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CALCULATION NOTES THAT SUPPORT ACCIDENT SCENARIO AND CONSEQUENCE OF THE EVAPORATOR DUMP.

Ralph D. Crowe

Westinghouse Hanford Company, Richland, WA 99352

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Key Words: Evaporator Dump, FSAR, and Safety Analysis

Abstract: The purpose of this calculation note is to provide the basis for evaporator dump consequence for the Tank Farm Safety Analysis Report (FSAR). Evaporator Dump scenario is developed and details and description of the analysis methods are provided.

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Ralph D. Crowe 9-27-96
Release Approval Date

Approved for Public Release

Calculation Notes to Support Accident Scenario and Consequence Determination for Evaporator Dump

Ralph Crowe
Nuclear Analysis and Characterization

Purpose

The evaporator "dump" is the sudden uncontrolled discharge of hot evaporator fluid from the evaporator to a waste tank 241-AW-102. The dump pressurizes the tank headspace and releases aerosolized waste to the environment. This calculation note develops the accident scenario and calculates the radiological and toxicological consequences of this accident.

Methodology

This note defines the scenario for the evaporator dump accident, quantifies the postulated material at risk for an unmitigated evaporator dump scenario, determines the quantity released to the environment and estimates the radiological and toxicological consequences of the release.

A calculational model was developed to track the pressure, temperature, aerosol concentration and exhaust flow from the headspace of 241-AW-102. The total amount of tank waste released to the environment is the integral of the product of the exhaust flow and aerosol concentration. The methodology and atmospheric constants used to calculate dose consequences are described in WHC-SD-WM-SAR-067, Section 3.4.1 Methodology.

Assumptions

The composition of the waste in the evaporator dump scenario was assumed to be that of DST liquids, and the toxicological composition of the waste was assumed to be equivalent to DST liquids.

The aerosol release fraction and respirable fraction used were selected from DOE Handbook 3010 (DOE 1994) for the free-fall of an concentrated aqueous solution for fall distances 3 meters or less to a hard surface. For this situation, the median aerosol release fraction (ARF) is $1 \text{ E-}6$ with a respirable fraction (RF) of 0.3. Since the evaporator dump is impacting a liquid surface instead of a hard surface, the use of the median ARF and RF was considered acceptable even though the falling distance may be a more than 3 m because the kinetic energy of the falling liquid is dissipated by the viscous forces as the dump liquid flows down through the DST liquid waste instead of going into the generation of aerosol.

No credit is taken for the HEPA filters. Since this is an unmitigated accident that meets guidelines, no mitigated consequences are calculated.

It is assumed that the ventilation system was on but has stopped operating. This assumption gives the greatest temperature differential between the headspace and the evaporator waste and maximizes the heat transfer to the headspace and the headspace pressure increase due to waste temperature. Presently, 241-AW-102 has only 3 ft of waste with a liquid temperature of 78 F and a vapor space temperature of 5 degrees less. Last winter the temperature in the headspace was as low as 55 F with corresponding waste temperatures of 65 F. While the evaporator was operating the temperatures were higher (see attached figure). Consequently, the DST waste temperature is assumed to be 65 F with a head space temperature of 55 F.

The maximum allowable temperature for the evaporator vessel is 200 F (WHC 1995). The maximum dump volume is 26000 gallons with a drain time of 11 minutes (WHC 1995). In order to do the calculation, it is assumed that the evaporator dump waste at 200 F mixes with an equal amount of tank waste at 65 F and spreads across the surface of the existing waste with a layer depth of 2 feet. The temperature of this pool is the average temperature of 135 F. The two foot layer and its temperature are somewhat arbitrary but they should be conservative since the falling evaporator waste will sink into the DST waste, mix and cool to near the temperature of the DST waste as opposed to forming a hot pool over the surface of the DST waste.

Input Data

Heat transfer coefficient for the waste surface is calculated from simplified equations for air flow over a horizontal plate facing upwards (Holman 1990). Rayleigh number calculated for minimum height of 3 meters to check applicability of turbulent convection ($Ra > 10^9$).

$$T_{\text{dump}} := 200\text{ F} \quad T_{\text{waste}} := 65\text{ F} \quad T_{\text{air}} := 55\text{ F} \quad T_{\text{mix}} := \frac{T_{\text{dump}} + T_{\text{waste}}}{2}$$

$$\Delta T := T_{\text{mix}} - T_{\text{air}} \quad \Delta T = 77.5\text{ F}$$

Rayleigh number in air at 3 meters

$$Ra_L := \frac{90.7}{\text{cm}^3 \cdot \text{K}} (3\text{ m})^3 \cdot \Delta T \quad Ra_L = 1.1 \cdot 10^{11}$$

From the reference, the simplified equation for the heat transfer for turbulent natural convection is:

$$h_{\text{turbulent}} := 1.52 \left(\frac{\Delta T}{\text{C}} \right)^{\frac{1}{3}} \frac{\text{watt}}{\text{m}^2 \cdot \text{C}} \quad h_{\text{turbulent}} = 5.33 \frac{\text{watt}}{\text{m}^2 \cdot \text{C}} \quad T_{\text{mix}} = 132.5\text{ F}$$

Ventilation flow from # IVF-Chapter 3-08 (attached) gives a flow rate of 100 cfm for 2 inches of water gauge. The ventilation is modeled as two paths. When the ventilation system is operating, filtered air flows in the inlet and exhausts through the outlet ducting at a constant flow rate. It is assumed that when the ventilation system is not operating, flow is out both the inlet and outlet flow paths as a function of the headspace pressure. Thus there are two flow paths from the headspace to vent the pressure increase due to the evaporator dump. A discharge coefficient for both paths can be estimated from the normal operating conditions (Crane 1985). A temperature of 80 F was chosen for the operating vapor temperature.

$$Q = c_v \sqrt{\Delta P \cdot \rho_{\text{air}}} \quad Q := 100 \frac{\text{ft}^3}{\text{min}} \quad \Delta P := 2 \cdot \text{in}_\text{H}_2\text{O} \quad \rho_{\text{air}} = \frac{1 \cdot \text{atm}}{R_{\text{gas}} \cdot T_{\text{toK}}(80\text{ F})} \quad \rho_{\text{air}} = 0.1 \frac{\text{lb}}{\text{ft}^3}$$

$$c_v := \frac{Q}{\sqrt{\Delta P \cdot \rho_{\text{air}}}}$$

$$c_v = 87.7 \cdot \frac{\frac{\text{ft}^3}{\text{sec}}}{\sqrt{\text{atm} \cdot \frac{\text{lb}}{\text{ft}^3}}}$$

Evaporator -

The evaporator dumps 26000 gallons of waste in 11 minutes based on Figure 9-3 in the Evaporator SAR (WHC 1995).

$$\text{vol_evap} := 26000 \cdot \text{gal} \quad \text{drain_time} := 11 \cdot \text{min} \quad \text{dump_flow} := \frac{\text{vol_evap}}{\text{drain_time}} \quad T_{\text{dump}} = 200 \cdot \text{F}$$

Tank -

The evaporator dump waste mixes with equal amounts of tank waste to form a pool of hot waste that spreads across the surface of the tank waste at a depth of 2 ft.

$$\begin{aligned} \text{tank_diameter} &:= 75 \cdot \text{ft} & \text{tank_area} &:= \frac{\pi}{4} (75 \cdot \text{ft})^2 & \text{tank_area} &= 410.4 \cdot \text{m}^2 \\ \text{depth} &:= 2 \cdot \text{ft} & T_{\text{waste}} &= 65 \cdot \text{F} \end{aligned}$$

Headspace -

The depth of waste in the tank is the LCO limit of 410" minus the change in depth due to the dump. The volume of the headspace is derived by subtracting the volume of waste from the total tank volume (Hopkins 1995).

$$\begin{aligned} \text{depth_waste} &:= 410 \cdot \text{in} - \frac{26000 \cdot \text{gal}}{2764 \cdot \frac{\text{gal}}{\text{in}}} & \text{depth_waste} &= 400.6 \cdot \text{in} & \text{pressure} &:= 1 \cdot \text{atm} \\ \text{headspace} &:= 187976 \cdot \text{ft}^3 - \text{depth_waste} \cdot 2764 \cdot \frac{\text{gal}}{\text{in}} & \text{air_temp} &:= T_{\text{air}} \\ \text{air_p} &:= \frac{\text{pressure}}{R_{\text{gas}} \cdot \text{FtoK}(\text{air_temp})} & \text{headspace} &= 1.13 \cdot 10^3 \cdot \text{m}^3 \\ \text{air_mass} &:= \text{headspace} \cdot \text{air_p} & \text{air_p} &= 0.1 \cdot \frac{\text{lb}}{\text{ft}^3} \\ \text{specific heat of air} &= 1.006 \cdot \frac{\text{joule}}{\text{gm} \cdot \text{K}} = 0.24 \cdot \frac{\text{BTU}}{\text{lb} \cdot \text{R}} \end{aligned}$$

Calculations

A decrease in the headspace volume and an increase in headspace pressure is produced by the addition of evaporator waste to the tank. The headspace pressure also increases with the temperature rise in the headspace from the energy convected to the headspace from the hot layer of evaporator waste spreading across the surface of the waste. This calculational model uses the values of the various tank conditions, (ie. temperature, pressure, vent flow) to estimate the conditions at the next time step. Basically for each time step, the temperature increase in the headspace is calculated from the heat added to the headspace by convection from the waste surface. The new temperature and headspace volume are used to calculate a new headspace pressure based the ideal gas equation. The vent flow is calculated from this pressure. The vent flow is used to calculate the volume and mass of air vented from the headspace.

The respirable concentration of liquid in the headspace is derived by multiplying the release fractions by the volume of evaporator material dumped up to that step time and dividing by the current headspace volume. The product of the headspace respirable concentration and the vent flow gives the volume of liquid released. The sum over time of the product of the release rate and the time step gives the total quantity released for that time step.

The next time step uses the conditions from the previous time step to continue the process.

$\text{event_time} := 60 \cdot \text{min}$	$\text{nsteps} := 3600$	$i := 1 \dots \text{nsteps}$	$\delta t := \frac{\text{event_time}}{\text{nsteps} \cdot \text{sec}}$	$\delta t = 1$
$t_0 := 0 \cdot \text{sec}$	$t_i := t_{i-1} + \delta t \cdot \text{sec}$			time
	$\text{fill}_i := \text{if} \left(t_i > \text{drain_time}, 0 \cdot \frac{\text{ft}^3}{\text{sec}}, \frac{\text{vol_evap}}{\text{drain_time}} \right)$			drain rate
$\text{vol}_0 := 0 \cdot \text{ft}^3$	$\text{vol}_i := \text{vol}_{i-1} + \text{fill}_i \cdot \delta t \cdot \text{sec}$			volume of dump
$\text{head}_0 := \text{headspace}$	$\text{head}_i := \text{headspace} - \text{vol}_i$			volume of headspace
$\text{surf}_0 := 0 \cdot \text{ft}^2$	$\text{surf}_i := \text{if} \left(\frac{\text{vol}_i}{\text{depth}} > \text{tank_area}, \text{tank_area}, \frac{\text{vol}_i}{\text{depth}} \right)$			surface area of dump

Initialize calculational variables

$x_{0,1} := \frac{T_{\text{air}}}{R}$		air temperature
$x_{0,2} := \frac{\text{atm_headspace}}{R_{\text{gas}} (x_{0,1} \cdot R + 459.67 \cdot R)} \cdot \frac{1}{\text{lb}}$		total air mass in headspace
$x_{0,3} := \frac{1 \cdot \text{atm}}{\text{atm}}$		pressure
$x_{0,4} := \frac{0 \cdot \frac{\text{ft}^3}{\text{min}}}{\left(\frac{\text{ft}^3}{\text{min}} \right)}$		vent flow
$c_p := \frac{0.24 \cdot \frac{\text{BTU}}{\text{lb} \cdot \text{F}}}{\left(\frac{\text{BTU}}{\text{lb} \cdot \text{F}} \right)}$		specific heat of air

$$\text{dump}(n, \delta t, x, \text{surf}, \text{head}, h_c, c_d, T_{\text{mix}}, T_w, c_p) := \text{for } i \in 1..n \left[\begin{array}{l} \text{area} \leftarrow 4418 \cdot \text{ft}^2 \\ c_0 \leftarrow \frac{x_{0,3} \cdot \text{head}_0}{x_{0,2} \cdot (x_{0,1} + 459.67)} \\ q \leftarrow \frac{h_c}{\text{ft}^2} \left[\text{surf}_i \cdot \left(\frac{T_{\text{mix}}}{F} - x_{i-1,1} \right) + (\text{area} - \text{surf}_i) \cdot \left(\frac{T_w}{F} - x_{i-1,1} \right) \right] \\ x_{i,1} \leftarrow x_{i-1,1} + \frac{q \cdot \delta t}{x_{i-1,2} \cdot c_p} \\ x_{i,2} \leftarrow x_{i-1,2} \cdot \left(1 - \frac{x_{i-1,4} \cdot \delta t \cdot \text{ft}^3}{\text{head}_i} \right) \\ x_{i,3} \leftarrow \frac{c_0 \cdot x_{i,2} \cdot (x_{i,1} + 459.67)}{\text{head}_i} \\ \text{rho} \leftarrow \frac{x_{i,2} \cdot \text{ft}^3}{\text{head}_i} \\ x_{i,4} \leftarrow 2 \cdot c_d \cdot \text{if} \left[x_{i,3} > 1, \sqrt{\text{rho} \cdot (x_{i,3} - 1)}, \sqrt{\text{rho} \cdot (1 - x_{i,3})} \right] \end{array} \right]$$

Initialize the variables and check for consistency

$$c_d := c_v \cdot \left[\frac{\frac{\text{ft}^3}{\text{sec}}}{\sqrt{\text{atm} \cdot \frac{\text{lb}}{\text{ft}^3}}} \right]^{-1} \quad h_{\text{turbulent}} = 5.3 \cdot \frac{\text{watt}}{\text{m}^2 \cdot \text{C}} \quad h_c := h_{\text{turbulent}} \cdot \left(\frac{\text{BTU}}{\text{ft}^2 \cdot \text{sec} \cdot \text{R}} \right)^{-1} \quad c_p = 0.2$$

$$x = (0 \quad 55 \quad 3.1 \cdot 10^3 \quad 1 \quad 0) \quad \frac{x_{0,3} \cdot \text{head}_0}{x_{0,2} \cdot (x_{0,1} + 459.67)} = 0.0252 \cdot \text{ft}^3 \quad \frac{R_{\text{gas}}}{MW_{\text{air}}} = 0.0252 \cdot \frac{\text{atm} \cdot \text{ft}^3}{\text{lb}_{\text{mole}} \cdot \text{R}}$$

$$h_c = 2.6 \cdot 10^{-4} \quad c_d = 87.7 \quad T_{\text{mix}} = 132.5 \cdot \text{F} \quad T_{\text{waste}} = 65 \cdot \text{F}$$

Calculate dump transient

$$x := \text{dump}(n\text{steps}, \delta t, x, \text{surf}, \text{head}, h_c, c_d, T_{\text{mix}}, T_{\text{waste}}, c_p)$$

$$P_i := x_{i,3} \cdot \text{atm} \quad T_i := x_{i,1} \cdot \text{R} \quad \text{vent}_i := x_{i,4} \cdot \frac{\text{ft}^3}{\text{sec}} \quad (\max(P) - 1 \cdot \text{atm}) = 9 \cdot \text{in}_{\text{H}_2\text{O}} \\ \max(P) - 1 \cdot \text{atm} = 2.2 \cdot 10^3 \cdot \text{Pa}$$

Source Term Analysis

The source term for the evaporator dump identifies the amount of material released to the environment. The methodology and atmospheric constants used with the source term to calculate dose consequences are described in WHC-SD-WM-SAR-067, Section 3.4.1 Methodology.

The aerosol release fraction (ARF) is $1 \text{ E-}6$ with a respirable fraction (RF) of 0.3. The concentration in the headspace is the time dependent volume of liquid released divided by the corresponding headspace volume. The headspace is assumed to have an initial concentration of 10^{-8} DST liters/liter.

$$\text{RF} := 1 \cdot 10^{-6} \quad \text{ARF} := 0.3 \quad \text{conc}_i := \left(10^{-8} + \frac{\text{RF} \cdot \text{ARF} \cdot \text{vol}_i}{\text{head}_i} \right) \cdot \frac{\text{liter}}{\text{liter}}$$

The release rate times the aerosol concentration is summed for the entire accident to get the total amount of radiological material released in terms of evaporator liquid (liters).

$$i := 1 \dots \text{nsteps} \quad \text{sum}_0 := 0 \cdot \text{liter} \quad \text{sum}_i := \text{sum}_{i-1} + (\text{conc}_i \cdot \text{vent}_i) \cdot \delta t \cdot \text{sec} \quad \text{max}(\text{sum}) = 5.09 \cdot 10^{-3} \cdot \text{liter}$$

Radiological Consequences

Constants from WHC-SD-SAR-0067, 3.4.1, Methodology Section

$$\text{Br} := 3.3 \cdot 10^{-4} \frac{\text{m}^3}{\text{sec}} \quad \chi_{Q_onsite} := 3.41 \cdot 10^{-2} \frac{\text{sec}}{\text{m}^3} \quad \chi_{Q_offsite} := 2.83 \cdot 10^{-5} \frac{\text{sec}}{\text{m}^3}$$

Evaporator ULD from WHC-SD-WM-SARR-037, 1996, *Development of Radiological Concentrations and Unit Liter Doses for TWSR FSAR Radiological Consequence Calculations*. The Evaporator SAR (WHC 1995) has an Administrative Control that defines the bounding radionuclide inventory for the evaporator waste.

SARR-37 calculated a ULD of 7.7×10^3 for the evaporator waste.

$$\text{ULD} := 7.7 \cdot 10^3 \frac{\text{Sv}}{\text{liter}}$$

Onsite radiological dose

$$\text{max}(\text{sum}) \cdot \text{ULD} \cdot \chi_{Q_onsite} \cdot \text{Br} = 0.44 \cdot \text{mSv}$$

Onsite guideline for "anticipated" event

$$5 \cdot \text{mSv}$$

Offsite radiological dose

$$\text{max}(\text{sum}) \cdot \text{ULD} \cdot \chi_{Q_offsite} \cdot \text{Br} = 3.66 \cdot 10^{-4} \cdot \text{mSv}$$

Offsite guideline for "anticipated" event

$$1 \cdot \text{mSv}$$

Toxicological Consequences

$$n := \frac{15 \cdot \text{min}}{60 \cdot \text{sec}} \quad \text{tox}_0 := 0 \cdot \frac{\text{liter}}{\text{sec}} \quad \text{tox}_i := \text{tox}_{i-1} + \frac{1}{n} \left[\left(\text{conc}_i \cdot \text{vent}_i \right) - \text{if} \left(i > n, \text{conc}_{i-n} \cdot \text{vent}_{i-n}, 0 \cdot \frac{\text{liter}}{\text{sec}} \right) \right]$$

$$\text{max}(\text{tox}) = 4.6 \cdot 10^{-6} \cdot \frac{\text{liter}}{\text{sec}}$$

The toxicological consequences sum-of-the-fractions methodology is described in reference WHC (1996a). The maximum 15 minute maximum averaged release rate is 4.6×10^{-6} liters/sec of liquid released to the environment as a continuous release. For the toxicological consequences, the released waste waste if assumed to be DST Liquid. The calculated onsite and offsite toxicological consequences are:

Sum of the fraction numbers for an "anticipated" continuous release.

$$\text{SoF}_{\text{onsite}} := 1 \cdot 10^4 \frac{\text{sec}}{\text{liter}} \quad \text{SoF}_{\text{offsite}} := 8.4 \cdot \frac{\text{sec}}{\text{liter}}$$

$$\text{max}(\text{tox}) \cdot \text{SoF}_{\text{onsite}} = 4.6 \cdot 10^{-2} \quad \text{max}(\text{tox}) \cdot \text{SoF}_{\text{offsite}} = 3.9 \cdot 10^{-5}$$

The SoF are normalized such that if the product of the SoF and the release amount is less than 1, the Risk Guidelines are met. Risk guidelines are therefore met for this event.

Comparison to Risk Guidelines

Both the onsite and offsite radiological doses are shown to be acceptable for an accident in the "anticipated" range (frequency of 1 to 10^{-2} per year). The toxicological sum-of-fractions are below one for an anticipated event, and hence well below the risk evaluation guidelines, for both onsite and offsite receptors.

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Note

This report was written in MathCad Plus 6.0 Professional Edition (Maftsoft 1995) . The following constants and equations were used as a part of the calculation.

$$\begin{aligned}
 \text{rem} &= 1 & \text{Sv} &= 100 \cdot \text{rem} & \text{mSv} &= 10^{-3} \cdot \text{Sv} & \text{rem} &= 10^{-2} \cdot \text{Sv} & \text{rem} &= 10 \cdot \text{mSv} \\
 \text{in_H}_2\text{O} &= \text{g} \cdot \frac{\text{gm}}{\text{cm}^3} \cdot 1 \cdot \text{in} & \text{MW_air} &= 28.967 & \text{lb_mole} &= \text{MW_air} \cdot \text{lb} & \text{kg_mole} &= \text{MW_air} \cdot \text{kg} \\
 R_{\text{gas}} &= 8.314510 \cdot 10^3 \cdot \frac{\text{joule}}{\text{kg_mole} \cdot \text{K}} & p &= 0 \cdot \text{in_H}_2\text{O}, 0.1 \cdot \text{in_H}_2\text{O}, 12 \cdot \text{in_H}_2\text{O} \\
 F &= R & \text{FtoK}(T) &= \frac{5 \cdot (T - 32 \cdot F)}{9 \cdot F} \cdot K + 273.15 \cdot K & \text{KtoF}(T) &= \frac{9 \cdot (T - 273.15 \cdot K)}{5 \cdot K} \cdot F + 32 \cdot F \\
 C &= K & \text{FtoK}(32 \cdot F) &= 273.1 \cdot K & \text{KtoF}(373.15 \cdot K) &= 212 \cdot F
 \end{aligned}$$

Information Validation Form

Tracking # IVF-Chapter 3-08

Name of Originator Grant W. Ryan (376-5114)	Organization or Team Chapter 3- Accident Analysis- Steam Pressurization	Date June 28, 1996											
<p>Statement of Problem</p> <p>For the steam pressurization accident, the following information may be used in the analysis:</p> <p>For tank 241-AW-102, at a ventilation flowrate of 100 cfm a vacuum of 2 inches water gauge is achievable. Size of the vent header for this tank is 12 inches.</p> <p>For DCRT 244-TX, at a ventilation flowrate of 50 cfm for the tank a vacuum of 0-2 inches water gauge is achievable. Size of the vent header for this tank is 4 inches. ^{7/8/96}</p> <p>EXPLICITLY concur with or deny (by including appropriate documentation) the assumptions made above, to provide a documentable information source.</p> <p>REFERENCES</p> <p>This information was obtained from Scott Pierce on Friday, June 28, 1996 at about 10:20 a.m.</p> <p>4</p>													
<table border="1"> <tr> <td>Alternatives</td> <td>Consequences to Alternatives</td> </tr> <tr> <td>5 N/A</td> <td>6 N/A</td> </tr> <tr> <td>Decision Reached</td> <td>Basis for Decision</td> </tr> <tr> <td>7</td> <td>8</td> </tr> <tr> <td>Date Requested 9 June 28, 1996</td> <td>Sent To 10 R. Tucker, Project Files</td> <td>Date Requested By 11 June 28, 1996</td> </tr> </table>			Alternatives	Consequences to Alternatives	5 N/A	6 N/A	Decision Reached	Basis for Decision	7	8	Date Requested 9 June 28, 1996	Sent To 10 R. Tucker, Project Files	Date Requested By 11 June 28, 1996
Alternatives	Consequences to Alternatives												
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Decision Reached	Basis for Decision												
7	8												
Date Requested 9 June 28, 1996	Sent To 10 R. Tucker, Project Files	Date Requested By 11 June 28, 1996											

Response #1 244-TX DCRF Ventilation system draws air from both the vault and the tank simultaneously. Due to this, it is not possible to measure flow rate from the tank itself. A review of the roundsheets taken on the tank vacuum however shows a normal vacuum of -0.5 " (CREATING TANK 12 DAILY.)

Response #2

13

Attachments (List)

References (List) 15

14

Responder #1 Name and Signature

Responder #2 Name and Signature

16 R.P. Tucker *R.P. Tucker*

17

POC:

Filed:

Routed:

Further Action Required (i.e., RML, Senior Management Attention, etc.)

18

Retrieval Date 8/23/96
Starting Date 12/1/95
Ending Date 8/23/96

AW102

Data Type
Good
Transcribed

ATEMPT08 Chart 2

Retrieval Date 8/23/96
Starting Date 12/1/95
Ending Date 8/23/96

AW102 *evaporator startup*

Data Type
Good
Transcribed

CHECKLIST FOR PEER REVIEW

Document Reviewed: "Calculation Notes That Support Accident Scenario and Consequence Determination for the Evaporator Dump," WHC-SD-WM-CN-060, Rev. 1, 9/96, by Ralph Crowe.

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.

Anthony V. Savino *AV Savino*
Reviewer (Printed Name and Signature)

9/19/96
Date

HEDOP REVIEW CHECKLIST for **Radiological and Nonradiological Release Calculations**

Document reviewed (include title or description of calculation, document number, author, and date, as applicable): "Calculation Notes That Support Accident Scenario and Consequence Determination for the Evaporator Dump," WHC-SD-WM-CN-060, Rev. 1, 9/96, by Ralph Crowe.

Submitted by: Grant Ryan

Date Submitted: 9/18/96

Scope of Review: Entire Document.

YES NO* N/A

[X] [] [] [X] [] [] [] [] [X] [] [] [X] [X] [] [] [X] [] [] [] [] [X] [X] [] [] [] [] [X] [X] [] []	[] [] [X] [X] [] [] [X] [] [X] []	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.

Anthony V. Savino *AS*
HEDOP-Approved Reviewer (Printed Name and Signature)

9/19/96
Date

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

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