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B.H. Gilbert [Signature] Authorized Representative Date for Receiving Organization						W.D. Leach [Signature] Cognizant Manager Date					
						[] Approved w/comments [] Disapproved w/comments					

TOXICOLOGICAL DOSE CALCULATIONS FOR SPILL ACCIDENT AT T PLANT

C. H. HUANG

Westinghouse Hanford, Richland, WA 99352
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Calculation Note.

Abstract: This document provides the toxicological dose calculations
related to the toxic chemical releases from spill accidents
at T Plant Facility.

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Toxicological Dose Calculations for Spill Accident at T Plant

September 24, 1996

PURPOSE

The purpose of this document is to provide estimates for onsite and offsite consequences for two postulated accidents in the 2706 T Decontamination Facility located in the 200 W Area. These accidents are (1) a spill of decontamination waste solution at the railcar loading station and (2) liquid spill due to a beyond design basis earthquake. The spilled decontamination waste liquid results in formation of a pool and release of toxic material to atmosphere.

SOURCE INVENTORY

The following Table 1 (see Dewitt, 1996) shows the inventory of decontamination waste material contained by the decontamination waste storage tanks that is available for release for the accidents previously identified.

The hazardous wastes generated from the decontamination activities are shown in Table 1. The total volume of the spill involved is assumed to be 21,000 gallons. Table 1 shows the chemical concentration in liquid phase, chemical weight, weight fraction, and concentration limit (ERPG) for Sodium Hydroxide, Nitric Acid, and Sulfuric Acid. ERPG values for Potassium Permanganate and Phosphoric Acid are not available. Therefore the NIOSH Time Weighted Average value is used to establish a limiting value for Phosphoric Acid. No limiting concentrations are provided for Potassium Permanganate.

Table 1. Chemical Composition of Decontamination Liquid Waste at the 2706T Facility

Total Volume of Spill 21,000 Gal.	Concentration Kg/L	Chemical Weight mg (Kg)	Weight Fraction	ERPG Concentration limits			TWA Limits mg/m ³
				1	2	3	
Potassium Permanganate	7.57E-03	6.0E+08 (602)	7.57E-03	-	-	-	-
Sodium Hydroxide	2.42E-02	1.926E+09 (1926)	2.42E-02	2 mg/m ³	40 mg/m ³	100 mg/m ³	-
Nitric Acid	1.15E-02	9.11E+08 (911)	1.15E-02	2 ppm	25 ppm	50 ppm	-
Phosphoric Acid	1.87E-02	1.488E+09 (1488)	1.87E-02	-	-	-	1 ST = 3
Sulfuric Acid	5.89E-03	4.68E+08 (468)	5.89E-03	2 mg/m ³	10 mg/m ³	30 mg/m ³	-
Total		(5395)					

*ST = STEL = 15 min TWA.

PHYSICAL AND CHEMICAL DATA

Some available physical and chemical data for the chemical mixture are shown in Table 2. This information is needed for the calculation of the mass release rate from a liquid pool. Table 2 shows the vapor pressure of pure liquid and the available molecular diffusivity.

Table 2. Physical and Chemical Data.

Total Volume of Spill 21,000 Gal.	Vapor Pressure Pure Liquid mmHg at 25°C	Diffusivity (cm ² /s)
Potassium Permanganate	-	-
Sodium Hydroxide	1 (739 °K)	-
Nitric Acid	62	0.123
Phosphoric Acid	5.80E-02	-
Sulfuric Acid	1.00E-06	0.08

ACCIDENT SCENARIOS**Case 1. Spill at Loading Station.**

It is postulated that a valve positioning error or a valve failure causes liquid being recirculated in the decontamination waste storage tank to be pumped into the line used to fill the railroad tank car. The transfer line is open at the railcar loading station and the entire maximum liquid content of the largest decontamination waste storage tank (51 m³) is discharged and falls 6.5 m to the loading station floor. Most of the liquid flows into the building sump except for a 36 m³ pool with an assumed depth of 1 cm which remains on the loading station floor. Although the release occurs inside the facility, no credit is taken for mitigation due to the building. The pump rate is specified to be 250 l/min so the duration of the leak is 204 min or 3.4 hr assuming the discharge is not detected before the tank is empty.

The source term is the material resuspended from the resulting pool on the loading station floor. The release from the pool on the floor was estimated using the methodology and assumptions that follow.

Case 2. Beyond Design Basis Earthquake:

It is postulated that the beyond design basis earthquake causes piping connections to the decontamination waste tanks to fail allowing 90% of the maximum contents of both tanks (i.e., 90% of 71.5 m^3) to drain to the catch basin where it forms a pool. A release from the pool occurs due to evaporation and entrainment for 48 hours before the pool is covered or the release otherwise stopped.

The dimensions of the catch basin at the 2706 T decontamination storage tank facility are:

$$\begin{aligned} 32' \times 23'-4'' &= 746.66 \text{ ft}^2 \\ &= 69.41 \text{ m}^2 \end{aligned}$$

METHODOLOGY AND ASSUMPTIONS

The accidental spill of toxic chemicals to the ground will form a liquid pool. The spill is a dilute solution which consists of Potassium Permanganate, Sodium Hydroxide, Nitric Acid, Phosphoric Acid, and Sulfuric Acid for the mixture. Due to the restriction of the physical and chemical data and the complexity of the problem, it is necessary to use various approaches to calculate the mass release rate for various chemicals. The three approaches considered are as follows:

1). Raoult's Law.

In establishing the dynamic equilibrium for an ideal liquid, the vapor pressure at the air-liquid interface may be expressed by the Raoult's law as:

$$p_v = x_a P_i \quad (1)$$

where p_v is the equilibrium vapor pressure of a species in vapor phase over the solution, i.e., above the air-liquid interface; x_a is the mole fraction of species A in the liquid phase; and P_i is the pure vapor pressure of a species measured at the equilibrium temperature of the solution.

2). Henry's Law.

A common form of nonideal behavior over a limited range of concentration, is given by Henry's law. The Henry's Law can be used to calculate the liquid vapor pressure at the air-liquid interface for the dilute solutions. The Henry's Law may be written as

$$p_v = H x_a \quad (2)$$

Where p_v is the vapor pressure of species A, H the Henry's constant, an empirical constant which depends on temperature and pressure, and x_a the mole fraction of species A.

The mole fraction of species A in liquid phase can be expressed as

$$\begin{aligned} x_a &= c_a/c \\ &= M\rho_a/(M_a\rho) \end{aligned} \quad (3)$$

where c_a is the molar density of species A, and c is the molar density of the mixture. M and M_a are the molecular weight of the mixture and the species A, respectively. ρ and ρ_a are the density of the mixture and the species A in solute, respectively.

The Henry's Law constant, H , may be defined as the ratio of the vapor pressure of species A in air to its concentration (or mole fraction) in liquid at equilibrium. Since the mole fraction of a species is related to the weight fraction of a species, w , for convenience, the Henry's Law, Eq.(2) may also be expressed as:

$$p_v = H' w \quad (4)$$

Thus, the Henry' Law constant, H' , for Nitric Acid can be derived from the available experimental data which yield more realistic results.

3). Aerosol Release Rate.

Airborne release fractions for a variety of releases are provided by Mishima (1994; DOE-HDBK-3010-94). A method for estimating the airborne release rate from a pond is given in DOE-HDBK-3010-94 (1994). This method will be utilized to estimate the airborne release from a liquid pool.

An Evaporation Model

An evaporation model for estimating the mass release rate has been derived by Huang (1996b;1996c). For a circular pool area of radius r , the rate of evaporation from a liquid pool into the atmosphere may be written as:

$$E_T(r) = c Sc^{-2/3} X_s u^{0.78} r^{1.9} \quad (5)$$

Where $c = 1.64 \times 10^{-2}$ is a constant; u the horizontal mean wind speed; Sc (ν/D) the Schmidt number, where ν is the air viscosity and D the diffusivity; and X_s the saturation vapor concentration at the air-liquid interface. The

vapor concentration can be calculated through the equation of state when the vapor pressure at the air-liquid surface is known.

CALCULATIONS AND RESULTS

Case 1. Spill at Loading Station.

The spill volume for case 1 is 21,000 gallons and the pool area is 36 m².

For a circular pool, the radius, r, can be calculated as:

$$A = \pi \times r^2$$

where A is the area of the circular pool. Thus, the radius, r, is:

$$\begin{aligned} r &= (A/\pi)^{0.5} \\ &= (36/3.14159)^{0.5} \\ r &= 3.385 \text{ m} \end{aligned}$$

Nitric Acid

According to the data (Perry and Green, 1984), the vapor pressure for Nitric Acid at 25 °C for a weight percentage of 40% is 0.12 mmHg. Thus, the Henry's constant in Eq.(4), H', can be estimated as:

$$H' = 0.12 \text{ mmHg}/0.4 = 0.3 \text{ mmHg}$$

Therefore, for Nitric Acid with the weight fraction of 1.15×10^{-2} (see Table 1), the vapor pressure at the air-liquid interface is calculated from Eq.(4) as:

$$\begin{aligned} p_v &= 0.3 \times 1.15 \times 10^{-2} \text{ mmHg.} \\ &= 3.45 \times 10^{-3} \text{ mmHg.} \end{aligned}$$

For a wind speed of 5 m/s (only used to generate the rate of evaporation) and with the known vapor pressure at the air-liquid interface, the rate of evaporation for Nitric Acid calculated by using Eq.(5) is 5.98×10^{-3} g/s (see Appendix A).

The Raoult's law is used to calculate the vapor pressure for Phosphoric Acid and Sulfuric Acid.

Phosphoric Acid ($M = 98.00$ gram/mole).

The mole fraction of Phosphoric Acid can be calculated as:

$$\begin{aligned}x_a &= M\rho_a / (M_a\rho) \\&= (18/98)(1.87 \times 10^{-2}) \\&= 3.43 \times 10^{-3}\end{aligned}$$

Therefore, the vapor pressure for Phosphoric Acid at the air-water interface is:

$$\begin{aligned}p_v &= x_a P_l \\&= 3.43 \times 10^{-3} \times 5.82 \times 10^{-2} \text{ mmHg} \\p_v &= 2.00 \times 10^{-4} \text{ mmHg}\end{aligned}$$

Sulfuric Acid ($M = 98.08$ gram/mole).

The mole fraction of Sulfuric Acid can be calculated as

$$\begin{aligned}x_a &= M\rho_a / (M_a\rho) \\&= (18/98.08)(5.89 \times 10^{-2}) \\&= 1.08 \times 10^{-2}\end{aligned}$$

Therefore, the vapor pressure at the air-water interface is:

$$\begin{aligned}p_v &= x_a P_l \\&= 1.08 \times 10^{-2} \times 1.00 \times 10^{-6} \text{ mmHg} \\p_v &= 1.08 \times 10^{-8} \text{ mmHg}\end{aligned}$$

The vapor pressures over the liquid solution for the chemicals of Nitric Acid, Phosphoric Acid, and Sulfuric Acid were calculated and are summarized in Table 3. And the calculated evaporation rate for various liquids is given in Appendix A.

Table 3. Vapor Pressure for Various Chemicals at the Air-Liquid Interface.

Total Volume of Spill 21,000 Gal.	Vapor Pressure Pure Liquid mmHg at 25°C	Mole Fraction	Weight (Mass) Fraction	Vapor Pressure at the interface mmHg
Potassium Permanganate	-	-	7.57E-03	-
Sodium Hydroxide	-	-	2.42E-02	-
Nitric Acid	62	3.29E-03	1.15E-02	3.45E-03
Phosphoric Acid	5.80E-02	3.43E-03	1.87E-02	2.00E-04
Sulfuric Acid	1.00E-06	1.08E-02	5.89E-03	1.08E-08

Potassium Permanganate and Sodium Hydroxide.

Airborne release fractions for a variety of releases are provided by Mishima (1994; DOE-HDBK-301-94). The method for estimating the airborne release rate will be utilized to estimate the airborne release for Potassium Permanganate and Sodium Hydroxide from a liquid pool. The mass release rate can be estimated from the Fig.3-8 (DOE-HDBK-3010-94). In the figure the mass release rate is expressed as a function of downwind fetch and wind speed. For the wind speed, u , of 5 m/s, the mass release rate can be approximated as

$$F_m = BX \quad \text{for } u = 5 \text{ m/s} \quad (6)$$

Where F_m is the mass release rate ($\text{kg/m}^2\text{s}$), B is a constant, and X (m) is the fetch, the distance from the leading edge in the downwind direction. The estimated value of B is 1.25×10^{-12} ($\text{kg/m}^3\text{s}$) which was obtained from Fig.3-8 (DOE-HDBK-3010-94).

Thus, for a circular area of 36 m^2 (equivalent to a square area with a fetch of 6 m), the mass release rate is:

$$MR = F_m \times A = B \times A$$

WHC-SD-WM-CN-046, Rev.0

$$= 1.25 \times 10^{-12} \text{ (kg/m}^3\text{s)} \times 6 \text{ m} \times 36 \text{ m}^2$$

$$= 2.7 \times 10^{-10} \text{ kg/s}$$

$$= 2.7 \times 10^{-10} \text{ L/s}$$

Thus, the mass release rate for Potassium Permanganate with the concentration of 7.57×10^{-3} Kg/L is:

$$\text{MR} = 7.57 \times 10^{-3} \text{ Kg/L} \times 2.7 \times 10^{-10} \text{ L/s}$$

$$= 2.04 \times 10^{-12} \text{ Kg/s}$$

$$= 2.04 \times 10^{-6} \text{ mg/s}$$

Thus, the mass release rate for Sodium Hydroxide with the concentration of 2.42×10^{-2} Kg/L is:

$$\text{MR} = 2.42 \times 10^{-2} \text{ Kg/L} \times 2.7 \times 10^{-10} \text{ L/s}$$

$$= 6.53 \times 10^{-12} \text{ Kg/s}$$

$$= 6.53 \times 10^{-6} \text{ mg/s}$$

The calculated mass release rate for Potassium Permanganate and Sodium Hydroxide are given in Table 4 (an alternative method for the estimation of the mass release rate has been proposed by Huang (1995); the method takes into account the characteristics of the atmospheric flow).

The mass release rate for Nitric Acid, Phosphoric Acid, and Sulfuric Acid in the solution calculated from Eq.(5) are also shown in Table 4.

Table 4. The Calculated Mass Release Rate.

Total Volume of Spill 21,000 Gal.	Vapor Pressure mmHg at 25°C	Diffusivity cm ² /s	Weight Fraction	Evaporation Rate (mg/s)
Potassium Permanganate	-	-	7.57E-03	2.04E-6
Sodium Hydroxide	-	-	2.42E-02	6.53E-6
Nitric Acid	3.45E-3	0.123	1.15E-02	5.98
Phosphoric Acid	2.00E-04	-	1.87E-02	3.62E-01
Sulfuric Acid	1.08E-08	0.08	5.89E-03	2.18E-05

The calculated X/Q values for various onsite and offsite receptor locations for T Plant are shown in Table 5 (Huang, 1996a).

Table 5: 99.5 Percentile Dispersion Factors (X/Q) at Various Onsite and Offsite Receptor Locations (Acute Ground Level Releases).

Case	Receptor	No. Plume Meander X/Q (s/m ²)	Plume Meander X/Q(s/m ²)
1	100 m	3.41E-02 (E)	1.13E-02 (ESE)
2	500 m (SSE)*	1.00E-03	3.94E-04
3	1000 m	6.88E-04 (E)	2.46E-04 (ESE)
4	Site Boundary (13.09 km)	1.52E-05 (W)	1.25E-05 (W)
5	Near River (8.98 km)	2.74E-05 (N)	2.07E-05 (N)
6	240 Highway (5.89 km)	4.26E-05 (W)	2.92E-05 (W)

* for onsite facility.

From the mass release rate (see Table 4) and the value of X/Q (see Table 5), we can calculate the chemical concentrations at various receptor locations. The calculated chemical concentrations and ERPG concentration limits for onsite and offsite receptors are shown in Table 6. The ERPG concentration limits are obtained from Table 1 and based on the frequency for spill according to WHC-CM-5-34 (1996). The frequency for spill is 3×10^{-2} /yr for the anticipated event. Thus, ERPG 1 and PEL-TWA values are used as criteria to make comparisons with the calculated concentration values for the onsite and offsite receptors, respectively.

Table 6. Concentration Limits and the Calculated Onsite and Offsite Chemical Concentrations.

Total Volume of Spill 21,000 Gal.	ERPG Concentration Limits (mg/m ³)		Concentration (mg/m ³)			
	Onsite	Offsite	100 m	Facility 500 m (SSE)	Site Boundary	Near River
Potassium Permanganate	-	-	6.96E-08	2.04E-09	3.10E-11	5.59E-11
Sodium Hydroxide	2	2	2.23E-07	6.53E-09	9.92E-11	1.79E-10
Nitric Acid	5 (2 ppm)	5 (2 ppm)	2.04E-01	5.98E-03	9.09E-05	1.64E-04
Phosphoric Acid	1 (ST=3)	1 (ST=3)	1.24E-02	3.62E-04	5.50E-06	9.92E-06
Sulfuric Acid	2	1	7.43E-07	2.18E-08	3.31E-10	5.97E-10

Table 6 shows that the calculated concentrations for various chemicals at various receptor locations are within the criteria of the concentration limits.

Case 2. Beyond Design Basis Earthquake.

The area ratio of case 2 to case 1 is:

$$69.41 \text{ m}^2 / 36 \text{ m}^2 = 1.93$$

Applying this scaling factor of 1.93 to Table 6, we obtain the chemical concentrations at the receptor locations for Design Basis Earthquake (case 2). The results are shown in Table 7. Table 7 shows the calculated concentrations for various chemicals at receptor locations. No limits are established for DBBE events with frequency of occurrence less than 1.0×10^{-6} /yr. However, by

comparing the concentration values in Table 7 with ERPG and TWA values in Table 1, it is evident that none of these concentration values are exceeded.

Table 7. Calculated Chemical Concentrations for Beyond Design Basis Earthquake.

Total Volume of Spill 21,000 Gal.	Concentrations (mg/m ³)			
	Onsite	Facility 500 m (SSE)	Site Boundary	Near River
Potassium Permanganate	1.34E-07	3.94E-09	5.98E-11	1.08E-10
Sodium Hydroxide	4.30E-07	1.26E-08	1.91E-10	3.45E-10
Nitric Acid	3.94E-01	1.15E-02	1.75E-04	3.17E-04
Phosphoric Acid	2.39E-02	6.99E-04	1.06E-05	1.91E-05
Sulfuric Acid	1.43E-06	4.21E-08	6.39E-10	1.15E-09

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APPENDIX A

CALCULATIONS OF EVAPORATION RATE

VAPOR CONCENTRATION: XS

$$p := 3.45 \cdot 10^{-3} \text{ mm Hg} \quad \text{nitric acid: HNO}_3 \text{ at } 25 \text{ C}$$

$$pv := p \cdot 1.01325 \cdot \frac{10^5}{760}$$

$$pv = 0.46$$

$$pa = N/m.m$$

$$mw := 0.06302$$

$$kg/mol$$

$$tp := 298$$

$$rr := 8.314$$

$$xs := pv \cdot \frac{mw}{rr \cdot tp}$$

$$xs = 1.17 \cdot 10^{-5} \quad kg/m^3$$

EVAPORATION RATE : ET

$$u := 5. \quad m/s$$

$$r := 3.385 \quad m$$

$$mu := 0.15 \quad cm/s*s$$

$$dif := 0.123$$

$$sc := \frac{mu}{dif}$$

$$sc = 1.22$$

$$cs := 1.64 \cdot 10^{-2}$$

$$et := cs \cdot sc^{-0.67} \cdot xs \cdot u^{0.78} \cdot r^{1.9}$$

$$et = 5.979 \cdot 10^{-6} \quad kg/s$$

file : pools.mcd---dat: 9/23/96

VAPOR CONCENTRATION: XS

sulfuric acid - H2SO4

$$p := 1.08 \cdot 10^{-8} \text{ mm Hg}$$

at 25 C

$$pv := p \cdot 1.01325 \cdot \frac{10^5}{760}$$

$$pv = 1.44 \cdot 10^{-6}$$

pa = N/m.m

$$mw := 0.09808$$

kg/mol

$$tp := 298$$

$$rr := 8.314$$

$$xs := pv \cdot \frac{mw}{rr \cdot tp}$$

$$xs = 5.7 \cdot 10^{-11}$$

kg/m*3

EVAPORATION RATE : ET

$$u := 5. \text{ m/s}$$

$$r := 3.385 \text{ m}$$

$$nu := 0.15 \text{ cm/s*s}$$

$$dif := 0.08$$

$$sc := \frac{mu}{dif}$$

$$sc = 1.875$$

$$cs := 1.64 \cdot 10^{-2}$$

$$et := cs \cdot sc^{-0.67} \cdot xs \cdot u^{0.78} \cdot r^{1.9}$$

$$et = 2.184 \cdot 10^{-11} \text{ kg/s}$$

file : pools.mcd---dat: 6/13/96

VAPOR CONCENTRATION: XS

$$p := 2.0 \cdot 10^{-4} \text{ mm Hg} \quad \text{phosphoric acid - p}$$

$$pv := p \cdot 1.01325 \cdot \frac{10}{760} \quad \text{at 25 C}$$

$$pv = 0.027$$

$$pa = N/m.m$$

$$mw := 0.098$$

$$kg/mol$$

$$tp := 298$$

$$tr := 8.114$$

$$xs := pv \cdot \frac{mw}{tr \cdot tp}$$

$$xs = 1.055 \cdot 10^{-6} \quad kg/m^3$$

EVAPORATION RATE : ET

$$u := 5. \quad m/s$$

$$r := 3.385 \quad m$$

$$uml := 0.15 \quad cm/s^2$$

$$dif := 0.068$$

$$sc := \frac{uml}{dif}$$

$$sc = 2.206$$

$$cs := 1.64 \cdot 10^{-2}$$

$$et := cs \cdot sc^{-0.67} \cdot xs \cdot u^{0.78} \cdot r^{1.9}$$

$$et = 3.624 \cdot 10^{-7} \quad kg/s$$

CHECKLIST FOR PEER REVIEW

Document Reviewed: C. H. Huang, " TOXICOLOGICAL DOSE CALCULATIONS FOR SPILL
ACCIDENT AT T PLANT," September 24, 1996.

Scope of Review: Entire Document

Yes No NA

☒	☐	☐	☐	*	Previous reviews complete and cover analysis, up to scope of this review, with no gaps.
☒	☐	☐	☐		Problem completely defined.
☒	☐	☐	☐		Accident scenarios developed in a clear and logical manner.
☒	☐	☐	☐		Necessary assumptions explicitly stated and supported.
☐	☐	☐	☒		Computer codes and data files documented.
☒	☐	☐	☐		Data used in calculations explicitly stated in document.
☒	☐	☐	☐		Data checked for consistency with original source information as applicable.
☐	☐	☐	☒		Mathematical derivations checked including dimensional consistency of results.
☒	☐	☐	☐		Models appropriate and used within range of validity or use outside range of established validity justified.
☒	☐	☐	☐		Hand calculations checked for errors. Spreadsheet results should be treated exactly the same as hand calculations.
☐	☐	☐	☒		Software input correct and consistent with document reviewed.
☐	☐	☐	☒		Software output consistent with input and with results reported in document reviewed.
☒	☐	☐	☐		Limits/criteria/guidelines applied to analysis results are appropriate and referenced. Limits/criteria/guidelines checked against references.
☐	☐	☐	☒		Safety margins consistent with good engineering practices.
☒	☐	☐	☐		Conclusions consistent with analytical results and applicable limits.
☒	☐	☐	☐		Results and conclusions address all points required in the problem statement.
☐	☐	☐	☒		Format consistent with appropriate NRC Regulatory Guide or other standards
☐	☐	☒	☐	*	Review calculations, comments, and/or notes are attached.
☒	☐	☐	☐		Document approved.

J. C. Van Keuren J. C. Van Keuren
Reviewer (Printed Name and Signature)

7/30/96
Date

HEDOP REVIEW CHECKLIST
for
Radiological and Nonradiological Release Calculations

Document Reviewed: C. H. Huang, " TOXICOLOGICAL DOSE CALCULATIONS FOR SPILL
ACCIDENT AT T PLANT," September 24, 1996.

Date Submitted: September 24, 1996.

Scope of Review: Entire Document

YES NO* N/A

☒	☐	☐	1. A detailed technical review and approval of the environmental transport and dose calculation portion of the analysis has been performed and documented.
☒	☐	☐	2. Detailed technical review(s) and approval(s) of scenario and release determinations have been performed and documented.
☐	☐	☒	3. HEDOP-approved code(s) were used.
☐	☐	☒	4. Receptor locations were selected according to HEDOP recommendations.
☒	☐	☐	5. All applicable environmental pathways and code options were included and are appropriate for the calculations.
☒	☐	☐	6. Hanford site data were used.
☐	☐	☒	7. Model adjustments external to the computer program were justified and performed correctly.
☒	☐	☐	8. The analysis is consistent with HEDOP recommendations.
☐	☐	☒	9. Supporting notes, calculations, comments, comment resolutions, or other information is attached. (Use the "Page 1 of X" page numbering format and sign and date each added page.)
☒	☐	☐	10. Approval is granted on behalf of the Hanford Environmental Dose Overview Panel.

* All "NO" responses must be explained and use of nonstandard methods justified.

D.A. Himes 10/2/96
HEDOP-Approved Reviewer (Printed Name and Signature) Date

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

DISTRIBUTION SHEET

To	From	Page 1 of 1
B.H. Girbert	C.H. Huang	Date 9/24/96
Project Title/Work Order		EDT No. 156485
Toxicological Dose Calculations for Spill Accidents at T Plant		ECN No. N/A

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
R.F. Carlstrom	T4-06	X			
T.L. Erickson	T3-28	X			
J.P. Estrellado	T4-06	X			
B.H. Gilbert	A3-34	X			
C.H. Huang	A3-34	X			
L.E. Johnson	A2-25	X			
L.S. Semmens	T4-06	X			
S.M. Stahl	A3-37	X			
J.C. Van Keuren	A3-34	X			
<i>Central Files</i>	<i>A3-88</i>	X			