ENGINEERING CHANGE NOTICE

1. ECN 609895

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Proj.
ECN

2. ECN Category (mark one) Supplemental ☐ Direct Revision ☒ Change ECN ☐ Temporary ☐ Standby ☐ Supersedeure ☐ Cancel/Void ☐	3. Originator's Name, Organization, MSIN, and Telephone No. RJ Van Vleet, 8M400, A3-34, 376-2613	4. USQ Required? ☐ Yes ☒ No	5. Date September 19, 1996
	6. Project Title/No./Work Order No. TWRS FSAR/BIO	7. Bldg./Sys./Fac. No. Single-Shell Tanks, Double-Shell Tanks, Aging Waste Facility Tanks, Double-Contained Receiver Tanks	8. Approval Designator NA
12a. Modification Work ☐ Yes (fill out Blk. 12b) ☒ No (NA Blks. 12b, 12c, 12d)	12b. Work Package No. NA	12c. Modification Work Complete NA Design Authority/Cog. Engineer Signature & Date	12d. Restored to Original Condition (Temp. or Standby ECN only) NA Design Authority/Cog. Engineer Signature & Date
13a. Description of Change WHC-SD-WM-CN-055, Rev. 0 EDT 614541 13b. Design Baseline Document? ☐ Yes ☒ No Clarification is provided in the sum-of-fractions section and in the section describing the release time. Minor math errors are corrected in the spreadsheet.			
14a. Justification (mark one) Criteria Change ☐ Design Improvement ☒ Environmental ☐ Facility Deactivation ☐ As-Found ☐ Facilitate Const ☐ Const. Error/Omission ☐ Design Error/Omission ☐ 14b. Justification Details Document is improved when the math errors are corrected.			
15. Distribution (include name, MSIN, and no. of copies) CM Bellis A2-26 DS Leach A3-34 PD Rittmann H0-31 RJ Van Vleet A3-34 Central Files A3-88			

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DATE:	MANROD RELEASE
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16. Design Verification Required		17. Cost Impact				18. Schedule Impact (days)			
		ENGINEERING		CONSTRUCTION					
☐ Yes		Additional ☐ \$		Additional ☐ \$		Improvement ☐			
☒ No		Savings ☐ \$		Savings ☐ \$		Delay ☐			
19. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 13. Enter the affected document number in Block 20.									
SDD/DD	☐	Seismic/Stress Analysis	☐	Tank Calibration Manual	☐				
Functional Design Criteria	☐	Stress/Design Report	☐	Health Physics Procedure	☐				
Operating Specification	☐	Interface Control Drawing	☐	Spares Multiple Unit Listing	☐				
Criticality Specification	☐	Calibration Procedure	☐	Test Procedures/Specification	☐				
Conceptual Design Report	☐	Installation Procedure	☐	Component Index	☐				
Equipment Spec.	☐	Maintenance Procedure	☐	ASME Coded Item	☐				
Const. Spec.	☐	Engineering Procedure	☐	Human Factor Consideration	☐				
Procurement Spec.	☐	Operating Instruction	☐	Computer Software	☐				
Vendor Information	☐	Operating Procedure	☐	Electric Circuit Schedule	☐				
OM Manual	☐	Operational Safety Requirement	☐	ICRS Procedure	☐				
FSAR/SAR	☐	IEFD Drawing	☐	Process Control Manual/Plan	☐				
Safety Equipment List	☐	Cell Arrangement Drawing	☐	Process Flow Chart	☐				
Radiation Work Permit	☐	Essential Material Specification	☐	Purchase Requisition	☐				
Environmental Impact Statement	☐	Fac. Proc. Samp. Schedule	☐	Tickler File	☐				
Environmental Report	☐	Inspection Plan	☐	None	☒				
Environmental Permit	☐	Inventory Adjustment Request	☐		☐				
20. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below. Document Number/Revision Document Number/Revision Document Number/Revision <i>NA</i>									
21. Approvals <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>Signature _____ Date _____</p> <p>Design Authority</p> <p>Cog. Eng. RJ Van Vleet, A3-34 <i>[Signature]</i> <u>09/19/96</u></p> <p>Cog. Mgr. DS Leach, A3-34 <i>[Signature]</i> <u>9/19/96</u></p> <p>QA _____</p> <p>Safety _____</p> <p>Environ. _____</p> <p>Other PD Rittmann, H0-31 <i>[Signature]</i> <u>9/19/96</u></p> </div> <div style="width: 45%;"> <p>Signature _____ Date _____</p> <p>Design Agent</p> <p>PE _____</p> <p>QA _____</p> <p>Safety _____</p> <p>Design _____</p> <p>Environ. _____</p> <p>Other _____</p> </div> </div> <p style="text-align: center;"><u>DEPARTMENT OF ENERGY</u></p> <p style="text-align: center;">Signature or a Control Number that tracks the Approval Signature</p> <p style="text-align: center;"><u>ADDITIONAL</u></p>									

Flammable Gas Deflagration Consequence Calculations for the Tank Waste Remediation System Basis for Interim Operation

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Abstract: This paper calculates the radiological dose consequences and the toxic exposures for deflagration accidents at various Tank Waste Remediation System facilities. These will be used in support of the Tank Waste Remediation System Basis for Interim Operation.

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**FLAMMABLE GAS DEFLAGRATION CONSEQUENCE CALCULATIONS
FOR THE TANK WASTE REMEDIATION SYSTEM
BASIS FOR INTERIM OPERATION**

This calculation note calculates the radiological consequences and toxicological exposures associated with various deflagration accident scenarios. The radiological consequences were calculated using the unit liter doses found in Cowley (1996) and the methodology for calculating consequences is found in Van Keuren and Savino (1996). The unit liter doses are the radiation doses received per liter of tank waste. The doses were calculated using the pathways of submersion (direct radiation), inhalation, and 24-hour ingestion. Cowley (1996) provides the technical basis for the unit liter doses. Van Keuren and Savino (1996) states that the following equation is to be used for calculating the inhalation and submersion dose. Note: generally, the submersion dose is insignificant (orders of magnitude lower) compared to the inhalation dose.

$$EDE_{inhalation} = Q \frac{\chi}{Q'} B_r ULD_{inhalation}$$

where Q is the volume of waste resuspended (L), χ/Q' is the atmospheric dispersion coefficient (s/m^3), B_r is the standard man breathing rate during light activity (m^3/s), and the $ULD_{inhalation}$ is the unit liter dose (Sv/L) due to inhalation and submersion.

Ingestion doses are calculated using the following equation.

$$EDE_{ingestion} = Q \frac{\chi}{Q'} ULD_{ingestion}$$

where again, Q is the volume of waste resuspended (L), χ/Q' is the atmospheric dispersion coefficient (s/m^3) and $ULD_{ingestion}$ is the unit liter dose ($Sv \cdot m^3/s \cdot L$) due to 24-hour ingestion.

The toxicological consequences were calculated using the sum-of-fractions values and methodology found in Van Keuren (1996). For a release of solid or liquid toxic materials, the peak concentration is of concern. The following equation was used to calculate the peak concentration, C (mg/m^3) for a continuous release of solid or liquid toxic material.

$$C_i = Q' \frac{\chi}{Q'}$$

where C_i is the concentration of the i^{th} toxic material, Q' is the release rate (mg/s) and χ/Q' is the integrated atmospheric dispersion coefficient (s/m³).

This method has been extended to include the multiple chemicals contained in the tank waste. To do this, a sum-of-fractions methodology has been applied. That is, on a per unit basis (where the unit is either a liter or a liter per second), the ratio of a chemical's concentration in ppm or mg/m³ (calculated either at the 100 m receptor or the offsite receptor) is compared to the appropriate limit, again either in ppm or mg/m³. Note: the limit and the concentration must be in the same measurement units so that the SOF has either dimensions of s/L or 1/L. This was done for all chemicals involved, then the ratios or fractions were summed.

$$SOF = \frac{C_1}{Limit_1} + \frac{C_2}{Limit_2} + \dots + \frac{C_n}{Limit_n}$$

If the sum-of-fractions is less than or equal to 1, the risk guidelines are considered to have been met. If the sum-of-fractions is greater than 1, the risk guidelines are considered to have been exceeded. Thus, the above equation now becomes,

$$T = Q' SOF$$

where T is the measure of acceptance, Q' is the toxic material release rate (L/s) and SOF is the sum-of-fractions of the risk guidelines (s/L) for either the onsite or offsite receptor. For a puff release, Q' is the amount of toxic material released (L) and SOF is the sum-of-fractions of the risk guidelines (1/L). The sum-of-fractions for each accident has been calculated for each of the frequency categories, i.e., anticipated, unlikely, and extremely unlikely. The following spreadsheet pages document the calculations. The maximum waste material accumulation in ventilation systems is taken from WHC-SD-WM-CN-054, Rev. 0 (Van Vleet 1996). An in-depth example calculation is shown here for the single-shell tanks. Other deflagration accidents in Tank Waste Remediation System facilities are treated in a similar fashion.

Double-shell tank calculations were performed using the ULD for double-shell tank liquids. Aging Waste Facility tank calculations were performed using the ULD for aging waste facility liquids. Single-shell tank calculations were performed using the ULD for single-shell tank solids. Double-contained receiver tank calculations were performed using single-shell tank liquids for the HEPA filter loading and a mixture of 95% single-shell tank liquids and 5% single-shell tank solids for material exiting from the double-contained receiver tank vessel.

These choices are consistent with the waste types currently stored in the single-shell, double-shell, aging waste facility, and double-contained receiver tanks.

EXAMPLE

Radiological Dose Consequences - Onsite

The radiological dose consequences from a deflagration will consist of the sum of two releases. These releases are (1) the material from the ventilation system and (2) the material entrained from the tank waste by the deflagration. The following paragraphs show how the values were calculated for each release.

The cumulative effective dose equivalent for the onsite receptor from the calculated release of waste accumulations in the ventilation system for a single-shell tank due to a high pressure event (such as a deflagration) is

$$\begin{aligned} EDE_{inhalation} &= Q \frac{X}{Q} B_r ULD_{inhalation} \\ &= (0.00613 \text{ L}) (3.41 \times 10^{-2} \frac{\text{S}}{\text{m}^3}) (3.3 \times 10^{-4} \frac{\text{m}^3}{\text{S}}) (2.2 \times 10^5 \frac{\text{Sv}}{\text{L}}) \\ &= 1.517 \times 10^{-2} \text{ Sv} \end{aligned}$$

where the material released is 0.00613 L (Van Vleet 1996), the acute atmospheric dispersion coefficient is $3.41 \times 10^{-2} \text{ s/m}^3$ (Van Keuren and Savino 1996), the breathing rate for light activity is $3.3 \times 10^{-4} \text{ m}^3/\text{s}$ (Van Keuren and Savino 1996), and the ULD for single-shell tank solids is $2.2 \times 10^5 \text{ Sv/L}$ (Cowley 1996).

The amount of material entrained from the waste surface is a combination of the material in the headspace (that naturally in the headspace and that introduced by the gas release event) and the material entrained by the flame front (LANL 1996).

$$\begin{aligned} M_{deflagration} &= M_{headspace} + M_{entrained} \\ &= 0.35 \text{ kg} + 5.45 \text{ kg} \\ &= 5.80 \text{ kg} \end{aligned}$$

This material is assumed to be 100% respirable material (LANL 1996). Only a portion of this material will exit the tank. The fraction released can be calculated based upon the pressure the tank reaches and atmospheric pressure.

$$\begin{aligned}
 M_{released} &= (5.8 \text{ kg}) \left(\frac{(4 \text{ bar}) (100000 \frac{\text{Pa}}{\text{bar}}) - 101325 \text{ Pa}}{(4 \text{ bar}) (100000 \frac{\text{Pa}}{\text{bar}})} \right) \\
 &= (5.8 \text{ kg}) (0.747) \\
 &= 4.33 \text{ kg}
 \end{aligned}$$

Using an assumed density of 1.65 kg/L, the volume of material released due to the deflagration is

$$\begin{aligned}
 Q &= \frac{4.33 \text{ kg}}{1.65 \frac{\text{kg}}{\text{L}}} \\
 &= 2.62 \text{ L}
 \end{aligned}$$

The cumulative effective dose equivalent to the onsite receptor from the calculated release of material during a deflagration is

$$\begin{aligned}
 EDE_{inhalation} &= Q \frac{X}{Q'} B_r ULD_{inhalation} \\
 &= (2.62 \text{ L}) (3.41 \times 10^{-2} \frac{\text{s}}{\text{m}^3}) (3.3 \times 10^{-4} \frac{\text{m}^3}{\text{s}}) (2.2 \times 10^5 \frac{\text{Sv}}{\text{L}}) \\
 &= 6.5 \text{ Sv}
 \end{aligned}$$

where the material released is 2.62 L, the acute atmospheric dispersion coefficient is $3.41 \times 10^{-2} \text{ s/m}^3$ (Van Keuren and Savino 1996), the breathing rate is $3.3 \times 10^{-4} \text{ m}^3/\text{s}$ (Van Keuren and Savino 1996), and the ULD for single-shell tank solids is $2.2 \times 10^5 \text{ Sv/L}$ (Van Keuren and Savino 1996).

Thus, the total cumulative effective dose equivalent to the onsite receptor is

$$\begin{aligned}
 CEDE &= CEDE_{ventilation} + CEDE_{deflagration} \\
 &= 1.517 \times 10^{-2} \text{ Sv} + 6.5 \text{ Sv} \\
 &= 6.5 \text{ Sv}
 \end{aligned}$$

Radiological Dose Consequences - Offsite

The cumulative effective dose equivalent for the offsite receptor from inhalation of the calculated release of waste accumulations in the ventilation system for a single-shell tank due to a high pressure event (such as a deflagration) is

$$\begin{aligned}
 EDE_{inhalation} &= Q \frac{X}{Q'} B_r ULD_{inhalation} \\
 &= (0.00613 \text{ L}) (2.83 \times 10^{-5} \frac{\text{S}}{\text{m}^3}) (3.3 \times 10^{-4} \frac{\text{m}^3}{\text{S}}) (2.2 \times 10^5 \frac{\text{Sv}}{\text{L}}) \\
 &= 1.259 \times 10^{-5} \text{ Sv}
 \end{aligned}$$

where the material released is 0.00613 L (Van Vleet 1996), the acute atmospheric dispersion coefficient is $2.83 \times 10^{-5} \text{ s/m}^3$ (Van Keuren and Savino 1996), the breathing rate is $3.3 \times 10^{-4} \text{ m}^3/\text{s}$ (Van Keuren and Savino 1996), and the ULD for single-shell tank solids is $2.2 \times 10^5 \text{ Sv/L}$ (Cowley 1996).

The cumulative effective dose equivalent to the offsite receptor from inhalation of the calculated release of material during a deflagration is

$$\begin{aligned}
 EDE_{inhalation} &= Q \frac{X}{Q'} B_r ULD_{inhalation} \\
 &= (2.62 \text{ L}) (2.83 \times 10^{-5} \frac{\text{S}}{\text{m}^3}) (3.3 \times 10^{-4} \frac{\text{m}^3}{\text{S}}) (2.2 \times 10^5 \frac{\text{Sv}}{\text{L}}) \\
 &= 5.383 \times 10^{-3} \text{ Sv}
 \end{aligned}$$

where the material released is 2.62 L, the acute atmospheric dispersion coefficient is $2.83 \times 10^{-5} \text{ s/m}^3$ (Van Keuren and Savino 1996), the breathing rate for light activity is $3.3 \times 10^{-4} \text{ m}^3/\text{s}$ (Van Keuren and Savino 1996), and the ULD for single-shell tank solids is $2.2 \times 10^5 \text{ Sv/L}$ (Cowley 1996).

The cumulative effective dose equivalent to the offsite receptor due to 24-hour ingestion is

$$\begin{aligned}
 CEDE_{ingestion} &= Q \frac{X}{Q'} ULD_{ingestion} \\
 &= (0.00613 \text{ L} + 2.62 \text{ L}) (2.83 \times 10^{-5} \frac{\text{S}}{\text{m}^3}) (4.10 \frac{\text{Sv m}^3}{\text{S L}}) \\
 &= 3.05 \times 10^{-4} \text{ Sv}
 \end{aligned}$$

Thus, the total cumulative effective dose equivalent to the offsite receptor is

$$\begin{aligned}
 CEDE &= CEDE_{ventilation} + CEDE_{deflagration} + CEDE_{ingestion} \\
 &= 1.26 \times 10^{-5} \text{ Sv} + 5.39 \times 10^{-3} \text{ Sv} + 3.05 \times 10^{-4} \text{ Sv} \\
 &= 5.7 \times 10^{-3} \text{ Sv}
 \end{aligned}$$

Toxicological Exposures - Onsite

The sum-of-fractions for each accident has been calculated for each of the frequency categories, i.e., anticipated, unlikely, and extremely unlikely. This example demonstrates the method for anticipated, continuous releases. Calculations for other frequencies or for puff releases are similar.

Toxic exposures were calculated from three sources: (1) material released from the ventilation system, (2) material released from the tank due to the deflagration, and (3) pre-existing (i.e., before the deflagration) material released from the headspace.

For material released from the ventilation system, the onsite sum-of-fractions is:

$$\begin{aligned} T_{\text{ventilation}} &= Q' \text{ SOF} \\ &= \left(\frac{0.00613 \text{ L}}{200 \text{ s}} \right) (40000 \frac{\text{s}}{\text{L}}) \\ &= 1.23 \end{aligned}$$

where 200 s is the duration of the release. The release duration was chosen because (1) the time during the pressurization of the tank due to the gas release event and (2) the time the pressure pulse from the burn (which is over in approximately 1/10 s (LANL 1995)) lasts give this release time.

Similarly for the material released from the deflagration.

$$\begin{aligned} T_{\text{deflagration}} &= Q' \text{ SOF} \\ &= \left(\frac{2.62 \text{ L}}{200 \text{ s}} \right) (40000 \frac{\text{s}}{\text{L}}) \\ &= 524 \end{aligned}$$

For the material pre-existing in the headspace, the onsite sum-of-fractions is:

$$\begin{aligned} T_{\text{headspace}} &= Q' \text{ SOF} \\ &= \left(\frac{3350 \text{ m}^3}{200 \text{ s}} \right) (77 \frac{\text{s}}{\text{m}^3}) \\ &= 1290 \end{aligned}$$

where 3350 m³ represents the maximum volume of the headspaces of flammable gas single shell tanks, i.e., tank 241-A-103. Thus, the total toxicological exposure to the onsite receptor is

$$\begin{aligned} T &= T_{\text{ventilation}} + T_{\text{deflagration}} + T_{\text{headspace}} \\ &= 1.23 + 524 + 1290 \\ &= 1815 \end{aligned}$$

Toxicological Exposures - Offsite

For the material released from the ventilation system, the offsite sum-of-fractions is:

$$\begin{aligned} T_{\text{ventilation}} &= Q' \text{ SOF} \\ &= \left(\frac{0.00613 \text{ L}}{200 \text{ s}} \right) \left(94 \frac{\text{s}}{\text{L}} \right) \\ &= 2.88 \times 10^{-3} \end{aligned}$$

where 200 s is the duration of the release.

Similarly for the material released from the deflagration.

$$\begin{aligned} T_{\text{deflagration}} &= Q' \text{ SOF} \\ &= \left(\frac{2.62 \text{ L}}{200 \text{ s}} \right) \left(94 \frac{\text{s}}{\text{L}} \right) \\ &= 1.23 \end{aligned}$$

For the material pre-existing in the headspace, the offsite sum-of-fractions is:

$$\begin{aligned} T_{\text{headspace}} &= Q' \text{ SOF} \\ &= \left(\frac{3350 \text{ m}^3}{200 \text{ s}} \right) \left(6.6 \times 10^{-2} \frac{\text{s}}{\text{m}^3} \right) \\ &= 1.106 \end{aligned}$$

where 3350 m³ represents the volume of the headspace in single-shell tank 241-A-103.

Thus, the total toxicological exposure to the offsite receptor is

$$\begin{aligned} T &= T_{\text{ventilation}} + T_{\text{deflagration}} + T_{\text{headspace}} \\ &= 2.88 \times 10^{-3} + 1.23 + 1.11 \\ &= 2.3 \end{aligned}$$

REFERENCES

- Cowley, W. L., 1996, *Development of Radiological Concentration and Unit Liter Doses for Tank Waste Remediation System Final Safety Analysis Report Radiological Consequence Calculations*, WHC-SD-WM-SARR-037, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- LANL, 1995, *A Safety Assessment for Proposed Pump Mixer Operations to Mitigate Episodic Gas Releases in Tank 241-SY-101: Hanford Site, Richland, Washington*, LA-UR-92-3196, Rev. 14, Los Alamos National Laboratory, Los Alamos, New Mexico.
- LANL, 1996, *A Safety Assessment for Salt Well Jet Pumping Operations in Tank 241-A-101: Hanford Site, Richland, Washington*, WHC-SD-WM-SAD-036, Rev. 0, Los Alamos National Laboratory, Los Alamos, New Mexico.
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- Van Keuren, J. C., 1996, *Toxic Chemical Considerations for Tank Farm Releases*, WHC-SD-WM-SARR-011, Rev. 2, Westinghouse Hanford Company, Richland, Washington.
- Van Vleet, R. J., 1996, *Waste Tank Ventilation System Waste Material Accumulations*, WHC-SD-WM-CN-054, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

VENTILATION SYSTEM RELEASES									
Q1a =	0.0010 L	(DST)							(WHC-SD-WM-CN-054, Rev 0)
Q1b =	0.0056 L	(AWF)							(WHC-SD-WM-CN-054, Rev 0)
Q1c =	0.0061 L	(SST)	0.7466875						(WHC-SD-WM-CN-054, Rev 0)
Q1d =	0.0023 L	(DCRT)							(WHC-SD-WM-CN-054, Rev 0)
DST DEFLAGRATIONS=>DOME FAILURE									
Q2a =	2.76 L		M2a =	4.55 kg	(LA-UR-92-3196, Rev 14, App. D, pg. D-10 to -12)				Note: M2a includes normal dome loading of rads and has been adjusted for the pressure pulse.
Q2b =	7.74 L		M2b =	12.77 kg	(LA-UR-92-3196, Rev 14, App. M, pg M-5)				Note: M2b is just from the waste on pump column and must be added to M2a.
			rho =	1.65 kg/L	Waste density based upon 101-SY sample results				Note: M2c includes normal dome loading of rads and has been adjusted for the pressure pulse.
SST DEFLAGRATIONS=>DOME FAILURE									
Q2c =	2.62 L		M2c =	4.33 kg	(WHC-SD-WM-SAD-036, Rev 0, App. I, pg I-3 and LA-UR-92-3196, Rev 14, App. D, pg D-10 to -12)				
Q2d =	18.28 L				(WSRC-TR-93-445, page III and WHC-SD-WM-ISB-001, Vol 2, page 1-333)				
DCRT DETONATIONS									
X/Q Values									
	Cont. (s/m3)	Puff (1/m3)							
Onsite	3.4E-02	9.9E-03							(WHC-SD-WM-SARR-016, Rev 2)
Offsite	2.8E-05	1.1E-07							(WHC-SD-WM-SARR-016, Rev 2)
Breathing Rate = 3.3E-04 m3/s (Standard man doing light activity)									
ULD									
	(Sv/L)	(Sv m3)/(s L)							
	Inhalation	Ingestion							
All Liquids	1.2E+04	0.11							(WHC-SD-WM-SARR-037, Rev 0)
All Solids	1.9E+06	8.20							(WHC-SD-WM-SARR-037, Rev 0)
SST Liquids	1.1E+04	0.05							(WHC-SD-WM-SARR-037, Rev 0)
SST Solids	2.2E+05	4.10							(WHC-SD-WM-SARR-037, Rev 0)
DST Liquids	6.1E+03	0.07							(WHC-SD-WM-SARR-037, Rev 0)
DST Solids	5.3E+05	0.48							(WHC-SD-WM-SARR-037, Rev 0)
AWF Liquids	1.4E+03	0.09							(WHC-SD-WM-SARR-037, Rev 0)
AWF Solids	1.7E+06	8.10							(WHC-SD-WM-SARR-037, Rev 0)
DST Vapor Space Vol = 2.5E+03 m3 (Represents the headspace volume of DST 103-SY)									
SST Vapor Space Vol = 3.3E+03 m3 (Represents the headspace volume of SST 103-A)									
AWF Vapor Space Vol = 1.8E+03 m3 (Represents the headspace volume of AWF 101-AY)									
Partition Factor = 1.0E-08 (WHC-SD-WM-SAR-065, Rev 0, page 3.4-225)									
Duration = 2.0E+02 s (Used for toxic calculations) (LA-UR-92-3196, Rev 14)									
The following Sum-of-Fractions come from WHC-SD-WM-SARR-011, Rev. 2.									
Toxic Sum-of-Fractions of Risk Guidelines per Liter, 10+0 to 10-2 frequency range									
Continuous Release					Puff Release				
(s/L)					(1/L)				
DST Solids	DST Liquids	SST Solids	SST Liquids	Vapor Space	DST Solids	DST Liquids	SST Solids	SST Liquids	Vapor Space
Onsite	1.8E+04	1.0E+04	4.0E+04	9.6E+03	7.7E+01	5.2E+03	2.9E+03	1.2E+04	2.8E+03
Offsite	1.9E+02	8.4E+00	9.4E+01	8.0E+00	6.6E-02	7.7E-01	3.4E-02	3.8E-01	3.2E-02
Toxic Sum-of-Fractions of Risk Guidelines per Liter, 10-2 to 10-4 frequency range									
Continuous Release					Puff Release				
(s/L)					(1/L)				
DST Solids	DST Liquids	SST Solids	SST Liquids	Vapor Space	DST Solids	DST Liquids	SST Solids	SST Liquids	Vapor Space
Onsite	3.3E+03	7.5E+02	2.1E+03	7.5E+02	9.4E+00	9.7E+02	2.2E+02	6.0E+03	2.2E+02
Offsite	1.5E+01	8.4E+00	3.3E+01	8.0E+00	6.6E-02	5.9E-02	3.4E-02	1.3E-01	3.2E-02
Toxic Sum-of-Fractions of Risk Guidelines per Liter, 10-4 to 10-6 frequency range									
Continuous Release					Puff Release				
(s/L)					(1/L)				
DST Solids	DST Liquids	SST Solids	SST Liquids	Vapor Space	DST Solids	DST Liquids	SST Solids	SST Liquids	Vapor Space
Onsite	6.3E+02	2.1E+02	1.0E+03	2.0E+02	1.9E+00	1.8E+02	6.0E+01	2.9E+02	5.7E+01
Offsite	2.8E+00	6.2E-01	1.7E+01	6.2E-01	8.1E-03	1.1E-02	2.5E-03	6.9E-02	2.5E-03

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Radiological Consequences (Sv)									
DST HEPA*		DST Deflagration*		TOTAL					
Cont.	Puff	Cont.	Puff	Cont.	Puff				
Onsite	6.7E-05	Not App.	1.9E-01	Not App.	1.9E-01	Not App.	*Assumes DST liquids		
Offsite	5.8E-08	Not App.	1.6E-04	Not App.	1.6E-04	Not App.			
DST HEPA*		DST Pump Ejection*		TOTAL					
Cont.	Puff	Cont.	Puff	Cont.	Puff				
Onsite	6.7E-05	Not App.	7.2E-01	Not App.	7.2E-01	Not App.	*Assumes DST liquids		
Offsite	5.8E-08	Not App.	6.2E-04	Not App.	6.2E-04	Not App.			
AWF HEPA*		AWF Deflagration*		TOTAL					
Cont.	Puff	Cont.	Puff	Cont.	Puff				
Onsite	8.9E-05	Not App.	4.3E-02	Not App.	4.4E-02	Not App.	*Assumes AWF liquids		
Offsite	8.8E-08	Not App.	4.3E-05	Not App.	4.3E-05	Not App.			
SST HEPA*		SST Deflagration*		TOTAL					
Cont.	Puff	Cont.	Puff	Cont.	Puff				
Onsite	1.5E-02	Not App.	6.5E+00	Not App.	6.5E+00	Not App.	*Assumes SST solids		
Offsite	1.3E-05	Not App.	5.7E-03	Not App.	5.7E-03	Not App.			
DORT HEPA*		DORT Deflagration**		TOTAL					
Cont.	Puff	Cont.	Puff	Cont.	Puff				
Onsite	2.8E-04	Not App.	4.4E+00	Not App.	4.4E+00	Not App.	*Assumes SST liquids		
Offsite	2.4E-07	Not App.	3.8E-03	Not App.	3.8E-03	Not App.	**Assumes 5% SST solids 95% SST liquids		
Toxicological Sum-of-Fractions of Risk Guidelines, 10+ to 10-2 frequency range									
DST HEPA*		DST Deflagration*		DST Vapor Space		TOTAL			
Cont.	Puff	Cont.	Puff	Cont.	Puff	Cont.	Puff		
Onsite	4.9E-02	2.8E+00	1.4E+02	8.0E+03	9.8E+02	5.8E+04	1.1E+03	6.5E+04	*Assumes DST liquids
Offsite	4.1E-05	3.3E-05	1.2E-01	9.4E-02	8.3E-01	6.8E-01	9.4E-01	7.7E-01	
DST HEPA*		DST Pump Ejection*		DST Vapor Space		TOTAL			
Cont.	Puff	Cont.	Puff	Cont.	Puff	Cont.	Puff		
Onsite	4.9E-02	2.8E+00	5.2E+02	3.0E+04	9.8E+02	5.8E+04	1.5E+03	8.8E+04	*Assumes DST liquids
Offsite	4.1E-05	3.3E-05	4.4E-01	3.6E-01	8.3E-01	6.8E-01	1.3E+00	1.0E+00	
AWF HEPA*		AWF Deflagration*		AWF Vapor Space		TOTAL			
Cont.	Puff	Cont.	Puff	Cont.	Puff	Cont.	Puff		
Onsite	2.8E-01	1.6E+01	1.4E+02	8.0E+03	6.8E+02	4.0E+04	8.2E+02	4.8E+04	*Assumes AWF liquids
Offsite	2.4E-04	1.9E-04	1.2E-01	9.4E-02	5.8E-01	4.7E-01	7.0E-01	5.7E-01	
SST HEPA*		SST Deflagration*		SST Vapor Space		TOTAL			
Cont.	Puff	Cont.	Puff	Cont.	Puff	Cont.	Puff		
Onsite	1.2E+00	7.4E+01	5.2E+02	3.1E+04	1.3E+03	7.7E+04	1.8E+03	1.1E+05	*Assumes SST solids
Offsite	2.9E-03	2.3E-03	1.2E+00	1.0E+00	1.1E+00	9.0E-01	2.3E+00	1.9E+00	
DORT HEPA*		DORT Deflagration**		TOTAL					
Cont.	Puff	Cont.	Puff	Cont.	Puff				
Onsite	1.1E-01	6.4E+00	1.0E+03	6.0E+04	1.0E+03	6.0E+04	*Assumes SST liquids		
Offsite	9.1E-05	7.3E-05	1.1E+00	9.0E-01	1.1E+00	9.0E-01	**Assumes 5% SST solids 95% SST liquids		

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CHECKLIST FOR PEER REVIEW

Document Reviewed: WHC-SD-WM-CN-055, Rev. 1, *Flammable Gas Deflagration Consequence Calculations for the Tank Waste Remediation System Basis for Interim Operation*

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. <i>attached spreadsheet tables</i>
☒	☐	☐	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.

P.D. Rittmann

Reviewer (Printed Name and Signature)

Paul Rittmann

9-20-96

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.