Department of Energy
Washington, DC 20585

August 20, 1996

The Honorable John T. Conway
Chairman
Defense Nuclear Facilities Safety Board
625 Indiana Avenue, N.W.
Suite 700
Washington, D.C. 20004

Dear Mr. Chairman:

The purpose of this letter is to follow up on our March 8, 1996, correspondence to you concerning the ability of personnel within the Central Training Facility (CTF) to respond to accidental hazardous releases from adjacent facilities at the Savannah River Site. Specifically, the issues raised by the Board were identified by your staff during their November 14, 1995, visit. As stated in our previous letter, the Savannah River Operations Office (SR) was to review and evaluate the administrative and hardware changes to address these issues. The enclosed memorandum from the SR Manager and the "CTF Response Upgrade Report" provide information regarding the implementation of hardware changes that will enhance the notification process and response actions at the CTF.

It should be noted that the bulk of risk reduction is achieved with the implementation of remote and manual Heating, Ventilation and Air Conditioning (HVAC) shutdown modifications. Implementation of instrumentation that would shutdown HVAC systems when contaminant level setpoints are reached, while much more expensive, provides only marginal benefits beyond those options selected. These documents have been reviewed by my staff, and we agree with the proposed path forward. However, the original implementation date for these changes was June 28, 1996, this date has been changed and is now August 30, 1996. I plan to provide you notification upon full implementation.

Printed with soy ink on recycled paper

Thank you for your continued interest in this program. Should you require any additional information on this subject, please feel free to contact me at (202) 586-7709 or Steve Cowan of my staff at (202) 586-0370.

Sincerely,

for Richard J. Guimond

Alvin L. Alm
Assistant Secretary for
Environmental Management

Enclosure

cc:
M. Whitaker, S-3.1

Attch: Memo, Fiori to EM-1,
DNFSB Concerns for CTF. dated
JUN 0 7 1996

WSRC-TR-96-0089
Revision 0

CONSOLIDATED TRAINING FACILITY RESPONSE UPGRADE ASSESSMENT REPORT (U)

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4/1/96

Westinghouse Savannah River Company
Safety Engineering Department
Aiken, SC 29808

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ADC & Reviewing Official: [signature] Sr. E.
(Name and Title)
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EXECUTIVE SUMMARY

During the 1995 annual exercise for the Defense Waste Processing Facility, the Defense Nuclear Facilities Safety Board raised questions as to the ability of Central Training Facility (CTF) to provide protection for occupants during operational emergencies involving the release of hazardous materials (Ref. 3). One of the main protective actions at CTF is to have occupants remain indoors and secure the ventilation system until it is determined the atmosphere outside the CTF is safe. This report provides a cost-benefit assessment for the installation and use of various Heating Ventilation and Air Conditioning (HVAC) shutdown systems for the Central Training Facility (Building 766H). The improved shutdown systems considered are (1) installation of environmental monitoring equipment with ability to secure HVAC when the alarm setpoint is reached, (2) improved manual HVAC shutdown capability, and (3) remote manual HVAC shutdown capability.

In the event of an actual hazardous material incident involving CTF, it is desired that real-time measurements of hazardous material within CTF be available. Both stand-alone instrumentation and monitoring equipment analogous to the type of instrumentation used by Field Monitoring Teams were considered.

The maximum amount of money that could be allocated for installing an optimum HVAC shutdown system was calculated. This calculation is based on the avoidance of risks associated with operational emergencies involving hazardous material releases from facilities neighboring CTF (H and S Area). The dollar value of risks avoided by installing a shutdown system for the CTF HVAC is estimated at $137K. This estimate is based on a projected cost of $5000K per statistical cancer fatality avoided (Ref. 7, 8, 9).

The estimated cost of the improved HVAC shutdown systems are:

- Installed instrumentation system: $1680K.
- Enhanced manual shutdown of HVAC: $13K.
- Remote shutdown of HVAC: $30K

The estimated cost of habitability survey equipment is $25K.

Using the cost of risks avoided over the 40 year life of the facility ($137K) and the lifetime cost of installing monitoring equipment within CTF ($1680K), it is not cost-beneficial to install environmental monitoring equipment at CTF.

The cost for an enhanced manual shutdown and remote shutdown of the CTF HVAC is well within the target of avoided cost. The addition of habitability survey equipment would still maintain the total cost ($68K) within the target amount. Therefore, it would be prudent to implement any or all of these other options at CTF.

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1. Excel™ Spreadsheets Correlating Previous Reports and Event Frequency
2. Figures 1-8 Depicting Concentration and Dose Over Various Release Periods

INTRODUCTION

During the 1995 annual exercise for the Defense Waste Processing Facility, the Defense Nuclear Facilities Safety Board raised questions as to the ability of the Central Training Facility (CTF) to provide protection of occupants during operational emergencies involving the release of hazardous materials (Ref. 1). One of the main protective actions at CTF is to have occupants remain indoors and secure the ventilation system until it is determined the atmosphere outside CTF is safe. The purpose of this report is to provide a cost-benefit assessment for the installation and use of various HVAC shutdown systems for the CTF. Proposed systems, components or capabilities are expected to reduce the potential exposure of personnel inside the CTF following an accident event at any adjacent H- and S-Area facility.

DISCUSSION

Accident Information

In response to a request from the Emergency Services Department, spreadsheets (Att. 1) were developed to estimate the impact on personnel within the CTF for accidents evolving from H and S-Area facilities. These spreadsheets were derived from an older set which is based on previously issued technical reports that establish a CTF infiltration technical basis (Ref. 2) and summarize source term values (Ref. 3) for hazardous materials. Design Base Earthquake (DBE) events are not included in the revised spreadsheets because CTF is expected to undergo severe collateral damage in such cases. DBE events that would cause accidents in the process facilities are significantly stronger than the seismic events that CTF is designed to withstand. Emergency Preparedness Hazards Assessments along with Safety Analysis Reports were used to provide accident event descriptions and frequencies as well as a conservative estimate of the resultant dose or concentration. The final spreadsheets were revised from the original set as follows:

- All Beyond Design Basis Accidents (e.g., earthquake) were removed.
- All accidents that did not result in consequences greater than a Protective Action Guide (1 rem or ERPG-2) outside the CTF were removed.
- All accidents beyond the credible range ($\leq$1E-06 yr^{-1}) were removed.
- All accidents whose initiators would be expected to cause substantial collateral damage to CTF (e.g., Design Basis Earthquakes) were identified by italicizing the text.
- A column to indicate the calculated frequency (yr^{-1}) of the event was added.
- A column to calculate the risk ($rem\text{-}yr^{-1}$) to an individual standing <u>outside</u> of CTF under 95% adverse meteorological conditions was added.

The use of the spreadsheets for dose calculations should be limited to use for comparison purposes only. The formula used within the spreadsheets takes the final concentration after one hour as the average concentration during the exposure period. As radiological dose is an integration of the concentration buildup over time, use of the end point concentration for calculating dose to personnel within CTF can be misleading. The spreadsheets also do not account for dose received after the plume passes CTF from radioactivity trapped within CTF.

Cost Benefit Assessment Methodology

The cost benefit assessment methodology estimated the risk impact of accident events on occupants of CTF under two sets of conditions. The first set is where the HVAC outside air exchange functions normally, and the other is where the outside air exchange to the building is isolated. The difference in the overall risk provides a basis for estimating the averted number of cancer fatalities. This estimate is equated to a dollar savings based on a statistical fatality avoided. (i.e., $5000K per avoided cancer fatality)

Assumptions

To estimate the benefit of CTF ventilation system isolation the following assumptions have been made:

- CTF HVAC isolation would occur prior to significant radioactivity intake.
- The CTF normal air turnover rate is 1.0 per hour.
- When isolated the CTF air turnover rate is 0.2 per hour.
- The duration for the outdoor dose accumulation (and hence the CTF building immersion time) is assumed to be on the order of 20 min.
- It is assumed the occupants remain in CTF for an additional hour after the radioactive cloud has passed.

Attachment 2 illustrates the concentrations outdoors and inside the CTF building for normal and isolated HVAC conditions. The Figures also show the time integral of the building concentrations relative to the integral of the outdoor concentration. This relates how the indoor inhalation dose would compare to the outdoor inhalation dose under both normal and isolated HVAC conditions. The five sets of Figures in attachment 2 correspond to building immersion times of 5 min., 15 min., 1 hour, 3 hours, and 10 hours respectively.

Determination of Averted Risks and Impacts

The inhalation risk to an individual at CTF is estimated based on the doses for outdoor exposure after reduction for normal ventilation operation, and reduction for ventilation secured. For each accident considered, the risk and averted fatalities (including averted dollars) are estimated from the following relations:

$$\text{Risk} \cong \frac{\Delta t_{occ}}{8760}\sum_i F_i \sum_j \frac{\theta_j}{360} Pr_j FR(D_{i,j})$$

$$\text{Averted Fatalities} = Years \times Occ. \times (Risk_{norm} - Risk_{isol})$$

$$\text{Averted Dollars} = VL \times Averted\ Fatalities$$

where: subscript i refers to the accident considered
subscript j refers to whether average or adverse weather is assumed

- Δt_{occ} = hours per year the building is heavily occupied, assumed 2080
- F_i = frequency of the accident, per year
- θ_j = plume spread angle for weather j
- Pr_j = probability of weather j
- $D_{i,j}$ = dose in rem for event i with weather j
- FR = fatality risk at dose D
- Years = years of facility operation, assumed to be 40
- Occ = number of people in CTF during the day, assumed 1600
- VL = value of saving a statistical life, assumed $5000K.

The probability that the release blows in the direction of CTF is estimated by assuming an isotropic wind rose (this assumption is very good for wind direction dominating risk at CTF). Average and adverse meteorology doses are assumed to apply 90% and 10% of the time respectively. The fatality risk ($FR(D_{i,j})$) at a given dose is based on 5E-4 cancer fatalities per man rem, and similar chemical specific factors for chemical exposures.

<u>Upgrade Cost Estimates</u>

Installed Instrumentation Systems

Preliminary cost estimates for various facility and program upgrade options were developed to provide a range of options and are provided as attachments. Design estimates were based on the following assumptions and preconditions.

1. Functional Classification design class is General Service.
2. Detailed design and construction will be performed.
3. Hazardous materials monitoring for detection of tritium gas (oxide; 0.5-100 DAC hrs.), transuranic alpha equivalents (0.5-100 DAC hrs.) and organics (benzene, carbon tetrachloride; 0.5-100 ppm).
4. Instrumentation located on CTF roof adjacent to intake ducting.

5. Instrumentation will be housed in an enclosure (10 ft. by 10 ft.) with HVAC environmental system controls.
6. It is assumed that the roof will hold the additional load.
7. Isokinetic sampling is not required with ambient sampling.
8. On detection of hazardous materials at alarm setpoints, all HVAC systems will be automatically shutdown.
9. Heat tracing will be required for all sensing lines.
10. Analog meters for each variable will be provided on the first floor immediately adjacent to HVAC power breaker room. Audible and visual alarms will be provided to alert personnel.
11. One hour battery backup power for instrumentation system will be provided. Indication of battery status will be provided along with an alarm panel.
12. Equipment cost for tritium monitoring system is $20K. Annual maintenance and calibration support is estimated at 2 MM.
13. Equipment cost for organic monitoring system is $45K. Annual maintenance and calibration support is estimated at 2 MM.
14. Equipment cost for particulate radioisotope sampling system is $30K. Annual maintenance and calibration support is estimated at 2 MM.

The initial estimate (Ref. 4) addressed the installation of two sampling stations with organic vapor, transuranic particulate and tritium gas sampling capability. The stations were intended to be redundant to each other with each one having its own battery backup and independent capability to shutdown the CTF HVAC. The preliminary estimate was $600K containing a 30% management (overage) contingency factor ($420K-$600K) to address the preliminary nature of the estimate.

The estimate was revised (Ref. 5) to address using only one sampling station with redundant instrumentation to reduce construction and electronics costs (cable runs, battery backup, simplified maintenance and repair). The revised estimate is $423K, containing a 30% management (overage) contingency factor ($296-$423K) to address the preliminary nature of the estimate. Based on a 40 year life, the equipment lifetime maintenance cost is estimated to be $360K. This cost does not factor in the estimated labor time for surveillance and calibration estimated at 0.5 FTE [($45K/year/FTE)(0.5FTE)(40 years) = $900K). The total estimate for instrument installation at CTF over a 40 year period is estimated at $1680K.

Enhanced Manual Shutdown of HVAC

An enhanced manual shutdown system intended to eliminate the need for personnel to enter the electrical room and manipulate the breaker switches was estimated at $13K (Ref. 6). The estimate entails the installation of a switch outside the CTF breaker room.

Remote Shutdown of HVAC

A phone based remote shutdown system, using a non-dedicated line, with the capability to discriminate tone based identification and shutdown signals was estimated at $30K. Remote shutdown capability based on radio frequency or microwave was excluded due to anticipated costs and limited radio frequency availability.

CTF Habitability Survey Equipment

The cost of a CTF Habitability Survey kit similar to that used by the Emergency Response Organization Field Monitoring teams was estimated at $25K. The kits will consist of organic vapor, transuranic particulate and tritium gas sampling and analysis capability. Due to the variable nature of building infiltration rates based on meteorological conditions and the nature of the releases identified, the kits would enhance the CTF response capability. Personnel in CTF could sample and analyze hazardous material buildup rates to provide accurate trending data for the ERO to base personnel movement decisions.

RESULTS

Averted Risk Dollar Equivalent

The results for the radiological and chemical release accidents are shown below. The dose with the ventilation system operating normally is estimated to be 70% of the outdoor dose, and that with the ventilation system isolated is estimated to be 25% of the outdoor dose. This gives an overall reduction equivalent to 45% of the outdoor dose. The actual benefit of securing the isolation is scenario specific since it depends on both the duration of the building immersion, and how soon the occupants leave after the immersion ceases. However, the attached parametric curves show the benefit is not likely to exceed this estimated value.

Summary Of Existing Risk And Benefits Of HVAC Isolation

Release Type	Outdoor Individual Risk (yr^{-1})	Fatalities Averted	Dollars Averted ($)
Radiological	8.5E-7	0.024	$122,000
Chemical	9.5E-8	0.003	$15,000
total =	9.5E-7	0.027	$137,000

Installed Instrumentation System

The initial cost of placing a set of instruments at CTF is estimated to be ≈$463K. This includes procurement, design/construction costs and setup/calibration of the equipment. A factor of 10% of the initial cost is used to estimate the annual cost of maintaining the equipment over the lifetime of the facility. Based on a 40 year life, the lifetime costs of equipment and its maintenance are estimated to be $1680K.

Enhanced Manual Shutdown of HVAC

An enhanced manual shutdown intended to eliminate the need for personnel to enter the electrical room and manipulate the breaker switches was estimated at $13K.

Remote Shutdown of HVAC

A phone based remote shutdown system, using a non-dedicated line, with the capability to discriminate tone based identification and shutdown signals was estimated at $30K

CTF Habitability Survey Equipment

The cost of a CTF Habitability Survey kit similar to that used by Emergency Response Organization Field Monitoring Teams was estimated at $25K

CONCLUSION

Using the cost of risks avoided for the lifetime of the facility ($137K) and the lifetime cost of installing monitoring equipment within CTF ($1680K) it is not cost-effective to install environmental monitoring equipment at CTF.

Other options to potentially reduce dose at CTF based on HVAC shutdown appear more cost-effective. The cost for an enhanced manual shutdown and remote shutdown of the CTF HVAC is well within the target avoided cost. The addition of habitability survey equipment would still maintain the total cost ($68K) within the target amount. It would be prudent to implement any or all of these options at the CTF.

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ATTACHMENTS

1. Excel™ Spreadsheets Correlating Previous Reports and Event Frequency
2. Figures 1-8 Depicting Concentration and Dose Over Various Release Periods

* Last Page *

Facility : DWPF
Distances to Central Training Facility : 427 m (from DWPF); 762 m (from LWF)
Source Terms taken from References 8, 11, and 12.
Radiological Releases

Accident Scenario (EPHA Release Designation)	Type	Frequency	Risk	Source	EP Class	CTF Outside Dose		ACH	Time	CTF Indoor Dose	
			Adverse	(Pu-238eq)		Adverse	Average			Adverse	Average
		(yr^{-1})	($rem\text{-}yr^{-1}$)	(Ci)		(rem)	(rem)	(hr^{-1})	(min)	(rem)	(rem)
CPC sludge spill, ventilation inoperable, ground level release (4-RD-1)*	DBA	1.00E-04	1.50E-04	3.12E-04	SAE	1.5E+00	3.3E-03	1	20	4.3E-01	9.4E-04
SRAT to SME spill, ventilation inoperable, ground level release (4-RD-3)*	DBA	1.00E-04	1.30E-04	2.72E-04	SAE	1.3E+00	2.9E-03	1	20	3.7E-01	8.2E-04
SME to MFT spill, ventilation inoperable, ground release (4-RD-11)*	DBA	1.00E-04	2.20E-04	4.45E-02	SAE	2.2E+00	4.7E-01	1	20	6.2E-01	1.3E-01
Multiple canisters rupture (DBE initiator) (11-RD-2)	*DBA*	*2.00E-04*	*4.20E-04*	*4.32E-02*	*SAE*	*2.1E+00*	*4.5E-01*	*1*	*20*	*6.0E-01*	*1.3E-01*

*Based on SAR Frequency of "anticipated" for spill (which assumed the Safety Class ventilation system is operating properly) and a conservative probability of 10^{-2} for concurrent loss of ventilation due to loss of offsite power and/or loss of instrument air.

Facility : DWPF
Distances to Central Training Facility : 427 m (from DWPF); 762 m (from LWF)
Source Terms taken from References 8, 11, and 12.
Chemical Releases
ERPG-2 Values: C6H6 (150 ppm), HCOOH (20 ppm), NO (25 ppm), NO2 (15 ppm), SO2 (3 ppm)

Accident Scenario (EPHA Release Designation)	Type	Frequency	Evap Area	EP Class	CTF Outside Conc		ACH	Time	CTF Indoor Conc	
					Adverse	Average			Adverse	Average
		(yr^{-1})	(ft2)		(ppm)	(ppm)	(hr^{-1})	(min)	(ppm)	(ppm)
Breach of Formic Acid Storage Tank and dike (1-RD-2)	*DBA*	*2.00E-04*	*26000*	*SAE*	*71*	*14*	*1*	*20*	*20.13*	*3.97*
NO release from mixing of formic acid and nitric acid upon breach of Formic Acid Storage Tank and Nitric Acid Decon Tank (1-RD-4)	*DBA*	*2.00E-04*	*315 lbm/min for 2 min*	*SAE*	*103*	*47*	*1*	*20*	*29.20*	*13.32*
NO2 release from mixing of formic acid and nitric acid upon breach of Formic Acid Feed Tank and Nitric Acid Decon Tank (1-RD-5)	*DBA*	*2.00E-04*	*61.5 lbm/min for 8 min*	*SAE*	*70*	*8*	*1*	*20*	*19.84*	*2.27*
OWST rupture, releasing full tank of C6H6 (3-RD-1)*	DBA	1.00E-05	1214 kg/min	SAE	1160	728	1	20	328.82	206.37
Breach of formic acid tanker (18-RD-1)**	DBA	1.00E-05	23430	SAE	66	13	1	20	18.71	3.69

*Based on SAR Frequency of Extremely Unlikely
**Not on SAR list of Accidents selected for Detailed Quantitative Analysis; Binned as Extremely Unlikely in DWPF PHA.
Italics indicates accidents whose initiator would cause severe collateral damage to the CTF

Attachment 1

Facility: Tritium
Distance to Central Training Facility : 366 m
Source Terms taken from Reference 17

Radiological Releases

Accident Scenario (EPHA Release Designation)	Type	Frequency	Risk	Source	EP Class	CTF Outside Dose		ACH	Time	CTF Indoor Dose	
			Adverse	HTO		Adverse	Average			Adverse	Average
		(yr^{-1})	($rem\text{-}yr^{-1}$)	(Ci)		(rem)	(rem)	(hr^{-1})	(min)	(rem)	(rem)
In-tank deflagration, Building 232-H **(2-RD-2)**	**DBA**	3.00E-03	6.90E-03	3.70E+06	SAE	2.30E+00	1.10E+00	1	20	6.5E-01	3.1E-01
Design Basis Earthquake (2-RD-3)	*DBA*	*2.00E-04*	*3.40E-01*	*7.10E+07*	*GE*	*1.70E+03*	*2.30E+02*	*1*	*20*	*4.8E+02*	*6.5E+01*
Fire in ST-2 Hood, Building 232-H **(2-RD-4)**	**DBA**	2.70E-02	1.73E-01	1.30E+07	SAE	6.40E+00	3.20E+00	1	20	1.8E+00	9.1E-01
Design Basis Tornado (2-RD-5)	*DBA*	*9.50E-06*	*1.14E-05*	*5.20E+04*	*SAE*	*1.20E+00*	*1.70E-01*	*1*	*20*	*3.4E-01*	*4.8E-02*
Fire in Material Test Facility, Building 232-H **(2-RD-6)**	**DBA**	3.10E-05	2.91E-04	1.90E+07	SAE	9.40E+00	4.70E+00	1	20	2.7E+00	1.3E+00
DBE from RTF (3.2-RD-1)	*DBA*	*2.00E-04*	*2.60E-02*	*1.70E+07*	*GE*	*1.30E+02*	*4.80E+01*	*1*	*20*	*3.7E+01*	*1.4E+01*
*Mix tank leak to open glove box with combustion in Bldg 233-H (3.2-RD-7)**	*DBA*	*6.00E-07*	*2.22E-05*	*6.00E+06*	*SAE*	*3.70E+01*	*1.40E+01*	*1*	*20*	*1.0E+01*	*4.0E+00*
Mix tank deflagration in Building 233-H **(3.2-RD-8)**	**DBA**	6.60E-05	6.14E-04	1.20E+06	SAE	9.30E+00	3.40E+00	1	20	2.6E+00	9.6E-01
Failure of hard wired interlock; high pressure manifold; open glove box with combustion **(3.2-RD-24)**	**DBA**	6.00E-05	7.80E-04	2.10E+06	SAE	1.30E+01	4.80E+00	1	20	3.7E+00	1.4E+00
Building 233-H: P-EVAC Accountability Tank release, open glove box with combustion (3.3-RD-8)	*DBA*	*6.00E-07*	*1.38E-05*	*3.70E+06*	*SAE*	*2.30E+01*	*8.40E+00*	*1*	*20*	*6.5E+00*	*2.4E+00*
Building 233-H:Reactor bed/Z-beds release; open glove box; oxide release **(3.5-RD-1)**	**DBA**	2.50E-04	3.75E-04	1.90E+05	SAE	1.50E+00	5.40E-01	1	20	4.3E-01	1.5E-01
Fire in Room 301, Building 234-H. All reservoirs leak and fully oxidized **(4-RD-1)**	**DBA**	5.10E-04	1.48E-02	5.80E+07	GE	2.90E+01	1.40E+01	1	20	8.2E+00	4.0E+00

Italics indicates accidents whose initiator would cause severe collateral damage to the CTF
**Italics indicates the latest analysis shows the accident to have a frequency of <1.0E-06 yr^{-1}.*

Facility : H-Canyon and Outside Facility
Distance to Central Training Facility : 396 m
291-H Stack Height : 61 m
Source Terms taken from Reference 13
Radiological Releases

Accident Scenario (EPHA Release Designation)	Type	Frequency	Risk	Source	EP	CTF Outside Dose		ACH	Time	CTF Indoor Dose	
			Adverse	(Pu-238eq)	Class	Adverse	Average			Adverse	Average
		(yr^{-1})	($rem\text{-}yr^{-1}$)	(Ci)		(rem)	(rem)	(hr^{-1})	(min)	(rem)	(rem)
Release due to a 0.2g earthquake (1-RD-2-1.1)	*DBA*	*2.00E-04*	*6.40E-03*	*5.61E-01*	*SAE*	*3.2E+01*	*6.8E+00*	*1*	*20*	*9.1E+00*	*1.9E+00*
291-H stack release from 2nd Np Cycle due to a maximum fire (1-RD-2-2.2)	DBA	6.13E-04	8.58E-04	5.34E-01	SAE	1.4E+00	9.4E-01	1	20	4.0E-01	2.7E-01
291-H stack release from Frame Waste Recovery due to a maximum fire (1-RD-2-2.3)	DBA	3.56E-02	4.98E-02	5.24E-01	SAE	1.4E+00	9.3E-01	1	20	4.0E-01	2.6E-01
291-H stack release from 2nd U Cycle due to a maximum fire (1-RD-2-2.4)	DBA	6.13E-04	9.20E-04	5.53E-01	SAE	1.5E+00	9.8E-01	1	20	4.3E-01	2.8E-01
291-H stack release due to an uncontrolled reaction in Frame Waste Recovery (1-RD-2-3.3)	DBA	5.30E-05	1.59E-04	1.11E+00	SAE	3.0E+00	2.0E+00	1	20	8.5E-01	5.7E-01
Release from Dissolving Head End 1st Cycle HAW due to a maximum transfer error to 211-H (1-RD-2-5.1)	DBA	1.40E-04	1.09E-02	1.38E+00	SAE	7.8E+01	1.7E+01	1	20	2.2E+01	4.8E+00
Release from 2nd Np Cycle due to a maximum transfer error to 211-H (1-RD-2-5.2)	DBA	9.60E-05	3.07E-03	5.75E-01	SAE	3.2E+01	7.0E+00	1	20	9.1E+00	2.0E+00
Release from 2nd U Cycle due to a maximum transfer error to 211-H (1-RD-2-5.3)	DBA	3.68E-05	1.21E-03	5.88E-01	SAE	3.3E+01	7.1E+00	1	20	9.4E+00	2.0E+00
Release from LAW due to a maximum transfer error to 211-H (1-RD-2-5.4)	DBA	1.40E-04	5.04E-03	6.40E-01	SAE	3.6E+01	7.8E+00	1	20	1.0E+01	2.2E+00
Release from Np Storage due to a maximum transfer error to 211-H (1-RD-2-5.5)	DBA	9.60E-05	1.73E-03	3.19E-01	SAE	1.8E+01	3.9E+00	1	20	5.1E+00	1.1E+00
Release from Pu Storage due to a maximum transfer error to 211-H (1-RD-2-5.6)	DBA	9.60E-05	3.46E-03	6.46E-01	SAE	3.6E+01	7.8E+00	1	20	1.0E+01	2.2E+00
Release from Frame Recovery Waste due to a maximum transfer error to 211-H (1-RD-2-5.7)	DBA	4.03E-04	1.65E-02	7.38E-01	SAE	4.1E+01	9.0E+00	1	20	1.2E+01	2.6E+00
Release from a maximum coil/tube failure. Source from Dissolving Head End 1st Cycle HAW (1-RD-2-6.1)	DBA	7.20E-05	1.44E-03	3.61E-01	SAE	2.0E+01	4.4E+00	1	20	5.7E+00	1.2E+00
Release from a maximum coil/tube failure. Sources from 2nd Np Cycle, 2nd U Cycle, LAW (1-RD-2-6.2)	DBA	7.20E-05	7.13E-03	1.76E+00	SAE	9.9E+01	2.1E+01	1	20	2.8E+01	6.0E+00
Release from a maximum coil/tube failure. Sources from Np Storage, Pu Storage (1-RD-2-6.3)	DBA	7.20E-05	8.64E-03	2.21E+00	SAE	1.2E+02	2.7E+01	1	20	3.4E+01	7.7E+00
Release from a maximum coil/tube failure. Source from Frame Waste Recovery (1-RD-2-6.4)	DBA	7.20E-05	5.33E-03	1.32E+00	SAE	7.4E+01	1.6E+01	1	20	2.1E+01	4.5E+00
DBE ground level release from Scrap Recovery as Pu-238 (S-RD-2.1.1)	*DBA*	*2.00E-04*	*2.20E-04*	*2.00E-02*	*SAE*	*1.1E+00*	*2.5E-01*	*1*	*20*	*3.1E-01*	*7.1E-02*

Italics indicates accidents whose initiator would cause severe collateral damage to the CTF

Facility : H-Canyon and Outside Facility
Distance to Central Training Facility : 396 m
Source Terms taken from Reference 13
Chemical Releases
ERPG-2 Values: HNO_3 (15 ppm); hydrazine, H_2NNH_2 (0.8 ppm)

Accident Scenario (EPHA Release Designation)	Type	Frequency	Evap Area	EP Class	CTF Outside D		ACH	Time	CTF Indoor Dose	
					Advers	Average			Adverse	Average
		(yr^{-1})	(ft^2)		(ppm)	(ppm)	(hr^{-1})	(min)	(ppm)	(ppm)
Entire hydrazine inventory (20 drums) in 211-12H is breached (2-RD-1-1.10)	DBA	<1.0E-06*	9688	SAE	19	3.8	1	20	5.4E+00	1.1E+00

*Qualitative frequency based on accident being Beyond Extremely Unlikely

569

Facility: RBOF
Distance to Central Training Facility : 610 m
Source Terms taken from Reference 18
Radiological Releases

Accident Scenario (EPHA Release Designation)	Type	Frequency	Risk	Source	EP Class	CTF Outside Dose		ACH	Time	CTF Indoor Dose	
			Adverse			Adverse	Average			Adverse	Average
		(yr^{-1})	($rem\text{-}yr^{-1}$)	(Ci)		(rem)	(rem)	(hr^{-1})	(min)	(rem)	(rem)
Criticality 5E+18** fissions (2-RD-2)	DBA	3.40E-05	3.74E-06	Xe-138eq=4.4E+04	SAE	1.1E-01	1.0E-02	1	20	3.1E-02	2.8E-03
				I-131 eq. =4.0E+02		1.90E+00	2.90E-01	1	20	5.4E-01	8.2E-02
						Thyroid	Thyroid				

**Initially reported as 1.0E+20 fissions. Latest analysis shows 1.0E+20 fissions as <1E-06 yr^{-1} frequency. Initially reported doses reduced by ratio of fission yields. The resulting doses at CTF no longer exceed the appropriate PAC for a criticality accident.

Chemical Releases : None

669

Facility: H-Area Tank Farm
Distance to Central Training Facility : 700 m
Accidents taken from Reference 15
Source Terms taken from Reference 16
Radiological Releases

Accident Scenario (EPHA Release Designation)	Type	Frequency	Risk	Source	EP Class	CTF Outside Dose		ACH	Time	CTF Indoor Dose	
			Adverse	(Pu-238 eq)		Adverse	Average			Adverse	Average
		(yr^{-1})	($rem\text{-}yr^{-1}$)	(Ci)		(rem)	(rem)	(hr^{-1})	(min)	(rem)	(rem)
Design Basis Earthquake (source term 3.4.2.13)	*DBA*	*2.00E-04*	*5.60E-02*	*2.46E+01*	*GE*	*2.80E+02*	*6.10E+01*	*1*	*20*	*7.9E+01*	*1.7E+01*

Italics indicates accidents whose initiator would cause severe collateral damage to the CTF

Chemical Releases : None

769

Facility : ITP/ESP
Distance to Central Training Facility : 823 m
Source Terms taken from References 8, 11
Radiological Releases

Accident Scenario (EPHA Release Designation)	Type	Frequency	Risk	Source	EP Class	CTF Outside Dose		ACH	Time	CTF Indoor Dose	
			Adverse	(Pu-238 eq)		Adverse	Average			Adverse	Average
		(yr^{-1})	($rem\text{-}yr^{-1}$)	(Ci)		(rem)	(rem)	(hr^{-1})	(min)	(rem)	(rem)
Tank 48 annulus fire (5-RD-4)	DBA	1.10E-06	5.50E-05	3.56E+00	SAE	5.0E+01	1.1E+01	1	20	1.4E+01	3.1E+00
Tank 49 annulus fire (6-RD-3)	DBA	1.10E-06	5.50E-05	3.56E+00	SAE	5.0E+01	1.1E+01	1	20	1.4E+01	3.1E+00

3/7/96

869

Facility: NWTF
Distance to Central Training Facility : 850 m

Radiological Releases: None exceed PAC at CTF

Chemical Releases : None exceed PAC at CTF

Facility : CIF & Spent Solvents Storage Tanks
Distance to Central Training Facility : 396 m (from CIF); 488 m (from SSST)
Source Terms taken from Reference 14

Radiological Releases: None exceed PAC at CTF

Chemical Releases
ERPG-2 Values: CCl4 (100 ppm); C6H6 (150 ppm)

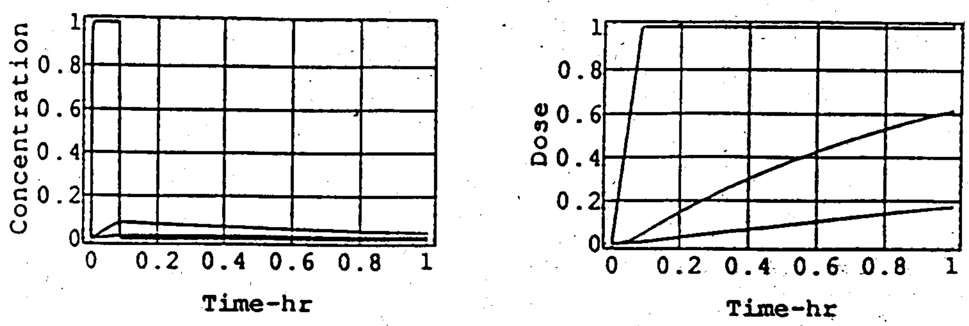
Accident Scenario (EPHA Release Designation)	Type	Frequency	Evap Are	EP Class	CTF Outside Conc		ACH	Time	CTF Indoor Dose	
					Adverse	Average			Adverse	Average
		(yr^{-1})	(. 2)		(ppm)	(ppm)	(hr^{-1})	(min)	(ppm)	(ppm)
Transportation accident causes breach of 60 55-gallon drums, releasing CCl4* (8-RD-2a, 8-RD-5)	DBA	<1.0E-6[(1)]	13450	SAE	149	138	1	20	42	39
Transportation accident causes breach of a 5000-gallon tanker, releasing CCl4* (8-RD-4a, 8-RD-7)	DBA	2.5E-3[(2)]	20374	SAE	213	190	1	20	60	54

*CCl4 is used as a bounding chemical

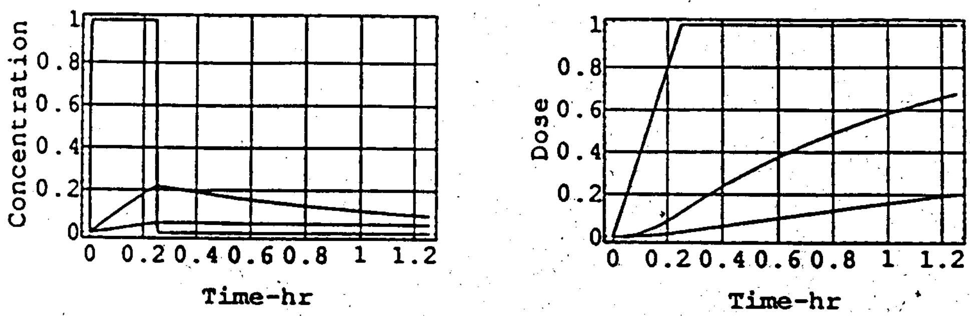
(1)High Energy event needed to postulate damage to entire shipment; based on the CIF surrounding terrain, this accident is binned as Beyond Extremely Unlikely.
[(2)]Spill Frequency is 7.0E-5/hr; Based on TeleCon with Cog Engineer: Estimate 10 hours to offload truck with 35 shipments per year
($7.0E-05\ hr^{-1}$)(10 hr)($35\ yr^{-1}$) = $2.5E-02\ yr^{-1}$ Assume 90% of all spills are recoverable, therefor overall frequency is $2.5E-03\ yr^{-1}$ for 5000 gal. spill.

Figures

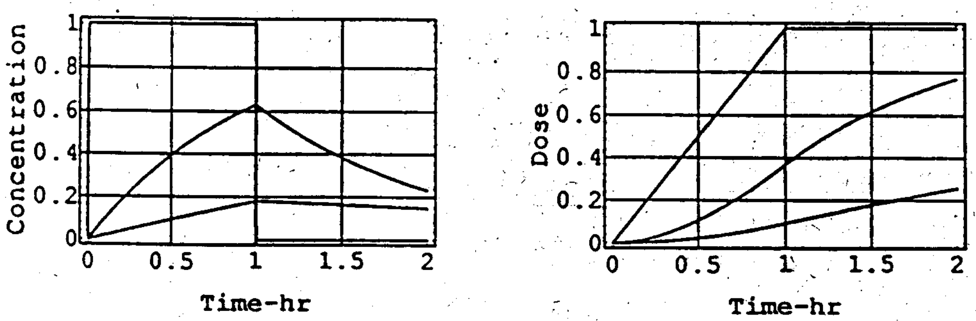
(1)



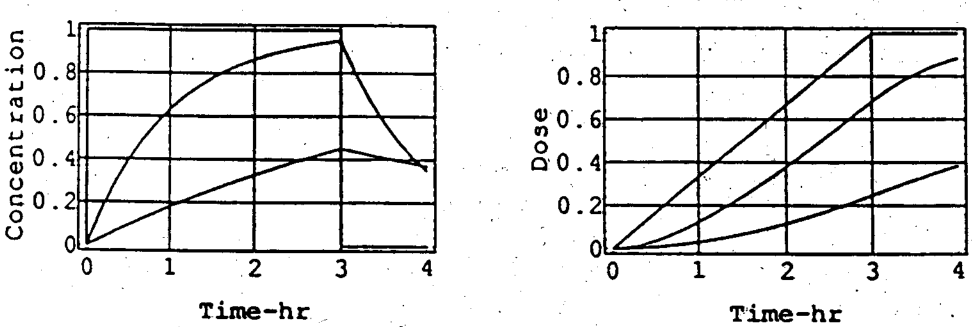
(2)



(3)



(4)



(5)