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5. Proj./Prog./Dept./Div.: 8M100	6. Cog. Engr.: G. W. Ryan	7. Purchase Order No.: N/A
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(G)	(H)	17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)						(G)	(H)
Reason	Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN
1	1	Cog. Eng. G. W. Ryan	<i>G. W. Ryan</i>	7/29/96	A3-37				
1	1	Cog. Mgr. D. S. Leach	<i>D. S. Leach</i>	7/29/96	A3-34				
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18. Signature of EDT Originator <i>G. W. Ryan</i> Date: 7/29/96	19. N/A Authorized Representative Date for Receiving Organization	20. D. S. Leach <i>D. S. Leach</i> Cognizant Manager Date: 7/29/96	21. DOE APPROVAL (if required) Ctrl. No. ☐ Approved ☐ Approved w/comments ☐ Disapproved w/comments
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Excavations in Hanford Ponds, Cribs, or Ditches

G. W. Ryan

Westinghouse Hanford Company, Richland, WA 99352

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

Unplanned Excavation/Drilling in Pond/Ditch/Crib.

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

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Release Approval

Date

Approved for Public Release

Calculation Cover Sheet

Project WHC TWRS FSAR Accident Analysis		Calculation Number M-CLC-G-0023 <i>8</i> <i>7-1-96</i>		Project Number -7/a	
Title Excavations in Hanford Ponds, Cribs, or Ditches. (u)		Functional Classification n/a		Sheet 1 of 34	
		Discipline MECHANICAL			
☐ Preliminary ☐ Committed ☒ Confirmed					
Computer Program No. (s) ☐ N/A				Version/Release No.	
Purpose and Objective The purpose of this Engineering Calculation (EC) is to calculate the radiological and toxicological consequences of an excavation in a Hanford pond, crib, or ditch. The results of this analysis will be included in Section 3.3 of the TWRS FSAR					
Summary of Conclusion The radiological and toxicological consequences of an excavation in a Hanford Site pond, crib, or ditch were calculated. The results of the calculations show that the consequences for the excavation of the soils contained in these facilities are within the risk evaluation guidelines for an anticipated event.					
Revisions					
Rev. No.	Revision Description				
0	Original Issue				
Sign Off					
Rev No.	Originator (Print) Sign / Date	Verification / Checking Method	Verifier / Checker (Print) Sign / Date	Manager (Print) Sign / Date	
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Classification <div style="text-align: center;"> DOES NOT CONTAIN UNCLASSIFIED CONTROLLED NUCLEAR INFORMATION </div> <div style="text-align: center;"> <i>Revising Official: [Signature] JK/abacus P. 5</i> <i>Date: 6/27/96</i> </div>					

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COMPUTER PROGRAMS USED

NAME	CONFIGURATION		If NO Description on page/in reference
	Control	Version	
	Yes	No	
	Yes	No	
	Yes	No	
	Yes	No	

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CALC-NOTE CHECKLIST

REVIEWER(S):

NAME (PRINT OR TYPE)

SIGNATURE

DATE

LORATO M. POZZI 6-26-96

CIRCLE ONE

1. Is the Subject and/or Purpose clearly stated? ☒ Yes ☐ No
2. Are the required Input Data and their references and source provided and are they consistent with the Calc-note purpose: ☒ Yes ☐ No
3. Are the Assumptions clearly identified, valid, and consistent with the Calc-note purpose: ☒ Yes ☐ No
4. Are the Analytical Methods clearly identified? ☒ Yes ☐ No
5. Are all pages consecutively numbered and identified by the calc-note number? ☒ Yes ☐ No
6. Is/are the version(s) of the computer program(s) used identified? Yes ☐ No ☒ N/A
7. Are input listings for all computer programs documented in this calc-note? Yes ☐ No ☒ N/A
8. Are the Results and Conclusions clearly stated? ☒ Yes ☐ No
9. Are all OUTPUT documents (if not part of the calculation) clearly referenced in the results section? Yes ☐ No ☒ N/A

IF NO TO ANY OF THE ABOVE, SHEET NUMBER(S) WITH JUSTIFICATION:

REVIEWER'S NOTES (use additional pages as necessary)

Review method used: Alternate calculation__ Attached: Y__ N__

Approximated Originator steps _____

LINE BY LINE CHECKING

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Introduction:**Description of the Accident**

This accident is initiated by an excavation in a Hanford Site pond, crib, or ditch. Ponds, cribs, and ditches were used at Hanford to dispose of liquid wastes. As a result these areas contain large quantities of contaminated soils.

Excavation in contaminated areas can cause the release radioactive and toxic materials to the environment through the generation and aerodynamic entrainment of respirable aerosols. An immediate release occurs when the soils are excavated followed by a continuous release due to resuspension by the wind.

This engineering calculation (EC) treats the contaminated soils in these facilities as if they were near the surface and easily exposed by a casual excavation. The fact is that these soils are buried under a large overburden of uncontaminated soils so that considerable excavation would have be performed before any contamination soils would be exposed.

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References:

1. EPA, 1988, "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion", EPA-520/1-88-020, Federal Guidance Report No. 11, U. S. Environmental Protection Agency, Washington, DC.
2. Van Keuren, J. C. and A. V. Savino, 1996, "Tank Farm Compositions and Atmosphere Dispersion Coefficients for use in Safety Analysis Consequence Assessments", WHC-SD-WM-SARR-016, Rev. 2, Westinghouse Hanford Company, Richland, Washington. (Final)
3. Waste Information Data System (WIDS), A database containing information about existing waste sites. Hard copy information from this database is available in Ref. 5.
4. DOE-HDBK-3010-94, 1994, "DOE Handbook Airborne Release Fractions/Rates and Restorable Fraction for Nonreactor Nuclear Facilities," U.S. Department of Energy, Richland, Washington
5. DOE/RL-88-30, 1988, "Hanford Site Waste Management Units Report, Rev. 4", U. S. Department of Energy, Richland, Washington (Attachment 1).
6. R. R. Lehrschall, 1992, "Safety assessment for Environmental Investigations and Site Characterizations, Volume 2 Aggregate Safety Assessment for Shallow/Near Surface Activities", WHC-SD-EN-SAD-016, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

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Input:

- The radiological source term was derived from inventory 216-U-14 ditch, 216-U-16 crib, 216-U-17 crib, and 216-Z-20 crib (Ref. 3 and Attachment 2). The largest inventory is for Crib 216-Z-20 (see Excel spreadsheet in Appendix 1). Table 1 lists the main contributors to the source term. Inventory values in column 2 and column 3 are in both curies (Ci) and becquerel (Bq). Effective Committed Dose Equivalent per Unit Intake (Inhalation) dose factors in sievert (Sv) per Bq are from Ref. 1. A general description of 216-Z-20 and its inventory is given in Ref. 5 (see Attachment 1)

Table 1 216-Z-20 Crib Radioactive Inventory

Isotope	Inventory (Ci)	Inventory (Bq)	Dose Factor (Sv/Bq)	Dose (Sv)
PU239	1.03E+00	3.81E+10	1.16E-04	4.42E+06
PU240	1.03E+00	3.81E+10	1.16E-04	4.42E+06
PU241	2.17E+00	8.03E+10	2.23E-06	1.79E+05
AM241	1.04E+00	3.85E+10	1.20E-04	4.62E+06
Total				1.37E+07

- Toxicological Soil Concentrations - Hanford soils contain a number of nonradiological contaminants such as heavy metals and organic compounds. Concentrations of these substances in the Hanford Site soils are relatively low with concentrations measured in the parts per billion but have been found in parts per million range. A summary of controlling inorganic and organic contaminant concentrations that were derived from process analytical data of Hanford (Ref. 6, Attachment 3) The data is summarized in Table 2 below.

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Table 2 Hazardous Organic and Inorganic Substances Anticipated in Hanford Soils

Analyte	Average Concentration (part per billion)	Maximum Concentration (part per billion)
Mercury	1.21	20
Lead	28	319
Chromium	54	380
Cyanide	51	246
Hydrazine	59	88
Carbon tetrachloride	4,352	8,700
Cyclohexane	670	900
Tetrachlorethane	410	1,200
Phenol	37	80

- The volume of contaminated soil in Crib 216-Z-20 is 2400 m³. (Input Validation Form, Attachment 4)
- The volume of soil overburden for Crib 216-Z-20 is 60,000 m³ (Input Validation Form, Attachment 4).
- Bounding Airborne Release Fractions (ARF), Airborne Release Rate (ARR), and Respirable Fractions (RF) for the suspension of falling powders and resuspension of powders was used in the analysis to bound the suspension of falling soils and resuspension soils is given in Table 3 (Ref. 4).

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Table 3 Bounding ARFs and RFs for Suspension and Resuspension of Powders

	ARF(ARR)	RF	ARF(ARR) x RF
Suspension of Falling Powders	0.002	0.3	0.0006
Homogeneous bed of powder exposed to nominal atmospheric conditions(< 2m/s with gusts up to 20 m/s)	(0.00004/h)	1.0	0.00004/h

- Onsite atmospheric dispersion coefficient χ/Q' with plume meander = 0.0113 s/m^3 . This value is used for release times greater than 2 hours (Ref. 2).
- Offsite atmospheric dispersion coefficient χ/Q' with plume meander = $1.49 \times 10^{-5} \text{ s/m}^3$. This value is used for release time greater than 2 hours (Ref. 2)
- The breathing rate for time less than 12 hours is $3.3 \times 10^{-3} \text{ m}^3/\text{s}$ and $2.7 \times 10^{-3} \text{ m}^3/\text{s}$ for periods greater than 12 hours (Ref. 2).

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Assumptions:

- The quantity of excavated material is bounded by an 12 hour excavation (1 shift) by a backhoe. The analysis assume that the backhoe removes 1 bucket of contaminated soil every 2 minutes. Based on a bucket size of 0.28 m^3 , the rate of excavation is estimated to be $10 \text{ m}^3/\text{hr}$ Attachment 4). This estimate is conservative since it is unlikely the excavation would continue uninterrupted for the entire shift.
- No credit is taken for uncontaminated overburden that must be excavated before reaching the contaminated crib soils. This is a conservation assumption since it will increase the volume of contaminated soils excavated.
- The average concentration of radiological and toxicological inventories in the crib are representative of the excavated material. This may not be the case since only 5 percent of the crib soils are excavated.
- It is conservatively assumed that the entire inventory contained in the excavated soils is subject to resuspension for a period of 24 hours from the start of the excavation. This is a very conservative assumption since only the soils near the surface of the dirt piles could be resuspended.

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Analytical Methods and Calculations:

Airborne Source Term

The determination of the airborne source term follows that of Equation 1.1 in Ref. 4:

$$Q = \text{MAR} \cdot \text{DR} \cdot \text{ARF} \cdot \text{RF} \cdot \text{LPF}$$

where

Q = Source term

MAR= Material at risk

DR= Damage ratio

ARF= Airborne release fraction

RF= Respirable fraction

LPF= Leakpath Factor

For aerodynamic entrainment/resuspension events, the airborne release rate (ARR) is given. It is multiplied by the time that the waste is subjected to the entrainment/resuspension mechanism to obtain the ARF.

Material at Risk and Damage Ratio

The excavation in cribs, ditches, or ponds accident analysis was conducted by using an accident scenario that bounds the material at risk in any excavation in one of these areas. The accident scenario postulates an excavation in 216-Z-20 Crib by a backhoe. The backhoe excavates 1 bucket of contaminated soil every 2 minutes for a period of 12 hours resulting in approximately 120 m³ being excavated. Therefore,

$$\text{MAR} = 120 \text{ m}^3$$

Since all of the excavated soils are assumed to come from the crib and not the overburden, DR=1.

Airborne Release Rates/Fractions, Respirable Fraction, and Leak Path Factor

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In the above scenario release and dispersion of airborne soil particles results from the successive dumping of contaminated soils and from the resuspension of contaminated soils by the wind. The ARF x RF for falling powders from Table 3 is used to calculate the airborne source term for the dumping of crib soils and the ARR x RF for the resuspension of loose powders from Table 3 is used for the resuspension of soils by the wind.

Once the soils are aerosolized by the free fall spill or resuspended by the wind, they leak directly to the atmosphere, LPF=1.

Airborne Source Term

Crib soils are excavated and dumped for 12 hr. Therefore, the airborne source term in liters (L) for the dumping of soils is

$$Q = 120 \text{ m}^3 \cdot 1000 \frac{\text{L}}{\text{m}^3} \cdot 0.0006 \cdot 1 = 72 \text{ L}$$

The airborne resuspension source term for an onsite receptor is

$$Q_{\text{onsite}}^{\text{resus}} = 60 \text{ m}^3 \cdot 1000 \frac{\text{L}}{\text{m}^3} \cdot 12 \text{ h} \cdot \frac{0.00004}{\text{h}} \cdot 1 = 28.8 \text{ L}$$

Therefore,

$$Q_{\text{onsite}} = 72 \text{ L} + 28.8 \text{ L} = 100.8 \text{ L}$$

The resuspension source term offsite is

$$Q_{\text{offsite}}^{\text{resus}} = 120 \text{ m}^3 \cdot 1000 \frac{\text{L}}{\text{m}^3} \cdot 12 \text{ h} \cdot \frac{0.00004}{\text{h}} \cdot 1 + Q_{\text{onsite}}^{\text{resus}} = 86.4 \text{ L}$$

The offsite airborne source is

$$Q_{\text{offsite}} = 72 \text{ L} + 86.4 \text{ L} = 158.4 \text{ L}$$

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Dose Consequence Analysis

The radiological dose for spilling or resuspension of contaminated soils in Sv is given by (Ref. 2):

$$D = Q \cdot \frac{X}{Q'} \cdot R \cdot ULD$$

where

Q = Quantity of respirable soil released (L)

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

R = Breathing rate (m^3/s)

ULD = CEDE or maximum organ dose per unit liter inhaled (Sv/L)

Calculation of ULD for Soils

An approximate ULD for excavated soils can be calculated using the expression:

$$ULD = \frac{1}{V_{\text{Soil}} \sum_{\text{isotopes}} C_i} \sum C_i dcf_i$$

where

V_{Soil} = Volume of contaminated soil in crib (L)

C_i = Crib inventory of radioactive isotope i (Bq)

dcf_i = Dose conversion factors (Sv/Bq) (Reference 1)

Using the isotopic concentrations and dose conversion factors from Table 2 gives

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$$UDL_{S_{oil}} = \frac{1.37 \cdot 10^7 Sv}{2400 m^3 \left(\frac{1000 L}{m^3} \right)} = 5.71 \frac{Sv}{L}$$

Atmospheric Dispersion Coefficients

The atmospheric dispersion coefficients for both onsite and offsite receptors were calculated using the methods in Ref. 2 for release times of 12 and 24 hours are given in Table 4.

Table 4 Atmospheric Dispersion Coefficients

Receptor	Release Time (h)	σ_z/Q' with Plume Meander (s/m^3)
Onsite	12	0.00554
Offsite	24	4.6×10^{-6}

Radiological Dose Consequence

Radiological dose consequences in milli-sievert (mSv) for onsite and offsite receptors are:

$$D_{onsite} = 100.8 L \cdot 0.00554 \frac{s}{m^3} \cdot 0.00033 \frac{m^3}{s} \cdot 5.71 \frac{Sv}{L} = 1.06 mSv$$

$$D_{offsite} = 158.4 L \cdot 4.6 \times 10^{-6} \frac{s}{m^3} \cdot 0.00027 \frac{m^3}{s} \cdot 5.71 \frac{Sv}{L} = 1.13 \times 10^{-3} mSv$$

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Toxicological Dose Consequence

Toxic chemicals are present in Hanford soils in the parts-per-million or parts-per-billion concentrations. Airborne concentrations of these chemicals due to excavation would be at most in parts-per-billion range. The toxicological consequence due to an excavation of the crib soils is therefore negligible.

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Results:

The dose consequence results for an excavation in a TWRS pond, crib, or ditch are compared with the risk evaluation guidelines in Table 5. For the purpose of comparison with the guidelines, calculated doses are expressed in rem (1 rem = 0.1 mSv).

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Table 5 Radiological and Toxicological Dose Consequences for Excavation in Ponds, Cribs, or Ditches

Consequences: Within Risk Guidelines for an event in the anticipated category				
Receptor/ Hazard	Calculated Dose/Exposure	Risk Evaluation Guidelines		
		Anticipated	Unlikely	Extremely Unlikely
Offsite/ Radiological	1.13×10^{-4} rem	0.1 rem	0.5 rem	4 rem
Onsite/ Radiological	0.11 rem	0.5 rem	5 rem	10 rem
Offsite/ Toxicological	Negligible	1	1	1
Onsite/ Toxicological	Negligible	1	1	1

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Conclusion:

The calculated radiological and toxicological dose consequences for an excavation in a pond, crib, or ditch are well within the risk evaluation guidelines. Therefore this accident does not pose a significant risk and will not require implementation of any safety significant controls.

The calculated results can be affected by an increase in the amount of material excavated, a change in the radioactive inventory, or by the use of a more conservative value of the ARF or RF. However, since the calculated onsite dose is only 20 percent of the risk evaluation guideline value, even a substantial increase in these factors will not have a significant impact on the results.

Appendices:

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Appendix 1 Unit Liter Doses for Ponds, Cribs, or Ditches

Ponds, Cribs, and Ditches													
Ci	3.70E+10	Bq											
V	2.40E+06	liter											
Isotope													Dose Factor Sv/Bq
	Crib Inv. 216-Z-20 (Ci)	Crib Inv. (Bq)	Ditch 216-U-14 (Ci)	Ditch Inv. (Bq)	Crib Inv. 216-U-16 (Ci)	Crib Inv. (Bq)	Crib Inv. 216-U-17 (Ci)	Crib Inv. (Bq)	Z-20	U-14	U-16	U-17	
CO60	2.99E-03	1.11E+08	4.96E-04	1.84E+07	0.00E+00	0.00E+00		0.00E+00	2.72E-06	4.52E-07	0.00E+00	0.00E+00	5.91E-08
SE79	1.63E-07	6.03E+03	1.87E-06	6.92E+04	6.56E-09	2.43E+02		0.00E+00	6.68E-12	7.67E-11	2.69E-13	0.00E+00	2.66E-09
SR90	9.22E-02	3.41E+09	5.88E-02	2.18E+09	8.17E-03	3.02E+08	5.70E-06	2.11E+05	9.20E-05	5.87E-05	8.15E-06	5.69E-09	6.47E-08
Y90	8.86E-02	3.28E+09	5.77E-02	2.13E+09	8.18E-03	3.03E+08		0.00E+00	3.11E-06	2.03E-06	2.88E-07	0.00E+00	2.28E-09
ZR93	2.11E-06	7.81E+04	2.41E-05	8.92E+05	8.48E-08	3.14E+03		0.00E+00	2.08E-10	2.37E-09	8.35E-12	0.00E+00	6.39E-09
TC99	9.39E-06	3.47E+05	1.72E-01	6.36E+09	3.77E-07	1.39E+04	1.26E-03	4.66E+07	4.01E-11	7.35E-07	1.61E-12	5.38E-09	2.77E-10
RU106	5.16E-06	1.91E+05	4.44E-12	1.64E-01	5.16E-07	1.91E+04		0.00E+00	1.03E-08	8.83E-15	1.03E-09	0.00E+00	1.29E-07
RH106	5.16E-06	1.91E+05	4.44E-12	1.64E-01	5.16E-07	1.91E+04		0.00E+00	4.59E-12	3.95E-18	4.59E-13	0.00E+00	5.77E-11
PD107	2.77E-08	1.02E+03	3.16E-07	1.17E+04	1.11E-09	4.11E+01		0.00E+00	2.96E-14	3.38E-13	1.19E-15	0.00E+00	6.94E-11
CD113M	9.29E-10	3.44E+01	4.22E-09	1.56E+02	3.76E-11	1.39E+00		0.00E+00	6.46E-12	2.93E-11	2.61E-13	0.00E+00	4.51E-07

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SN121M	9.13E-06	3.38E+05	5.01E-05	1.85E+06	3.85E-07	1.42E+04	0.00E+00	2.48E-10	1.36E-09	1.04E-11	0.00E+00	1.76E-09
SN126	3.62E-07	1.34E+04	4.13E-06	1.53E+05	1.45E-08	5.37E+02	0.00E+00	1.50E-10	1.71E-09	6.01E-12	0.00E+00	2.69E-08
SB125	5.61E-05	2.08E+06	0	0.00E+00	3.56E-06	1.32E+05	0.00E+00	2.85E-09	0.00E+00	1.81E-10	0.00E+00	3.30E-09
SB126	5.06E-08	1.87E+03	5.79E-07	2.14E+04	2.03E-09	7.51E+01	0.00E+00	2.47E-12	2.83E-11	9.92E-14	0.00E+00	3.17E-09
SB126M	3.62E-07	1.34E+04	4.13E-06	1.53E+05	1.45E-08	5.37E+02	0.00E+00	2.62E-10	2.99E-09	1.05E-11	0.00E+00	4.69E-08
TE125M	1.37E-05	5.07E+05	2.38E-16	8.81E-06	8.68E-07	3.21E+04	0.00E+00	4.16E-10	7.23E-21	2.64E-11	0.00E+00	1.97E-09
CS134	1.12E-05	4.14E+05	1.86E-08	6.88E+02	8.31E-07	3.07E+04	0.00E+00	2.16E-09	3.58E-12	1.60E-10	0.00E+00	1.25E-08
CS135	1.88E-07	6.96E+03	2.15E-06	7.96E+04	7.56E-09	2.80E+02	0.00E+00	3.56E-12	4.08E-11	1.43E-13	0.00E+00	1.23E-09
CS137	1.10E-01	4.07E+09	6.30E-02	2.33E+09	1.47E-02	5.44E+08	0.00E+00	1.46E-05	8.38E-06	1.96E-06	0.00E+00	8.63E-09
BA137M	1.03E-01	3.81E+09	5.32E-02	1.97E+09	1.39E-02	5.14E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PM147	4.25E-03	1.57E+08	4.68E-05	1.73E+06	2.27E-07	8.40E+03	0.00E+00	6.62E-06	7.29E-06	3.63E-08	0.00E+00	1.01E-07
SM151	5.64E-04	2.09E+07	5.22E-03	1.93E+08	2.30E-05	8.51E+05	0.00E+00	7.04E-08	6.52E-07	2.87E-09	0.00E+00	8.10E-09
EU152	4.26E-07	1.58E+04	1.06E-06	3.92E+04	1.90E-08	7.03E+02	0.00E+00	3.92E-10	9.76E-10	1.75E-11	0.00E+00	5.97E-08
EU154	4.30E-05	1.59E+06	1.56E-04	5.77E+06	1.87E-06	6.92E+04	0.00E+00	5.12E-08	1.86E-07	2.23E-09	0.00E+00	7.73E-08
EU155	2.41E-05	8.92E+05	1.27E-08	4.70E+02	1.97E-06	7.29E+04	0.00E+00	4.16E-09	2.19E-12	3.40E-10	0.00E+00	1.12E-08
BI214	1.05E-15	3.89E-05	1.92E-10	7.10E+00	5.75E-11	2.13E+00	6.05E-12	2.24E-01	2.36E-15	4.32E-10	1.29E-10	1.36E-11
PB214	1.05E-15	3.89E-05	1.92E-10	7.10E+00	5.75E-11	2.13E+00	6.05E-12	2.24E-01	3.42E-20	6.25E-15	1.87E-15	1.97E-16

K11C-SD-K1M-CN-053 REV 3[illegible]

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Attachments:

Attachment 1 General Description of Crib 216-Z-20

Unit 1

UNIT NAME: 216-Z-20
UNIT TYPE: Crib
WASTE CATEGORY: Low-Level Waste

OPERABLE UNIT: 200-UP-2
SWMU: Yes
UNIT STATUS: Active
START DATE: September 24, 1981

COORDINATES: N37830 W76523, N39280 W76130 (centerline)

WASTE TYPES AND AMOUNTS: The site has been receiving cooling water, steam condensate, storm sewer, building drains, HEDL RADTU cooling water, and chemical drains waste from the 234-5Z Building; cooling water steam condensate and laboratory drains from the 231-Z Building; and miscellaneous drains waste from 291-Z, 232-Z, and 236-Z buildings. The unit will also receive wastes from 2736-Z Building, which is now under construction (Project B-246).

SITE DESCRIPTION: The structure has varied depths of 9 to 29 ft below ground surface. Three 6-in. perforated PVC distribution pipes are located 3.5 ft apart along the length to within 1 ft of the south end, where the pipes are capped. A set of 3 risers stem from the distribution pipes, rising to 1.5 ft above grade at 4 locations throughout the unit. ~57,150 cu ft of 0.5-in. to 2.5-in. gravel fill is backfilled over with soil. The side slope is 1:2.

KNOWN RELEASES: On February 2, 1986, a release of 0.02 uCi/L alpha (amount unknown) occurred to this unit from 234-5Z Building tank leakage. On December 20, 1984, a release of 107 uCi/L unknown radionuclides (amount unknown) occurred to this unit from 234-5Z Building tank leakage. This unit received a spill of 7,594 lb of nitric acid on September 26, 1984.

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Attachment 2 Cumulative Decayed Inventory Report

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CUMULATIVE DECAYED INVENTORY REPORT

13:09

Site # 155: 216-U-14 DITCH (In CWM, 216-U-10)

Active from 03/01/52 to 12/31/94

Cumulative Waste Volume 1.22E+09 Liters

Radionuclides decayed to 12/31/94

	Isotope	Halflife	Curies
	-----	-----	-----
1.	H-3	12.3 Years	2.60E+00
2.	Co-60	5.27 Years	<4.96E-04
3.	Se-79	6.5E+4 Years	1.87E-06
4.	Sr-90	29.12 Years	5.88E-02
5.	Y-90	65 Hours	<5.77E-02
6.	Zr-93	5E+6 Years	2.41E-05
7.	Tc-99	2.13E+5 Years	1.72E-01
8.	Ru-106	368 Days	4.44E-12
9.	Rh-106	30 Seconds	4.44E-12
10.	Pd-107	7E+6 Years	3.16E-07
11.	Cd-113M	5.1 Years	4.22E-09
12.	Sn-121M	27.5 Hours	5.01E-05
13.	Sn-126	70 Minutes	4.13E-06
14.	Sb-126	9 Hours	5.79E-07
15.	Sb-126M	19 Minutes	4.13E-06
16.	Te-125M	58 Days	2.38E-16
17.	Cs-134	2.1 Years	1.86E-08
18.	Cs-135	2.9E+6 Years	2.15E-06
19.	Cs-137	30 Years	6.30E-02
20.	Ba-137M	2.6 Minutes	5.32E-02
21.	Ce-144	284 Days	1.51E-15
22.	Pr-144	17 Minutes	2.16E-17
23.	Pm-147	2.6 Years	4.68E-05
24.	Sm-151	70 Years	5.22E-03
25.	Eu-152	13.3 Years	1.06E-06
26.	Eu-154	8.8 Years	1.56E-04
27.	Eu-155	4.96 Years	1.27E-08
28.	Tl-208	3.1 Minutes	2.92E-18
29.	Bi-212	60.55 Minutes	8.11E-18
30.	Bi-214	19.9 Minutes	1.92E-10
31.	Pb-212	10.64 Hours	8.11E-18
32.	Pb-214	26.8 Minutes	1.92E-10
33.	Pu-212	3.1E-7 Seconds	5.20E-18
34.	Po-216	0.15 Seconds	8.11E-18
35.	Rn-220	55.6 Seconds	8.11E-18
36.	Ra-224	3.66 Days	8.11E-18
37.	Ra-226	1,600 Years	1.93E-10
38.	Ac-228	6.13 Hours	7.27E-17
39.	Th-232	1.41E+10 Years	4.12E-15
40.	U (Gross)	4.5E+9 Years*	6.39E-02
41.	U-233	1.62E+5 Years	6.60E-16
42.	U-235	7.04E+8 Years	6.30E-13
43.	Pu-239/40	24,131 Years*	1.60E-04
44.	Am-241	432 Years	2.88E-04
45.	Total α	n/a	3.11E-02

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CUMULATIVE DECAYED INVENTORY REPORT

Page 2

Site # 155: 216-U-14 DITCH (In CWM, 216-U-10)

	Isotope	Half-life	Curies
	-----	-----	-----
46.	Total B	n/a	2.45E-01

- The half-life shown for Total Uranium is the half-life of U-238. The half-life shown for mixed Plutonium-239/40 is the half-life of Pu-239.

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CUMULATIVE DECAYED INVENTORY REPORT

13:11

Site # 176: 216-Z-20 CRIB
Active from 09/24/81 to 12/31/94
Cumulative Waste Volume 4.45E+09 Liters
Radionuclides decayed to 12/31/94

	Isotope	Halflife	Curies
	-----	-----	-----
1.	Co-60	5.27 Years	<2.98E-03
2.	Se-79	6.5E+4 Years	1.63E-07
3.	Sr-90	29.12 Years	9.22E-02
4.	Y-90	65 Hours	<8.86E-02
5.	Zr-93	5E+6 Years	2.11E-06
6.	Tc-99	2.13E+5 Years	9.39E-06
7.	Ru-106	368 Days	<5.16E-06
8.	Rh-106	30 Seconds	<5.16E-06
9.	Pd-107	7E+6 Years	2.77E-08
10.	Cd-113M	5.1 Years	9.29E-10
11.	Sn-121M	27.5 Hours	9.13E-06
12.	Sn-126	70 Minutes	3.62E-07
13.	Sb-125	2.8 Years	5.61E-05
14.	Sb-126	9 Hours	5.06E-08
15.	Sb-126M	19 Minutes	3.62E-07
16.	Te-125M	58 Days	1.37E-05
17.	Cs-134	2.1 Years	1.12E-05
18.	Cs-135	2.9E+6 Years	1.88E-07
19.	Cs-137	30 Years	1.10E-01
20.	Ba-137M	2.6 Minutes	<1.03E-01
21.	Pm-147	2.6 Years	4.25E-03
22.	Sm-151	70 Years	5.64E-04
23.	Eu-152	13.3 Years	4.26E-07
24.	Eu-154	8.8 Years	4.30E-05
25.	Eu-155	4.96 Years	2.41E-05
26.	Bi-214	19.9 Minutes	1.05E-15
27.	Pb-214	26.8 Minutes	1.05E-15
28.	Ra-226	1,600 Years	1.06E-15
29.	U-233	1.62E+5 Years	2.92E-12
30.	U-234	2.45E+5 Years	2.63E-07
31.	U-235	7.04E+8 Years	1.01E-08
32.	Pu-238	87.8 Years	2.30E-02
33.	Pu-239/40	24,131 Years*	2.06E+00
34.	Pu-241	14.4 Years	2.17E+00
35.	Am-241	432 Years	1.04E+00
36.	Total α	n/a	2.25E+00
37.	Total β	n/a	4.15E-01

* The halflife shown for Total Uranium is the half-life of U-238. The halflife shown for mixed Plutonium-239/40 is the halflife of Pu-239.

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CUMULATIVE DECAYED INVENTORY REPORT

13:10

Site # 158: 216-U-17 CRIB
 Active from 01/31/88 to 12/31/94
 Cumulative Waste Volume 5.90E+06 Liters
 Radionuclides decayed to 12/31/94

	Isotope	Halflife	Curies
1.	H-3	12.3 Years	6.37E+01
2.	Sr-90	29.12 Years	5.70E-06
3.	Tc-99	2.13E+5 Years	1.26E-03
4.	Bi-214	19.9 Minutes	6.05E-12
5.	Pb-214	26.8 Minutes	6.05E-12
6.	Ra-226	1,600 Years	6.05E-12
7.	Ac-228	6.13 Hours	2.24E-18
8.	Th-232	1.41E+10 Years	1.29E-16
9.	U (Gross)	4.5E+9 Years*	1.14E-03
10.	U-233	1.52E+5 Years	1.51E-16
11.	U-235	7.04E+8 Years	1.46E-13
12.	Pu-239/40	24,131 Years*	<2.96E-05
13.	Am-241	432 Years	7.85E-05
14.	Total α	n/a	5.77E-04
15.	Total β	n/a	6.83E-03

* The half-life shown for Total Uranium is the half-life of U-238. The half-life shown for mixed Plutonium-239/40 is the half-life of Pu-239.

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CUMULATIVE DECAYED INVENTORY REPORT

13:10

Site # 157: 216-U-16 CRIB
 Active from 09/01/84 to 02/28/85
 Cumulative Waste Volume 4.09E+08 Liters
 Radionuclides decayed to 12/31/94

	Isotope	Halflife	Curies
	-----	-----	-----
1.	Se-79	6.5E+4 Years	<6.56E-09
2.	Sr-90	29.12 Years	<8.17E-03
3.	Y-90	65 Hours	<8.18E-03
4.	Zr-93	5E+6 Years	<8.48E-08
5.	Tc-99	2.13E+5 Years	<3.77E-07
6.	Ru-106	368 Days	<5.16E-07
7.	Rh-106	30 Seconds	<5.16E-07
8.	Pd-107	7E+6 Years	<1.11E-09
9.	Ag-110	24.5 Seconds	<5.71E-15
10.	Ag-110M	270 Days	<4.30E-13
11.	Cd-113M	5.1 Years	<3.76E-11
12.	Sn-119M	245 Days	<5.71E-13
13.	Sn-121M	27.5 Hours	<3.85E-07
14.	Sn-126	70 Minutes	<1.45E-08
15.	Sb-125	2.8 Years	<3.56E-06
16.	Sb-126	9 Hours	<2.03E-09
17.	Sb-126M	19 Minutes	<1.45E-08
18.	Te-125M	58 Days	<8.68E-07
19.	Te-127	9.3 Hours	<3.10E-18
20.	Te-127M	113 Days	<3.16E-18
21.	Cs-134	2.1 Years	<8.31E-07
22.	Cs-135	2.9E+6 Years	<7.56E-09
23.	Cs-137	30 Years	1.47E-02
24.	Ba-137M	2.6 Minutes	1.39E-02
25.	Ce-144	284 Days	<2.27E-07
26.	Pr-144	17 Minutes	<3.24E-09
27.	Pm-147	2.6 Years	<2.74E-04
28.	Sm-151	70 Years	<2.30E-05
29.	Eu-152	13.3 Years	<1.90E-08
30.	Eu-154	8.8 Years	<1.87E-06
31.	Eu-155	4.96 Years	<1.97E-06
32.	Bi-212	60.55 Minutes	1.37E-18
33.	Bi-214	19.9 Minutes	5.75E-11
34.	Pb-212	10.64 Hours	1.37E-18
35.	Pb-214	26.8 Minutes	5.75E-11
36.	Po-216	0.15 Seconds	1.37E-18
37.	Rn-220	55.6 Seconds	1.37E-18
38.	Ra-224	3.66 Days	1.37E-18
39.	Ra-226	1,600 Years	5.76E-11
40.	Ac-228	6.13 Hours	1.23E-17
41.	Th-232	1.41E+10 Years	1.23E-15
42.	U (Gross)	4.5E+9 Years*	5.91E-03
43.	U-233	1.62E+5 Years	6.63E-13
44.	U-235	7.04E+8 Years	4.44E-10
45.	Pu-239/40	24,131 Years*	9.02E-02

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CUMULATIVE DECAYED INVENTORY REPORT

Page 2

Site # 157: 216-U-16 CRIB

	Isotope	Half-life	Curies
	-----	-----	-----
46.	Am-241	432 Years	<2.31E-01
47.	Total α	n/a	7.39E-03
48.	Total β	n/a	5.15E-02

* The half-life shown for Total Uranium is the half-life of U-238. The half-life shown for mixed Plutonium-239/40 is the half-life of Pu-239.

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Attachment 3 Hazardous Organic and Inorganic Substances Anticipated in Hanford Soils

WHC-SD-EN-SAD-016, REV 0-C
VOLUME 2Table 2. Hazardous Organic and Inorganic Substances
Anticipated in Hanford Soils.

Analyte	Average concentration p/b	Maximum concentration p/b
Mercury	1.28	20
Lead	28	319
Chromium	54	380
Cyanide	51	246
Hydrazine	59	88
Carbon tetrachloride	4,352	8,700
Cyclohexane	670	900
Tetrachloroethane	410	1,200
Phenol	37	80

For most of the shallow/near surface sampling activities, the potential hazard inventory consists of the material sample volume that in most cases is less than one L. The methods (e.g., hand tools) used to obtain these samples generally do not provide sufficient energy for generating a source term to uninvolved individuals.

Excluding mechanized excavation sampling, mechanisms for generating a source term are not available in the shallow/near surface sampling activities. In the case of mechanized soil sampling, where there are relatively large volumes of dirt [$>1 \text{ m}^3$ (0.3 ft^3)], potentially contaminated soil can be brought to the surface, and exposure to wind or other dispersal mechanisms can occur. Any mechanized soil gas sampling could potentially result in small concentrations of CCl_4 vapors being released at the work site. The worst case concentrations of 25,000 p/m (under static well conditions) CCl_4 detected has been at the 216-Z Crib sites in the 200 West Area.

The shallow/near surface sampling activities can be segregated into five categories:

1. Nonintrusive/nonaccumulative (soil gas sampling, radiological surveys, etc.). Based on the lack of a material hazard, the activities fitting this description are excluded from safety review requirements.
2. Intrusive/accumulative sampling (mechanized or nonmechanized), where no contaminants are anticipated. Based on the lack of a material hazard, the activities fitting this description are excluded from safety review requirements.
3. Nonmechanized intrusive/accumulative sampling where the small volumes (measured in L) of accumulated material exceed the release criteria provided in WHC-CM-4-10, Section 11.4.6.

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Attachment 4 Input Validation Form

Information Validation Form

Tracking # RDG.2

Name of Originator 1 Ronald D. Graves	Organization or Team 2 WSRC FSAR TEAM	Date 3 4/29/96
<p>Statement of Problem: This accident involves the inadvertent excavation of a crib, ditch, or pond. The main uncertainties in the analysis is the material at risk (MAR) and the concentration of radionuclides and nonradiological chemical in the excavated soil.</p> <p>(1) It is assumed that the quantity of material excavated is bounded by an excavation by a backhoe that excavates 1 bucket, approximately 0.28 m³ every 2 minutes (10 m³/hr. is used in the analysis). The excavation last one 12 hour shift.</p> <p>(2) The radiological concentration in the excavated soil is bounded the radiological concentration in BY Crib as represented by soils under 200-BP-1 crib.</p> <p>(3) It is assumed that the toxicological source term is bounded by the summary of controlling inorganic and organic compound found in Hanford soils (See attachment 1) provided by Environmental Engineering.</p> <p>(3) The density of the excavated soils is 1.6 g/cm³.</p>		
Alternatives 5		Consequences to Alternatives 6
Decision Reached 7		Basis for Decision 8
Date Requested 9	Sent To 10	Date Requested By 5/6/96
<p>Response #1 Responses to the statement problems are: 1) Agree. 2) The 200-BP-1 crib doesn't belong to TWRS, use the 216-Z-20 crib. Use a volume of 2400 cubic meters and an over-burden of 60,000 cubic meters. 3) Was not able to find different data, use attachment 1 as the bounding case. 4) Use a density of 1.4 grams per cubic centimeter.</p>		
Response #2 13		
Attachments (List) 14	References (List) 15	

Responder #1 Name and Signature		Responder #2 Name and Signature	
16 Lankford Ruffin <i>L Ruff</i> 5-9-96		17	
POC:		Filed:	
		Routed:	
Further Action Required (i.e., RML, Senior Management Attention, etc.)			
18			

Attachment 1

Analyte	Average Concentration (p/b)	Maximum Concentration (p/b)
Mercury	1.21	20
Lead	28	319
Chromium	54	380
Cyanide	51	246
Hydrazine	59	88
Carbon tetrachloride	4,352	8,700
Cyclohexane	670	900
Tetrachlorethane	410	1,200
Phenol	37	80

DISTRIBUTION SHEET

To Distribution	From G. W. Ryan	Page 1 of 1			
		Date 7/29/96			
Project Title/Work Order Excavations in Hanford Ponds, Cribs, or Ditches.		EDT No. N/A			
		ECN No. 602624			

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
C. Carro	A2-34	X			
D. S. Leach	A3-34	X			
TWRS S & L Project Files (2)	A2-26	X			
G. W. Ryan	A3-37	X			
Central Files (Original + 1)	A3-88	X			