\text{Sv} \cdot \text{m}^3}{\text{s} \cdot \text{L}} \\
 &= 2.73 \frac{\text{Sv} \cdot \text{m}^3}{\text{s} \cdot \text{L}}
 \end{aligned}$$

Radiological Inhalation Dose Consequence

$$\begin{aligned}
 D_{\text{onsite}} &= 5.0 \times 10^{-3} \text{ L} \times 3.41 \times 10^{-2} \frac{\text{s}}{\text{m}^3} \times 3.3 \times 10^{-4} \frac{\text{m}^3}{\text{s}} \times 5.62 \times 10^5 \frac{\text{Sv}}{\text{L}} \\
 &= 3.16 \times 10^{-2} \text{ Sv}
 \end{aligned}$$

$$\begin{aligned}
 D_{\text{offsite}} &= 5.0 \times 10^{-3} \text{ L} \times 2.83 \times 10^{-5} \frac{\text{s}}{\text{m}^3} \times 3.3 \times 10^{-4} \frac{\text{m}^3}{\text{s}} \times 5.62 \times 10^5 \frac{\text{Sv}}{\text{L}} \\
 &= 2.62 \times 10^{-5} \text{ Sv}
 \end{aligned}$$

Radiological Ingestion Dose Consequence

Ingestion doses are only calculated for the offsite receptor (Cowley 1996).

$$\begin{aligned}
 D_{\text{offsite}} &= 5.0 \times 10^{-3} \text{ L} \times 2.83 \times 10^{-5} \frac{\text{s}}{\text{m}^3} \times 2.73 \frac{\text{Sv} \cdot \text{m}^3}{\text{s} \cdot \text{L}} \\
 &= 3.86 \times 10^{-7} \text{ Sv}
 \end{aligned}$$

Total Radiological Dose Consequences

$$D_{\text{onsite}} = 3.16 \times 10^{-2} \text{ Sv}$$

$$D_{\text{offsite}} = 2.66 \times 10^{-5} \text{ Sv}$$

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 is multiplied by the ARR and then multiplied by the appropriate sum-of-fraction (SOF) value from Table 3-8 of Van Keuren (1996). Table 3-8 of Van Keuren (1996b) is included in Appendix D and the important values for this scenario are reproduced in Table 3 below.

Table 3. Sum-of-Fraction of Risk Guidelines for a Unit Release of Chemicals. (from Table 3-8, Van Keuren [1996])

Tank Waste (Units of Sum-of-Fractions follow Tank Waste Type)*	Maximum Individual	Accident Frequency $>10^{-2}$
Double-Shell Liquids (s/L)	Onsite	1.0×10^4
Double-Shell Liquids (s/L)	Offsite	8.4
Double-Shell Solids (s/L)	Onsite	1.8×10^4
Double-Shell Solids (s/L)	Offsite	1.9×10^2

* The sum-of-fraction values for the double-shell liquids and solids include the source term values for the aging waste facility liquids and solids, respectively.

Composite sum-of-fraction values are calculated for the 67 vol% Aging Waste Facility (AWF) liquids and 33 vol% AWF solids just as for the radiological source term.

$$\begin{aligned}\text{SOF}_{\text{onsite}} &= (.33) \cdot (1.8 \times 10^4 \text{ s/L}) + (.67)(1.0 \times 10^4 \text{ s/L}) \\ &= 1.3 \times 10^4 \text{ s/L}\end{aligned}$$

$$\begin{aligned}\text{SOF}_{\text{offsite}} &= (.33) \cdot (1.9 \times 10^2 \text{ s/L}) + (.67)(8.4 \text{ s/L}) \\ &= 6.8 \times 10^1 \text{ s/L}\end{aligned}$$

For purposes of calculating toxic releases, an accident duration time of 15 minutes (900 s) is conservatively assumed. This gives an airborne release rate (ARR) of:

$$\begin{aligned}\text{ARR} &= 1/900 \text{ s} \\ &= 1.1 \times 10^{-3} \text{ s}^{-1}\end{aligned}$$

The amount released (Q) in the accident scenario, as calculated previously, was 5.0×10^{-3} L. This amount of waste is conservatively assumed to be released in the first 15 minutes of the fire, although the fire is likely to last longer, as discussed in the *Assumptions*.

The toxicological exposure consequences are therefore calculated using the equation:

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

The exposure consequences (D_{onsite}) to the onsite receptor are:

$$\begin{aligned} D_{\text{onsite}} &= (5.0 \times 10^{-3} \text{ L}) \cdot (1.1 \times 10^{-3} / \text{s}) \cdot (1.3 \times 10^4 \text{ s/L}) \\ &= 7.2 \times 10^{-2} \end{aligned}$$

The exposure consequences (D_{offsite}) to the onsite receptor are:

$$\begin{aligned} D_{\text{offsite}} &= (5.0 \times 10^{-3} \text{ L}) \cdot (1.1 \times 10^{-3} / \text{s}) \cdot (6.8 \times 10^1 \text{ s/L}) \\ &= 3.7 \times 10^{-4} \end{aligned}$$

7.0 ANALYSIS RESULTS

The results of the calculations (both radiological doses and toxicological exposures) are given in Table 4. The radiological results are well within risk evaluation guidelines for offsite receptors but over the risk evaluation guidelines for an onsite receptor for an *anticipated* event.

The toxicological exposure consequence results are well within the guidelines for both onsite and offsite receptors.

Table 4. Radiological Dose and Toxicological Exposure Consequences for Fire in a Contaminated Area Accident Scenario.

Unmitigated Accident Frequency: Anticipated				
Consequences: The calculated radiological dose exceeds the onsite guideline for an anticipated event but is within guidelines for an estimated event frequency of either unlikely or extremely unlikely.				
Receptor/ Hazard	Calculated Dose/Exposure	Risk Guidelines		
		Anticipated	Unlikely	Extremely Unlikely
Offsite/ Radiological	2.7×10^{-3} rem	0.1 rem	0.5 rem	4 rem
Onsite/ Radiological	3.2 rem	0.5 rem	5 rem	10 rem
Offsite/ Toxicological	3.7×10^{-4}	1	1	1
Onsite/ Toxicological	7.2×10^{-2}	1	1	1

8.0 CONCLUSIONS

For an offsite receptor the calculated radioactive dose consequences are well within the risk evaluation guidelines. However, for an onsite receptor, the calculated radiological dose is above the risk guidelines for an *anticipated* event. The toxicological exposure consequence results are well within the guidelines for both onsite and offsite receptors.

Since the onsite guidelines are exceeded for this unmitigated accident with a frequency of *anticipated*, controls are necessary to either mitigate or prevent the hazards associated with this accident scenario and are documented in the TWRS FSAR.

9.0 REFERENCES

- Van Keuren, J. C., 1996a, 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.
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APPENDIX A
ACCIDENT FREQUENCY DEVELOPMENT

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This accident is caused by a human error in positioning a crane or support vehicle. The hazard analysis placed this accident in the "Anticipated" category with frequency $>10^{-2}$ per year. However, an unmitigated accident frequency can be calculated for this, given the number of miles per year by a crane or support vehicle near a pit and the vehicle accident statistics involving fires compiled by the U.S. Department of Transportation (DOT) (Harwood and Russel 1990).

The highest accident frequency per mile for trucks operating on a rural roadway is according to data compiled in (Harwood and Russel 1990).

$$f_{\text{init}} = 4.5 \times 10^{-6} \frac{\text{collision}}{\text{mile}}$$

This is approximately the per mile accident rate recommended for Hanford Site and is considered to be conservative for congested areas (H&R 522-1, 1995, p. B-7).

The total distance traveled in a year by a crane or a support vehicle near a pit is

$$\begin{aligned} d &= 365 \frac{\text{day}}{\text{year}} \times 150 \frac{\text{m}}{\text{day}} \times \frac{\text{mile}}{1609\text{m}} \\ &= 34 \frac{\text{mile}}{\text{year}} \end{aligned}$$

The accident initiation frequency per year for the collision of a vehicle with a pit is

$$\begin{aligned} f &= 4.5 \times 10^{-6} \frac{\text{collision}}{\text{mile}} \times 34 \frac{\text{mile}}{\text{year}} \\ &= 1.5 \times 10^{-4} \frac{\text{collision}}{\text{year}} \end{aligned}$$

The frequency of a fire resulting from a collision not involving another vehicle is (Ref. 6)

$$t_{\text{fire}} = 6 \times 10^{-3} \frac{\text{fire}}{\text{collision}}$$

Therefore, the unmitigated event frequency for a fire in a pit due to a collision with a pit curb is estimated to be

$$\begin{aligned} f &= 6 \times 10^{-3} \frac{\text{fire}}{\text{collision}} \times 1.5 \times 10^{-4} \frac{\text{collision}}{\text{year}} \\ &= 9.0 \times 10^{-7} / \text{year} \end{aligned}$$

This frequency is per vehicle and would need to be multiplied by the total number of vehicles available that may operate in or near locations where this hazard is present.

APPENDIX B
SKETCHES OF TYPICAL VALVE PITS

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Figure 1-53. Valve Pits 241-AX-A and -B.

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APPENDIX C
INFORMATION VALIDATION FORM

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Name of Originator Ronald D. Graves	1	Organization or Team FSAR CHAPTER 3	2	Date 5/1/96	3
<p>Statement of Problem For the Fire in Contaminated Area accident the material at risk (MAR) is required. This is defined as the waste material that could accumulate in a pit/riser and be available for combustion.</p> <p>Assumptions:</p> <p>(1) The material at risk in this accident is bounded by a 1 in layer of waste at the bottom of a typical valve pit. The typical pit is 10 ft by 12 ft with a drain in one corner. The drain may have a 1 in lip above the floor that could cause waste from a leak to stagnate in the pit up to a depth of 1 inch at the drain. The floor of the pit slopes towards the drain from all sides of the pit. The floor elevation at the walls of the pit is 1.5 inches above the drain. Based on this fact the volume of waste is bounded by 5 ft³.</p> <p>(2) The composition of waste is 67 percent AWF liquids and 33 percent AWF solids.</p>					
Alternatives			Consequences to Alternatives		
5			6		
Decision Reached			Basis for Decision		
7			8		
Date Requested 9		Sent To 10		Date Requested By 5/13/96	
<p>Response #1 For the purpose of this analysis, the numbers you have provided can be used. I would offer that you look at Double Shell Tank Part B Permit Application Chapt. 4.0, which has tables with pit dimensions if it becomes necessary. For the Plant response to composition of waste, see IVF-Chapter 3-H1.</p>					
12					
Response #2					
13					
Attachments (List)			References (List) 15		
14					
Responder #1 Name and Signature			Responder #2 Name and Signature		
16 Lankford Ruffin <i>L Ruffin</i> 5-3-96			17		
POC:		Filed:		Routed:	

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APPENDIX D

SUM-OF-FRACTION OF RISK GUIDELINES FOR UNIT LITER RELEASE OF CHEMICALS

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Table 3-8. Sum-of-Fraction of Risk Guidelines for a Unit Release of Chemicals and Gases. (3 sheets)

*The sum of fractions are multiplied by the release rate for continuous release and release amount for a puff releases. Release rates for continuous releases are in units of liters per second for liquids and solids, and m3/s for gases. Puff release quantities are in units of liters for solids and liquids and m3 for gases.

Tank waste type (Units of sum of fractions follow tank waste type)	Maximum individual	Accident frequency, 1/yr		
		1 - 10-2	10-2 - 10-4	10-4 - 10-6
DST or SST solid or liquid continuous release				
Single-shell liquids(s/L)	Onsite	9.6 E+03	7.5 E+02	2.0 E+02
Single-shell liquids(s/L)	Offsite	8.0 E+00	8.0 E+00	6.2 E-01
Single-shell solids(s/L)	Onsite	4.0 E+04	2.1 E+03	1.0 E+03
Single-shell solids(s/L)	Offsite	9.4 E+01	3.3 E+01	1.7 E+01
Double-shell liquids(s/L)	Onsite	1.0 E+04	7.5 E+02	2.1 E+02
Double-shell liquids(s/L)	Offsite	8.4 E+00	8.4 E+00	6.2 E-01
Double-shell solids (s/L)	Onsite	1.8 E+04	3.3 E+03	6.3 E+02
Double-shell solids(s/L)	Offsite	1.9 E+02	1.5 E+01	2.8 E+00
DST or SST liquid or solid puff release				
Single-shell liquids (L-1)	Onsite	2.8 E+03	2.2 E+02	5.7 E+01
Single-shell liquids (L-1)	Offsite	3.2 E-02	3.2 E-02	2.5 E-03
Single-shell solids (L-1)	Onsite	1.2 E+04	6.0 E+03	2.9 E+02
Single-shell solids (L-1)	Offsite	3.8 E-01	1.3 E-01	6.9 E-02
Double-shell liquids (L-1)	Onsite	2.9 E+03	2.2 E+02	6.0 E+01
Double-shell liquids (L-1)	Offsite	3.4 E-02	3.4 E-02	2.5 E-03
Double-shell solids (L-1)	Onsite	5.2 E+03	9.7 E+02	1.8 E+02
Double-shell solids (L-1)	Onsite	7.7 E-01	5.9 E-02	1.1 E-02
Flammable gas watch list composite				
Continuous Release (s/L)	Onsite	1.3 E+04	1.1 E+03	2.6 E+02
Continuous Release (s/L)	Offsite	1.4 E+01	7.2 E+00	6.1 E-01
Puff Release (L-1)	Onsite	3.7 E+03	3.2 E+02	7.7 E+01
Puff Release (L-1)	Offsite	3.4 E-02	1.7 E-02	1.1 E-03

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APPENDIX E
PEER REVIEW AND HEDOP REVIEW CHECKLISTS

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CHECKLIST FOR PEER REVIEW

Document Reviewed: WHC-SD-WM-CN-056, Rev. 1, *Fire in a Contaminated Area.*

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.

Steven P. Roblyer Steven P. Roblyer
 Reviewer (Printed Name and Signature)

8/7/96
 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):

WHC-SD-WM-CN-056, Rev. 1, *Fire in a Contaminated Area.*

Submitted by: Grant W. Ryan

Date Submitted: 8/7/96

Scope of Review: Radiological and Toxicological 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. Hines
HEDOP-Approved Reviewer (Printed Name and Signature)

8/8/96

Date

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

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