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ENGINEERING DATA TRANSMITTAL

Page 1 of 1

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1	WHC-SD-WM-RPT-271		0	Calculation Note Review	N/A	1,2	1	1

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Approval Designator (F)		Reason for Transmittal (G)		Disposition (H) & (I)	
E, S, Q, D or N/A (see WHC-CM-3-5, Sec. 12.7)		1. Approval	4. Review	1. Approved	4. Reviewed no/comment
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		3. Information	6. Dist. (Receipt Acknow. Required)	3. Disapproved w/comment	6. Receipt acknowledged

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(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN
		Design Authority									
		Design Agent									
		Cog. Eng. <i>A. L. Ramble</i> 9/30/96									
1	1	Cog. Mgr. A. L. Ramble <i>A. L. Ramble</i> 9/30/96									
		QA									
		Safety									
		Env.									

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Calculation Note Review

A. L. Ramble

Westinghouse Hanford Company, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-87RL10930

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Abstract: This document contains a review of the calculation notes which were prepared for the Tank Waste Remediation System Basis for Interim Operation.

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Karen A. Roland 9/30/96
Release Approval Date
Release Stamp

Approved for Public Release

WHC-SD-WM-RPT-271, REV. 0

Calculation Note Review

A. L. Ramble

September 27, 1996

Westinghouse Hanford Company
Richland, Washington 99352

WHC-SD-WM-RPT-271, REV. 0

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1.0 INTRODUCTION

Westinghouse Hanford Company (WHC) is preparing a Basis for Interim Operation (BIO) for the Tank Waste Remediation System (TWRS). Chapter 5.0, Safety Analysis of the BIO contains the unique, representative and bounding accidents for TWRS. These accidents are based, in part, on calculation notes which are prepared for each accident.

This report documents a review of the calculation notes prepared for the accidents analyzed in the TWRS BIO.

2.0 REVIEW

2.1 Review Scope

The review was limited to the calculation notes which support the TWRS BIO accident analysis. The calculation notes and corresponding accident analyses are shown in Table 1.

Table 1. Accident Analysis Listing

BIO Accident Title	Calculation Note Title	Team No.
1. Nuclear Criticality	WHC-SD-WM-CN-047, Revision 1 Calculation Notes that Support Accident Scenario and Consequence Determination for a Waste Tank Criticality	3
2. In-Tank Fuel Fire Deflagration	WHC-SD-WM-CN-059 Calculation Notes that Support Accident Scenario and Consequence of the In-Tank Fuel Fire/Deflagration	1
3. Mixing of Incompatible Material - Tank Pressurization	M-CLL-G-00237 Chemical Reaction in a DCRT Leading to a Toxic Release	1
4. Flammable Gas Deflagration	WHC-SD-WM-CN-055 Flammable Gas Deflagration Consequence Calculations for the Tank Waste Remediation System Basis for Interim Operation	2
5. HEPA Filter Failure - Exposure to High Temperature or Pressure	WHC-SD-WM-CN-062 HEPA Filter Fire and Subsequent Unfiltered Release WHC-SC-WM-CN-063 Release from Failed HEPA Filters Due to an Overpressurization Event WHC-SC-WM-CN-054 Waste Tank Ventilation System Waste Material Accumulation	2

BIO Accident Title	Calculation Note Title	Team No.
6. Fire in a Contaminated Area	WHC-SD-WM-CN-056 Fire in a Contaminated Area	2
7. Organic Solvent Fire	WHC-SD-WM-CN-032 Analysis of Consequences of Postulated Solvent Fires in Hanford Site Tanks	1
8. Organic Salt-Nitrate Reaction	WHC-SD-WM-CN-058A Compilation of Calculation Notes in Support of Organic Salt Nitrate Reactions Safety Analysis	1
9. Tank Failure Caused by Excessive Loads, Vacuum or Degradation	WHC-SD-WM-CN-051 The Effects of Load Drop, Uniform Load and Concentrated Loads on Waste Tanks	1
10. Spray Leak in Structure or from Overground Transfer Lines	WHC-SD-WM-CN-048 Calculation Notes in Support of TWRS FSAR Spray Leak Accident	3
11. Spray Leak from Underground Waste Transfer Lines	S-CLC-G-0016- see Review Form for Frequency of SG-CLC-G-00132 Line Break from an Excavation S-CLC-G-00131 Cancelled Transfer Line Break Due to an Excavation Accident that Results in a Pool Release SG-CLC-G-00132 Transfer Line Break due to an Excavation Accident that Results in a Spray Release	3
12. Caustic Spray Leak	WHC-SD-WM-CN-065 Consequence Analysis of an Unmitigated NaOH Solution Spray Release During Addition to Waste Tank	3

BIO Accident Title	Calculation Note Title	Team No.
13. Tank Bump	WHC-SD-WM-CN-042 Viewed under CN-043 Evaluation of Potential and Consequences of Steam Bump in High Heat Waste Tanks...Validation of Goth Computer Code. WHC-SD-WM-CN-043 Tank Bump Consequences	1
14. Subsurface Leak Resulting in Pool	WHC-SD-WM-CN-057 Calculation Notes for Subsurface Leak Resulting in Pool, TWRS FSAR Accident Analysis	3
15. Evaporator Dump	WHC-SD-WM-CN-060 Calculation Notes that Support Accident Scenario and Consequence Determination of the Evaporator Dump	2
16. Mixing of Incompatible Waste - Toxic Vapor Generation	M-CLC-G-00238 Chemical Reaction in a DCRT Leading to a Toxic Release	1
17. Leak from a Railcar or Tank Trailer	WHC-SD-WM-CN-003 Calculation Notes that Support Accident Scenario and Consequence Development for the Leak from a Railcar/Tank Trailer at the 204- AR Waste Unloading Facility	2
18. Surface Leak Resulting in a Pool	WHC-SD-WM-CN-049 Calculation Notes for Subsurface Leak Resulting in Pool, TWRS FSAR Accident Analysis	3
19. Unplanned Excavation/ Drilling in Pond/Crib/ Ditch	WHC-SD-WM-CN-053 Excavations in Hanford Ponds, Cribs, or Ditches	2

BIO Accident Title	Calculation Note Title	Team No.
20. Subsurface Leak Remaining Subsurface	WHC-SD-WM-CN-004 Calculation Notes that Support Accident Scenario and Consequence Development for the Subsurface Leak Remaining Subsurface Accident	2
21. Sodium Fire	WHC-SD-WM-CN-045 Consequence Analysis of a Postulated NaOH Release from the 2727-W Sodium Storage Facility	1
22. Above ground Structure Failure	WHC-SD-WM-CN-061 Release from Failure of a Flexible Receiver Bag in High Winds	3
23. Steam Intrusion from Interfacing Systems	WHC-SD-WM-CN-044 Calculations Notes that Support Accident Scenario and Consequence Development for the Steam Intrusion from Interfacing Systems Accident.	

2.2 Review Teams

The review was accomplished by four review teams. A summary of qualifications of each member is contained in Appendix A. The membership for each team is listed below.

Team No. 1 - Paul Rittmann and Tom Tomaszewski

Team No. 2 - Tony Savino and Bryan Flanagan

Team No. 3 - Don Porten and Harvey Goldberg

Team No. 4 - Brad Evans and Kris Chitkara

2.3 Review Process

Both a detailed review and a cross-cut review of the calculation notes was performed. For the detailed review, each of the first three teams reviewed approximately one third of the calculations notes (see Table 1). The review focused on calculational errors, initial assumptions or conditions (with special emphasis on those needing protection in the BIO control section), correct referencing of all values in the calculations, correct basis for selection of variables used in the analysis, listing of preventative or mitigative features presented in the analysis, any

extraneous information used in the analysis, and correct use of the peer review checklist for the analysis.

For ease of information processing, a Review Form containing the above information was created (see Figure 1). Completed review forms for each calculation note reviewed are in Appendix B.

Each reviewer also provided a red-line mark-up of the calculation note to the calculation note author if math errors were found.

In addition to the detailed review, a cross-cut review of the calculation notes was performed. Team 2 reviewed the radiological release fractions used in all calculation notes to ensure consistency in release fraction versus release mechanism. Team 4 examined all calculation notes for consistency in initial conditions, consistency in dose/exposure calculations and important parameters in the analysis.

Figure 1. Calculation Note Review Forms

REVIEW FORM		
CALCULATION NO.	REVISION NO.	DATE OF REVIEW
CALCULATION NOTE TITLE:		
Review Completed by:		Date:
<p>_____ A. No math errors</p> <p>Comments:</p>		
<p>_____ B. All assum/IC stated & ID those needing protection</p> <p>Comments:</p>		
<p>_____ C. All values referenced</p> <p>Comments:</p>		
<p>_____ D. Basis for selection of variables</p> <p>Comments:</p>		
<p>_____ E. All mitigative features listed</p> <p>Comments:</p>		
<p>_____ F. No extraneous information</p> <p>Comments:</p>		
<p>_____ G. Correct use of peer reviews checklist</p> <p>Comments:</p>		

3.0 REVIEW CONCLUSIONS

3.1 Detailed Review Results

Detailed review forms for each calculation note are in Appendix B. The following general conclusions were drawn from the review.

- 1) Two calculation notes were found to have severe mathematical or unit errors and required significant revision. Several calculation notes were found with minor mathematical or unit errors which required revision, but did not effect the conclusion of the calculation note.
- 2) The initial conditions and assumptions on which the analyses were built was often difficult to ascertain.
- 3) Reference errors or omissions were found in almost all calculation notes.

Review forms for each calculation note were provided to the calculation note author. Dispositions to the review form comments were provided by the calculation note author. Review forms with dispositions are in Appendix C.

3.2 Cross-Cut Review Results

Detailed review findings are in Appendix D. The following general conclusions were drawn from the review.

- 1) The calculation notes used many draft documents. In addition, there were different revisions of supporting documents used in the calculation notes.
- 2) Dose/exposure calculations used different assumptions regarding ingestion dose, direct shine^{*} and skyshine^{*}.
- 3) Tank accident parameters were inconsistent across the calculation notes.
- 4) Mathematical errors or unit problems were noted in many calculation notes.

3.3 Release Fraction Review Results

Release fractions were found to be reasonable and conservative for all calculation notes. The release fraction review results are in Appendix E.

*Shine and Skyshine are trademarks of Grove Engineering, Inc., Rockville, MD.

4.0 Lessons Learned

The calculational note procedure should be modified to stress the following:

- 1) Peer review needs to carefully check the mathematics to ensure there are no errors.
- 2) All assumptions and initial conditions must be clearly stated.
- 3) All values used in the analysis must be referenced.

APPENDIX A
REVIEWER QUALIFICATIONS

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P. D. Rittmann

Paul Rittmann obtained his Ph.D in theoretical elementary physics from Purdue University in 1976. After serving four years as an instructor at the U.S. Naval Nuclear Power School in Orlando, Florida, he joined the Hanford workforce as a tank farm radiological engineer. He is a diplomat of the American Academy of Health Physics. Dr. Rittman has been performing environmental dose estimates for various postulated and actual Hanford emissions since 1983.

T. A. Tomaszewski

Following his B. S. in Aerospace Engineering, Tom Tomaszewski has accumulated twenty-eight years combined experience involving project engineering and project management of nuclear related tasks and systems. This has included eighteen years Nuclear Construction and Engineering experience on commercial and test reactors (WNP-2 and FFTF, both operational) and four years experience on space propulsion and power application reactor programs (NERVA and SP-100). Mr. Tomaszewski brings his skills of exegesis to the review of the TWRS Calc-Notes and Basis for Interim Operation. For the past two years, Mr. Tomaszewski has been assigned to the Westinghouse Hanford Company Packaging Engineering Department, primarily supporting the Radioisotope Thermoelectric Generator Transportation System Project.

A. V. Savino

Tony Savino has nine years experience in the commercial nuclear power field and four years experience performing safety analyses for DOE facilities and transportation packages. His area of specialty is in performing safety analyses which encompasses source term development, modeling of accident phenomena, and assessment of radiological and toxicological consequences. Mr. Savino also has extensive experience in PWR & BWR commercial nuclear power plant operations, core design, reactor physics, and shielding analysis. Mr. Savino holds a B. S. degree in Mechanical Engineering from the New Jersey Institute of Technology, and an M. S. degree in Nuclear Engineering from Columbia University in New York City. Specialized training includes courses on the SCALE Computer Code, Probabilistic Safety Assessments, Fundamentals of Internal Dose Assessment, as well as numerous courses on PWR/BWR core design, reactor physics and shielding analysis.

C. B. Evans

Brad Evans has a M.S. and B.S. in Nuclear Engineering, earned through the University of New Mexico. Mr. Evans' experience includes six years with DOE Facility Nuclear Safety and Engineering at both the Hanford and Rocky Flats Sites; two years in Navy Shipyard Radiological Controls at the Portsmouth Naval Shipyard; two years with Particle Beam Fusion Accelerator II at the Sandia National Laboratory, and one year with the SP-100 Space Nuclear Power Program at the Space Nuclear Power Institute.

Krishan K. Chitkara

Kris Chitkara has a Ph.D. in Nuclear Engineering, earned through the University of Cincinnati. He holds a M.Sc.(Honors) in Physics, earned from the Punjab University in India and a B.Sc.(Honors) in Physics, earned from the Punjab University, India. Dr. Chitkara has 23 years experience in the nuclear industry with emphasis on nuclear safety, nuclear engineering, and nuclear fuel management. He has managed the functions of core engineering, plant analysis, PRA, independent safety engineering, fuel supply, and training for nuclear utilities. He has been a member of the Nuclear safety Review Board. He was a member of the EPRI's Safety & Analysis Task Force and the BWR Owners' Group. In addition, he has worked at General Electric Company in their nuclear design group. At Westinghouse Hanford Company, he has performed independent safety reviews, surveillances, and appraisals for several projects. Currently, Dr. Chitkara is involved with nuclear safety programs dealing with requirements.

WHC-SD-WM-RPT-271, REV. 0

APPENDIX B

COMPLETED CALCULATION NOTE REVIEW FORMS

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REVIEW FORM		
CALCULATION NO. CN-003	REVISION NO. 0	DATE OF REVIEW 9/4/96
CALCULATION NOTE TITLE: Calculation Notes That Support Accident Scenario and Consequence Development for the Leak From a Railcar/Tank Trailer at the 204-AR Waste Unloading Facility.		
Review Completed by: Anthony V. Savino		Date: 9/4/1996
<p><u> </u> A. No math errors</p> <p>Comments:</p> <p>Page 31 - old offsite receptor distances are quoted. See redlined markup.</p> <p>Table 7-4 - p. 65 - refers to Appendix A - Where is appendix A?</p> <p>The 10 hr X/Q' for the onsite receptor was calculated correctly, however, the 22 hr X/Q' for the offsite receptor used the <2 h X/Q' value (2.83×10^{-5} s/m³) in the logarithmic interpolation instead of the plume-meander corrected value of 2.12×10^{-5} s/m³. This results in the offsite X/Q' value (5.99×10^{-6}) being high by about 25% (4.87×10^{-6}). This is conservative, but technically incorrect.</p> <p><u> X </u> B. All assum/IC stated & ID those needing protection</p> <p>Comments:</p> <p>The waste shipped to the 204-AR Waste Unloading facility is volume-limited - i.e., a maximum shipment volume is calculated based on the radionuclide content of the waste to be shipped. The volume is limited to low specific activity quantities (49 CFR 173.425).</p> <p>Liquid waste with a unit liter dose value greater than 6.1×10^3 Sv/L [which is the ULD for DST Liquids] cannot be received or transferred through the 204-AR Waste Unloading facility.</p> <p>Other variations in the scenario were found not to be credible because 1) there is currently only one rail car available to transfer waste (could this change?), 2) the waste is not flammable, 3) the waste is thermally stable. (p. 10)</p> <p>Note that there are many assumptions listed (17 pages worth) on the IVFs (too many to list here).</p> <p><u> X </u> C. All values referenced</p> <p>Comments:</p> <p>The accident frequency is qualitatively assigned as UNLIKELY for the analysis, however, "subsequent investigation showed the accident to be beyond extremely unlikely. [page 10]" While I understand it is conservative to compare the consequences to UNLIKELY risk guidelines, why confuse the reader?</p>		

REVIEW FORM		
CALCULATION NO. CN-003	REVISION NO. 0	DATE OF REVIEW 9/4/96
CALCULATION NOTE TITLE: Calculation Notes That Support Accident Scenario and Consequence Development for the Leak From a Railcar/Tank Trailer at the 204-AR Waste Unloading Facility.		
X C. All values referenced Comments: Release fractions/rates look reasonable and appropriate for the analysis. ARFxRF of 2×10^{-5} for free-fall spill of liquids - aqueous solution falling 1 m. Release rate of 2.6×10^{-8} L/hr for evaporation/resuspension of liquid from the surface pool created on the soil for Case 1 - 2,123 L spill. ARRxRF of 1.5×10^{-7} L/hr for evaporation/resuspension of liquid from the surface pool created on the soil for Case 2 - 75,700 L spill. ARRxRF of 4×10^{-6} /hr for 24 hr resuspension from wetted soil. ARRxRF of 7.2×10^{-6} /hr for 12 hr resuspension from soil [resuspension decreases with time as source material is reduced]. Appendix 3A - could not confirm the u (m/s) and K values on page 29 - however, these are referenced to Roblyer and Owczarski (1992).		
D. Basis for selection of variables Comments: Analysis assumes that the railcar spill results in a pool of 1 in depth on soil. No basis is given. It does not seem realistic that a standing pool of 1 in would remain on top of soil. Section 5.4 page 39/40 - should state why the release is considered continuous for the onsite receptor and a puff for the offsite receptor since this is used to select the appropriate sum-of-fractions values. (Release duration greater than 3.5 s, and less than 250 sec.) Also, see redline on page 40. Note that the MICROSHIELD/MICROSKYSHINE cases were run with the onsite receptor located 100 m from the CENTER of the pool, whereas, in the past, the onsite receptor was assumed to be located 100 m from the EDGE of the pool. For CASE 2 - 75,700 L spill, the receptor is only 45 m from the edge of the pool. This is conservative, but inconsistent with the methods in SARR-016, which is referenced as the methods used in the analysis (see p. 61). Note also that no credit was taken for the uncontaminated surrounding soil, as was done in SARR-016, although this has a negligible effect on the results.		
E. All mitigative features listed Comments: No mitigative features required.		

REVIEW FORM		
CALCULATION NO. CN-003	REVISION NO. 0	DATE OF REVIEW 9/4/96
CALCULATION NOTE TITLE: Calculation Notes That Support Accident Scenario and Consequence Development for the Leak From a Railcar/Tank Trailer at the 204-AR Waste Unloading Facility.		
☒ F. No extraneous information		
Comments:		
☒ G. Correct use of peer reviews checklist		
Comments: Peer and HEDOP Review Checklists included.		

REVIEW FORM		
CALCULATION NO. CN-004	REVISION NO. 0	DATE OF REVIEW 9/5/96
CALCULATION NOTE TITLE: Calculation Notes That Support Accident Scenario and Consequence Development for the Subsurface Leak Remaining Subsurface Accident		
Review Completed by: Anthony V. Savino		Date: 9/5/1996
<p>☐ A. No math errors</p> <p>Comments:</p> <p>Note that the "dose rates" quoted in rem/h from MICROSHIELD* and MICROSKYSHINE* are actually exposure rates in air (R/h). However, it is conservative to use the R/h values for dose rates in rem/h because the exposure-to-dose rate factors are generally less than 1. It should be stated, however, that the exposure rates from the codes are assumed to be equal to the dose rates.</p> <p>The MICROSKYSHINE case for the vertical cylinder at 100 m for Ba-137m and Eu-154 has an incorrect Ba-137m activity (2.71E4 Ci instead of the correct value of 3.349E4 Ci). This case needs to be corrected. Table 1.7-3 will also then need to be corrected.</p>		
<p>☒ B. All assum/IC stated & ID those needing protection</p> <p>Comments:</p> <p>An IVF documents concurrence with the assumption that the centerlines of the transfer pipes are approximately 1.1 m below the soil surface. The analysis is done assuming the centerlines are 1 m below the soil surface. The results are sensitive to this assumption.</p> <p>Maximum flow rate of 379 L/min (100 gpm) assumed when determining the amount of leakage from the pipe. Total volume released is assumed to be 5% of the total number of gallons pumped in 12 h (27,250 L = 0.05 * 379 L/min * 12 h * 60 min/h).</p> <p>The scenario assumes SST waste is involved in the accident with a 2/3 liquid to 1/3 solids ratio.</p>		
<p>☒ C. All values referenced</p> <p>Comments:</p>		

*MICROSHIELD and MICROSKYSHINE are trademarks of Grove Engineering, Inc., Rockville, MD.

REVIEW FORM		
CALCULATION NO. CN-004	REVISION NO. 0	DATE OF REVIEW 9/5/96
CALCULATION NOTE TITLE: Calculation Notes That Support Accident Scenario and Consequence Development for the Subsurface Leak Remaining Subsurface Accident		
☐ D. Basis for selection of variables Comments: Total volume released is assumed to be 5% of the total number of gallons pumped in 12 h - no basis is given for the 5% value, however, it is contained in an IVF. Note that the MICROSHIELD/MICROSKYSHINE cases were run with the onsite receptor located 100 m from the CENTER of the geometry (cylinder or sphere), whereas, in the past, the onsite receptor was assumed to be located 100 m from the outer radius of the cylinder or sphere. This is conservative, but inconsistent with the methods in SARR-016, which is referenced as the methods used in the analysis (Section 1.4 - p. 9).		
☐ E. All mitigative features listed Comments: No mitigative features required.		
☒ F. No extraneous information Comments:		
☒ G. Correct use of peer reviews checklist Comments: Peer Review Checklists included. HEDOP Review not required for this calcnote.		

REVIEW FORM		
CALCULATION NOTE 032	REVISION 0A	DATE ISSUED: 8-29-96
CALCULATION NOTE TITLE: Analysis of Consequences of Postulated Solvent Fires in Hanford Site Tanks		
Review Completed by: Paul D. Rittmann, PhD CHP		Date: Sept 9, 1996
<p>_____ A. Math Errors</p> <p>Comments: None were found. Due to time constraints, the tables copied from the spreadsheet could not be checked. (It would be quicker for me to redo the calculations and see if I got the same results.)</p>		
<p>_____ B. Assumptions Stated and Which Ones Need Protection</p> <p>Comments: Key assumptions are the diameter & depth of the flammable organic, the tank headspace volume, the aerosol release fractions, and the validity of the POOLFIRE software. Bounding values are used throughout, thus none should be "protected".</p> <p>The diameter & depth of the solvent, along with the headspace volume determines the duration of the fire, which controls the total emission and the emission rate. Various pool areas were tested to find the worst, and the entire tank volume was used to allow the fire to burn the longest.</p> <p>Bounding aerosol release fractions were taken from Mishima (1994).</p> <p>The documentation for POOLFIRE is supplied in Appendix A. It appears complete, and has been independently reviewed.</p> <p>Section 3.4.1 includes the tacit assumptions that tank solvents will not degrade with time to something more flammable than what is already in the tanks. Can this be justified or should it be protected somehow?</p>		
<p>_____ C. Values Referenced</p> <p>Comments: ULD & SOF, ARF, toxic gas creation by fires, heat transfer from burning organics to surfaces, ERPG, solvent flashpoints. In addition, there is a detailed discussion of referenced experimental data of ignition experiments. This discussion supports restrictions on metal cutting, vehicles and lightning.</p>		
<p>_____ D. Basis for Selection of Important Variables</p> <p>Comments: ARFs were selected according to the temperature and material becoming airborne. Other variables were selected to bound or identify bounding values.</p>		
<p>_____ E. Mitigative Features</p> <p>Comments: None were considered.</p>		
<p>_____ F. Extraneous Information</p> <p>Comments: None was noticed.</p>		

REVIEW FORM		
CALCULATION NOTE 032	REVISION 0A	DATE ISSUED: 8-29-96
CALCULATION NOTE TITLE: Analysis of Consequences of Postulated Solvent Fires in Hanford Site Tanks		
<p>_____ G. Peer Review Checklist</p> <p>Comments: Appears to have been thoughtfully completed.</p>		

REVIEW FORM		
CALCULATION NOTE 043	REVISION 1	DATE ISSUED: 8/7/96
CALCULATION NOTE TITLE: Tank Bump Consequence Analysis		
Review Completed by: Paul D. Rittmann, PhD CHP		Date: Sept 3, 1996
<p>A. Math Errors</p> <p>Comments: Page 13, the calculation of DST temperature limit appears to have an error. $105^{\circ}\text{C} - (0.5^{\circ}\text{C/d}) \cdot (30\text{d}) = 90^{\circ}\text{C}$ rather than 93°C reported.</p>		
<p>B. Assumptions Stated and Which Ones Need Protection</p> <p>Comments: Assumptions include (1) linear heat up rate of tank contents upon loss of active ventilation, (2) max conc of liquid in vapor is 1 g/m^3 (very conservative), (3) the GOTH model for tank bumps for 101-AZ with 5 risers (4 inch diameter) and one ventilation header with a diameter of 20 inches. (4) The temperature in 241-C-106 rose linearly during the 160 days that the ventilation system was out of service.</p> <p>The first two assumptions are upper bounds which cannot be exceeded. The third assumption is not justified in this calc note. Other scenarios presented in the GOTH document (CN-022) lead to worse consequences. The third assumption may need to be protected, if it can be justified. The fourth assumption is used to compute a heatup rate for several other tanks. If the rise was not linear, then the heatup rate could be greatly underestimated. The assumption of linear temperature rise needs to be justified.</p>		
<p>C. Values Referenced</p> <p>Comments: Some references are missing while others are misused.</p> <p><u>Missing References:</u> (1) page 4 refers to an FSAR for methodology, but provides no reference, (2) the formula on Page 6 is not referenced, nor are the terms defined, nor are the values plugged into it on succeeding pages referenced, and (3) the toxicological calculation results are presented on Page 9 without explaining how they are computed or providing a reference for the values for SOF, a term which is not defined. (3) On Page 13, the temperature limits for single and double shell tanks are computed using a "saturation temperature" of 105°C, which is not referenced.</p> <p><u>Misused References:</u> (1) Assuming SOF refers to the "Sum of Fractions" given in SARR-011, Rev 2, then the values used on Page 9 for Gas emissions are inconsistent. The value for Onsite comes from the "Worst Case" table, while the value for Offsite comes from the "Maximum Sample". One of these needs to be changed. (2) The calculation of DF with the cover blocks in place uses Figure 17 from the GOTH document to establish an 80 second release duration for the steam, but then fails to use Figure 18 to establish the release duration for the liquid.</p>		

REVIEW FORM		
CALCULATION NOTE 043	REVISION 1	DATE ISSUED: 8/7/96
CALCULATION NOTE TITLE: Tank Bump Consequence Analysis		
C. (continued)		
<p>A release duration of 80 seconds is assumed, while Figure 18 shows 4 seconds. The consequence tables on Pages 11 and 13 are thus incorrect by a factor of 20. (3) The various cases analyzed in the GOTH document generally give worse consequences than the case selected for this analysis. Without justifying the selection, it appears that some of the GOTH cases were not applied to the problem at hand.</p> <p><u>Adequate References:</u> (1) the partition fraction used to estimate air concentrations in the tank dome, (2) the solid & liquid densities of the tank waste, (3) the specific volume of steam, (4) the average heatup rate for 241-C-106.</p>		
<p>_____ D. Basis for Selection of Important Variables</p> <p>Comments: As mentioned under "Values Referenced", some variables have uncertain origins. Among these are the ULD, the SOF, the breathing rate, the X/Q, the saturation temperature, and the justification for using an average heatup rate to predict short-term temperature rise of tank waste.</p> <p>In addition, the partition fraction is poorly supported, since the reference is an accelerated safety analysis (SARR-018) rather than scientific literature.</p>		
<p>_____ E. Mitigative Features</p> <p>Comments: The only mitigative feature applied to the calculations is the elimination of liquid and solid emissions by the presence of cover blocks. The only emission left is liquid which could be entrained in the steam. The bounding assumption of 1 g/m³ in the steam means that the mitigation is used only in part. If the mitigated consequences are used in the SAR, then the presence of cover blocks must be protected.</p>		
<p>_____ F. Extraneous Information</p> <p>Comments: None was found.</p>		
<p>_____ G. Peer Review Checklist</p> <p>Comments: The reviewer for Rev 1 assumed that Rev 0 had been properly reviewed. However, the Rev 0 reviewer failed to check this calc note against source information. In addition, no mathematical derivations were found in the calc note, although this box was checked "Yes".</p>		

REVIEW FORM		
CALCULATION NO. 44	REVISION NO. 0	DATE OF REVIEW
CALCULATION NOTE TITLE: Calculation Notes That Support Accident Scenario and Consequence Development for the Steam Intrusion from Interfacing Systems Accident.		
Review Completed by: Bryan Flanagan		Date: Sept 2, 1996
<p>☒ A. No math errors</p> <p>Comments: No math errors encountered.</p>		
<p>☐ B. All assum/IC stated & ID those needing protection</p> <p>Comments: The volume of the headspace used (calculated from radius of tank) is not referenced or verified (assumption G).</p> <p>Stated in Section 1.4.1 that HEPA filters sufficiently fail at a pressure of 17 psia.</p> <p>HEPA filter dose rates limited to 200 mr/h on page 48-49.</p> <p>Saturated steam flow rate into the tank headspace is 2400 lbm/sec (note: included in an IVF).</p> <p>Headspace air temperature is assumed to be initially at 150 F (note: included in an IVF).</p> <p>Waste material made airborne and contained on the HEPA filters is assumed to be DST Liquids.</p>		
<p>☒ C. All values referenced</p> <p>Comments: Standard physical properties of air and steam have each been check to be correct.</p> <p>Partition fractions of 1.0×10^{-8} for tanks during active ventilation, and 1.0×10^{-10} for tanks under passive ventilation are referenced to an "RHO" document.</p> <p>ARFxFRF of 1.0×10^{-2} for HEPA filter blowout from HDBK-3010.</p>		
<p>☒ D. Basis for selection of variables</p> <p>Comments: Basis for all assumptions appear to be reasonable and conservative.</p>		
<p>☐ E. All mitigative features listed</p> <p>Comments: Toxic guidelines for onsite receptor is exceeded with no remedy stated (page 22-23).</p>		

REVIEW FORM		
CALCULATION NO. 44	REVISION NO. 0	DATE OF REVIEW
CALCULATION NOTE TITLE: Calculation Notes That Support Accident Scenario and Consequence Development for the Steam Intrusion from Interfacing Systems Accident.		
☐ F. No extraneous information Comments: In the 1st calculation (pages 12-17), a more thorough analysis was performed than was actually needed once the answer was determined (see Table C-1). Some solutions were needlessly calculated to simply show that a pressure buildup of steam inside the headspace is possible.		
☒ G. Correct use of peer reviews checklist Comments: Peer and HEDOP Review Checklists included.		

REVIEW FORM		
CALC #WHC-SD-WM-CN-045	REVISION 0	DATE OF REVIEW 8/30/96
CALC NOTE TITLE: Consequence Analysis of a Postulated NaOH Release from the 2727-W Sodium Storage Facility		
<p>A. No math errors</p> <p>Comments: MATH ERRORS: pgl: 20 psi wind load should be stated as 20 lb per square foot (Units error only - does not effect math). pgl: should area of fire surface be doubled (from 240 to 480 sq ft) then multiplied by 5 to account for both halves and all 5 of the vessels? See also redline markup.</p> <p>B. All assumptions/IC stated & ID those needing protection.</p> <p>Comments: Assumptions are stated but not Initial Conditions. Must protect total bldg inventory of 0.005 Ci and five tanks and 20 lb/ft2 bldg design load. pg3 "ordinary" and therefore 100mg/m3 as most conservative # does not appear to be a defensible position during a 90 mph wind! The calculations are based on a fire from only one of the 5 tanks. No reference is given to support not assuming all 5 tanks catch on fire. See also redline markup.</p> <p>C. All values referenced</p> <p>Comments: pgl: Total bldg inventory of 0.005Ci is not referenced nor is 20ft tank "effective length" referenced or reconciled to 21ft tank length. pgl: Sodium burn rate of 8lb/ft2-hr and 35% release fraction are not referenced. Pgl states that the tanks are covered with refractory brick - this is not referenced, and, from personal experience, the Hallam sodium tanks are insulated with ASBESTOS! The validity of using the Johnson 1979 data (Attachment 2 of the SD) as a model was not validated. See also redline markup.</p> <p>D. Basis for selection of variables</p> <p>Comments: Pg 2: The breathing rate "BR" is stated for light activity. There is no reason given for choosing "light" BR. People running from a sodium fire during 90 mph wind are doing more than light breathing.</p> <p>E. All mitigative features listed</p> <p>Comments: None listed.</p> <p>F. No extraneous information</p> <p>Comments: Na 22 half life is not used in calculations.</p> <p>G. Correct use of peer reviews checklist</p> <p>Comments: Based on the above findings I would have to say no.</p>		
Tom Tomaszewski		\ 8-30-96
Review Completed by		Date

REVIEW FORM		
CALCULATION NO. WHC-SD-WM-CN-047	REVISION NO. 1	DATE OF REVIEW 9 Sept 1996
CALCULATION NOTE TITLE: Calculation Notes That Support Accident Scenario and Consequence Determination For a Waste Tank Criticality		
Review Completed by: Harvey Goldberg		Date: 9 Sept 1996
<p>_____ A. No math errors</p> <p>Comments: 1) This document consists of a merging of Mathcad calculations and a wordperfect text. The mathematics within the Mathcad sections is correct, but it often does not correspond exactly to the numbers in the wordperfect text. While many of these discrepancies are just round off of the numbers in the Mathcad sections, the divergences tend to increase as a person reading the text utilizes a series of rounded off values, while the Mathcad uses five significant figures.</p> <p>This can lead to a red flag for checkers such as $2+2=5$ in the text, while the Mathcad has actually added 2.49978 and 2.5002. This, coupled with the fact that the mathcad calculations are extremely hard to follow and are not adequately explained in the test, would lead a reviewer to conclude that a mistake had been made.</p> <p>2) Page 4: The value of 212 MeV/fission should be referenced (I believe it comes from Physics of Nuclear Kinetics by Keepin. Nuclear Energy by Bodansky has 207 MeV/fission from fission and decay products emitting beta particles and gamma radiation. In addition he has another 5 MeV form gamma rays emitted from neutron capture reactions that do not cause fission. These differences will not influence the final number very much, but if a EOD reviewer has a different number in his memory, it's nice to have a reference.</p>		
<p>_____ B. All assum/IC stated & ID those needing protection</p> <p>Comments: 1) The main assumption is that this almost inconceivable event of a criticality could occur. Most of the other assumptions are mental gymnastics to make the scenario seem plausible. This assumption should not be protected.</p> <p>2) Five hundred liters of 10 g Pu/L solution is transferee to a double shell tank.</p> <p>3) The viscosity of the waste in the tank before the transfer in question is neither so large that the new transfer forms a thin disk on top of it, nor so small that mixing is thorough, but just right that the new transfer form a spherical pocket within the previously transferee waste.</p>		

REVIEW FORM		
CALCULATION NO. WHC-SD-WM-CN-047	REVISION NO. 1	DATE OF REVIEW 9 Sept 1996
CALCULATION NOTE TITLE: Calculation Notes That Support Accident Scenario and Consequence Determination For a Waste Tank Criticality		
<p>B. (continued)</p> <p>4) The new 10 g Pu/L solution is transferee at a rate of 75 gal/min.</p> <p>5) The criticality is similar, but smaller than the one described by Hetrick.</p> <p>6) The heat capacity and heat of vaporization of the waste is equal to that of water.</p> <p>7) The heat produced is transferee to the surroundings fast enough so that are not regions of superheating, driving the temperature substantially above 100°C.</p> <p>8) All of the isotopes in the waste are vaporized equally (0.05% of salt content). This will generally hold if the previous assumption holds.</p> <p>9) All of the nobel gases and iodine produced by the fission are releases.</p> <p>10) The DCF for ²³⁹Pu was taken from the EDP Federal Guidance Report #11 (with no reference) as the class "weeks" compound for plutonium (e.g. nitrates). It is more likely that the plutonium will be in an oxide state (class "years"). However this assumption is more conservative.</p> <p>11) It is assumed that the gas in the head space and the steam released are non-compressible ideal gases that do not interact.</p> <p>12) The waste is assumed to have a density of $1.03 \times 10^3 \text{ kg/m}^3$.</p>		
<p>C. All values referenced</p> <p>Comments: 1) The energy per fission is not referenced.</p> <p>2) The heat of vaporization and heat capacity of the waste and the density of the steam are not referenced.</p> <p>3) WHC-SD-WM-SAR-067 was referenced but is not available....it has not been published as of yet. I tried to get section 3.4.1 but was unsuccessful. Several dose related variables were taken from this document. If the document is not available, the original source should be referenced.</p>		

REVIEW FORM		
CALCULATION NO. WHC-SD-WM-CN-047	REVISION NO. 1	DATE OF REVIEW 9 Sept 1996
CALCULATION NOTE TITLE: Calculation Notes That Support Accident Scenario and Consequence Determination For a Waste Tank Criticality		
<p>C. (continued)</p> <p>4) I'm not sure if this belongs in this section, but I don't know where else to put it. The GENII files are referenced as being attached to this document. They are not attached.</p> <p>5) The dose results on page 7 reference WHC-SD-WM-TI-52, which is not released and I could not obtain, and Calculational Notes WHC-SD-WM-CN-067 which do not seem to agree with the data used in this section of this document.</p> <p>6) The toxicological section references WHC (1966a). There is only one reference to a WHC document that is not referenced under the author's name. The lower case letter at the end of the date is used only to differentiate between multiple references identified by the same name and issued in the same year.</p>		
<p>_____ D. Basis for selection of variables</p> <p>Comments: Much of this section is included in the previous sections (B&C).</p>		
<p>_____ E. All mitigative features listed</p> <p>Comments: There were no mitigative features.</p>		
<p>_____ F. No extraneous information</p> <p>Comments: No extraneous information.</p>		
<p>_____ G. Correct use of peer reviews checklist</p> <p>Comments: Yes</p>		

REVIEW FORM		
CALCULATION NO. WHC-SD-WM-CN-048	REVISION NO. 0	DATE OF REVIEW 9/3/96
CALCULATION NOTE TITLE: Calculation Notes in Support of TWRS FSAR Spray Leak Accident		
Review Completed by: D. R. Porten		Date: 9/3/96
<p><u>Yes</u> A. Math errors</p> <p>In Section 4.2.1.1, on page 13, the value for the equivalent volume of waste released over the first hour, Q(1st hr) is stated to be 5.7 E-03 L from Section 3.2.3 and is used in the calculation of the dose to the onsite receptor. The correct value from Section 3.2.3 is 5.8 E-03 L. The attached marked-up text includes notations of the incorrect values.</p>		
<p><u>YES</u> B. All assum/IC stated & ID those needing protection</p> <p>Comments: My judgement is that there are no assumptions listed here that need protection.</p> <ol style="list-style-type: none"> 1. A spray leak inside a DST valve pit during a transfer of aging waste was selected as the bounding representative accident for detailed analysis. 2. The unmitigated analysis assumes away all preventative and mitigative barriers, therefore the pit cover blocks are off at the time of the leak. 3. The uncovered spray leak is assumed to continue unabated for 24 hours. 4. The onsite receptor is assumed to be exposed to the plume for 12 hours. 5. The mitigated spray leak is assumed to continue for the same duration as the unmitigated scenario, or 24 hours. 6. The waste being sprayed is assumed to be composed of a composite slurry of aging waste containing 33 vol % solids, 67 vol % liquids. 7. For purposes of modelling, the spray leak was assumed to occur at a misaligned jumper connection to a 2 in. schedule 40 slurry transfer line. The leak was assumed to be 5.1 cm (2 in.) long. 8. The leak was assumed to occur at a maximum waste gauge pressure of 2.1 MPa (300 psi). 9. Waste slurry was assumed to have a viscosity approaching that of water, or 1 cPs. 		

REVIEW FORM		
CALCULATION NO. WHC-SD-WM-CN-048	REVISION NO. 0	DATE OF REVIEW 9/3/96
CALCULATION NOTE TITLE: Calculation Notes in Support of TWRS FSAR Spray Leak Accident		
<p><u>YES</u> B. All assum/IC stated & ID those needing protection</p> <p>Comments: continued.....</p> <p>10. For the mitigated analysis it is assumed that any air expelled from the pit would be limited in aerosol concentration to the quasi-stable aerosol loading limit of 100 mg/m³. The aerosols expelled from the pit are all conservatively assumed to be in the respirable size range (< 10 um in diameter).</p> <p>11. Air in the pit is initially assumed to be at 30 F and 15 % relative humidity (R.H.). Conservative final values are assumed to 120 F and 100 % R.H..</p> <p>12. An estimated density for the waste was 1.4 g/cm³.</p>		
<p><u>No</u> C. All values referenced</p> <p>Comments: All values were found to be referenced, however some of the references quoted in text, cannot be found in the Reference Section, Section 10. Since the Reference Section contains the complete title and information about the references, some references found in the text are not usable. The attached marked-up text includes circles or notations of the incomplete references.</p>		
<p><u>YES</u> D. Basis for selection of variables</p> <p>Comments: The basis for all variables used in this analysis was either stated or referenced. Note in Section 4.2.1.1, the 11 hour onsite X/Q' value is stated to come from Table D-1, which should be Table D-3.</p>		
<p><u>Yes</u> E. All mitigative features listed</p> <p>Comments: The major mitigative feature described in this analysis of spray leaks in a valve pit is to have the cover blocks in place. Calculations for both mitigated (cover blocks in place), unmitigated (pit open) are included in this analysis.</p>		
<p><u>NO</u> F. No extraneous information</p> <p>Comments: No extraneous information was found.</p>		
<p><u>YES</u> G. Correct use of peer reviews checklist</p> <p>Comments: A documented peer review checklist is contained in the report and its completeness is evident by the quality of the report and the small number of math errors.</p>		

REVIEW FORM		
CALCULATION NO. WHC-SD-WM-CN-049,	REVISION NO.0	DATE OF REVIEW 12 Sept 1996
CALCULATION NOTE TITLE: Calculation Notes for Surface Leak Resulting in Pool, TWRS FSAR Accident Analysis		
Review Completed by: Harvey Goldberg		Date: 12 September 1996
<p>_____ A. No math errors</p> <p>Comments: On page 11, for the Q (resuspension, soil), I get 67.5 rather than 67.4.</p>		
<p>_____ B. All assum/IC stated & ID those needing protection</p> <p>Comments: 1) The waste is aging waste facility waste.</p> <p> 2) The waste is 33% entrained solids by volume with $\rho=1.4 \text{ g/cm}^3$.</p> <p> 3) The valve pit drain is plugged at the time of the leak.</p> <p> 4) Mass balances and visual observations are not performed. Thus the leak is not detected for 12 hours.</p> <p> 5) The transfer pump is shut off 12 hours after the leak.</p> <p> 6) The depth of the pool external to the pit is 1.4 in.</p> <p> 7) The flowrate through the leak is 300 gpm.</p> <p> 8) The leak is assumed to happen in the A-A valve pit, the smallest valve pit.</p> <p> 9) The ambient temperature is well below the saturation temperature of the waste.</p> <p> 10) Section 2.3.5.1: The bounding RRF value in Mishima for aqueous solutions is 1×10^{-4}. This analysis used 4×10^{-5} which is the bounding value for slurries.</p> <p> 11) Section 2.3.6.1: The RRF assumed is 2×10^{-10} which is a real eye-strain reading of a graph in Mishima, from one paper by Roblyer and Owczarski. Mishima's bounding values are 4×10^{-6} for wind speeds of approximately 30 mph and 4×10^{-7} for low wind speeds</p>		

REVIEW FORM		
CALCULATION NO. WCH-SD-WM-CN-049,	REVISION NO.0	DATE OF REVIEW 12 Sept 1996
<p>CALCULATION NOTE TITLE: Calculation Notes for Surface Leak Resulting in Pool, TWRS FSAR Accident Analysis</p> <p>12) The onsite receptor is 100 m from the edge of the pool.</p> <p>13) The pool of waste is circular.</p> <p>14) The onsite receptor is exposed for a period of 12 hours.</p> <p>15) The offsite receptor is exposed for a period of 36 hours.</p> <p>16) None of the waste soaks into the soil while the pump is running.</p> <p>17) After the pump is shut off and the waste sinks into the soil, the contaminated surface is not sprayed with liquid, fixant, nor covered with clean soil.</p> <p>18) In the mitigated case the pit leak detector alarms when the waste has filled the pit up to 2".</p> <p>19) In the mitigated case the pump is shut off 30 min after the alarm.</p>		
<p>_____ C. All values referenced</p> <p>Comments: Yes, but I could not find the reference to SARR-037 in section 2.4.</p>		
<p>_____ D. Basis for selection of variables</p> <p>Comments: With the exception of those variables commented on in item B-10 and 11, all the variables are conservative.</p>		
<p>_____ E. All mitigative features listed</p> <p>Comments: 1) The alarm detects the leak.</p> <p>2) The pump is shut off 30 minutes after the alarm.</p> <p>3) The pit cover blocks are in place during the transfer.</p>		
<p>_____ F. No extraneous information</p> <p>Comments: No extraneous information.</p>		

REVIEW FORM		
CALCULATION NO. WHC-SD-WM-CN-049,	REVISION NO.0	DATE OF REVIEW 12 Sept 1996
CALCULATION NOTE TITLE: Calculation Notes for Surface Leak Resulting in Pool, TWRS FSAR Accident Analysis		
<p>_____ G. Correct use of peer reviews checklist</p> <p>Comments: Both peer review checklist are completed correctly.</p>		

REVIEW FORM		
CALCULATION NO. 51	REVISION NO. 0	DATE OF REVIEW
CALCULATION NOTE TITLE: The Effects of Load Drop, Uniform Load and Concentrated Loads on Waste Tanks.		
Review Completed by: Bryan Flanagan		Date: Sept 9, 1996
<p>☐ A. No math errors</p> <p>Comments: The units do not appear equal between equations 1 and 2 on page 5. Page 11, SST should read DST.</p>		
<p>☐ B. All assum/IC stated & ID those needing protection</p> <p>Comments: An assumption was made that Aging Waste Tanks do not have a floating saltcake/slush. It is stated on page 5 that a significant analysis is based on a "unwieldy" equation (equation 1). An empirical correlation is stated as $2 \times 10^{-4} \text{ cm}^3/\text{J}$ without justification. There is nothing stated about the effects of the ventilation/filtering system which is sure to be drawing a vacuum during a pump removal. Note that the analysis was based on DST solids resulting in higher radiological doses, however SST solids result in worse toxic chemical consequences.</p>		
<p>☐ C. All values referenced</p> <p>Comments: Weight of mixer pump is listed as 20,000 lb based on 101-SY pump with no reference or comparison.</p>		
<p>☐ D. Basis for selection of variables</p> <p>Comments: Basis for all assumptions appear to be reasonable and conservative.</p>		
<p>☐ E. All mitigative features listed</p> <p>Comments: The onsite toxicological consequences are exceeded with no remedy stated (page 14).</p>		
<p>☒ F. No extraneous information</p> <p>Comments:</p>		
<p>☐ G. Correct use of peer reviews checklist</p> <p>Comments: No checklists on my electronic copy.</p>		

REVIEW FORM		
CALCULATION NO. CN-053	REVISION NO. 0	DATE OF REVIEW 9/5/96
CALCULATION NOTE TITLE: Excavations in Hanford Ponds, Crips, or Ditches.		
Review Completed by: Anthony V. Savino		Date: 9/5/1996
<p>A. No math errors</p> <p>Comments:</p> <p>The offsite χ/Q' value (1.49×10^{-5} s/m³ listed in the input section (p. 8) is incorrect (it corresponds to the old site boundary value). The correct value should have been 2.12×10^{-5} s/m³. Note that the 24 h interpolated offsite χ/Q' value in Table 4 (p. 13) is correct, so they must have used the correct value in their interpolation.</p> <p>The sentence on breathing rate (p. 8) is incorrect. It should read "The breathing rate for the onsite receptor for a release duration less than 12 h is 3.3×10^{-4} m³/s, and the breathing rate for an offsite receptor is 3.3×10^{-4} m³/s for release durations less than 24 h, and is 2.7×10^{-4} m³/s for release durations greater than or equal to 24 h."</p> <p>There is no explanation why 60 m³ is used to calculate the airborne resuspension source term for an onsite receptor (p. 11) instead of 120 m³. The onsite receptor inhales contaminated soils made airborne during 12 h of excavation (based on 120 m³ being excavated in 12 h), and also inhales for 12 h the contamination from resuspended soil which had previously been excavated (which should also be 120 m³).</p> <p>On p. 17 the 1st sentence says that calculated radiological and toxicological dose consequences are well within the risk evaluation guidelines. However, toxic chemical exposure consequences were not calculated in the calcnote. A sentence should be added that toxic chemical exposure consequences are negligible due to the low concentrations of chemicals in the soil.</p> <p>Appendix 1 - ULD calculations - there a few mistakes in the table which have no impact on the final results but are noted anyway. Eu-155 is included twice. The Pm-147 value for crib U-16 is incorrect (2.27E-7 instead of 2.74E-4). The U-gross (6.39E-2 Ci) value from Attachment 1 was used in Appendix 1 for the U233 value for Crib U-14 instead of the U233 value from Attachment 1 (6.6E-16 Ci). The U233 value from Attachment 1 for Crib U-17 was used for U234 in Appendix 1. The U-gross value from Attachment 1 for Crib U-17 was used for the Pu238 value in Appendix 1</p> <p>Also, in Appendix 1 - they should state that inventories for radionuclides which were reported as "less than" in the Cumulative Decayed Inventory Reports in Attachment 1 were conservatively assumed to be equal to the "less than" values. They should also state that there are several radionuclides in the Cumulative Decayed Inventory Reports in Attachment 1 that are not included in Appendix 1, however, they have a negligible on the ULDs because of their low total activities.</p>		

REVIEW FORM		
CALCULATION NO. CN-053	REVISION NO. 0	DATE OF REVIEW 9/5/96
CALCULATION NOTE TITLE: Excavations in Hanford Ponds, Cribs, or Ditches.		
☒ B. All assum/IC stated & ID those needing protection Comments: Rate of excavation is $10 \text{ m}^3/\text{h}$. The quantity of excavated material is bounded by a 12 hour excavation (1 shift).		
☒ C. All values referenced Comments:		
☐ D. Basis for selection of variables Comments: Release fractions/rates look reasonable and appropriate for the analysis. ARF _x RF of 6×10^{-4} for suspension of falling powders [excavated soil]. ARR _x RF of $4 \times 10^{-5}/\text{hr}$ for resuspension from a homogeneous bed of powder exposed to nominal atmospheric conditions ($<2 \text{ m/s}$ w/ gusts up to 20 m/s) [resuspension of excavated soil]. Average concentration of radiological and toxic chemical inventories in the crib are representative of the excavated material (p. 9). This is a reasonable and conservative assumption, however, how can these inventories be controlled or protected since the results of the analysis are very sensitive to these values?		
☐ E. All mitigative features listed Comments: No mitigative features required.		
☐ F. No extraneous information Comments: On p. 7 the volume of soil overburden for a Crib is listed ($60,000 \text{ m}^3$) as an input assumption but I could not find its use anywhere.		
☐ G. Correct use of peer reviews checklist Comments: Peer Review Checklists included (looks like a WSRC variety). NO HEDOP Review was performed.		

REVIEW FORM		
CALCULATION # CN-054	REVISION 0	DATE OF REVIEW 8/30/96
CALCULATION NOTE TITLE: Waste Tank Ventilation System Waste Material Accumulation		
<p><u> X </u> A. No math errors</p> <p>Comments:</p>		
<p><u> X </u> B. All assum/IC stated & ID those needing protection</p> <p>Comments:</p> <p>Filter contact dose rate - 200 mrem/h</p>		
<p><u> </u> C. All values referenced</p> <p>Comments:</p> <p>IVFs for filter dimensions not included (should there be one?).</p> <p>IVFs (if needed) for the 4 ventilation configurations and number of filter banks were not included. I cannot verify the configurations.</p>		
<p><u> </u> D. Basis for selection of variables</p> <p>Comments:</p> <p>ARF - 1×10^{-2} for filter pressurization - referenced HDBK-3010 - looks okay</p> <p>No discussion of basis for selection of different waste types for the different ventilation systems (e.g., SST Solids for SX,C-106, SST Liquids for DCRTs, etc.)</p>		
<p><u> NA </u> E. All mitigative features listed</p> <p>Comments:</p>		
<p><u> X </u> F. No extraneous information</p> <p>Comments:</p>		
<p><u> X </u> G. Correct use of peer reviews checklist</p> <p>Comments: NO HEDOP REVIEW IS REQUIRED FOR THIS CALC-NOTE</p>		
<u>Anthony V. Savino</u> Review Completed by		<u>8/30/96</u> Date

REVIEW FORM		
CALCULATION NOTE 055	REVISION 0	DATE ISSUED: Aug 1996
CALCULATION NOTE TITLE: Flammable Gas Deflagration Consequence Calculations for the Tank Waste Remediation System Basis for Interim Operation		
Review Completed by: Paul D. Rittmann, PhD CHP		Date: Sept 4, 1996
<p>_____ A. Math Errors</p> <p>Comments: None were found.</p>		
<p>_____ B. Assumptions Stated and Which Ones Need Protection</p> <p>Comments: The activity airborne is taken from other documents. Nearly all of the airborne activity is described in WHC-SD-WM-SAD-036, Rev 0, which I do not have a copy of, and could not verify. The assumptions behind the emissions calculations in this report may need to be protected. The insignificant portion of the release is described in CN-054, which I did have a copy of.</p> <p>The assumed SST solids density is 1.65 kg/L, which is not referenced, only assumed on page 6. Tank solids densities don't vary enough to warrant further refinement. This number probably cannot be protected anyway.</p> <p>The only other assumption is a 200 second release duration for the toxicological calculations. This is justified in the report as an engineering judgement. Since the consequences exceed unity both onsite and offsite, this assumption may need to be refined. The chemical emission rate due to the deflagration is not subject to operations control, and cannot be protected.</p>		
<p>_____ C. Values Referenced</p> <p>Comments: All but two values were referenced. Those from SARR-011 and SARR-016 were verified. The others were not. The two values not referenced were assumed, and are described above.</p>		
<p>_____ D. Basis for Selection of Important Variables</p> <p>Comments: The most important variables were derived in another document, which I did not have access to at the time of this review.</p> <p>The 200 second emission time for the toxicological calculation was assumed based on times for other portions of the deflagration. The value chosen seems reasonable, but may warrant further investigation since it is inversely proportional to the final consequence.</p>		

REVIEW FORM		
CALCULATION NOTE 055	REVISION 0	DATE ISSUED: Aug 1996
CALCULATION NOTE TITLE: Flammable Gas Deflagration Consequence Calculations for the Tank Waste Remediation System Basis for Interim Operation		
_____ E. Mitigative Features Comments: No mitigative features were introduced in this report. There may be some in SAD-036, but it was not available.		
_____ F. Extraneous Information Comments: None was noted.		
_____ G. Peer Review Checklist Comments: No mathematical derivations are present in this report. This block should have been marked NA rather than YES. Other than that the checklist appears to be filled out correctly.		

REVIEW FORM		
CALCULATION NO. CN-056	REVISION NO. 1	DATE OF REVIEW 09/02/96
CALCULATION NOTE TITLE: Fire in a Contaminated Area		
Review Completed by: Anthony V. Savino		Date: 09/02/96
<div style="margin-bottom: 10px;"> ☒ A. No math errors Comments: </div> <div> ☐ B. All assum/IC stated & ID those needing protection Comments: <p>It is assumed that the valve pits contain an amount of material with the highest radioactive risk, but no justification is provided for this assumption (i.e., what about pump pits, diversion boxes, etc). Some discussion of this should be included.</p> <p>It is assumed that a 1 inch layer of dried AWF material is on the floor, but no controls/detection instruments are described to ensure that a greater amount could not be present. (Note that the IVF states that "for the purpose of this analysis, the numbers you have provided [i.e., 12 ft by 10 ft valve pit with 1 in layer] can be used.")</p> <p>The IVF refers to another IVF (Chapter 3-H1) for use of 1/3 AWF Solids and 2/3 AWF liquids. I do not have the other IVF. However, I recall that last year most analyses used 1/3 AWF Solids and 2/3 SST Liquids since this results in the worst radiological dose consequences. The bottom line is that there must be some controls in place to ensure that waste with a greater radiological hazard than analyzed for does not end up in the valve pits.</p> </div>		
<div style="margin-bottom: 10px;"> ☒ C. All values referenced Comments: </div> <div> ☐ D. Basis for selection of variables Comments: <p>Although the accident frequency developed in Appendix A does not appear to be used in the calcnote, I am not convinced that the accident frequency of 4.5×10^{-6} collision/mi, which is associated with trucks operating on a rural roadway, is applicable to the scenario involved with human error in positioning a crane or support vehicle. Note, however, that the unmitigated event frequency of 9.0×10^{-7} per year (per vehicle) for a fire in a pit due to a collision with a pit curb is so low that an order of magnitude increase will have only a minor impact on the final conclusion of the analysis.</p> </div>		

REVIEW FORM		
CALCULATION NO. CN-056	REVISION NO. 1	DATE OF REVIEW 09/02/96
CALCULATION NOTE TITLE: Fire in a Contaminated Area		
<p>☐ E. All mitigative features listed</p> <p>Comments:</p> <p>It is stated on page 16 that since the onsite guidelines are exceeded for 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." No mitigative features are listed in the calcnote although they are required to meet risk guidelines.</p>		
<p>☐ F. No extraneous information</p> <p>Comments:</p> <p>The frequency analysis in Appendix A does not appear to be used anywhere.</p>		
<p>☒ G. Correct use of peer reviews checklist</p> <p>Comments: Peer and HEDOP review checklists appear to be properly used.</p>		

REVIEW FORM		
CALCULATION NO. WHC-SD-WM-CN-057	REVISION NO. 0	DATE OF REVIEW 9/6/96
CALCULATION NOTE TITLE: Calculation Notes for Subsurface Leak Resulting in Pool, TWRS FSAR Accident Analysis		
Review Completed by: D. R. Porten		Date: 9/6/96
<p><u>No</u> A. Math errors</p> <p>There were no math errors found in this analysis.</p>		
<p><u>YES</u> B. All assum/IC stated & ID those needing protection</p> <p>Comments: My judgement is that there are no assumptions listed here that need protection.</p> <p>In the unmitigated accident analysis, the representative case analyzed is a leak from an unencased bermed line during an SST transfer which utilizes a submersible pump. The key assumptions in the analysis are as follows:</p> <ol style="list-style-type: none"> 1. The waste leaked is assumed to be SST waste, as defined in WHC-SD-WM-SARR-037 (1996), containing 33 vol% entrained solids. 2. The leak is assumed to cause a washout of the berm due to "piping" phenomena. 3. The leak is assumed to be catastrophic, with 100 % of pipe flow after berm washout assumed to be available to form a surface pool. 4. The leak is assumed to occur at the maximum submersible pump flowrate of 50 gpm. 5. The surface pool is assumed to ultimately cover a soil surface area of 3000 yd², based on the above raw water leak. 6. The transfer pump is assumed to be shut off after 37,500 gal of waste has leaked to the soil surface, approximately 12.5 hours after the leak is initiated. 7. After the transfer pump is shut off, the waste is assumed to soak into the soil, leaving entrained and dissolved salts as surface contamination. 8. The maximally exposed onsite receptor is assumed to be exposed to particles resuspended from the contaminated soil surface after the waste has soaked in, for a period of 12 hours (1 work shift with overtime). 		

REVIEW FORM		
CALCULATION NO. WHC-SD-WM-CN-057	REVISION NO. 0	DATE OF REVIEW 9/6/96
<p>CALCULATION NOTE TITLE: Calculation Notes for Subsurface Leak Resulting in Pool, TWRS FSAR Accident Analysis</p>		
<p>9. The maximally exposed onsite receptor is assumed to be exposed to shine and skyshine from the contaminated soil, after the waste has soaked in, for a period of 12 hours.</p>		
<p>10. The maximally exposed offsite receptor is assumed to be exposed to resuspended waste from the surface of the growing liquid pool for the first 12.5 hours of the accident and to waste particles resuspended from the contaminated soil for an additional 24 hours.</p>		
<p>11. For calculating shine and skyshine doses to the onsite receptor, the surface pool is assumed to be circular, located between the berm and the receptor.</p>		
<p>12. For calculating shine and skyshine doses, the onsite receptor is assumed to be 100 m from the site of the leak (100 m from the far edge of the circular pool).</p>		
<p>13. For calculating shine and skyshine doses to the onsite receptor, the waste is assumed to soak in to the soil to an average depth of 5.5 in, based on a soil porosity of 0.4. The waste is assumed to occupy the void spaces in the soil.</p>		
<p>14. For calculating shine and skyshine doses to the onsite receptor, the soil is assumed to have shielding properties similar to concrete with a density of 1.6 g/cc.</p>		
<p>15. For calculating shine and skyshine doses to the onsite receptor, the waste is assumed to have self shielding properties similar to water with a density of 1.4 g/cc.</p>		
<p>16. Shine and skyshine doses to the offsite receptor are assumed to be negligible due to distance.</p>		
<p>The mitigated scenario credits operator surveillances performed every 30 minutes with detecting the leak. Credit is also taken for emergency response actions to evacuate the onsite receptor to an upwind staging area at a safe distance within 30 minutes of detection to the leak. The key assumptions used in the mitigated analysis are summarized as follows:</p>		
<p>1. The leak is assumed to occur in an unencased bermed transfer line during an SST transfer using a submersible transfer pump.</p>		
<p>2. The waste leaked is assumed to be SST waste, as defined in WHC-SD-WM-SARR-037 (1996), containing 33 vol% entrained solids.</p>		
<p>3. The leak is assumed to washout the berm due to "piping" phenomena.</p>		
<p>4. The leak is assumed to occur at the maximum submersible pump flowrate of 50 gpm.</p>		

REVIEW FORM		
CALCULATION NO. WHC-SD-WM-CN-057	REVISION NO. 0	DATE OF REVIEW 9/6/96
<p>CALCULATION NOTE TITLE: Calculation Notes for Subsurface Leak Resulting in Pool, TWRS FSAR Accident Analysis</p>		
<p>5. The leak is assumed to be catastrophic, with 100 % of pipe flow after berm washout assume to be available to form a surface pool.</p>		
<p>6. Berm washout is assumed to occur shortly after an operator surveillance.</p>		
<p>7. The leak is assumed to continue undetected until the next operator surveillance 30 minutes later.</p>		
<p>8. 30 minutes is assumed for operator action to turn off the appropriate transfer pump and to evacuate the onsite receptor to a safe distance upwind.</p>		
<p>9. The waste is assumed to form a liquid pool on the surface for a period of 1 hour until the transfer pump is shut off.</p>		
<p>10. The surface pool is assumed to soak into the ground after the transfer pump is shut off.</p>		
<p>11. The onsite receptor is assumed to be exposed to resuspended material from the surface of the growing liquid waste pool for a period of 1 hour. The onsite receptors exposure after 1 hour is assumed to be negligible due to emergency response.</p>		
<p>12. The onsite receptor is assumed to be exposed to shine and skyshine from the growing liquid pool for a period of 1 hour.</p>		
<p>13. The maximum offsite receptor is assumed to be exposed to resuspended aerosols from the pool surface for 1 hour and to resuspended particulates from the contaminated soil for an additional 24 hours after the waste soaks into the ground.</p>		
<p>14. For calculating shine and skyshine doses to the onsite receptor, the surface pool is assumed to be circular, located between the berm and the receptor.</p>		
<p>15. For calculating shine and skyshine doses to the onsite receptor, the pool is assumed to spread to an average thickness of 1 in.</p>		
<p>16. For calculating shine and skyshine doses, the onsite receptor is assumed to be 100 m from the site of the leak (100 m from the far edge of the circular pool).</p>		

REVIEW FORM		
CALCULATION NO. WHC-SD-WM-CN-057	REVISION NO. 0	DATE OF REVIEW 9/6/96
<p>CALCULATION NOTE TITLE: Calculation Notes for Subsurface Leak Resulting in Pool, TWRS FSAR Accident Analysis</p> <p>17. For calculating shine and skyshine doses to the onsite receptor, the waste is assumed to have self shielding properties similar to water with a density of 1.4 g/cc.</p> <p>18. For calculating shine and skyshine doses to the onsite receptor, the soil between the pool and the receptor is assumed to have immersion shielding properties similar to concrete with a density of 1.6 g/cc.</p> <p>19. Shine and skyshine doses to the offsite receptor are assumed to be negligible due to distance.</p>		
<p><u>Yes</u> C. All values referenced</p> <p>Comments: All values used in the analysis were referenced.</p>		
<p><u>YES</u> D. Basis for selection of variables</p> <p>Comments: The basis for all variables used in this analysis was either stated or referenced.</p>		
<p><u>Yes</u> E. All mitigative features listed</p> <p>Comments: The major mitigative feature described in this analysis credits operator surveillances performed every 30 minutes with detecting the leak. Credit is also taken for emergency response actions to evacuate the onsite receptor to an upwing staging area at a safe distance within 30 minutes of detection of the leak. Calculations for both mitigated (operator surveillance), and unmitigated are included in this analysis.</p>		
<p><u>Yes</u> F. No extraneous information</p> <p>Comments: No extraneous information was found.</p>		
<p><u>YES</u> G. Correct use of peer reviews checklist</p> <p>Comments: A documented peer review checklist is contained in the report and its completeness is evident by the quality of the report and the absence of math errors.</p>		

REVIEW FORM		
CALCULATION NOTE 058	REVISION A	DATE ISSUED: NA
CALCULATION NOTE TITLE: Compilation of Calculation Notes in Support of Organic Salt Nitrate Reactions Safety Analysis		
Review Completed by: Paul D. Rittmann, PhD CHP		Date: Sept 17, 1996
<p><u> </u> A. Math Errors</p> <p>Comments: None observed. The statistical calculations in Attachment 1, Appendix A, could not be checked. (Some tables in Appendix B of Attachment 1 could not be read, eg B-3 through B-9, and B-23). Some of the values cited in Section B.6.4 do not match the tables. For example, the text references Figure B-26, but the actual graph used is B-22. The comments in Section B.6.5, 3rd paragraph appear to apply to a previous version of the graphs.</p>		
<p><u> </u> B. Assumptions Stated and Which Ones Need Protection</p> <p>Comments: Assumptions are already listed in Section 5.0, based on assumption lists in Sections 3.1 and 5.2 of Attachment 1. Since the conclusions are dependent on the tank sampling results, it is important that the statistical evaluation be repeated periodically, as new information becomes available, both as a check on the predictions and a refinement of them (Section 7 of Attachment 1).</p> <p>Additional assumptions related to the details of the calculations of release fractions are listed in Section B.4.2.1 of Attachment 1. These are all bounding and need no protection.</p>		
<p><u> </u> C. Values Referenced</p> <p>Comments: All had references except the inhalation dose factors in Tables 5-1 and C-2 of Attachment 1.</p>		
<p><u> </u> D. Basis for Selection of Important Variables</p> <p>Comments: Variables were selected to lead to an upper bound the potential consequences of any accidents.</p>		
<p><u> </u> E. Mitigative Features</p> <p>Comments: None were singled out. Administrative controls are given instead.</p>		
<p><u> </u> F. Extraneous Information</p> <p>Comments: None observed.</p>		
<p><u> </u> G. Peer Review Checklist</p> <p>Comments: None provided for review. Appendix A of Attachment 1 needs a thorough peer review by someone knowledgeable in statistics. Appendix B of Attachment 1 needs a thorough peer review by someone knowledgeable in chemistry & heat transfer.</p>		

REVIEW FORM		
CALCULATION NO. WHC-SD-WM-CN-059	REVISION NO. REV 0.	DATE OF REVIEW 9/9/96
CALCULATION NOTE TITLE: Calculation Notes that Support Accident Scenario and Consequence of the In-Tank Fuel Fire/Deflagration		
Review Completed by: Tom Tomaszewski		Date: 9/9/96
<p><u> </u> A. No math errors</p> <p>Comments: The following math differences were found:</p> <p>Sht 2: Lange, pg 20, Revised 10th Ed., 1967, lists gasoline LFL as 1.3% vs 1.4% shown in the SD. Using a value of 1.3% would be more conservative in this analysis.</p> <p>Sht 2: The stated values for f-LFL and f-UFL are incorrect for the conversion of "Gallons of gasoline per cubic meter of head space...etc.". The stated values are <u>correct</u> to convert "<u>CUBIC METERS</u> of gasoline per cubic meter of head space...etc.". The distinction is important since f-LFL is used in the example on Sht 4 along with an unstated factor of 264.17 gallons/m3. The value of 264.17 gallons/m3 is not explicitly stated in the document. The corrected values for "<u>Gallons</u> of gasoline per cubic meter of head space...etc." are f-LFL = 0.01775 and f-UFL = 0.07608.</p> <p>Sht 4: Using the numbers shown, the lower limit was calculated as 17.26 gallons compared to 17.5 gallons, and the upper limit was calculated as 74.00 gallons compared to 75.0 gallons.</p> <p>Sht 5: The fuel limits shown in the center of the page could not be verified since the tank dimensions and calculations are not shown.</p> <p>Shts 6, 7, 8, and 9: Selected entries were verified and found to be correct.</p>		
<p><u> </u> B. All assumptions/IC stated & ID those needing protection</p> <p>Comments:</p> <p>Protect the (unstated) assumption on Sht 4 that the waste vapor space does not exceed 300 °K. The value of 300 °K affects the pressure rise ratio.</p> <p>Protect each Empty Volume, Waste Volume, and Vapor Space shown on Shts 6 through 9. (If these data change, the "LDL gal" column entry would change.)</p>		
<p><u> </u> C. All values referenced</p> <p>Comments: Values are referenced.</p>		
<p><u> </u> D. Basis for selection of variables</p> <p>Comments: The basis for selection of variables is stated in the Calc-Note.</p>		

REVIEW FORM		
CALCULATION NO. WHC-SD-WM-CN-059	REVISION NO. REV 0.	DATE OF REVIEW 9/9/96
CALCULATION NOTE TITLE: Calculation Notes that Support Accident Scenario and Consequence of the In-Tank Fuel Fire/Deflagration		
<p>_____ E. All mitigative features listed</p> <p>Comments: Mitigative features listed on Sht 2.</p>		
<p>_____ F. No extraneous information</p> <p>Comments: Sht 2: UFL and f-UFL calculations may be superfluous to the stated purpose of the Calc-Note which is to establish the lower limits of flammability.</p>		
<p>_____ G. Correct use of peer reviews checklist</p> <p>Comments: Based on Item A above, the peer review checklist is acceptable except for the entry "Data used in calculations explicitly stated in document."</p>		

REVIEW FORM		
CALCULATION NO. CN-060	REVISION NO. 0	DATE OF REVIEW 9/11/96
CALCULATION NOTE TITLE: Calculation Notes That Support Accident Scenario and Consequence Determination of the Evaporator Dump		
Review Completed by: Anthony V. Savino		Date: 9/11/1996
<p>☒ A. No math errors</p> <p>Comments:</p> <p>See redlined copy for minor corrections in text.</p>		
<p>☒ B. All assum/IC stated & ID those needing protection</p> <p>Comments:</p> <p>The analysis assumes that the DST waste temperature is 65 F, and the head space temperature is 55 F.</p> <p>Maximum allowable temperature for the evaporator vessel is 200 F.</p> <p>Maximum dump volume is 26,000 gal with a drain time of 11 min.</p> <p>Tank assumed to be filled initially at LCO limit of 410 in.</p>		
<p>☒ C. All values referenced</p> <p>Comments:</p>		
<p>☒ D. Basis for selection of variables</p> <p>Comments:</p> <p>The median ARFxRF of 3.0E-7 was used instead of the bounding value of 2.0E-5 (page 3-4 of HDBK-3010) for free-fall spill of aqueous solutions (3 m fall distance) onto a hard surface. Some of the liquid from the evaporator is made airborne as the evaporator liquid impacts the surface of the liquid in the tank. Since the evaporator dump is impacting a liquid surface instead of a hard surface, it was argued that the median ARFxRF is considered acceptable. Note that although I think the use of the median value is reasonable, the onsite dose of 0.44 mSv is only about a factor of ten below the 5 mSv limit. If the bounding ARFxRF value was used, the onsite dose limit would be exceeded.</p> <p>No basis is given for the statement that the toxic chemical composition of the waste is "conservatively" assumed to be equivalent to DST Liquids. Do we know that the toxic chemicals in the evaporator are less hazardous than those in DST Liquids? Note that the SOF value for the onsite receptor is a factor of 20 below the limit, so there is plenty of margin if the evaporator contents were more hazardous than DST liquids.</p>		

REVIEW FORM		
CALCULATION NO. CN-060	REVISION NO. 0	DATE OF REVIEW 9/11/96
CALCULATION NOTE TITLE: Calculation Notes That Support Accident Scenario and Consequence Determination of the Evaporator Dump		
D. (continued) Results are relatively insensitive to various assumptions (e.g., heat transfer coefficient, discharge coefficient, tank waste temperature, 2 ft depth of evaporator waste, etc.)		
_____ E. All mitigative features listed Comments: No mitigative features required.		
☒ F. No extraneous information Comments:		
_____ G. Correct use of peer reviews checklist Comments: Peer Review Checklists included. HEDOP Review was NOT performed but should have been.		

REVIEW FORM		
CALCULATION NO. WHC-SD-WM-CN-061	REVISION NO. 0	DATE OF REVIEW 9/10/96
CALCULATION NOTE TITLE: Releases from Failure of a Flexible Receiver Bag in High Winds		
Review Completed by: D. R. Porten		Date: 9/10/96
<p><u>No</u> A. Math errors</p> <p>There were no math errors found in this analysis.</p>		
<p><u>YES</u> B. All assum/IC stated & ID those needing protection</p> <p>Comments: Control exists over the assumptions listed here about operations during high wind conditions and if the assumption about windspeed threshold to maintain control is protected, then failure of the flexible receiver bag in high winds is prevented.</p> <ol style="list-style-type: none"> 1. The analysis assumes a wind-induced failure of a flexible receiver bag containing contaminated equipment removed from an underground waste storage tank.. 2. Based on preoperational testing where crane operators had difficulty in precisely positioning a loaded flexible receiver in winds greater than about 32 km/h (20 mph), it is assumed that crane operators could manage a loaded flexible receiver in winds up to 64 km/h (40 mph) if necessary. For wind gusts at 97 km/h (60 mph) it is assumed a loaded flexible receiver would be essentially out of control and that these wind gusts are sufficient to cause the flexible receiver to swing and puncture or tear the fabric. 3. It is conservatively assumed the wind gusts occur at the time the flexible receiver is at risk. 4. Aging waste tank liquids were assumed because the flexible receiver has been used primarily on aging waste tanks. 5. The inside surfaces of the flexible receiver bag and instrument were assumed to have a water film carrying the 11.6 L of contaminates. These surfaces were assumed to drain to the ground when the flexible receiver bag was torn or punctured by high winds. The resulting source term was partitioned into a vapor space term, and a liquid term that was assumed to drain to the soil. Radiological doses are based on a combined puff release of aerosols from the vapor space and a time-dependent release of aerosols from liquids dispersed in soil. 6. To bound the release from the vapor space inside the flexible receiver, it was assumed that the respirable aerosol content could be no greater than 100 mg/m³. 		

REVIEW FORM		
CALCULATION NO. WHC-SD-WM-CN-061	REVISION NO. 0	DATE OF REVIEW 9/10/96
CALCULATION NOTE TITLE: Releases from Failure of a Flexible Receiver Bag in High Winds		
_ Yes _ C. All values referenced Comments: All values used in the analysis were referenced.		
_ YES _ D. Basis for selection of variables Comments: The basis for all variables used in this analysis was either stated or referenced.		
_ Yes _ E. All mitigative features listed Comments: The major mitigative feature described in this analysis is to avoid extraction of equipment into receiver bags during high wind conditions. Assuming administrative controls are in place to restrict crane operations in high winds, and assuming the controls work as intended, the flexible receiver bag failure in high winds is prevented. Calculations for the unmitigated condition are included in this analysis.		
_ Yes _ F. No extraneous information Comments: No extraneous information was found.		
_ YES _ G. Correct use of peer reviews checklist Comments: A documented peer review checklist is contained in the report and its completeness is evident by the quality of the report and the absence of math errors.		

REVIEW FORM		
CALCULATION # CN-062	REVISION 0	DATE OF REVIEW 8/30/96
CALCULATION NOTE TITLE: HEPA Filter Fire (and Subsequent Unfiltered Release)		
<p>☐ A. No math errors</p> <p>Comments: Math/data errors noted on redlined copy.</p>		
<p>☒ B. All assum/IC stated & ID those needing protection</p> <p>Comments:</p> <p>Filter contact dose rate - 200 mrem/h</p> <p>No liquids in compactor building or catch tanks.</p>		
<p>☐ C. All values referenced</p> <p>Comments:</p> <p>Qualitative accident frequencies assigned "based on operational history of Tank Farms" - $>10^{-2}$/yr - Active Ventilation systems (w/ heaters), 10^{-2} to 10^{-4}/yr - Passive Ventilation (w/out heaters)</p> <p>IVFs for filters not included (note - OPEN ITEM from previous review).</p>		
<p>☐ D. Basis for selection of variables</p> <p>Comments:</p> <p>Did not have references to confirm ventilation flow rates (p. 6)- from SAR-067, -065, and -009.</p> <p>PF - 10^{-8} active, 10^{-10} passive - No basis provided.</p> <p>ARF - 1×10^{-4} for filter fire - referenced HDBK-3010 - looks okay</p> <p>No discussion of basis for selection of different waste types for the different ventilation systems (e.g., SST Solids for SX,C-106, SST Liquids for DCRTs, etc.)</p>		
<p>☒ E. All mitigative features listed</p> <p>Comments: Safety significant CAM interlock to detect and shut off ventilation during an unfiltered release within 10 minutes for DSTs, 244-AR, and SSTs (w/ active ventilation only).</p>		

REVIEW FORM		
CALCULATION # CN-062	REVISION 0	DATE OF REVIEW 8/30/96
CALCULATION NOTE TITLE: HEPA Filter Fire (and Subsequent Unfiltered Release)		
☒ F. No extraneous information Comments:		
☒ G. Correct use of peer reviews checklist Comments: Looks like a WSRC calc-note checklist. NO HEDOP REVIEW IS EVIDENT.		
Anthony V. Savino	8/30/96	
Review Completed by	Date	

REVIEW FORM		
CALCULATION # CN-063	REVISION 0	DATE OF REVIEW 8/30/96
CALCULATION NOTE TITLE: Release from Failed HEPA Filters Due To an Overpressurization Event		
<p><u> </u> A. No math errors</p> <p>Comments: Math/data errors noted on redlined copy.</p> <p><u> X </u> B. All assum/IC stated & ID those needing protection</p> <p>Comments:</p> <p>Filter contact dose rate - 200 mrem/h</p> <p>No liquids in compactor building or catch tanks.</p>		
<p><u> X </u> C. All values referenced</p> <p>Comments:</p> <p><u> </u> D. Basis for selection of variables</p> <p>Comments:</p> <p>Amount released for Compactor Building and Catch Tanks is not included in the referenced source document (CN-054), however, the value for DSTs was used (9.79E-04 L). The basis for this needs to be provided.</p> <p>PF - 10^{-8} active, 10^{-10} passive - No basis provided.</p> <p>ARF - 1×10^{-4} for filter fire - referenced HDBK-3010 - looks okay</p> <p>No discussion of basis for selection of different waste types for the different ventilation systems (e.g., SST Solids for SX,C-106, SST Liquids for DCRTs, etc.)</p>		
<p><u> NA </u> E. All mitigative features listed</p> <p>Comments:</p> <p>Controls to mitigate are not developed or proposed. The results from this Calc-note will be used in other sections.</p> <p><u> X </u> F. No extraneous information</p> <p>Comments:</p>		

REVIEW FORM		
CALCULATION # CN-063	REVISION 0	DATE OF REVIEW 8/30/96
CALCULATION NOTE TITLE: Release from Failed HEPA Filters Due To an Overpressurization Event		
☒ G. Correct use of peer reviews checklist Comments: HEDOP REVIEW IS INCLUDED.		
Anthony V. Savino		8/30/96
Review Completed by		Date

REVIEW FORM		
CALCULATION NO. WHC-SD-WM-CN-065	REVISION NO. 0	DATE OF REVIEW 9/6/96
CALCULATION NOTE TITLE: Consequence Analysis of an Unmitigated NaOH Solution Spray Release During Addition to Waste Tank		
Review Completed by: D. R. Porten		Date: 9/6/96
<p><u>No</u> A. Math errors</p> <p>There were no math errors found in this analysis.</p>		
<p><u>YES</u> B. All assum/IC stated & ID those needing protection</p> <p>Comments: My judgement is that there are no assumptions listed here that need protection.</p> <ol style="list-style-type: none"> 1. The unmitigated analysis assumes that no preventative and mitigative barriers are in place, therefore no sleeving or wrap is in place at the time of the leak. 2. The temperature of the NaOH water mixture is assumed to be 120°F (50°C). 3. Pressure of system is assumed to be 125 psig. 4. The maximum spray leak was assumed to be a crack with a minimum depth equal to the lightest (schedule 10) pipe wall thickness of 0.109 inches and a maximum length equal to one pipe diameter, i.e., 1 inch. 5. It is assumed that the liquid fraction of the spray evaporates very quickly. 6. Evacuation of offsite receptors is assumed not to occur. 		
<p><u>Yes</u> C. All values referenced</p> <p>Comments: All values used in the analysis were referenced.</p>		
<p><u>YES</u> D. Basis for selection of variables</p> <p>Comments: The basis for all variables used in this analysis was either stated or referenced.</p>		

REVIEW FORM		
CALCULATION NO. WHC-SD-WM-CN-065	REVISION NO. 0	DATE OF REVIEW 9/6/96
CALCULATION NOTE TITLE: Consequence Analysis of an Unmitigated NaOH Solution Spray Release During Addition to Waste Tank		
<p>☐ Yes ☐ E. All mitigative features listed</p> <p>Comments: The major mitigative feature described in this analysis of spray leaks of caustic soda is a sleeve or wrapping of the pipe and joints. Calculations for the unmitigated condition are included in this analysis.</p>		
<p>☐ Yes ☐ F. No extraneous information</p> <p>Comments: No extraneous information was found.</p>		
<p>☐ YES ☐ G. Correct use of peer reviews checklist</p> <p>Comments: A documented peer review checklist is contained in the report and its completeness is evident by the quality of the report and the absence of math errors.</p>		

REVIEW FORM		
CALCULATION # CN-063	REVISION 0	DATE OF REVIEW 8/30/96
CALCULATION NOTE TITLE: Release from Failed HEPA Filters Due To an Overpressurization Event		
<p><u> </u> A. No math errors</p> <p>Comments: Math/data errors noted on redlined copy.</p>		
<p><u> X </u> B. All assum/IC stated & ID those needing protection</p> <p>Comments:</p> <p>Filter contact dose rate - 200 mrem/h</p> <p>No liquids in compactor building or catch tanks.</p>		
<p><u> X </u> C. All values referenced</p> <p>Comments:</p> <p><u> </u> D. Basis for selection of variables</p> <p>Comments:</p> <p>Amount released for Compactor Building and Catch Tanks is not included in the referenced source document (CN-054), however, the value for DSTs was used (9.79E-04 L). The basis for this needs to be provided.</p> <p>PF - 10^{-8} active, 10^{-10} passive - No basis provided.</p> <p>ARF - 1×10^{-4} for filter fire - referenced HDBK-3010 - looks okay</p> <p>No discussion of basis for selection of different waste types for the different ventilation systems (e.g., SST Solids for SX,C-106, SST Liquids for DCRTs, etc.)</p>		
<p><u> NA </u> E. All mitigative features listed</p> <p>Comments:</p> <p>Controls to mitigate are not developed or proposed. The results from this Calc-note will be used in other sections.</p>		
<p><u> X </u> F. No extraneous information</p> <p>Comments:</p>		

X G. Correct use of peer reviews checklist

Comments: HEDOP REVIEW IS INCLUDED.

Anthony V. Savino

8/30/96

Review Completed by

Date

REVIEW FORM		
CALCULATION NO. WHC-SD-WM-CN-065	REVISION NO. 0	DATE OF REVIEW 9/6/96
CALCULATION NOTE TITLE: Consequence Analysis of an Unmitigated NaOH Solution Spray Release During Addition to Waste Tank		
Review Completed by: D. R. Porten		Date: 9/6/96
<p><u>No</u> A. Math errors</p> <p>There were no math errors found in this analysis.</p>		
<p><u>YES</u> B. All assum/IC stated & ID those needing protection</p> <p>Comments: My judgement is that there are no assumptions listed here that need protection.</p> <ol style="list-style-type: none"> 1. The unmitigated analysis assumes that no preventative and mitigative barriers are in place, therefore no sleeving or wrap is in place at the time of the leak. 2. The temperature of the NaOH water mixture is assumed to be 120°F (50°C). 3. Pressure of system is assumed to be 125 psig. 4. The maximum spray leak was assumed to be a crack with a minimum depth equal to the lightest (schedule 10) pipe wall thickness of 0.109 inches and a maximum length equal to one pipe diameter, i.e., 1 inch. 5. It is assumed that the liquid fraction of the spray evaporates very quickly. 6. Evacuation of offsite receptors is assumed not to occur. 		
<p><u>Yes</u> C. All values referenced</p> <p>Comments: All values used in the analysis were referenced.</p>		
<p><u>YES</u> D. Basis for selection of variables</p> <p>Comments: The basis for all variables used in this analysis was either stated or referenced.</p>		

REVIEW FORM		
CALCULATION NO. WHC-SD-WM-CN-065	REVISION NO. 0	DATE OF REVIEW 9/6/96
CALCULATION NOTE TITLE: Consequence Analysis of an Unmitigated NaOH Solution Spray Release During Addition to Waste Tank		
<p>☐ Yes ☐ E. All mitigative features listed</p> <p>Comments: The major mitigative feature described in this analysis of spray leaks of caustic soda is a sleeve or wrapping of the pipe and joints. Calculations for the unmitigated condition are included in this analysis.</p>		
<p>☐ Yes ☐ F. No extraneous information</p> <p>Comments: No extraneous information was found.</p>		
<p>☐ YES ☐ G. Correct use of peer reviews checklist</p> <p>Comments: A documented peer review checklist is contained in the report and its completeness is evident by the quality of the report and the absence of math errors.</p>		

REVIEW FORM

CALCULATION NO.
S-CLC-G-00132
(also S-CLC-G-00116)*

REVISION NO.
A

DATE OF REVIEW
September 2, 1996

CALCULATION NOTE TITLE: Transfer Line Break due to an Excavation Accident that Results in Spray Releases (also Frequency of a Transfer Line Break from an Excavation)

Review Completed by: Harvey Goldberg

Date: September 2, 1996

A. No math errors

Comments: No math errors

B. All assum/IC stated & ID those needing protection

Comments: (from 116)

- 1) Assume that the Savannah River Human Error Data Base applies to us.....Don't we have one of our own?

(from 132)

- 2) The conclusion from the above document is that no more than 20 transfers are done per year.....This should be protected.
- 3) "appropriate controls are in place"...this is standard operating procedure here and, of course, should be protected.
- 4) A maximum of 33% of the material transferred is solids...this should be protected, but the physics of the transfer would probably preclude its being violated.
- 5) The unit liter doses are taken from an issued and reviewed document. I have serious considerations concerning the appropriateness of the methodology concerning the one day ingestion doses. However, since these constitute a small part of the offsite dose expected doses, because all of the other assumptions in the dose assessment model are quite conservative, and because this has been a standard calculational procedure for about five months, I am raising this issue elsewhere.
- 6) In section 4.0 data 7 through 10, are taken from Toxic Chemical Considerations for Tank Farm Releases, WHC-SD-SARR-011, Rev 2, Table 3-8. I have access only to Rev 1 of this document, but using this source I read the sums of fraction multipliers as.....

Case	My number	Document's number
7 DST solid onsite	560 s/L	630 s/L
8 DST liquid onsite	210 s/L	210 s/L
9 DST solid offsite	1.4 s/L	2.8 s/L
10 DST solid onsite*	0.42 s/L	0.62 s/L

* I am assuming that datum #10 is mislabeled and should read liquid offsite

REVIEW FORM		
CALCULATION NO. S-CLC-G-00132 (also S-CLC-G-00116)*	REVISION NO. A	DATE OF REVIEW September 2, 1996
CALCULATION NOTE TITLE: Transfer Line Break due to an Excavation Accident that Results in Spray Releases (also Frequency of a Transfer Line Break from an Excavation)		
<div style="margin-bottom: 10px;"> 7) Data 11 & 12 were taken from Tank Farm Compositions and Atmospheric Dispersion Coefficients for Use in Safety Analysis Consequence Assessments, WHC-SD-WM-SARR-016, Rev 2, I have access only to Rev 1 of this document, but using this source I believe that the bounding atmospheric dispersion coefficient is 3.44×10^{-2} rather than 3.41×10^{-2} for the onsite receptor and 1.88×10^{-5} rather than 2.83×10^{-5} for the offsite receptor. The page and/or table that the document took its data is not identified. I took mine from Page T-6, Tables 4 & 5, respectively. </div> <div style="margin-bottom: 10px;"> 8) The bounding respirable spray release (0.21 L/min) is taken from a document analyzing a spray from a 2" Sch 40 pipe (ID=2.067"). The accident analyzed by this document analyzes a release from a 3" Sch 40 (ID=3.068") and 10S (ID=3.260") pipe. Using the same volumetric transfer rate the larger pipe should result in lower pressure and thus a lower release rate and thus the assumption is conservative. However, I feel that some mention of the differing parameters should be made. </div> <div> 9) Section 5, assumption 4 explains why the DSTs were chosen as the ULDs in the radiological case. A similar justification should be made in assumption 5 for the toxicological case. </div>		
<div style="margin-bottom: 10px;"> C. All values referenced Comments: Generally, all values are referenced, but see comment B-7. Reference 4 has not been issued. The sum of fraction multiplier for the mitigated release were not referenced. </div> <div style="margin-bottom: 10px;"> D. Basis for selection of variables Comments: With the exception of the comments above concerning the (perhaps) errors in transcribing values, the bases for variable selection seems OK. </div> <div> E. All mitigative features listed Comments: See the last comment in section C. The values used were not stated, only the results. </div>		

REVIEW FORM		
CALCULATION NO. S-CLC-G-00132 (also S-CLC-G-00116)*	REVISION NO. A	DATE OF REVIEW September 2, 1996
CALCULATION NOTE TITLE: Transfer Line Break due to an Excavation Accident that Results in Spray Releases (also Frequency of a Transfer Line Break from an Excavation)		
☐ F. No extraneous information Comments: I agree.		
☐ G. Correct use of peer reviews checklist Comments: Two of the questions were not answered.		

REVIEW FORM		
CALCULATION NO. M-CLC-G-00237	REVISION NO. Rev 2.	DATE OF REVIEW 9/3-6,8/96
CALCULATION NOTE TITLE: Chemical Reaction in a DCRT		
Review Completed by: Tom Tomaszewski		Date: 9/8/96
<p>_____ A. No math errors</p> <p>Comments: Because of the question about the use of acid density rather than water density in the calculations, this review was terminated at the end of Sht 28. Shts 25 & 26 and 29 through 50 were not reviewed. The following math errors were found:</p> <p>The Heat of Reaction entries at the bottom of the table of Section 4.5, sht 7, are not consistent with the units given. Using the equation at the bottom of sht 6, and the values in the table, the summations would be: delta H Ref 8: $(-106.65 - 68.32) - (-112.24 - 49.37) = -13.36 \text{ kcal/g-mole.}$ delta H Ref 9: $(-106.88 - 68.317) - (-112.193 - 49.21) = -13.794 \text{ kcal/g-mole.}$ Values of -13.794 kcal/g-mole and its equivalent value of -57.7 kJ/g-mole both appear on sht 24, however, only the value of -57.7 kJ/g-mole is used in subsequent calculations on Sht 27. The difference in the two numbers are the units - joules vs calories - with the conversion being approximately 4.185 J/cal.</p> <p>Section 4.8, Table: the offsite direction/distance is given as "W 11,100 m", whereas Table 5 of Reference [6] (SARR-16, Rev 2) shows "N 8,760 m".</p> <p>Section 5.3: The DST solids fraction is stated as 1/2, whereas it should be 1/3.</p> <p>Section 6.1.1, Sht 10: The units for "ULDing" should be [Sv-m3/s-L] rather than [Sv/L] in the Ingestion equation. Also, the definition of "ULDing" should read "Ingestion Unit liter dose per second" rather than "Ingestion Unit liter dose".</p> <p>_____ B. All assumptions/IC stated & ID those needing protection</p> <p>Comments: Protect these requirements:</p> <ol style="list-style-type: none"> 1) Sht 11: HEPA filters be designated safety significant AND that they be in place to mitigate the onsite toxic and radiological consequences, 2) Section 5.2: the hydroxide content of DCRT wastes contained in DCRT to be no greater than 10M, 3) Calc Cover Sheet: "...ensure that all incoming wastes are neutralized prior to acceptance into a DCRT.", 		

REVIEW FORM

CALCULATION NO. M-CLC-G-00237

REVISION NO. Rev 2.

DATE OF REVIEW
9/3-6,8/96

CALCULATION NOTE TITLE: Chemical Reaction in a DCRT

B. (continued)

4) Calc Cover Sheet: "... incoming wastes are compatible with DCRT and DST contents with respect to criticality, chemical reactivity, organics, and other safety and operational considerations.",

5) Section 5.1: a 1000 gallon (maximum) transfer of 57 weight percent (maximum) of nitric acid (12M),

6) Section 5.1: maintain the waste stored in the 222-S 4000 gallon tank to being no more acidic than a pH of 1 $[H^+] = 0.1M$,

7) Calc Cover Sheet & Sht 5: DCRTs should be limited to receive wastes only from DSTs,

8) Section 5.3: the radionuclide ratio of 1/3 solid & 2/3 liquid,

9) Section 4.9: onsite & offsite breathing rates,

10) Section 5.4: the 150 °F initial waste temperature (a temperature greater than 150 °F will result in a larger amount of vaporized material).

11) Sht 19: an administrative control must be established and protected between B-plant and the DCRTs such that if B-plant ever stores more than 1000 gallons of nitric acid, an amount greater than 1000 gallons cannot be transferred into a DCRT.

C. All values referenced

Comments: The following are not referenced:

- 1) Sht 5, first full paragraph: the Hazard Analysis,
- 2) Sections 4.3 & 4.4: the DCRT volumes and ventilation rates (also Section 5.5),
- 3) Section 4.9: onsite & offsite breathing rates,
- 4) Section 4.10: the Dose Limits,
- 5) Section 5.4: the 150 °F initial waste temperature,
- 6) Sht 14: the selection of tank DCRT 244-A and, thereby, the 16,280 gallon volume.

REVIEW FORM

CALCULATION NO. M-CLC-G-00237

REVISION NO. Rev 2.

DATE OF REVIEW
9/3-6,8/96

CALCULATION NOTE TITLE: Chemical Reaction in a DCRT

D. Basis for selection of variables

Comments: Section 4.6: The table could use text to explain its use. The table's data were verified against SARR-16 Rev 2 (the source document) rather than Reference 4, SARR-037, per guidance from A. Savino. Perhaps the table should reference SARR-16 Rev 2 rather than SARR-037.

Section 4.9: No reason was given for selection of the onsite & offsite breathing rates.

Sht 5: substantiate that the wastes are always more dilute than the nitric acid and (second bullet) that a 57 wgt % of nitric acid bounds the acid transfer from any single source,

Section 5.4: State the basis for the 150 °F initial waste temperature. Does this section intend to mean that both the DCRT and the transferred wastes (represented by nitric acid) are both at 150 °F? If so, that should be explicitly stated. Also, if the nitric acid is specified to be at 150 °F, that temperature would have to be defended since Sht 14 states that DST wastes are stored at temperatures much lower than 150 °F. Specifying an initial temperature of nitric acid below 150 °F would necessitate changing its density on Shts 24 & 27.

Shts 24 & 27: The weight % of nitric acid is shown as 40% in database Columns E4 & E5, whereas Section 5.1 refers to 57 weight % nitric acid being the bounding condition. The 1200 kg/m³ density corresponds to a 40 weight % nitric acid at 65 °C (150 °F). The Cal-Note does not explicitly state what is the initial temperature of the nitric acid. The acid temperature needs to be specified then the density needs to be reconciled/revised for acid weight % and temperature. Note: 57 weight % nitric acid has a density of 1291 kg/m³ at 65 °C. The density discrepancy needs to be reconciled.

Shts 27: Calculations in Columns I15, I16, & I17 for the temperature rise of water incorrectly use the density of nitric acid from Sht 24, Column E1. Either another density entry be made for water or the density in database Sht 24, Column E1 be given for water (1000kg/m³) rather than for nitric acid.

E. All mitigative features listed

Comments: Second full paragraph of sht 5 mentions the consequences were assessed "...in the absence of engineered mitigative systems", however, Sht 11 mentions that HEPA filters must be in place to mitigate onsite toxic and radiological consequences. For consistency, perhaps sht 5 should read: "...with and without engineered mitigative systems."

REVIEW FORM		
CALCULATION NO. M-CLC-G-00237	REVISION NO. Rev 2.	DATE OF REVIEW 9/3-6,8/96
CALCULATION NOTE TITLE: Chemical Reaction in a DCRT		
<p>_____ F. No extraneous information</p> <p>Comments: The statement on the Calc Cover Sheet: "...incoming wastes are compatible with DCRT and DST contents with respect to criticality, chemical reactivity, organics, and other safety and operational considerations" is not developed in the Calc-Note.</p> <p>Section 6.1.2, Sht 10, Item 2: reference is made to SST (should this be DST?).</p> <p>Section 6.1.2, Sht 11: In the definitions, "Q" should be replaced by "S" and the units changed to "mg/s" from "L/s".</p> <p>Sht 24: The value of "-13.794 kcal/g-mole" for the heat of reaction, "Hxrn", in column B6 is not used in the calculations on Sht 27, columns H15, H16, & H17...nor should it be. Its entry into the database is misleading and probably should be removed. The value of -57.7 kJ/g-mole in column B7 is used, correctly, in the calculations on Sht 27, however, it is not labeled as "Hrxn".</p> <p>The review was terminated on Sht 28 and did not ascertain up to that point whether or not "time" from Sections 5.6 & 5.7 was used.</p>		
<p>_____ G. Correct use of peer reviews checklist</p> <p>Comments: Considering the above findings, I would have to say no.</p>		

REVIEW FORM		
CALCULATION NO. M-CLC-G-00238	REVISION NO. Rev 1.	DATE OF REVIEW 9-2-96
CALCULATION NOTE TITLE: Chemical Reaction in a DCRT Leading to a Toxic Release		
Review Completed by: Tom Tomaszewski		Date: 9-2-96
<p>_____ A. No math errors</p> <p>Comments: There are no math errors.</p>		
<p>_____ B. All assumptions/IC stated & ID those needing protection</p> <p>Comments: Section 2: no reason is given for analyzing the accident as an "anticipated" event.</p> <p>Section 4.2: The assumption that the ammonia is primarily NH_4 leads to the stated conclusion that its molarity is 0.03M. Ostensibly, this assumption comes from another assumption in Section 5.1, i.e., the waste is less than 9.27 pH. No basis are stated for either the assumption of NH_4 or the conclusion of molarity equal to 0.03M. 0.03 is later used in the calculation on sht 6 and, thereby, its value affects the conclusion. Since some SSTs have a pH much less than 9.27 it would be helpful to state, for completeness reasons, that the 0.03 represents the worst pH situation, if in fact this is true. This comment is similar to peer review comments #s 6 (a) and 6 (b) on sheet 25. It doesn't appear to this reviewer that those comments were resolved in a most clear fashion.</p> <p>Section 6: The definition of $[\text{NH}_4\text{OH}]$ on sht 6 is different than the definition in Section 4.1, on pg 5.</p>		
<p>_____ C. All values referenced</p> <p>Comments: See B above.</p>		
<p>_____ D. Basis for selection of variables</p> <p>Comments: See B above.</p>		
<p>_____ E. All mitigative features listed</p> <p>Comments: Pg 8 states that the accident is analyzed as an unmitigated accident.</p>		

REVIEW FORM		
CALCULATION NO. M-CLC-G-00238	REVISION NO. Rev 1.	DATE OF REVIEW 9-2-96
CALCULATION NOTE TITLE: Chemical Reaction in a DCRT Leading to a Toxic Release		
<p>_____ F. No extraneous information</p> <p>Comments: The 4th paragraph of the "Calculation Cover Sheet" refers to the document as Rev 2 whereas it is Rev 1.</p> <p>The page numbers within the Table of Contents do not correspond to the document.</p> <p>The last two sentences of Section 5.1 may benefit from a re-write as shown in the redline, attached.</p>		
<p>_____ G. Correct use of peer reviews checklist</p> <p>Comments: There was no "peer review checklist" attached, however, there was a "CALC-NOTE CHECKLIST" attached that only addressed that the FSAR Comment Resolutions were incorporated. The handwritten note on the bottom of this sheet incorrectly refers to the document as Rev 2 (see 1st comment in F above).</p>		

WHC-SD-WM-RPT-271, REV. 0

APPENDIX C
DISPOSITIONED CALCULATION REVIEW FORMS

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REVIEW COMMENT DISPOSITIONS		
CALCULATION NO. CN-003	REVISION NO. 0	DATE OF REVIEW September 4, 1996
CALCULATION NOTE TITLE: Calculation Notes that Support Accident Scenario and Consequence Development for the Leak from a Railcar/Tank Trailer at the 204-AR Waste Unloading Facility		
Review Completed by: A. V. Savino Dispositions Completed by: Grant W. Ryan		Date: September 11, 1996
A. Math errors		
Dispositions: Math errors that were discovered in the review have been corrected and revision 1 of the document will be issued. See attached for confirmation.		
B. All assumptions/initial conditions stated & ID those needing protection		
Dispositions: None required.		
C. All values referenced		
Dispositions: First ¶ - Discussion of the frequency has been revised. See revision 1 document.		
No other dispositions required.		
D. Basis for selection of variables		
Dispositions: First ¶ - A pool depth of 1 inch was assumed at the start of the scenario (this was an assumption made early on with concurrence with project management). Instead of crediting a certain absorption percentage into the soil, the total amount leaked was assumed to be available for release.		
Second ¶ - Statement has been added to Revision 1 to address the comment.		
Third ¶ - Since this is conservative and changing the calculation will not show higher consequences, descriptive text will be added to state that the way the calculations were performed in this document do differ from those cited in SARR-016. Calculations of the direct/skyshine dose from the pools will not be revised.		
Fourth ¶ - Statement has been added to Revision 1 to address the comment.		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO. CN-003	REVISION NO. 0	DATE OF REVIEW September 4, 1996
CALCULATION NOTE TITLE: Calculation Notes that Support Accident Scenario and Consequence Development for the Leak from a Railcar/Tank Trailer at the 204-AR Waste Unloading Facility		
E. All mitigative features listed Dispositions: None required.		
F. No extraneous information Dispositions: None required.		
G. Correct use of peer reviews checklist Dispositions: None required.		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO. CN-004	REVISION NO. 0	DATE OF REVIEW September 5, 1996
CALCULATION NOTE TITLE: Calculation Notes That Support Accident Scenario and Consequence Development for the Subsurface Leak Remaining Subsurface Accident		
Review Completed by: A. V. Savino Dispositions Completed by: Grant W. Ryan		Date: September 13, 1996
A. Math errors		
Dispositions: Math errors (and other notes) that were discovered in the review have been corrected and revision 1 of the document will be issued. See attached for confirmation.		
B. All assumptions/initial conditions stated & ID those needing protection		
Dispositions: First ¶ - The IVF included in the document justifies the use of 1 m for buried pipe depth (see IVF for confirmation).		
Second ¶ - The total volume released is calculated as stated in the comment except 24 hours is used instead of 12 hours.		
Third ¶ - None required.		
C. All values referenced		
Dispositions: None required.		
D. Basis for selection of variables		
Dispositions: First ¶ - Discussion has been added to the text to state that the maximum flow rate and 5% value were based on engineering judgement.		
Second ¶ - Since this accident is assumed to remain undetected to both the facility worker and onsite receptor, conservative values were developed using the leak point (i.e., pipe break point) as Z = 0.		
E. All mitigative features listed		
Dispositions: None required.		
F. No extraneous information		
Dispositions: None required.		
G. Correct use of peer reviews checklist		
Dispositions: None required.		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO. 032	REVISION NO. 0	DATE OF REVIEW 9/9/96
CALCULATION NOTE TITLE: Analysis of Consequences of Postulated Solvent Fires in Hanford Site Tanks		
Review Completed by: Paul D. Rittman		Date: 9/9/96
A. Math errors		
Dispositions: No errors		
B. All assumptions/initial conditions stated & ID those needing protection		
Dispositions: The reviewer asks if solvents will degrade to a more flammable form. The opposite actually occurs. The solvents degrade to less flammable forms.		
C. All values referenced		
Dispositions: No action required		
D. Basis for selection of variables		
Dispositions: No action required		
E. All mitigative features listed		
Dispositions: No action required		
F. No extraneous information		
Dispositions: No action required		
G. Correct use of peer reviews checklist		
Dispositions: No action required		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO. CN-043	REVISION NO. 1	DATE OF REVIEW 8/7/96
CALCULATION NOTE TITLE: Tank Bump Consequence Analysis		
Review Completed by: Paul D. Rittmann, PhD CHP		Date: 9/5/96
A. Math errors		
Dispositions: Page 13, the DST temperature limit reported (93°C) is based on 25 days ("approximately one month") rather than 30 days.		
B. All assumptions/initial conditions stated & ID those needing protection		
Dispositions: The third assumption listed (GOTH model used) is justified in section 3.2 of the calc note.		
<p>The fourth assumption listed (linear temperature rise in C-106 during 1992 ventilation outage) is not specifically justified in the calc note. Review of temperature data (WHC-SD-WM-ER-427, Rev. 0, Figure 3.5) indicates that sludge temperature response (the data used) is well represented by a linear model while headspace temperature response is not well represented by a linear model. In addition, the rate of temperature rise tends to decrease with increasing temperature. The temperature limits specified are greater than the data used. Therefore, as tanks approach the temperature limits the rate of temperature rise will be bounded by this linear interpolation of lower temperatures. This information will be added to the calc note.</p>		
C. All values referenced		
Dispositions: <u>Missing References:</u> The following references will be added: (1) SARR-016 and SARR-011, (2) SARR-016, (3) SARR-011, (3) ER-198		
<p><u>Misused References:</u> (1) "Maximum Sample" should be used for all gas toxic calculations. This calculation will be revised. (2) It is recognized that the decontamination factor is actually a transient value which would be quite high near the beginning of a bump event and low near the end. The integrated and averaged quantities are used to provide a representation of the entire event. (3) Refer to section 3.2</p>		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO. CN-043	REVISION NO. 1	DATE OF REVIEW 8/7/96
CALCULATION NOTE TITLE: Tank Bump Consequence Analysis		
D. Basis for selection of variables		
<p>Dispositions: See section C.</p> <p>SARR-018, SARR-011, and SARR-016 are easily retrievable (i.e., maintained by document control) technical documents generated around the same time for the same purpose. They are not the unapproved accelerated safety analysis (ASA). They were references for the ASA the same way the CN documents are references for the BIO and FSAR documents.</p>		
E. All mitigative features listed		
<p>Dispositions: Cover blocks are not considered for controls in the FSAR, only as defense-in-depth.</p>		
F. No extraneous information		
<p>Dispositions: N/A</p>		
G. Correct use of peer reviews checklist		
<p>Dispositions: I consider page 10 to contain a mathematical derivation.</p>		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO. CN-044	REVISION NO. 0	DATE OF REVIEW September 2, 1996
CALCULATION NOTE TITLE: Calculation Notes That Support Accident Scenario and Consequence Development for the Steam Intrusion From Interfacing Systems Accident		
Review Completed by: Bryan Flanagan Dispositions Completed by: Grant W. Ryan		Date: September 13, 1996
A. Math errors		
Dispositions: None required.		
B. All assumptions/initial conditions stated & ID those needing protection		
Dispositions: First ¶ - Additional discussion has been added to Assumption G regarding the headspace volume. Also, the headspace assumption was approved on an IVF (see page 28).		
No other dispositions required.		
C. All values referenced		
Dispositions: None required.		
D. Basis for selection of variables		
Dispositions: None required.		
E. All mitigative features listed		
Dispositions: None required.		
F. No extraneous information		
Dispositions: The calculation note was developed to show ALL the work required to arrive at the solution. No calculations have been performed needlessly.		
G. Correct use of peer reviews checklist		
Dispositions: None required.		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO. WHC-SD-WM-CN-045	REVISION NO. 0	DATE OF REVIEW 8/30/96
CALCULATION NOTE TITLE: Consequence Analysis of a Postulated NaOH Release from the 2727-W Sodium Storage Facility		
Review Completed by: T. Tomaszewski		Date: 8/30/96
A. Math errors		
Dispositions: Units fixed on 20 lb/ft ² wind loading. Fire area is correct.		
B. All assumptions/initial conditions stated & ID those needing protection		
Dispositions: The 0.005 Ci ²² Na inventory in the solid sodium cannot change except by radioactive decay. How to "protect" the 20 lb/ft ² wind load rating of the building has not yet been decided and will be handled in another document. Further material has been added to substantiate the 100 mg/m ³ air loading at 100 m. The scenario section has been rewritten to give a detailed sequence of events and to make clear that the dispersion of the NaOH occurs under low wind speed conditions. Information has been added and referenced that show only one tank to be half full. The other four tanks are either completely full or empty and therefore not subject to this accident.		
C. All values referenced		
Dispositions: All requested references have been added. The reference Johnson 1979 is available for inspection by any reviewer.		
D. Basis for selection of variables		
Dispositions: Not accepted. The light activity breathing rate is assumed because the receptor is assumed to be uninvolved in the accident and to not be taking any protective action. In any case, the breathing rate only enters into the radiological exposure, which would be negligible for any breathing rate. Breathing rate does not enter into the toxic exposure.		
E. All mitigative features listed		
Dispositions: N/A		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO. WHC-SD-WM-CN-045	REVISION NO. 0	DATE OF REVIEW 8/30/96
CALCULATION NOTE TITLE: Consequence Analysis of a Postulated NaOH Release from the 2727-W Sodium Storage Facility		
F. No extraneous information		
Dispositions: Not accepted. The ^{22}Na half life gives information on the future hazard as a function of time.		
G. Correct use of peer reviews checklist		
Dispositions: Not accepted. Given the time available, the reviewer did as well as could be expected. Also, except for the units on the building wind loading, none of the comments here involved a technical error, and were subjective or due to unfamiliarity with this type of analysis.		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO. WHC-SD-WM-CN-047	REVISION NO. Rev 1	DATE OF REVIEW Sept 9, 1996
CALCULATION NOTE TITLE: Calculation Note That Supports Accident Scenario and Consequence Determination for a Waste Tank Criticality		
Review Completed by: H. Goldberg		Date: 9/9/96
<p>A. Math errors</p> <p>Dispositions: 1. The number of significant figures was reduced. 2. The value now used for Mev/fission is 200 from the text by Duderstadt.</p>		
<p>B. All assumptions/initial conditions stated & ID those needing protection</p> <p>Dispositions: the assumptions are as stated. No disposition is required.</p>		
<p>C. All values referenced</p> <p>Dispositions: 1, 2 - The data used are now all referenced. 4, 5 - The GENII files are contained in Calc Note CN-067 which is now issued. 3 - The reference to SAR-067 has been removed and replaced by a reference to SARR-037. 6 - The Tox section reference is now correct.</p>		
<p>D. Basis for selection of variables</p> <p>Dispositions: No disposition is required</p>		
<p>E. All mitigative features listed</p> <p>Dispositions: No disposition required</p>		
<p>F. No extraneous information</p> <p>Dispositions: No disposition required</p>		
<p>G. Correct use of peer reviews checklist</p> <p>Dispositions: No disposition required</p>		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO. WHC-SD-WM-CN-048	REVISION NO. 0	DATE OF REVIEW 9/3/96
CALCULATION NOTE TITLE: Calculation Notes in Support of TWRS FSAR Spray Leak Accident Analysis		
Review Completed by: D.R. Porten		Date: 9/3/96
<p>A. Math errors</p> <p>Dispositions: 5.7E-03 was changed to 5.8E-03. This changed the total onsite dose to 4.1E-02 Sv (bottom of pg. 13). Table 5-1 was revised accordingly.</p>		
<p>B. All assumptions/initial conditions stated & ID those needing protection</p> <p>Dispositions: NA</p>		
<p>C. All values referenced</p> <p>Dispositions: Missing references PNL-4154 (1982), PNL-2844 (1979), BNWL-1732 (1973), and WHC-SD-GN-SWD-20007 (1994) were added to Section 10. Call out to Rosin and Rammler reference was deleted from text.</p>		
<p>D. Basis for selection of variables</p> <p>Dispositions:</p>		
<p>E. All mitigative features listed</p> <p>Dispositions: Changed Table D-1 to Table D-3.</p>		
<p>F. No extraneous information</p> <p>Dispositions: NA</p>		
<p>G. Correct use of peer reviews checklist</p> <p>Dispositions: NA</p>		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO. WHC-SD-WM-CN-049	REVISION NO. 0	DATE OF REVIEW 9/12/96
CALCULATION NOTE TITLE: Calculation Notes for Surface Leak Resulting in Pool, TWRS FSAR Accident Analysis		
Review Completed by: Harvey Goldberg		Date: 9/12/96
<p>A. Math errors</p> <p>Dispositions: Q(resuspension,soil) was changed from 67.4 to 67.5 where used throughout the document.</p>		
<p>B. All assumptions/initial conditions stated & ID those needing protection</p> <p>Dispositions: Comment 10) The waste spilled in this analysis is assumed to contain 33 vol% solids. The slurry splatter RRF is judged to be more applicable to this type of waste than the bounding aqueous splatter RRF.</p> <p>Comment 11) The 2E-10 value used is a resuspension release flux, not a mass fraction release rate. The release off a pool surface is intuitively a function of pool surface area. The units on the resuspension release flux are kg/m²-s. The bounding release fractions suggested in comment 11 are mass fraction release rates (unitless) and are not directly comparable to the resuspension flux used in the analysis. The basis for using the resuspension flux is provided in the calc note. No changes will be made to the calculation note.</p>		
<p>C. All values referenced</p> <p>Dispositions: The reference callout in Section 2.4 was expanded from "SARR-037" to "WHC-SD-WM-SARR-037 (1996)" to be consistent with reference provided in Section 8.</p>		
<p>D. Basis for selection of variables</p> <p>Dispositions: See dispositions in Box B.</p>		
<p>E. All mitigative features listed</p> <p>Dispositions: no response required.</p>		
<p>F. No extraneous information</p> <p>Dispositions: no response required.</p>		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO. WHC-SD-WM-CN-049	REVISION NO. 0	DATE OF REVIEW 9/12/96
CALCULATION NOTE TITLE: Calculation Notes for Surface Leak Resulting in Pool, TWRS FSAR Accident Analysis		
G. Correct use of peer reviews checklist		
Dispositions: no response required.		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO. WHC-SD-WM-CN-051	REVISION NO. Rev 0	DATE OF REVIEW 9/9/96
CALCULATION NOTE TITLE: The Effects of Load Drop, Uniform Load and concentrated Load on Waste Tanks		
Review Completed by: Bryan Flanagan		Date: 9/9/96
A. Math errors		
Dispositions: 1. The units were made equal 2. SST was changed to DST on page 11		
B. All assumptions/initial conditions stated & ID those needing protection		
Dispositions: third sentence: The correlation is now justified as coming from the DOE Handbook. Fourth sentence: There are words stating that since the hole size is so large, ventilation flow will not be very effective in pulling the aerosol out the HEPA's. Therefore no flow through the vent system was considered. Fifth sentence: The onsite tox guidelines are not met with DST solids, so performing the analysis with SST solids will only confirm that fact. Besides a mixer pump will not be placed in SST.		
C. All values referenced		
Dispositions: The pump weight is not specifically referenced. I do not think it needed to be. The reference for the mixer pump weight is from July. Since July is referred to in many places within the document where the pump weight is used, I assume it is clear that the weight is found in that document.		
D. Basis for selection of variables		
Dispositions: No disposition is needed		
E. All mitigative features listed		
Dispositions: No disposition is needed		
F. No extraneous information		
Dispositions: No disposition is needed.		
G. Correct use of peer reviews checklist		
Dispositions: The Peer Review form is now attached.		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO. CN-053	REVISION NO. 0	DATE OF REVIEW September 5, 1996
CALCULATION NOTE TITLE: Excavations in Hanford Ponds, Cribs, or Ditches		
Review Completed by: Anthony V. Savino Dispositions Completed by: Grant W. Ryan		Date: September 19, 1996
A. Math errors		
Dispositions: The requested changes and clarifications have been included in the revision 1 document. See attached copy for verification.		
B. All assumptions/initial conditions stated & ID those needing protection		
Dispositions: None required.		
C. All values referenced		
Dispositions: None required.		
D. Basis for selection of variables		
Dispositions: First ¶ - None required. Second ¶ - text has been added in assumptions section.		
E. All mitigative features listed		
Dispositions: None required.		
F. No extraneous information		
Dispositions: This assumption was approved by IVF and was used in the FSAR write-up.		
G. Correct use of peer reviews checklist		
Dispositions: None required.		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO. WHC-SD-WM-CN-054	REVISION NO. Rev. 0	DATE OF REVIEW 08/30/96
CALCULATION NOTE TITLE: Waste Tank Ventilation System Waste Material Accumulation		
Review Completed by: Rick J. Van Vleet		Date: 09/16/96
<p>A. Math errors</p> <p>Dispositions: Not applicable.</p>		
<p>B. All assumptions/initial conditions stated & ID those needing protection</p> <p>Dispositions: Not applicable.</p>		
<p>C. All values referenced</p> <p>Dispositions: Information validation form IVF-Chapter 3-RJVV-008 documents the information used for filter dimensions, ventilation configurations. This information validation form will be attached to WHC-SD-WM-CN-054 in the next revision.</p>		
<p>D. Basis for selection of variables</p> <p>Dispositions: Information validation form IVF-Chapter 3-RJVV-008 documents information on the selection of different waste types for the different ventilation systems (e.g., SST solids were used for the actively and passively ventilated single-shell tanks, SST liquids were used for the DCRTs, DST liquids were used for double-shell tanks and 204AR/244AR, and AWF liquids were used for the aging waste facility (241-AY and 241-AZ). This information validation form will be attached to WHC-SD-WM-CN-054 in the next revision.</p>		
<p>E. All mitigative features listed</p> <p>Dispositions: Not applicable.</p>		
<p>F. No extraneous information</p> <p>Dispositions: Not applicable.</p>		
<p>G. Correct use of peer reviews checklist</p> <p>Dispositions: Not applicable.</p>		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO. WHC-SD-WM-CN-055	REVISION NO. Rev. 0	DATE OF REVIEW 08/30/96
CALCULATION NOTE TITLE: Flammable Gas Deflagration Consequence Calculations for the Tank Waste Remediation System Basis for Interim Operation		
Review Completed by: Rick J. Van Vleet		Date: 09/16/96
<p>A. Math errors</p> <p>Dispositions: Not applicable.</p>		
<p>B. All assumptions/initial conditions stated & ID those needing protection</p> <p>Dispositions: Reference materials (WHC-SD-WM-SAD-036, Rev. 0, and LA-UR-92-3196, Rev. 14) were given to P.D. Rittmann. He re-reveiwed WHC-SD-WM-CN-055 and verified the numbers. He then stated that none of the assumptions need to be protected and that WHC-SD-WM-CN-055 does not need to be revised.</p>		
<p>C. All values referenced</p> <p>Dispositions: Reference materials (WHC-SD-WM-SAD-036, Rev. 0, and LA-UR-92-3196, Rev. 14) were given to P.D. Rittmann. He re-reveiwed WHC-SD-WM-CN-055 and verified the numbers. He then stated that none of the assumptions need to be protected and that WHC-SD-WM-CN-055 does not need to be revised.</p>		
<p>D. Basis for selection of variables</p> <p>Dispositions: Reference materials (WHC-SD-WM-SAD-036, Rev. 0, and LA-UR-92-3196, Rev. 14) were given to P.D. Rittmann. He re-reveiwed WHC-SD-WM-CN-055 and verified the numbers. He then stated that none of the assumptions need to be protected and that WHC-SD-WM-CN-055 does not need to be revised.</p>		
<p>E. All mitigative features listed</p> <p>Dispositions: Not applicable.</p>		
<p>F. No extraneous information</p> <p>Dispositions: Not applicable.</p>		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO. WHC-SD-WM-CN-055	REVISION NO. Rev. 0	DATE OF REVIEW 08/30/96
CALCULATION NOTE TITLE: Flammable Gas Deflagration Consequence Calculations for the Tank Waste Remediation System Basis for Interim Operation		
G. Correct use of peer reviews checklist		
Dispositions: Not applicable.		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO. WHC-SD-WM-CN-055	REVISION NO. Rev. 0	DATE OF REVIEW 09/09/96
CALCULATION NOTE TITLE: Flammable Gas Deflagration Consequence Calculations for the Tank Waste Remediation System Basis for Interim Operation		
Review Completed by: Rick J. Van Vleet		Date: 09/20/96
<p>A. Math errors</p> <p>Dispositions: The text describing the SOF has been clarified. This includes the unit basis for the SOF (either liters or liters/second) and the units of the concentration (either ppm or mg/m³) and the units of the limits (either ppm or mg/m³). This yields a SOF with units of either 1/L or s/L.</p>		
<p>B. All assumptions/initial conditions stated & ID those needing protection</p> <p>Dispositions: Not applicable.</p>		
<p>C. All values referenced</p> <p>Dispositions: Not applicable.</p>		
<p>D. Basis for selection of variables</p> <p>Dispositions: Text was clarified to state that 3350 m³ was the maximum headspace volume for the single-shell flammable gas tanks, i.e., tank 241-A-103. In a similar fashion, the maximum headspace volume for the aging waste facility flammable gas tanks is 1800 m³ (241-AY-101) and for double-shell tanks is 2500 m³ (241-SY-103). These values are documented in the spreadsheet tables.</p> <p>Each calculation note (CN-043, CN-055, and CN-059), utilizes a tank specific headspace volume. There is not a discrepancy because of this.</p> <p>The 200 s release time has been further clarified. Two hundred seconds is used because of the time during the gas release event when the tank is pressurized and the time the tank is pressurized due to the burn. The reader is referenced back to LA-UR-92-3196 for further details (see appendix D).</p>		
<p>E. All mitigative features listed</p> <p>Dispositions: Not applicable.</p>		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO. WHC-SD-WM-CN-055	REVISION NO. Rev. 0	DATE OF REVIEW 09/09/96
CALCULATION NOTE TITLE: Flammable Gas Deflagration Consequence Calculations for the Tank Waste Remediation System Basis for Interim Operation		
F. No extraneous information		
Dispositions: Not applicable.		
G. Correct use of peer reviews checklist		
Dispositions: Not applicable.		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO. 056	REVISION NO. 1	DATE OF REVIEW September 2, 1996
CALCULATION NOTE TITLE: Fire in a Contaminated Area		
Review Completed by: A. V. Savino Dispositions Completed by: Grant W. Ryan		Date: September 3, 1996
<p>A. Math errors</p> <p>Dispositions: None Required</p>		
<p>B. All assumptions/initial conditions stated & ID those needing protection</p> <p>Dispositions: First ¶ - The assumptions currently in the calc note clearly state the basis for the use of the valve pit and amount of waste material used in the analysis.</p> <p>Second ¶ - The assumptions, analysis input, and supporting Information Validation Form clearly state the basis for the amount of material found in the valve pit (because of the drain lip protruding above the floor about 1 inch).</p> <p>Third ¶ - This assumption is consistent (and conservative) with other analysis that has been performed (i.e., <i>Spray Leak in Structure or from Overground Waste Transfer Lines.</i>) The IVF associated with this assumption is on file with TWRS S & L Project Files.</p>		
<p>C. All values referenced</p> <p>Dispositions: None required.</p>		
<p>D. Basis for selection of variables</p> <p>Dispositions: Revision 2 of this calculation note (which was not reviewed due to availability and timing) more correctly presents the analysis of the frequency. This frequency, while not used to compare consequence results, is not considered to be extraneous information. Moving the frequency to a lower category will not change the results of the analysis.</p>		
<p>E. All mitigative features listed</p> <p>Dispositions: No mitigative or preventive feature are listed for the reasons given in the calculation note. Putting this information in the calculation note would lead to possible wording inconsistencies and as such, has been avoided. The controls chosen for this accident scenario are present in the FSAR.</p>		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO. 056	REVISION NO. 1	DATE OF REVIEW September 2, 1996
CALCULATION NOTE TITLE: Fire in a Contaminated Area		
F. No extraneous information		
Dispositions: See response to Section D.		
G. Correct use of peer reviews checklist		
Dispositions: None required.		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO.	REVISION NO.	DATE OF REVIEW
CALCULATION NOTE TITLE: Calculation Notes (#057) for Subsurface Leak Resulting in Pool, TWRS FSAR Accident Analysis		
Review Completed by: D. R. Porten		Date: 9/18/96
<p>A. Math errors</p> <p>Dispositions: No math errors were identified.</p>		
<p>B. All assumptions/initial conditions stated & ID those needing protection</p> <p>Dispositions: No changes required.</p>		
<p>C. All values referenced</p> <p>Dispositions: No changes required.</p>		
<p>D. Basis for selection of variables</p> <p>Dispositions: No changes required.</p>		
<p>E. All mitigative features listed</p> <p>Dispositions: No changes required.</p>		
<p>F. No extraneous information</p> <p>Dispositions: No changes required.</p>		
<p>G. Correct use of peer reviews checklist</p> <p>Dispositions: No changes required.</p>		

PAGE 1 OF 2		REVIEW DISPOSITIONS	
CALCULATION NOTE 058		REVISION A	DATE ISSUED: NA
CALCULATION NOTE TITLE: Compilation of Calculation Notes in Support of Organic Salt Nitrate Reactions Safety Analysis			
Review Completed by: Paul D. Rittmann, PhD CHP		Date: Sept 17, 1996 AB Webb Response Sept. 23, 1996	
<p><u> </u> A. Math Errors</p> <p>Comments: None observed. The statistical calculations in Attachment 1, Appendix A, could not be checked. (Some tables in Appendix B of Attachment 1 could not be read, eg B-3 through B-9, and B-23). Some of the values cited in Section B.6.4 do not match the tables. For example, the text references Figure B-26, but the actual graph used is B-22. The comments in Section B.6.5, 3rd paragraph appear to apply to a previous version of the graphs.</p> <p><u>Dispositions:</u> The tables noted above are being replaced with legible tables, see ECN. In addition, the reference to Figure B-26 has been corrected to B-22. Also, the later versions of Figures B-31 through B-36 are being changed to accord with the textual references as shown in the ECN of changes.</p> <p><u> </u> B. Assumptions Stated and Which Ones Need Protection</p> <p>Comments: Assumptions are already listed in Section 5.0, based on assumption lists in Sections 3.1 and 5.2 of Attachment 1. Since the conclusions are dependent on the tank sampling results, it is important that the statistical evaluation be repeated periodically, as new information becomes available, both as a check on the predictions and a refinement of them (Section 7 of Attachment 1).</p> <p><u>Disposition:</u> The CalcNote has been changed via ECN to indicate that the statistical evaluation will be repeated periodically as new information becomes available.</p> <p>[Rittman Comment:] Additional assumptions related to the details of the calculations of release fractions are listed in Section B.4.2.1 of Attachment 1. These are all bounding and need no protection.</p> <p><u> </u> C. Values Referenced</p> <p>Comments: All had references except the inhalation dose factors in Tables 5-1 and C-2 of Attachment 1.</p> <p><u>Dispositions:</u> The dose conversion factors come from EPA-520 (Fed. Bulletin No. 11) and references have been added to both places, see ECN change package.</p> <p><u> </u> D. Basis for Selection of Important Variables</p> <p>Comments: Variables were selected to lead to an upper bound the potential consequences of any accidents.</p>			

PAGE 1 OF 2		REVIEW DISPOSITIONS	
CALCULATION NOTE 058		REVISION A	DATE ISSUED: NA
CALCULATION NOTE TITLE: Compilation of Calculation Notes in Support of Organic Salt Nitrate Reactions Safety Analysis			
_____ E. Mitigative Features			
Comments: None were singled out. Administrative controls are given instead.			
_____ F. Extraneous Information			
Comments: None observed.		(SEE CONTINUATION PAGE)	
_____ G. Peer Review Checklist		(PAGE 2 OF 2)	
Comments: None provided for review. Appendix A of Attachment 1 needs a thorough peer review by someone knowledgeable in statistics. Appendix B of Attachment 1 needs a thorough peer review by someone knowledgeable in chemistry & heat transfer.			
<u>Dispositions:</u> The peer review checklists appear at the beginning of the original release of the CalcNote. These show that Appendix A was reviewed by Louis Jensen. Changes were made to respond to Mr. Jensen's comments. The ECN package contains some additional editorial changes as well, for example: section, figure, and table callouts for Appendix B of Attachment 1 have been revised to correspond to actual pages numbers in Rev. 0.			

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO. WHC-SD-WM-CN-059	REVISION NO. Rev. 0	DATE OF REVIEW 9/9/96
CALCULATION NOTE TITLE: Calculation Notes that Support Accident Scenario and Consequence Analysis of the In-Tank Fire/Deflagration		
Review Completed by: Tom Tomaszewski Review Comment Dispositions Completed by: Ralph Crowe		Disposition Date: 9/19/96
<p>A. Math errors - None</p> <p>Dispositions:</p> <p>Sht 2: Changed gasoline LFL changed to 1.3% to agree with Lange, pg. 20. Sht 2: Changed conversion factor units to "gallons of gasoline to cubic meters of headspace". Sht 4: Changed to 16.3 gallons for LFL of 1.3%. Sht 5: Changed to clarify calculation is for an empty tank and waste depth is not applicable. Sht 6, 7, 8 and 9.: No change.</p>		
<p>B. All assumptions/initial conditions stated & ID those needing protection</p> <p>Dispositions:</p> <p>Sht 4: No change, there is no need to protect the assumption of 300 K. The purpose of the discussion in the calcnote was to show that the pressure increase due to a in-tank fuel deflagration is equivalent to a hydrogen deflagration. Although 300 K was used for the calculation, any reasonable vapor space temperature could be used since both deflagration would be equally affected.</p> <p>Shts 6 through 9: No change. The values are already protected since the empty volume of a waste tank can not change. All 149 single shell tanks are "out-of-service" and have not been authorized to accept new waste since November 21, 1980.</p>		
<p>C. All values referenced</p> <p>Dispositions: No change.</p>		
<p>D. Basis for selection of variables</p> <p>Dispositions: No change.</p>		
<p>E. All mitigative features listed</p> <p>Dispositions: No Change.</p>		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO. WHC-SD-WM-CN-059	REVISION NO. Rev. 0	DATE OF REVIEW 9/9/96
CALCULATION NOTE TITLE: Calculation Notes that Support Accident Scenario and Consequence Analysis of the In-Tank Fire/Deflagration		
F. No extraneous information Dispositions: Sht 2: Changed, all reference to UFL deleted.		
G. Correct use of peer reviews checklist Dispositions: No Change.		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO. WHC-SD-WM-CN-060	REVISION NO. Rev. 0	DATE OF REVIEW 9/11/96
CALCULATION NOTE TITLE: Calculation Notes that Support Accident Scenario and Consequence of the Evaporator Dump.		
Review Completed by: Anthony V. Savino Review Comment Disposition Completed by: Ralph D. Crowe		Disposition Date: 9/19/96
A. Math errors		
Dispositions: Minor editorial corrections as identified were made and calcnote re-issued as Rev. 1.		
B. All assumptions/initial conditions stated & ID those needing protection		
Dispositions: No changes.		
C. All values referenced		
Dispositions: No changes.		
D. Basis for selection of variables		
Dispositions: The word "conservatively" removed from text. It is assumed that since the DST liquid SOF is calculated to incorporate waste in the tanks that came from the evaporator, the DST liquid SOF is a reasonable representation of the dump waste. As pointed out, the onsite SOF is a factor of twenty below the limit and therefore there is plenty of margin.		
E. All mitigative features listed		
Dispositions: No changes.		
F. No extraneous information		
Dispositions: No changes.		
G. Correct use of peer reviews checklist		
Dispositions: No changes.		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO. WHC-SD-WM-CN-061	REVISION NO. 0	DATE OF REVIEW 9/10/96
CALCULATION NOTE TITLE: Releases from Failure of a Flexible Receiver Bag in High Winds		
Review Completed by: COMMENTS-- D. R. Porten DISPOSITION-- Don Slaughterbeck		Date: Comments-09/10/96 Disposition-9/17/96
A. Math errors Dispositions: No math errors were found.		
B. All assumptions/initial conditions stated & ID those needing protection Dispositions: The accident meets risk evaluation guidelines without controls		
C. All values referenced Dispositions: All values were referenced.		
D. Basis for selection of variables Dispositions: The basis for variables was stated or referenced.		
E. All mitigative features listed Dispositions: Mitigative feature is listed.		
F. No extraneous information Dispositions: No extraneous information was found.		
G. Correct use of peer reviews checklist Dispositions: Correct use of peer review checklist was employed.		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO.	REVISION NO.	DATE OF REVIEW
WHC-SD-WM-CN-062	0	August 30, 1996
CALCULATION NOTE TITLE: HEPA Filter Fire (and Subsequent Unfiltered Release)		
Dispositions Completed by: Thomas B. Powers		Date: September 5, 1996
A. Math errors		
Dispositions: Will be corrected in revision 1 of the calculation note.		
B. All assumptions/initial conditions stated & ID those needing protection		
Dispositions: None needed		
C. All values referenced		
Dispositions: The IVF for filter dimensions is Tracking # MKG-Chapter 3-02 and will be entered in the reference list and a copy included in revision 1 of the calculation note.		
D. Basis for selection of variables		
Dispositions: The reference for the partition factors (PF) of 10^{-8} active and 10^{-10} passive is RHO-RE-SA-216P and Calculation Note WHC-SD-WM-CN-044, Rev. 0, page 47 of 58. This reference will be called out in revision 1 of the calculation note.		
E. All mitigative features listed		
Dispositions: None needed		
F. No extraneous information		
Dispositions: None needed		
G. Correct use of peer reviews checklist		
Dispositions: HEDOP review not required for this calculation note.		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO. 063	REVISION NO. 0	DATE OF REVIEW August 30, 1996
CALCULATION NOTE TITLE: Releases From Failed HEPA Filters Due to an Overpressurization Event		
Review Completed by: A. V. Savino Dispositions Completed by: Grant W. Ryan		Date: September 5, 1996
<p>A. Math errors</p> <p>Dispositions: Math errors that were discovered in the review have been corrected and revision 1 of the document will be issued. See attached for confirmation.</p>		
<p>B. All assumptions/initial conditions stated & ID those needing protection</p> <p>Dispositions: These assumptions are consistent with the base documents, CN-054 and CN-062, respectively.</p>		
<p>C. All values referenced</p> <p>Dispositions: None required.</p>		
<p>D. Basis for selection of variables</p> <p>Dispositions: Response to first comment: The table will be footnoted to reflect that these values were obtained from CN-062.</p> <p>Response to second comment: Reference to the partition fraction has been included with an appendix specifically detailing the values used and derived from the Kimura document. The filter fire partition fraction was not used in this calc. note, it was used in CN-062.</p> <p>Response to third comment: There is no discussion of the basis for the waste types chosen since this is the base assumption used in developing the release amounts in CN-054.</p>		
<p>E. All mitigative features listed</p> <p>Dispositions: None required.</p>		
<p>F. No extraneous information</p> <p>Dispositions: None required.</p>		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO. 063	REVISION NO. 0	DATE OF REVIEW August 30, 1996
CALCULATION NOTE TITLE: Releases From Failed HEPA Filters Due to an Overpressurization Event		
G. Correct use of peer reviews checklist		
Dispositions: None required.		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO. WHC-SD-WM-CN-065	REVISION NO. 0	DATE OF REVIEW 9/6/96
CALCULATION NOTE TITLE: Consequence Analysis of an Unmitigated NaOH Solution Spray Release During Addition to Waste Tank		
Review Completed by: D.R. Porten		Date: 9/6/96
A. Math errors Dispositions: No action required.		
B. All assumptions/initial conditions stated & ID those needing protection Dispositions: No action Required.		
C. All values referenced Dispositions: No action required.		
D. Basis for selection of variables Dispositions: No action required.		
E. All mitigative features listed Dispositions: No action required.		
F. No extraneous information Dispositions: No action required.		
G. Correct use of peer reviews checklist Dispositions: No action required.		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO. S-CLC-G-00132 WHC-SD-WM-CN-072	REVISION NO. A	DATE OF REVIEW 9/2/96
CALCULATION NOTE TITLE: Chemical reaction in a DCRT Leading to a Toxic Release		
Review Completed by: Tom Tomaszewski Dispositions Completed by: Thomas B. Powers		Date: September 20, 1996
A. Math errors Dispositions: None needed		
B. All assumptions/initial conditions stated & ID those needing protection Dispositions: 1. Hazards analysis classified this as an "anticipated" event. Also, since a frequency analysis was not performed, this is the most conservative assumption. 2.		
C. All values referenced Dispositions: None needed		
D. Basis for selection of variables Dispositions: None needed		
E. All mitigative features listed Dispositions: ?		
F. No extraneous information Dispositions: ?		
G. Correct use of peer reviews checklist Dispositions: Mr. Tomaszewski will be asked to review the changes and sign off on a peer review checklist.		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO.	REVISION NO.	DATE OF REVIEW
M-CLC-G-00237	2	9/3-6,8/96
CALCULATION NOTE TITLE: Chemical reaction in a DCRT		
Review Completed by: Tom Tomaszewski Dispositions Completed by: Thomas B. Powers		Date: September 19, 1996
<p>A. Math errors</p> <p>Dispositions:</p> <ul style="list-style-type: none"> (1) The density of water is now used in the calculations. (2) The Heat of Reaction entries at the bottom of the table of Section 4.5, sht 7 have been corrected. (3) Section 4.8, Table: the offsite direction/distance entries have been corrected. (4) Section 5.3: the DST solids fraction has been corrected to 1/3. (5) Section 6.1.1, Sht 10: The units for "ULD_{ing}" have been corrected to [Sv-m³/s-L]. The meaning of unit liter dose is the dose from one liter of released material. The naming convention for unit liter dose does not imply that there are only the units of dose and liters. Thus the definition of "ULD_{ing}" is correct as "Ingestion Unit liter dose" NOT "Ingestion Unit liter dose per second". 		
<p>B. All assumptions/initial conditions stated & ID those needing protection</p> <p>Dispositions: No responses were needed but it is noted that maximum transfer of 57 wt% nitric acid has been changed from 1000 gallons to 110 gallons AND the initial waste temperature has changed from 150 °F to 200 °F.</p>		
<p>C. All values referenced</p> <p>Dispositions: For comment 1, the hazard analysis does not have to be referenced according to Dirk Leach. References will be included for comments 2-4. Comment 5 has been eliminated in Revision 3 of the Savannah River Calculation note. Comment 6 relates to the FSAR section and is supported in the calc note.</p>		

REVIEW COMMENT DISPOSITIONS

CALCULATION NO.	REVISION NO.	DATE OF REVIEW
M-CLC-G-00237	2	9/3-6,8/96
CALCULATION NOTE TITLE: Chemical reaction in a DCRT		
D. Basis for selection of variables		
Dispositions:	Section 4.6:	Reference will be to SARR-037.
	Section 4.9:	Reason for using the selected onsite & offsite breathing rates is included now.
	Sht 5:	Administrative controls say that unneutralized waste will be neutralized before transfer to tank farms..
	Section 5.4:	Reference to a 150 °F initial waste temperature has been eliminated in Revision 3 of the Savannah River Calculation note.
	Shts 24 & 27:	Density of water (1000 kg/m ³) is now used throughout the calculation.
	Sht 27:	Density of water (1000 kg/m ³) is now used throughout the calculation.
E. All mitigative features listed		
Dispositions:	Change has been made in the text.	
F. No extraneous information		
Dispositions:	The statement on the Calc Cover Sheet: The referenced statement is not in the latest version of the cover sheet plus the calculation sheets are not for proposing controls so this comment does not need to be developed in the calc note.	
	Section 6.1.2, Sht 10, Item 2:	This is a generic reference with an "etc." so it includes DST wastes also.
	Section 6.1.2, Sht. 11: The changes were incorporated.	
	Sht 24:	-57.7 kJ/g-mole is labelled Hrxn and is noted as being used in the calculations.
	Time is used to determine the x/Q for the consequence calculations.	

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO.	REVISION NO.	DATE OF REVIEW
M-CLC-G-00237	2	9/3-6,8/96
CALCULATION NOTE TITLE: Chemical reaction in a DCRT		
G. Correct use of peer reviews checklist		
Dispositions: Mr. Tomaszewski will be asked to review the changes and sign off on a peer review checklist.		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO. M-CLC-G-00238 whc-sd-wm-cn-074	REVISION NO. 1	DATE OF REVIEW 9/2/96
CALCULATION NOTE TITLE: Chemical reaction in a DCRT Leading to a Toxic Release		
Review Completed by: Tom Tomaszewski Dispositions Completed by: Thomas B. Powers		Date: September 20, 1996
A. Math errors Dispositions: None needed		
B. All assumptions/initial conditions stated & ID those needing protection Dispositions: <ol style="list-style-type: none"> 1. Hazards analysis classified this as an "anticipated" event. Also, since a frequency analysis was not performed, this is the most conservative assumption. 2. Ammonia concentration comes from Ref. 3, Table 3-1. It is assumed that the ammonia concentration is the maximum found in any of the tanks. It is then converted to a molar concentration of 0.03 M by dividing by the molecular weight of ammonia. We do not know what the pH this concentration is at, but assume that it is less than 9.27. If it were greater than 9.27, there would be no release. 3. As caustic is added, the pH goes above the target region of 0.01 M hydroxide [pH=12]. The ammonia is assumed to be released at the highest possible partial pressure (conservative) as calculated from the equilibrium reaction. 4. Definition of [NH₄OH]: See revised text on sheet 6 of 29. 		
C. All values referenced Dispositions: None needed		
D. Basis for selection of variables Dispositions: None needed		
E. All mitigative features listed Dispositions: Since the consequences of the unmitigated scenario are well below the risk evaluation guidelines, a mitigated analysis is not required. No mitigative features were identified.		

REVIEW COMMENT DISPOSITIONS		
CALCULATION NO. M-CLC-G-00238 whc-sd-wm-cn-074	REVISION NO. 1	DATE OF REVIEW 9/2/96
CALCULATION NOTE TITLE: Chemical reaction in a DCRT Leading to a Toxic Release		
F. No extraneous information		
Dispositions: 1. Changed rev 2 to rev 1 on sheet 3 of 29. 2. Corrected page numbers on sheet 2 of 29. 3. Incorporated changes at the end of Section 5.1.		
G. Correct use of peer reviews checklist		
Dispositions: Mr. Tomaszewski will be asked to review the changes and sign off on a peer review checklist.		

APPENDIX D
CROSSCUT REVIEW

WHC-SD-WM-RPT-271, REV. 0

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Review Team 4, Crosscut Review

Brad Evans (lead)

Kris Chitkara

Review Plan

The crosscut review will examine all of the Calc Notes supporting the TWRS BIO for consistency in initial conditions, important assumptions, parameters, uncertainty, methodology, and use of results. The Review Forms generated by the teams performing the detailed Calc Note reviews may be used as they become available, but will not substitute for the Calc Notes themselves. It is understood that release fractions will be reviewed by Team 2 (Tony Savino, lead) and are not in the scope of the crosscut review.

The initial conditions, important assumptions, parameters, uncertainty, methodology, and use of results to be examined by the review team will be apportioned among the reviewers such that each reviewer examines similar parameters across all of the Calc Notes and shares notes to ensure complete coverage without duplication of effort. When inconsistencies are found, the crosscut reviewer will identify them and indicate whether any results may be affected. The reviewer may contact the Calc Note author for clarification or insight as necessary. The review team will document its findings to the review coordinator, Al Ramble, and attach copies of its notes and redlines.

The crosscut review team will submit its results no later than the last scheduled day for detailed Calc Note review (currently 9/9/96), but will provide interim findings as they become available.

Review Results

The crosscut review examined the Calc Notes listed in Attachment 1. The review team generated notations of assumptions, parameters, references, methodology, and important conclusions. The team then compared these across similar processes in the calc notes to identify potential inconsistencies and vulnerabilities in particular calc notes and document them as observations.

The review has resulted in few significant findings, but does identify several observations judged to warrant follow-up.

1. Use of DRAFT or inconsistent supporting documents:

- Many CNs use WHC-SD-WM-SARR-016, Rev 2 and SARR-011, Rev 2; these are listed in several CNs as draft documents.
- CN-065 references SARR-011, Rev 1 as the basis for its toxic consequence calculations. Other CNs reference Rev 2.

- CN-051 uses damage diameter from WHC-SD-TWR-RPT-002 DRAFT, and dome section parameters from DRAFT July report as bases for calculating respirable fraction.
 - CN-043 references the partition fraction of 10^{-8} for actively ventilated tanks from WHC-SD-WM-SARR-018. CN-044 cites RHO-RE-SA-216 for the same value.
 - CN-032 references WHC-SD-WM-SARR-036, DRAFT, as the basis for several parameters and conclusion regarding large and small pool fires.
2. Inconsistent dose/exposure calculations:
- CN-003 calculates direct dose and skyshine from the pool; no brehmsstrahlung is calculated.
 - CN-044 does not include ingestion dose with the offsite dose calculation.
 - CN-045 does not include ingestion dose with the offsite dose calculation.
 - CN-045 does not use the SOF methodology. Since, instead, the maximum particulate concentration is established as 100 mg/m^3 , it should be established at the release location and not 100-m downwind.
 - CN-048 does not include direct shine and skyshine, or consider pool/soil resuspension.
 - CN-049, Section 2.4.2 provides ingestion ULD for SST slurry. However, the information corresponds to the AFW slurry.
 - CN-053 does not include direct shine and skyshine from 120 m^3 of excavated soil.
 - CN-057 uses the 12-hour breathing rate for a 26.5-hr dose to the offsite receptor.

- N-058, Section 10.1.2 presents unmitigated consequences in Table 2. However, the table is titled "Mitigated ----- Consequences - ----- and Comparison to ----- Guidelines." Also, the radiological guidelines included in the table are for the anticipated and not the unlikely frequency category.
 - CN-060 does not calculate ingestion dose to the offsite receptor.
 - CN-062 calculates a 1-year dose consequence to the onsite and offsite receptors. Other CNs calculate a 12-hr onsite dose and 24-hr offsite dose.
 - CN-062 uses the 24-hr average breathing rate and an "occupancy factor" to calculate a 1-yr dose to the onsite receptor; should use the 12-hr breathing rate and exposure time.
 - CN-063 sums toxic exposure SOFs based on an anticipated frequency with SOFs taken from CN-062 calculated for an unlikely frequency; affected calculations are consequences from SST passive ventilation systems. There is a potential to exceed unity for one of the passive ventilation system toxic consequence calculations when the anticipated SOFs are substituted.
 - CN S-CLC-G-00131 does not include direct shine and skyshine from the pool.
 - CN S-CLC-G-00132 does not include direct shine and skyshine from the spray release, or resuspension from the pool/soil.
3. Tank accident parameters inconsistent without explanation:
- CN-043 uses headspace volume as a "fixed" 1900 m³ based on WHC-SD-WM-ER-526, Rev 1, CN-055 uses headspace volume of 3350 m³ based on 241-A-103. In contrast, CN-059 uses 986 m³ (241-A-101), but explains the reason for using the tank with the minimum available volume.
 - CN-043 considers the consequences of gas, respirable solid, and respirable liquid components of a tank bump. CN-047 considers venting of some portion of the headspace and fission gas, but does not investigate entrained liquids or solids as a result of the generation of steam in a tank via criticality.
 - CN S-CLC-G-00131 assumes time to shutdown from a transfer line break is 40 min (the construction PIC is relied on to mitigate the accident consequences). CN-057 assumes one hour for shutdown of pumps after a transfer line break. CN S-CLC-G-00116 recommends a transfer line surveillance frequency of 2-hrs during waste

transfers based on accident frequency calculations. These assumptions and calculations should be reconciled.

- CN-044 and CN-060 evaluate intrusion of hot fluid into a tank headspace and use similar methodology for calculating constituent quantities vented from the tank. For its 4-min calculation, CN-044 uses a 10-sec time step for calculating steam (mass and energy) added to the headspace; for its 60-min calculation, CN-060 uses a 1-s time interval. This is noted because the thermodynamic calculation of CN-043 for tank bump was sensitive to time-steps in some cases.
4. Math/unit errors or needed clarification:
- CN-055 description of sum-of-fractions (SOF) methodology for toxic consequences needs to clarify units for $\text{Limit}_1, \text{Limit}_2, \dots, \text{Limit}_n$ to obtain the correct units for SOF and a unitless T. This has been discussed with the author.
 - CN-043 contains a summation math error in onsite dose consequences. This does not affect the result.
 - CN-057 contains conversion errors from rem to mSv in calculation of direct shine dose to the onsite receptor. This has been discussed with the author.
 - CN-061 provides onsite dose from calculation of direct shine and skyshine using units of mR. These are exposure from shine, not dose.
 - CN M-CLC-G-00237 provide the ingestion ULD in units of (Sv/L) rather than $(\text{Sv}\cdot\text{m}^3/\text{s}\cdot\text{L})$.
 - CN M-CLC-G-00237 provides no sample calculation or values selected from the available parameters, so minimal cross-check was possible.

5. Other needed clarification or reference:

- CN-055 uses a 200-s release as a result of tank deflagration, despite stating that the pressure pulse lasts only 10 seconds per WHC-SD-WM-SAD-036. This leads to the assumption of a continuous release rather than a puff release to the offsite receptor. The results are not impacted.
- CN-032, Appendix C calculates a frequency of a wick-stabilized fire as $9.9\text{E-}3/\text{yr}$ based on an estimated 9 tanks (extrapolated from 71% sampling data), each with frequency $1.1\text{E-}3/\text{yr}$. This is at the cusp of the "anticipated" frequency range.

APPENDIX E
RELEASE FRACTION REVIEW RESULTS

WHC-SD-WM-RPT-271, REV. 0

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REVIEW FORM**CALCULATION NO. ALL****REVISION NO. 0****DATE OF REVIEW 9/11/96****CALCULATION NOTE TITLE: Review of Release Fractions Values Used in All Calcnotes****Review Completed by: Anthony V. Savino****Date: 9/13/1996****SUMMARY OF REVIEW**

There were 3 parts to the review, as summarized below:

- 1) The ARFxRF values for each of the calcnotes were identified and summarized below along with the calcnote number and a brief description of the scenario.
- 2) The ARFxRF values were evaluated to determine their validity for the accident scenario of interest.
- 3) The ARFxRFs from the different calcnotes were then grouped together by release mechanism (e.g., fire, spills, evaporation/resuspension, etc.). The ARFxRF values within each group were compared with each other and differences were identified and evaluated as summarized below. See the more detailed description of the ARFxRFs for each calcnote if the summary below seems to be too cryptic. Note that some scenarios were unique and were therefore not listed in the groups below since there was no need to evaluate inconsistencies between calcnotes for those values.

CONCLUSIONS

Overall, the ARFxRF values selected appear to be reasonable and conservative for each of the scenarios.

For releases from valve pits (CN-43, 48, 49), it initially appeared that two different methods were used (DF vs air expulsion). However, the concept of the DF was derived similarly to the use of air expulsion. It is probably wise to review the DFs to be sure they give reasonably similar results if the conditions are similar.

Where differences were evident, there are usually logical reasons for the differences. For example, under SPILLS, ARFxRF values of 2×10^{-5} and 4×10^{-5} were used. However, the former was for aqueous waste while the latter was for slurries. Similar arguments exist for the values listed in the EVAPORATION/RESUSPENSION group, although one could argue that different values were used for similar conditions, since some calcnotes used a resuspension rate for essentially infinite sources, while others used area-dependent resuspension rates.

The only exception is the use of the median instead of bounding ARFxRF value for free-fall spill of aqueous solution onto a hard surface for the Evaporator Dump scenario. Some of the liquid from the evaporator is made airborne as the evaporator liquid impacts the surface of the liquid in the tank. Since the evaporator dump is impacting a liquid surface instead of a hard surface, it was argued that the median ARFxRF is considered acceptable.

Note that a detailed review of the nuclide-dependent ARFxRF values contained in the Organic Nitrate calcnote was not performed.

REVIEW FORM

CALCULATION NO. ALL

REVISION NO. 0

DATE OF REVIEW 9/11/96

CALCULATION NOTE TITLE: Review of Release Fractions Values Used in All Calcnotes
THE SCENARIO GROUPINGS ARE LISTED BELOW

HEPA FILTER BLOWOUT (PRESSURIZATION)

1×10^{-2} CN-44 and CN-54 (NOTE CN-63 USES VALUES FROM CN-54)

HEPA FILTER FIRE

1×10^{-4} CN-62

FIRE

2×10^{-4} CN-56 Fire of aqueous solution or air-dried salts

NONE QUOTED CN-59 In-tank fire/deflagration - it was argued that the consequences of either scenario are bounded by the Organic Solvent Fire Accident and the SST/DST Flammable Gas Deflagration Accidents.

SPILLS

3×10^{-7} CN-60 Evap dump - liquid into liquid (median value of free fall of liquid onto hard surface was used)

2×10^{-5} CN-3 Free fall spill of aqueous solution < 1 m.

4×10^{-5} CN-131 Free fall spill of slurries < 3 m.

4×10^{-5} CN-49 Slurry waste from open nozzle onto floor < 3 m.

2×10^{-5} CN-49 Viscous waste flowing and splashing < 3 m.

REVIEW FORM		
CALCULATION NO. ALL	REVISION NO. 0	DATE OF REVIEW 9/11/96
<p>CALCULATION NOTE TITLE: Review of Release Fractions Values Used in All Calcnotes</p> <p><u>EVAPORATION/RESUSPENSION</u></p> <p>9 x 10⁻⁵/h CN-61 High winds resuspending ground contamination</p> <p>2 x 10⁻¹⁰ kg/m²s CN-57 & 49 Resuspension release from growing pool</p> <p>Modified Roblyer equation Q = 2.8 x 10⁻⁹ * F CN-3 Resuspension of liquid from surface of pool</p> <p>4 x 10⁻⁶/h CN-131, 57, 49 Resuspension from soil after waste soaks in</p> <p>4 x 10⁻⁵/h CN-53 Resuspension of excavated soil.</p> <p>4 x 10⁻⁶/h CN-3 Resuspension from liquid wetted soil over 24 hr</p> <p>7.2 x 10⁻⁶/h CN-3 Resuspension from liquid wetted soil over 12 hr</p> <p>6 x 10⁻⁴ CN-53 Initial suspension of falling soil during excavation</p> <p><u>LOAD DROP ONTO WASTE SURFACE</u></p> <p>2 x 10⁻⁴ J/cm³ CN-51 Concentrated loads dropped onto waste surface</p> <p><u>SPRAY</u></p> <p>Spray code used CN-65 NaOH Spray</p> <p>0.21 L/min CN-132 Spray from hole in pipe - taken from a reference for "A spray lead inside a DST valve pit during a transfer of aging waste ..." This was calculated using the SPRAY code.</p> <p>Spray code used for unmitigated spray leak [coverblocks off] CN-48</p> <p><u>RELEASES FROM VALVE PITS</u></p> <p>100 mg/m³ and expulsion of 1 pit volume of air (15 m³) [coverblocks on] CN-49</p> <p>Decontamination factor (DF) of 46 derived for cover blocks CN-43</p> <p>100 mg/m³ and liquid inflow displaces air at rate of 4.6 m³/h [coverblocks on] CN-48</p>		

REVIEW FORM		
CALCULATION NO. ALL	REVISION NO. 0	DATE OF REVIEW 9/11/96
<p>CALCULATION NOTE TITLE: Review of Release Fractions Values Used in All Calcnotes</p> <p><u>BOILING LIQUIDS IN TANKS</u></p> <p>2 x 10⁻³ CN-32 Solvent fire</p> <p>2 x 10⁻³ CN-237 Mistransfer of acid/acidic solution to DCRT</p> <p>CN-003: Railcar spills liquid waste and forms a pool.</p> <p>1) Maximum Shipment Size Worksheet from the SARP (SD-RE-SAP-013) contains ARFxRFs of 1.7 x 10⁻³ with fire, and 3.7 x 10⁻⁴ w/out fire (I did not evaluate the validity of these ARFxRFs because accident scenario information was not available).</p> <p>2) Suspension of liquid from falling and splashing - ARFxRF of 2.0 x 10⁻⁵ for free-fall spill of aqueous solution falling a distance of 1 m (3010 - Table 3-6).</p> <p>3) Evaporation/resuspension of liquid from the surface pool created on the soil - windspeed dependent equation for infinite fetch from 3010 is quoted - $C_{air} = C_{water} * (3 \times 10^{-11}) * 10^{0.098 * v}$</p> <p>This equation is actually not used, Appendix 3A identifies an equation from Roblyer and Owczarski which is then slightly modified. The formula actually used is - $Q = 2.8 \times 10^{-9} F$, ($Q = L/h$, F = pond length assuming a square pond, meters)</p> <p>The following values resulted from use of this equation:</p> <p>Release rate of 2.6 x 10⁻⁸ L/hr for evaporation/resuspension of liquid from the surface pool created on the soil for Case 1 - 2,123 L spill. ARRxRF of 1.5 x 10⁻⁷ L/hr for evaporation/resuspension of liquid from the surface pool created on the soil for Case 2 - 75,700 L spill.</p> <p>Note that this contribution to the total contributions from 2), 3), & 4) is negligible.</p> <p>4) resuspension of liquid from the wetted soil -</p> <p>ARRxRF of 4 x 10⁻⁶/hr for 24 hr resuspension from wetted soil. ARRxRF of 7.2 x 10⁻⁶/hr for 12 hr resuspension from soil [resuspension decreases with time as source material is reduced].</p> <p>CN-004: Leak from underground pipe forms underground source - direct shine/skyshine dose</p> <p>NO ARFxRF - ONLY DIRECT DOSE</p>		

REVIEW FORM		
CALCULATION NO. ALL	REVISION NO. 0	DATE OF REVIEW 9/11/96
<p>CALCULATION NOTE TITLE: Review of Release Fractions Values Used in All Calcnotes</p> <p>CN-022: Steam bump results in airborne release</p> <p>NO ARFxRF QUOTED.</p> <p>GOTH computer code used to simulate tank/systems behavior during steam dump.</p> <p>CN-032: Solvent Pool fire results in airborne release</p> <p>1) Solvent smoke release - bounding ARFxRF of 0.03 (from 3010) for large pools which burn to oxygen extinction in minutes.</p> <p>2) Boil off of aqueous solution in tanks - ARFxRF of 0.002 (from 3010) for boiling liquids.</p>		
<p>CN-043: Tank Bump results in release of airborne tank waste</p> <p>NO ARFxRF DIRECTLY QUOTED</p> <p>A cover block decontamination factor of 46 is derived (p. 10). The GOH computer code is used to calculate the release into the coverblocks. The tank headspace is assumed to be air with a quantity of aerosolized liquid waste entrained due to aerodynamic re-suspension. A PF of 10^{-8} was used to calculate the headspace concentration.</p>		
<p>CN-044: Steam Intrusion from Interfacing Systems causes an increase in tank headspace pressure and results in an aerosol release through unfiltered pathways</p> <p>1) Direct release to atmosphere from tank headspace - PF of 10^{-8} is used to calculate the headspace concentration.</p> <p>2) Pressurization causes HEPA filter rupture - ARFxRF of 1.0×10^{-2} is used - from 3010 - HEPA filter media with no enclosure or for which enclosure has been totally destroyed and the filter media is widely scattered and impacted.</p>		
<p>CN-045: Release of NaOH From the 2727-W Sodium Storage Facility - due to a sodium pool fire</p> <p>"The standard open pool sodium burn rate of 8 lb/ft²hr with an aerosol release fraction of 35% were assumed."</p> <p>NO ARFxRF QUOTED.</p> <p>A quantity of tank waste evaporated is calculated and 0.05% of this is assumed to be aerosolized. From RG 3.35 - "Aerosol should be assumed to comprise 0.05% of the salt content of the solution that is evaporated."</p>		
<p>CN-047: Tank Criticality</p>		

REVIEW FORM		
CALCULATION NO. ALL	REVISION NO. 0	DATE OF REVIEW 9/11/96
CALCULATION NOTE TITLE: Review of Release Fractions Values Used in All Calcnotes		
CN-048: Spray Leak Accident		
<p>1) Unmitigated - spray leak inside valve pits with cover blocks off - NO ARFxRF - SPRAY code used to determine aerosolized quantity.</p> <p>2) Mitigated - cover blocks on - NO ARFxRF - assumed valve pit concentration of 100 mg/m³. To calculate the release, a rate of 4.6 m³/hr was assumed for liquid spilling into the pit and displacing air from the pit.</p>		
CN-053: Excavation in ponds, cribs or ditches - results in airborne releases		
<p>1) From initial dump/excavation activities - used bounding ARFxRF of 6×10^{-4} (0.002×0.3) (from 3010) for suspension of falling powders - fall distance of <3 m, air velocity normal to powder flow, general forced enclosure ventilation or general low-wind outside conditions.</p> <p>2) From resuspension of excavated material - used ARRxRF of 4×10^{-5}/hr for resuspension from a homogeneous bed of powder exposed to nominal atmospheric conditions (<2 m/s w/ gusts up to 20 m/s).</p>		
CN-054: Tank Ventilation System Waste Material Accumulation		
For HEPA filter blowout, used ARFxRF of 1% (1×10^{-2}) - crushed HEPA filter in unconfined space (3010).		
CN-055: Flammable Gas Deflagration		
NO ARFxRF QUOTED.		
Amount of material released taken from CN-054 and LANL documents (Safety Assessments for Pumping Operations).		
CN-056: Fire in Contaminated Area - fuel spill/fire impacts a layer of dried out waste in the form of a powdery residue on the bottom of a valve pit.		
<p>ARFxRF of 2.0×10^{-4} ($5 \times 10^{-3} \times 0.4$) is used (from 3010) - thermal stress on an aqueous solution or air-dried salts under gasoline fire on a porous or otherwise absorbing surface. [Bounds the release of powders and the release from contaminated surfaces due to thermal stress.]</p> <p>For toxic evaluation - assumed an ARR of 1/900 s (1.1×10^{-3}/s) - i.e., the entire quantity released in 15 min.</p>		

REVIEW FORM		
CALCULATION NO. ALL	REVISION NO. 0	DATE OF REVIEW 9/11/96
CALCULATION NOTE TITLE: Review of Release Fractions Values Used in All Calcnotes		
CN-057: Subsurface Leaks Resulting in Pools		
<p>1) Resuspension release from surface of growing liquid pool - a resuspension release flux of 2×10^{-10} kg/sm² was estimated from Figure 3-8 of 3010. This corresponds to a pond with a 200 m fetch at wind speeds less than 5 m/s.</p> <p>2) Resuspension release from contaminated soil after pool soaks in - an ARFxRF of 8.4×10^{-5} over 24 hrs, which corresponds to 4.0×10^{-6}/hr, (from 3010 Section 3.2.4.4) is used to estimate the resuspension release after the transfer pump is shut off. The ARFxRF represents experiments with UNH solutions spilled on soil and dried under low wind speed conditions (<2.5 mph).</p>		
NOTE: SAME VALUES USED FOR UNMITIGATED AND MITIGATED ACCIDENT (WHICH IS OKAY)		
CN-062: HEPA Filter Fire		
ARFxRF - Bounding value for HEPA filters under thermal stress conditions - 1×10^{-4} (from 3010)		
CN-063: HEPA Filter Pressurization		
NO ARFxRF QUOTED.		
Release quantities taken from CN-054, which used an ARFxRF of 1×10^{-2} .		
CN-065: NaOH Spray Release During Addition to Waste Tank		
NO ARFxRF QUOTED		
SPRAY code used to determine aerosolized quantity.		
CN-00116: Frequency of a Transfer Line Break from an Excavation		
NO ARFxRF QUOTED - Frequency analysis.		
CN-00131: Transfer Line Break from an Excavation - Pool Release		
<p><1 hr free fall - ARFxRF of 4×10^{-5} ($5 \times 10^{-5} \times 0.8$) - Applies to case where a broken pipe drains by gravity and liquid free falls onto various surfaces in the excavation. The ARFxRF used is the bounding ARFxRF value for less than a 3 m fall distance (from 3010) from slurries (<40% solids). This value also bounds the other 3 applicable values in 3010.</p> <p><1 hr resuspension - The ARRxRF of 4×10^{-6}/hr is the bounding value (from 3010) for large pools/ponds, higher windspeeds to 30 mph.</p>		

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<p>CN-00132: Transfer Line Break from an Excavation while a transfer is in progress - which results in a Spray Release</p> <p>The bounding respirable release rate due to a spray from a hole in a damaged pipe is assumed to be 0.21 L/min.</p> <p>Taken from a reference for "A spray lead inside a DST valve pit during a transfer of aging waste ..." This was calculated using the SPRAY code.</p>		
<p>CN-00237: Mistransfer of acid or acidic waste into a DCRT - causes exothermic chemical reaction and an airborne release.</p> <p>An ARFxRF of 2×10^{-3} was used for boiling of liquid waste (from 3010). This is the bounding value for boiling liquids under thermal stress in 3010.</p>		
<p>CN-00238: Chemical Reaction in DCRT leading to Toxic Release - due to the addition of NaOH to a waste tank which leads to a change in the ammonia solubility and its release to the environment.</p> <p>NO ARFxRF QUOTED - chemical analysis to determine airborne concentration of ammonia</p>		
<p>CN-059: In-Tank Fuel Fire/Deflagration - fuel from a ruptured vehicle tank spills into the waste storage tank and ignites. Consequences are identified for a pool fire on surface of the waste and a deflagration in headspace.</p> <p>NO ARFxRF QUOTED - it was argued that the consequences of either scenario are bounded by the Organic Solvent Fire Accident and the SST/DST Flammable Gas Deflagration Accidents.</p>		
<p>CN-051: The Effects of Load Drop, Uniform Load and Concentrated Loads on Waste Tanks.</p> <p>Respirable fraction of 2×10^{-4} (J/cm³) from 3010. Applies to impact of dome/pump onto the waste surface - For excess concentrated load this formula yields an ARFxRF of 2×10^{-3}.</p> <p>Fraction of particles remove from the surface - RF of 0.1 used to represent particles made airborne as pump falls onto waste. This value is for the suspension of powder due to a deflagration above powder (from 3010).</p> <p>For Whole Dome Collapse (BDBE) - ARFxRF is 9×10^{-4}, which is derived again from 2×10^{-4} (J/cm³) from 3010.</p> <p>For dome impacting tank waste surface - if a liquid surface is assumed - the</p> <p>ARF = $(8.12 \times 10^{-10})(ARCH)^{0.55}$ RF = 0.54</p> <p>from Ballinger for spill of liquid onto an unyielding surface.</p>		

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CN-061: Releases from Failure of a Flexible Receiver Bag in High Winds Contamination from the inside of the flexible receiver bag is released to the ground when the flexible receiver bag was torn or punctured by high winds. High winds cause aerodynamic entrainment and suspension of the waste from the ground. An ARRxRF of 9×10^{-5} /hr is used - bounding ARR for suspension of contaminates deposited on soil from 3010 (Sect 3.2.4.5, p 3-42).		
CN-049: Surface Leak Resulting in Pool - UNMITIGATED SCENARIO 1) Release due to splatter and splashing - waste flowing out the open nozzle will splatter off the floor of the pit, and after a layer of liquid is formed, will splash. ARFxRF of 4×10^{-5} was used which is the bounding value for free fall spills of slurries (3 m fall) from 3010. 2) Resuspension release from surface of the waste in the pit while the pit fills - a resuspension release flux of 2×10^{-10} kg/sm ² was estimated from Figure 3-8 of 3010. This contribution to the total is negligible. 3) Resuspension release from surface of pool after pit overflows - a resuspension release flux of 2×10^{-10} kg/sm ² was used again. 4) Resuspension release from contaminated soil after pool soaks in - an ARFxRF of 8.4×10^{-5} over 24 hrs, which corresponds to 4.0×10^{-6} /hr, (from 3010 Section 3.2.4.4) is used to estimate the resuspension release after the transfer pump is shut off. The ARFxRF represents experiments with UNH solutions spilled on soil and dried under low wind speed conditions (<2.5 mph). 5) Continued resuspension release from surface of waste in the pit - a resuspension flux of 1.4×10^{-10} L/m ³ is used. This is equal to the resuspension release flux of 2×10^{-10} kg/sm ² (from 2 above) divided by the density (1.4 kg/L). UNMITIGATED SCENARIO 1) Aerosols generated due to splatter and splashing while the waste is flowing - An ARFxRF of 2×10^{-5} was used which is the bounding value for viscous slurries spilled from heights up to 3 m (from 3010). 2) Air concentration in the pit - quasi-stable aerosol loading limit of air - 100 mg/m ³ . Release determined using 100 mg/m ³ and an air expulsion quantity of 1 pit volume (15 m ³).		

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<p>CN-060: Evaporator Dump</p> <p>The median ARFxRF of $3.0\text{E-}7$ was used instead of the bounding value of $2.0\text{E-}5$ (page 3-4 of HDBK-3010) for free-fall spill of aqueous solutions (3 m fall distance) onto a hard surface. Some of the liquid from the evaporator is made airborne as the evaporator liquid impacts the surface of the liquid in the tank. Since the evaporator dump is impacting a liquid surface instead of a hard surface, it was argued that the median ARFxRF is considered acceptable.</p>		
<p>CN-058: Organic Nitrate</p> <p>Detailed chemical analysis to determine the nuclide dependent release fractions.</p>		

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