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			○ Disapproved w/comments

S

HAZARD EVALUATION FOR 244-CR VAULT

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Abstract: This document presents the results of a hazards identification and evaluation performed on the 244-CR Vault to close a USQ (USQ #TF-98-0785, *Potential Inadequacy in Authorization Basis (PIAB): To Evaluate Miscellaneous Facilities Listed In HNF-2503 And Not Addressed In The TWRS Authorization Basis*) that was generated as part of an evaluation of inactive TWRS facilities.

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HAZARD EVALUATION FOR 244-CR VAULT

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF TERMS

AB	Authorization Basis
AIChE	American Institute of Chemical Engineers
BIO	Basis for Interim Operation
Cat	category
Con	consequence
DOE-RL	Department of Energy – Richland Operations Office
Env	environmental
Freq	Frequency
GRE	gas release event
Grp	group
HAZOP	Hazards And Operability Analysis
ID	identification
Mit	mitigative
NC	No Controls
PHA	Preliminary Hazards Assessment
PPP	Prefabricated Pump Pit
Prev	preventive
Rep Acc	representative accident
SSC	structure, system, and component
TBD	to be determined
TSR	Technical Safety Requirement
TWRS	Tank Waste Remediation System
USQ	Unreviewed Safety Question

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1.0 INTRODUCTION

1.1 PURPOSE

USQ #TF-98-0785, *Potential Inadequacy in Authorization Basis (PIAB): To Evaluate Miscellaneous Facilities Listed In HNF-2503 And Not Addressed In The TWRS Authorization Basis* identified three inactive tanks in the 244-CR Vault that were not described in the current Tank Waste Remediation System (TWRS) Basis for Interim Operation (HNF-SD-WM-BIO-001, 1998, Revision 1). The purpose of this document is to identify the hazardous conditions associated with the 244-CR Vault where Authorization Basis (AB) controls may not be sufficient or may not exist. The hazard evaluation results will also be used to add information to the existing BIO database for more complete coverage of Tank Farm facilities.

This document is not intended to authorize the activity, it is only intended to provide information about the hazardous conditions associated with this activity. The Control decision process as defined in the AB will be used to determine the adequacy of controls and whether the proposed activity is within the AB. This hazard evaluation does not constitute an accident analysis.

1.2 BACKGROUND

An evaluation of TWRS facilities identified a number of inactive facilities that were potentially not adequately covered by the existing Authorization Basis. Since three of the tanks in the 244-CR Vault are not described in the BIO, it is not possible to assure that the hazardous conditions associated with these tanks are bounded by the BIO analyses.

In addition, concerns were raised about grouping the 244-CR vault in the BIO with the Double-Contained Receiver Tanks (DCRTs). There are significant differences between the 244-CR Vault and a "standard" DCRT. These differences could involve new or modified accidents that are not addressed adequately by the AB. It was also not known if the controls specified in the AB were adequate to prevent these accidents, or mitigate their consequences.

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2.0 DESCRIPTION

2.1 HISTORY

The 244-CR vault was built in 1952 to support the uranium metal recovery program, which began in the early 1950's. The 244-CR vault and associated tanks and cells were used as the uranium sludge recovery and distribution vault for the 241-C Tank Farm. The 244-CR Vault was also used for the interim storage and transfer of waste from B-Plant, PUREX, Hot Semi-Works including PUREX Acidified Sludge (PAS), and for fission product "crudes" between PUREX and B-Plant. Tanks CR-002, CR-003, and CR-011 have stainless-steel walls, per OSD-T-151-00015.

WHC-MR-0132 shows that waste was transferred from 244-CR (no CR tank identified) to tank 241-C-101 in 1965, to tank 241-C-104 in 1974, and to tank 241-C-106 in 1965. WHC-MR-0132 also shows that waste was transferred to 244-CR (no CR tank identified) from tank 241-C-104 in 1954.

From 1968 to 1978 tanks 244-CR-003 and 244-CR-002 were used to receive the sluiced PAS waste in AR vault (received from A and AX tank farms) and then transferred the waste to B-Plant. After 1983 the 244-CR vault was used for sluicing operation of Hot Semi-Works tank CX-70. The supernatant from tank CX-70 was pumped out in the late 1970's to tank 244-CR-011. In 1987 the sludge from tank CX-70 was pumped into 244-CR-003, agitated, and then transferred to double-shell tanks.

2.2 FACILITY DESCRIPTION

The 244-CR vault is located in the East Area C Farm complex, near the southwest corner, adjacent to the 271-CR building. It is a two-level, multi-cell reinforced concrete structure built below grade, with 0.61 m (2 ft) thick dividing walls and cover blocks. The facility contains two carbon steel ~151,416 L (40,000 gal) tanks, 244-CR-001 and 244-CR-011, and two stainless steel ~56,781 L (15,000 gal) tanks, 244-CR-002 and 244-CR-003. The upper cells contain piping and equipment utilized for vault operation; the lower cells contain the process tanks and sumps. In 1996, the above-ground piping and instrument cabinets were removed, cell cover blocks were sealed with polyurethane, and the areas were resurfaced with crushed rock.

2.3 TANK LIQUID LEVELS AND WASTE INFORMATION

2.3.1 Tank 244-CR-001

Liquid level in tank 244-CR-001 is unknown, as all sensing lines between the instrument cabinet and the tank are plugged. The liquid volume after the last known transfer was 7,381 L (1,950 gal) on 6/16/82. A liquid level reading taken on 6/1/87 indicated zero, but this reading is questionable due to deterioration of the sensing lines.

Tank 244-CR-001 was used as a slurry accumulator, receiving waste from the C Tank Farm. The slurry was processed with nitric acid. Before October 1954, the uranium recovery waste had been stored in an untreated condition. In November 1955, scavenging of these wastes started at the 244-CR facility, resulting in additional scavenged supernatant being disposed into the ground. This operation was completed in 1957. It is assumed that tank 244-CR-001 was used in this operation.

WHC-MR-0132 shows that tank 244-CR-001 received waste from tank 241-C-108 in 1956, from tank 241-C-109 in 1955, and from tank 241-C-110 in 1956. WHC-SD-WM-ER-349 shows that waste was transferred from tank 244-CR-001 to tank 241-C-112 in 1955.

The last waste received in tank 244-CR-001 was from tank 241-C-110 in 1956. The best basis inventory estimates for tank 241-C-110 from HNF-SD-WM-ER-367, Rev. 1, Table B3-3 will be used to estimate the curie content in tank 244-CR-001. See Table 2-1 for the estimated radionuclides and curie content in tank 244-CR-001, and comparison with DOE-STD-1027-92 threshold values for Hazard Categories 2 and 3, and BIO bounding values. Table 2-1 shows that 244-CR-001 exceeds the Threshold Quantities (TQs) for Hazard Category 3 but is below the TQs for Hazard Category 2.

2.3.2 Tank 244-CR-002

A liquid level reading in tank 244-CR-002 taken on 6/1/87 was equivalent to 17,790 L (4,700 gal) of sludge. A more recent reading taken on 11/14/95 indicated equipment malfunction. The weight factor dip tube appeared to be plugged, and the specific gravity dip tube indicated zero, suggesting a level less than 5,916 L (1,563 gal), provided that the specific gravity dip tube was not leaking.

Tank 244-CR-002 was used as a blending tank, mixing waste from tank 244-CR-001 with nitric acid. Historical records indicate that this tank provided additional lag storage, and served as a transfer point for feed from tank 244-AR-001 to B-Plant for strontium recovery, and contained residual PUREX acidified sludge (PAS). The sludge volume, if any, is unknown. The tank has been inactive and isolated since 1985, and no further missions include its use.

The last known waste transfer to tank 244-CR-002 was PAS received from 244-AR-001 in 1978. In the absence of any other sample data or waste composition information available for tank 244-CR-002, sample data for tank 244-AR-001 (see Table 2-2) could be used to estimate the waste composition in tank 244-CR-002. See Table 2-3 for the estimated radionuclides and curie content in tank 244-CR-002, and a comparison with DOE-STD-1027-92 Threshold values for Hazard Categories 2 and 3, and BIO bounding values. Table 2-3 shows that 244-CR-002 exceeds the Threshold Quantities (TQs) for both Hazard Categories 2 and 3.

2.3.3 Tank 244-CR-003

Liquid level in tank 244-CR-003 is approximately 15,140 L (4,000 gal), and is monitored daily via manual tape. Liquid level detection is provided by a zip cord installed 12.5 mm (0.5 in) off the surface of the liquid level of the 244-CR-003 sump, working in conjunction with a leak detector which is 5.08 cm (2 in) off the surface to provide an intrusion Alarm in case liquid should overflow to the sump during saltwell pumping operations. Daily surveillance datasheet entries show the 244-CR-003 sump level as "out of service".

Tank level has decreased approximately 1,893 L (500 gal) from October 1994 through November 1997 (Discrepancy report 97-836, dated 11/97). Even though there are no OSD criteria for leak detection, an investigation began on November 14, 1997. A preliminary analysis suggests that evaporation is a viable means for the decrease. In January and February 1998, this tank received intrusions totaling 1,703 L (450 gal). A video was taken inside the vault on February 5, 1998. Until further investigation, it was determined that water from rain intrusion is a viable cause for the increase. The level has decreased at a rate of approximately 91 L (24 gal) per month since March, 1998.

An operational error occurred on 1/6/98. During project W-320 routine work, 8,896 L (2,350 gal.) of raw water was misrouted, causing an intrusion of approximately 1,261 L (333 gal) of raw water into tank 244-CR-003 from an abandoned 5 cm (2 in) line at the 271-CR facility. No significant cause and effect or adverse conditions were determined (by Operations) which would warrant documenting the occurrence. It is expected that tank 244-CR-003 will continue to be in an interim status until saltwell retrieval is completed in the "C" Tank Farm.

Tank 244-CR-003 was used as a blending tank, mixing waste from tank 244-CR-001 with nitric acid. This tank was also utilized as the primary lag storage and transfer station for PUREX acidified sludge (PAS) during the uranium metal recovery program. Before 1995, the remaining heel in 244-CR-003 was considered to be PAS and Hot Semi-Works tank CX-70 sludge.

The most recent use of tank 244-CR-003 was in 1995 during the SST stabilization campaign for Tanks 241-C-102, 241-C-107, and 241-C-110. Those waste streams have since been removed from 244-CR-003. The best basis inventory estimates from Tank Characterization documents for Tanks 241-C-102 (HNF-SD-WM-ER-651, Rev. 0A), 241-C-107 (HNF-SD-WM-

ER-474, Rev. 0), and 241-C-110 (HNF-SD-WM-ER-367, Rev. 1) could be used to estimate the curie content in tank 244-CR-003. See Tables 2-4A, 2-4B, and 2-4C for the estimated radionuclides and curie content in tank 244-CR-003, and a comparison with DOE-STD-1027-92 Threshold Values for Hazard Categories 2 and 3, and BIO bounding values. Tables 2-4A, 2-4B, and 2-4C show that 244-CR-003 exceeds the Threshold Quantities (TQs) for Hazard Category 3 but is below the TQs for Hazard Category 2.

2.3.4 Tank 244-CR-011

Liquid level in tank 244-CR-011 taken on 3/24/86 after the last known transfer was 135,060 L (35,683 gal). The bulk of this inventory is approximately 79,494 L (21,000 gal) of Hot Semi-Works tank CX-70 supernatant liquid transferred in 1979. The remaining inventory is expected to be rainwater from the Hot Semi-Works and 244-CR vault sump drainage. The most recent liquid level was taken on 11/15/95. A portable air tank and digital pressure gauge was connected to the specific gravity dip tube. A dip tube pressure measurement of 62 cm (24.8 in) of water calculates to a waste volume of 20,893 L (5,520 gal).

Initially, tank 244-CR-011 acted as a process pump tank for the transfer of processed waste from the 244-CR vault to the diversion station to be transferred to the uranium recovery facility, or other operations. In the 1970's, tank 244-CR-011 was used as the sump receiver for the 244-CR vault, and from tank 69 at Hot Semi-Works. Small rainwater accumulations were jetted from the other three 244-CR vault sumps. The tank sludge content is not known.

The results of the 244-CR-011 waste sample taken on 10/3/81 are as follows:

Al	< 0.3510 E-02 M
OH^-	0.9500 E-02 M
CO_3	0.3310 E-01 M
TOC	0.1550 E+00 g/L C
GEA	0.1635 E+04 μCi/L ^{137}Cs
NO_2	0.8670 E-01 M
Pu	0.1780 E-04 g/L

In May, 1984, the Hot Semi-Works decontamination team made its last transfer to tank 244-CR-011. A sample information from an internal memorandum (#65452-84-093 of Rockwell International Co., dated 5/18/84) from the Analytical Process group to the Safety Integration group has been used to figure out the curie content in this tank. In the absence of any known specific gravity of the waste in the tank, a specific gravity value of 1.5 was used as a conservative number. See Table 2-5 for the estimated radionuclides and curie content in tank 244-CR-011, and a comparison with DOE-STD-1027-92 Threshold Values for Hazard Categories 2 and 3, and BIO bounding values. Table 2-5 shows that 244-CR-011 exceeds the Threshold Quantities (TQs) for Hazard Category 3 but is below the TQs for Hazard Category 2.

2.4 VENTILATION

Ventilation in the 244-CR vault consists of gravity, or ambient, air supply with air directed and controlled through the vault by operation of the 291-CR ventilation, air filtration, and exhaust system. A 30 in diameter inlet header supplies filtered air, via sub-headers, to the pump pits and to the four vault sections containing tanks 244-CR-001, 244-CR-002, 244-CR-003, and 244-CR-011. Exhaust air from the tanks, pump pits, and vault areas is routed to the inlet plenum of the exhaust filters. Two exhaust fans (one operating, one in standby mode) each rated at 119 m^3/min (4,200 ft^3/min) and 18.68 mm Hg (10 in wg) provide the power for supply and exhaust air. Loss of power to the fans will activate an alarm on the operating control panel. The alarm signal will also be transmitted to 244-AR.

Exhaust ports connecting the upper and lower vault sections allow airflow between the two sections. Air is removed from the lower vault section at the floor level, and is routed into a filter plenum. A double bank of HEPA filters treat the air prior to exhausting to the atmosphere through the stack. However, there is no separate vessel ventilation system for the tanks themselves. Exhaust air from the tanks enters the lower and upper vault sections via floor drains and exhaust ports and is then swept away by the vault ventilation system airflow.

There are no ventilation flow instruments for the tanks themselves. In addition, no gas monitoring has been performed for these tanks to determine if the ventilation provided to these tanks by the vault ventilation system is adequate to maintain the flammable gas concentrations within acceptable levels (i.e., less than 25% of the LFL). Until adequate ventilation is verified, and controls for maintaining it operable are implemented, equipment located in the headspace of these tanks must meet ignition source controls (set 2), or be deenergized.

Because tank 244-CR-003 is desired to be maintained in active status for possible use as lag storage during the saltwell pumping of tank 241-C-103, and because gas sampling is more practical in tank 244-CR-003 due to tank access being available through the manual tap access riser, the adequacy of the ventilation provided to tank 244-CR-003 will be verified by obtaining gas samples of the tank vapor space. Air purging will be provided in this facility if sample results indicate flammable gas concentrations $\geq$ 25% of the LFL. LCO 3.2.4 requires the operability of ventilation to tank 244-CR-003 (HNF-SD-WM-TSR-006). In addition, AC 5.11.2.d requires that the ventilation flow be verified to be adequate for new waste types prior to placing new waste types in this tank (HNF-SD-WM-TSR-006).

Due to the remaining sludge heels in tanks 244-CR-001, 244-CR-002, and 244-CR-003, these tanks are categorized as Facility Group 3. This conservative categorization ensures that the potential hazard of releasing gases that may be retained by the waste solids is adequately considered during waste disturbing operations (e.g., sludge heel removal). The supernatant liquid contained in tank 244-CR-011 was determined by the BIO analysis to have no significant gas retention potential and, therefore, this tank is categorized in AC 5.9, Flammability Controls, as non-GRE, and is not subject to waste intrusive, waste-intruding, or GRE controls as identified in BIO Appendix E.

Table 2-1: Estimated Radionuclides in 244-CR-001 and Comparison with Threshold Values. (Based on 241-C-110 waste composition)

Radionuclide in 244-CR-001 (Assumed same as 241-C-110)	241-C-110 Sludge composition (µCi/g) (Ref. HNF-SD-WM-ER-367, Rev. 1, Table B3-3)	Estimated curie content in 244-CR-001 based on 241-C-110 concentration (curies)	Category 2 Threshold Curies (DOE-STD-1027-92)	Category 3 Threshold Curies (DOE-STD-1027-92)	BIO Source Term Conc. (Bq/L) Table 5.3.1-4 (SST Solids)	BIO Source Term Conc. (Ci/L) Table 5.3.1-4 (SST Solids)	Estimated curie content in 244-CR-001 based on BIO concentration (curies)
^{60}Co	< 3.61 E-02	< 3.86 E-01	1.9 E+05	2.8 E+02	4.2 E+08	1.134E-02	8.36 E+01
^{90}Sr	4.93 E+00	5.28 E+01	2.2 E+04	1.6 E+01	1.6 E+12	4.32E+01	3.18 E+05
^{99}Tc	3.30 E-02	3.53 E-01	3.8 E+06	1.7 E+03	Not Listed	Not Listed	N/A
^{137}Cs	1.95 E+01	2.09 E+02	8.9 E+04	6.0 E+01	1.0 E+11	2.7E+00	1.99 E+04
^{154}Eu	< 9.33 E-02	< 9.98 E-01	1.1 E+05	2.0 E+02	5.8 E+09	1.5667E-01	1.15 E+03
^{155}Eu	< 1.12 E-01	1.2 E+00	7.3 E+05	9.4 E+02	Not Listed	Not Listed	N/A
^{238}Pu	< 4.13 E-03	< 4.42 E-02	6.2 E+01	6.2 E+01	1.9 E+08	5.13E-03	3.78 E+02
$^{239/240}$Pu	8.00 E-02	8.56 E-01	5.6 E+01	5.2 E-01	4.4 E+08	1.188E-02	8.76 E+01
^{237}Np	< 3.66 E-02	< 3.92 E-01	5.8 E+01	4.2 E-01	3.0 E+07	8.1E-04	5.97 E+00
^{14}C	3.2 E-04	3.42 E-03	1.4 E+06	4.2 E+02	Not Listed	Not Listed	N/A

Sludge density = 1.45 g/ml

Table 2-2: AR Vault Sludge Processing Sample (Dated 4/18/78) Serial No. 8194, AR-001P

Analysis	Supernatant	Solids
pH	0	Not Available
H^+	0.481	Not Available
SpG	1.054	Note 1
Pu	2.43 E-03 g/gal	1.85 E-04 g/g
$^{89,90}Sr$	1.44 E+07 µCi/gal	2.09 E+04 µCi/g
Complexible Cations	0.238 M	Not Available
Ca	1.05 E-02 M	Not Available
Na	0.129 M	Not Available
^{137}Cs	3.14 E+05 µCi/gal	2.54 E+02 µCi/g
^{60}Co	8.74 E+03 µCi/gal	84.9 µCi/g
^{144}Ce	Not Available	2.15 E+02 µCi/g
^{154}Eu	Not Available	1.85 E+02 µCi/g
^{155}Eu	7.84 E+02 µCi/gal	4.92 E+02 µCi/g
^{125}Sb	Not Available	9.78 E+02 µCi/g

Volume of supernatant:	5.90 ml
Volume of solids:	0.70 ml
Weight of solids:	0.368 g
Volume of solids dissolution:	450 ml

Note 1: As the waste density is not available, we will assume the specific gravity of solids in the waste to be 1.5 (DST average waste specific gravity).

Table 2-3. Estimated Radionuclides in 244-CR-002 and Comparison with Threshold Values. (Based on 244-AR-001 waste Composition)

Radionuclide in 244-CR-002 (Assumed same as 244-AR-001)	244-AR-001 Solids Composition (μCi/g)	Estimated curie content in 244-CR-002 based on 244-AR-001 concentration (curies)	Category 2 Threshold Curies (DOE-STD-1027-92)	Category 3 Threshold Curies (DOE-STD-1027-92)	BIO Source Term Conc. (Bq/L) Table 5.3.1-4 (SST Solids)	BIO Source Term Conc. (Ci/L) Table 5.3.1-4 (SST Solids)	Estimated curie content in 244-CR-002 based on BIO concentration (curies)
^{60}Co	84.90 E+00	7.53 E+02	1.9 E+05	2.8 E+02	4.2 E+08	1.134E-02	6.71 E+01
^{90}Sr	2.09 E+04	1.85 E+05	2.2 E+04	1.6 E+01	1.6 E+12	4.32E+01	2.55 E+05
^{137}Cs	2.54 E+02	2.25 E+03	8.9 E+04	6.0 E+01	1.0 E+11	2.7E+00	1.59 E+04
^{154}Eu	1.85 E+02	1.64 E+03	1.1 E+05	2.0 E+02	5.8 E+09	1.567E-01	9.27 E+02
^{155}Eu	4.92 E+02	4.37 E+03	7.3 E+05	9.4 E+02	Not Listed	Not Listed	N/A
^{125}Sb	9.78 E+02	8.68 E+03	Not Listed*	Not Listed*	Not Listed	Not Listed	N/A

Assume density = 1.5 g/ml

* Only ^{124}Sb and ^{126}Sb listed in DOE-STD-1027-92, Attachment 1, Table A.1

Table 2-4A. Estimated Radionuclides in 244-CR-003 and Comparison with Threshold Values. (Based on 241-C-102 waste Composition)

Radionuclide in 244-CR-003 (Assumed same as 241-C-102, sample based)	241-C-102 Sludge Composition (μCi/g) (Ref. HNF-SD-WM-ER-651, Rev. 0A, Table D2-3)	Estimated curie content in 244-CR-003 based on 241-C-102 concentration (curies)	Category 2 Threshold Curies (DOE-STD-1027-92)	Category 3 Threshold Curies (DOE-STD-1027-92)	BIO Source Term Conc. (Bq/L) Table 5.3.1-4 (SST Solids)	BIO Source Term Conc. (Ci/L) Table 5.3.1-4 (SST Solids)	Estimated curie content in 244-CR-003 based on BIO concentration (curies)
^{60}Co	0.184	5.02 E+00	1.9 E+05	2.8 E+02	4.2 E+08	1.134E-02	1.72 E+02
^{137}Cs	9.06	2.47 E+02	8.9 E+04	6.0 E+01	1.0 E+11	2.7E+00	4.08 E+04
^{154}Eu	0.033	9.00 E-01	1.1 E+05	2.0 E+02	5.8 E+09	1.567E-01	2.37 E+03
^{155}Eu	0.033	9.00 E-01	7.3 E+05	9.4 E+02	Not Listed	Not Listed	N/A
$^{239, 240}Pu$	2.54	6.93 E+01	5.6 E+01	5.2 E-01	4.4 E+08	1.188E-02	1.80 E+02
^{241}Am	0.53	1.45 E+01	5.5 E+02	5.2 E-01	2.3 E+08	6.21E-03	9.4 E+00

Sludge density = 1.8 kg/L

Table 2-4B. Estimated Radionuclides in 244-CR-003 and Comparison with Threshold Values. (Based on 241-C-107 waste Composition)

Radionuclide in 244-CR-003 (Assumed same as 241-C-107)	241-C-107 Sludge Composition (µCi/g) (Ref. HNF-SD-WM-ER-474, Rev. 0, Table ES2-5)	Estimated curie content in 244-CR-003 based on 241-C-107 concentration (curies)	Category 2 Threshold Curies (DOE-STD-1027-92)	Category 3 Threshold Curies (DOE-STD-1027-92)	BIO Source Term Conc. (Bq/L) Table 5.3.1-4 (SST Solids)	BIO Source Term Conc. (Ci/L) Table 5.3.1-4 (SST Solids)	Estimated curie content in 244-CR-003 based on BIO concentration (curies)
^{90}Sr	469	9.59 E+03	2.2 E+04	1.6 E+01	1.6 E+12	4.32E+01	6.54 E+05
^{137}Cs	13.3	2.72 E+02	8.9 E+04	6.0 E+01	1.0 E+11	2.7E+00	4.08 E+04
$^{239,240}Pu$	0.165	3.37 E+00	5.6 E+01	5.2 E-01	4.4 E+08	1.188E-02	1.80 E+02

Waste density = 1.35 g/ml

Table 2-4C. Estimated Radionuclides in 244-CR-003 and Comparison with Threshold Values. (Based on 241-C-110 waste composition)

Radionuclide in 244-CR-003 (Assumed same as 241-C-110)	241-C-110 Sludge composition (μCi/g) (Ref. HNF-SD-WM-ER-367, Rev. 1, Table B3-3)	Estimated curie content in 244-CR-003 based on 241-C-110 concentration (curies)	Category 2 Threshold Curies (DOE-STD-1027-92)	Category 3 Threshold Curies (DOE-STD-1027-92)	BIO Source Term Conc. (Bq/L) Table 5.3.1-4 (SST Solids)	BIO Source Term Conc. (Ci/L) Table 5.3.1-4 (SST Solids)	Estimated curie content in 244-CR-003 based on BIO concentration (curies)
^{60}Co	< 3.61 E-02	< 7.93 E-01	1.9 E+05	2.8 E+02	4.2 E+08	1.134E-02	1.72 E+02
^{90}Sr	4.93 E+00	1.08 E+02	2.2 E+04	1.6 E+01	1.6 E+12	4.32E+01	6.54 E+05
^{99}Tc	3.30 E-02	7.24 E-01	3.8 E+06	1.7 E+03	Not Listed	Not Listed	N/A
^{137}Cs	1.95 E+01	4.29 E+02	8.9 E+04	6.0 E+01	1.0 E+11	2.7E+00	4.08 E+04
^{154}Eu	< 9.33 E-02	< 2.05 E+00	1.1 E+05	2.0 E+02	5.8 E+09	1.567E-01	2.37 E+03
^{155}Eu	< 1.12 E-01	< 2.46 E+01	7.3 E+05	9.4 E+02	Not Listed	Not Listed	N/A
^{238}Pu	< 4.13 E-03	< 9.07 E-02	6.2 E+01	6.2 E+01	1.9 E+08	5.13E-03	7.77 E+01
$^{239/240}Pu$	8.00 E-02	1.76 E+00	5.6 E+01	5.2 E-01	4.4 E+08	1.188E-02	1.80 E+02
^{237}Np	< 3.66 E-02	< 8.04 E-01	5.8 E+01	4.2 E-01	3.0 E+07	8.1E-04	1.22 E+01
^{14}C	3.2 E-04	7.02 E-03	1.4 E+06	4.2 E+02	Not Listed	Not Listed	N/A

Sludge density = 1.45 g/ml

Table 2-5. Estimated Radionuclides in 244-CR-011 and Comparison with Threshold Values. (Based on 3/13/84 Sample)

Radionuclide in 244-CR-011 (Assumed same as sample data dated 3/13/84)	291-C (reverse well) Hot Semi-Works (Rockwell letter #65452-84-093) (μCi/g)	Estimated curie content in 244-CR-011 based on sample concentration (curies)	Category 2 Threshold Curies (DOE-STD-1027-92)	Category 3 Threshold Curies (DOE-STD-1027-92)	BIO Source Term Conc. (Bq/L) Table 5.3.1-4 (SST Solids)	BIO Source Term Conc. (Ci/L) Table 5.3.1-4 (SST Solids)	Estimated curie content in 244-CR-011 based on BIO concentration (curies)
^{90}Sr	628	1.97 E+04	2.2 E+04	1.6 E+01	1.6 E+12	4.32E+01	9.03 E+05
^{137}Cs	0.10	3.13 E+00	8.9 E+04	6.0 E+01	1.0 E+11	2.7E+00	5.64 E+04
^{154}Eu	0.16	0.50 E+01	1.1 E+05	2.0 E+02	5.8 E+09	1.567E-01	3.27 E+03
^{155}Eu	0.17	0.53 E+01	7.3 E+05	9.4 E+02	Not Listed	Not listed	N/A
^{241}Am	0.18	0.56 E+01	5.5 E+01	5.2 E-01	2.3 E+08	6.21E-03	1.29 E+02
^{239}Pu	5.2 E-02	1.63 E+00	5.6 E+01	5.2 E-01	4.4 E+08	1.188E-02	2.48 E+02

Assume Specific Gravity as 1.5

3.0 HAZARD IDENTIFICATION AND EVALUATION

The hazards identification and evaluation for the 244-CR Vault used the Hazards and Operability Analysis (HAZOP) method. In a HAZOP, a team leader systematically guides the HAZOP team through the system/process being evaluated using a fixed set of process parameters (e.g., flow, temperature, pressure) and guide words (e.g., high, low, less, more). The combination of the process parameters and guide words are applied at specific points or "nodes" in the system design to identify potential hazardous conditions associated with the operation of the system.

The waste transfer HAZOP was performed by an interdisciplinary team to identify the combinations of process parameters and guide words (the combination is generally referred to as deviations) associated with the installation and operation of waste transfer equipment that could potentially result in undesirable consequences. Process parameters, guide words, and deviations are listed in Table 3-1. During the HAZOP process potential consequences of the deviations were estimated, hazardous conditions formulated, and possible corrective and/or preventive measures identified and discussed. This process is recognized by the American Institute of Chemical Engineers (AIChE) and is described in AIChE, 1992, *Guidelines for Hazard Evaluation Procedures*. The HAZOP uses a tabular format to record the results of the systematic process.

Because the HAZOP process tends to be qualitative in nature, the expertise and experience of the team is of primary importance in establishing the credibility of the analysis. A short resume' of each team member is included in Appendix A to document the expertise and experience level of each team member.

3.1 METHODOLOGY

The HAZOP team met to develop the raw data. The information was recorded systematically in tabular format. The following sections describe the HAZOP table structure, information recording details, and process node descriptions.

3.1.1 HAZOP Table

The HAZOP table (Appendix B, Table B-1) was structured to ensure a systematic and thorough evaluation of the potential hazards. The HAZOP table captured the following information:

Node description: A description of the node being evaluated. This information is captured in the table row preceding the first item for a given node, and is summarized in Section 3.1.2.

Item ID: The item identification (ID); used to record a unique identifier for the hazardous condition.

Node: Specific point in the system or process where the deviation from the desired condition of a process variable is evaluated. Nodes are chosen to ensure that no area where an undesirable condition could occur is left unevaluated. See Figure 3-1, "Node Diagram".

Process Variable: The characteristics of a process, such as flow, pressure, or temperature, which are used to define proper operation.

Guide Word: Words that describe the variance in the process variable of concern such as high, low, more, or less. A complete summary of process variables and deviation guide words is given in Table 3-1.

Possible Causes of Deviation: The causes of the deviation that leads to the Hazardous Condition. Identifying causes is important to identifying potential preventive or mitigative controls or features for significant hazardous conditions as well as potential consequences. In many cases, multiple hardware or operational faults are required to produce a hazardous condition. This column identifies the sequence of hardware and operational faults required to produce the postulated hazardous condition.

Hazardous Condition: The hardware failures, operational faults, or conditions that could result in undesired consequences during waste transfer activities. The Hazardous Condition is a concise statement combining the Cause, Consequence, and mode of radioactive material release.

Consequence: The potential consequences that could result from the postulated deviation.

Potential SSCs: SSCs are engineered features (hardware items) identified by the HAZOP team that have the potential to mitigate or prevent the hazardous condition of concern. The use of the term SSC is applied in the generic sense of "systems, structures, and components" and encompasses, but is not limited to, the AB defined set. No attempt is made to provide an exhaustive list. During the HAZOP, information captured in this column aids in determination of the frequency of the event without preventive or mitigative features. During the subsequent evaluation of the hazardous conditions, this information assists in identification of hazardous conditions which may require SSCs but for which no AB authorized SSCs exist. Information contained in this column may also be used during consequence analysis to assist in identification of new SSCs. The items contained in this column should not be construed as being the "official" SSCs that would eventually be credited in the AB.

Potential TSRs: TSRs are administrative controls identified by the HAZOP team that have the potential to mitigate or prevent the hazardous condition of concern. The use of the term TSR is applied in the generic sense of administrative controls and encompasses, but is not limited to, the existing AB set. No attempt is made to provide an exhaustive list. During the HAZOP information captured in this column aids in determination of the frequency of the event without

preventive or mitigative administrative controls. During the subsequent evaluation of the hazardous conditions this information assists in identification of hazardous conditions which may require administrative controls but for which no AB authorized controls exist. Information contained in this column may also be used during consequence analysis to assist in identification of new TSRs. The items contained in this column should not be construed as being the "official" TSRs that would eventually be credited in the AB.

Con Cat The consequence category is a code designator for the level of consequence associated with a hazardous condition. The consequence ranking is a "first cut," qualitative estimate of the safety severity of the consequences assuming no controls are present. The following system is used:

S0 Negligible safety concerns for the facility worker.

S1 Potential industrial injury, low radiological or chemical exposure dose consequences to the facility worker.

S2 Potential significant radiological dose consequences or chemical exposure to onsite workers located outside the facility.

S3 Potential significant radiological dose consequences or chemical exposure to the offsite population.

Freq Cat: The frequency category is a "first cut," qualitative estimate of the likelihood of the hazardous condition assuming no controls are present. The following system is used:

F3 Events that are expected to occur one or more times during the lifetime of the facility, categorized as "anticipated" events. The frequency range associated with this category is 1E-02/yr to 0.1/yr.

F2 Events that could occur during the lifetime of the facility, but with low probability. Such events are categorized as "unlikely" and fall in the range of 1E-04/yr to 1E-02/yr.

F1 Events not expected to occur during the lifetime of the facility, categorized as "extremely unlikely." The frequency range associated with this category is 1E-06/yr to 1E-04/yr.

F0 Events categorized as "beyond extremely unlikely," with a frequency less than 1E-06/yr. Events in this category (such as meteor strike) are so unlikely they generally do not require special controls.

Env Cat: The environmental consequence ranking is a "first cut," qualitative estimate of the environmental severity of the hazardous condition assuming no controls are present. The following system is used:

E0 No significant environmental effect outside the facility confinement systems.

E1 Limited environmental discharge of hazardous material outside the facility.

E2 Large environmental discharge of hazardous material within the plant site boundary.

E3 Significant environmental discharges of hazardous material outside the plant site boundary.

Remarks: Miscellaneous observations or clarifying comments for a given item.

The following additional nomenclatures derived from HNF-SD-WM-TI-784 have been used in Tables B-5 and B-6:

- **BIN**-A code that describes the release attributes for high Safety Consequence (S2 and S3) and Worker Hazard (S1) with anticipated frequency (F3) Hazardous condition.
- **Cause Grp**-- Cause Group-An alpha/numeric code used to permit sorting of data by the cause of a Hazardous Condition.
- **MAR**--Material at Risk-A description of the type and quantity (when applicable) of material that may be affected by the occurrence of a Hazardous Condition.
- **Rep Acc**--Representative Accident- An alpha/numeric code used to specify the analyzed accident by which the specified Hazardous Condition is represented. Only Hazardous Conditions with high Safety Consequence (S2 or S3) were assigned representative accidents

3.1.2 HAZOP Node Description

The 244-CR Vault HAZOP was based on nodes chosen to capture points in the process where deviations could result in significant consequences. The nodes are:

Node 1: Waste and waste level in tank 244-CR-003.

Node 1A: Cooling coil and raw water supply to tank cooling coils.

Node 2: Tank cell for 244-CR-003 (including cell sump).

Node 3: Tank 244-CR-003 physical structure including supports.

Node 4: Vault physical structure of tank cell CR-003 including cover blocks.

Node 5: Tank 244-CR-003 vapor space.

Node 6: 244-CR facility ventilation system inlet.

Node 7: Ventilation distribution in vault 244-CR and tanks.

Node 8: Ventilation exhaust downstream of fan.

Tank 244-CR-003 was chosen as the "model" tank for this facility. All nodes were initially based upon only tank 244-CR-003. When the HAZOP process had been completed for tank 244-CR-003 for each node, the question was asked "Is there any difference between Tank 244-CR-003 and any of the other 244-CR tanks for this node?" Only in cases where a recognizable difference was identified between Tank 244-CR-003 and another 244-CR vault tank was the HAZOP process undertaken for of the other tank. See Figure 3-1, "Node Diagram".

3.2 MAJOR ASSUMPTIONS

The specific assumptions as developed during the hazards identification/evaluation team meeting, that are unique to this hazard analysis are:

1. Tank 244-CR-003 to be considered inactive, except for saltwell pumping.

2. Other tanks deactivated but potential exists for unidentified connections being present.

3. Ventilation inlet configuration uncertain - the inlet building is not in service - tank ventilation configuration has no flow through.

4. Electrical power to pumps severed to control centers.

5. Electrical power to leak detectors and pit heaters exists only to 244-CR-003 (locked out) - severed to all other leak detectors and pit heaters.

6. Isolation status of facility is not known.

7. Raw water isolation status is unknown.

3.3 EVALUATION

A total of 119 hazardous conditions was identified as a result of the HAZOP process, and are shown in Appendix B, Table B-1: HAZOP Data - 244-CR Vault. Of these 119 hazardous conditions, 75 were assigned S2 consequences; there were no conditions with S3 consequences assigned.

Tables B-2, B-3, and B-4 of Appendix B present hazardous conditions grouped by consequence category (S2, S1, and S0, respectively). These tables contain the item ID number, Hazardous Condition, Cause, Frequency Category Without Controls (Freq Cat), and the Environmental Impact Category (Env Cat).

Table B-5 of Appendix B presents the potential applicability of current TWRS AB controls to hazardous conditions with S2 consequences, listed in order of Representative Accident number. This table is intended to demonstrate that potential controls for prevention or mitigation of the identified hazardous conditions exist in the TWRS AB. However, the specified controls are not to be construed as the approved set of controls for the hazardous condition. Designation of the approved set of controls is outside the scope of this analysis.

Table B–6 of Appendix B, groups all of the S2 accidents found to have characteristics

similar to the Representative Accidents under the BIO Accident category. Hazardous condition frequency was not considered in assignment to a Representative Accident. Representative Accidents and Cause Group identifiers were assigned from WHC-SD-WM-TI-764, Rev. 0, *Hazard Analysis Database Report.*

Although all S2 accidents can be assigned to a BIO Accident category, 5 of these S2 accidents were found to have control allocation problems requiring further evaluation. Four of the accidents (with ID numbers CR-244-23A, -23B, -23C, and -23D) involve a leak from any of the 244-CR vault tanks into the associated cell sump; the material in the sump dries out and is assumed to become resuspended in a dry state. Although these conditions fall under the general category of HEPA Filter Failure - Exposure to High Temperature or Pressure, it is unclear that the dry material being released is fully bounded by the existing AB analyses, and a specific analysis of this material should be performed to assure that the source term is bounded.

One accident, (with ID number CR-244-81) raises TSR applicability concerns. The applicable TSRs (LCO 3.1.4, Ventilation Stack Continuous Air Monitor (CAM) Interlock Systems, LCO 3.2.4, DCRT Ventilation, AC 5.10, Ignition Controls, and AC 5.11, Flammable Gas Monitoring Controls) currently apply only to tank 244-CR-003, while the accident may occur in any of the four cells. The TSR applicability should be reviewed to determine if the other 3 tanks should be included in the TSR applicability statement.

In addition, it was noted that intrusive activity controls should be reviewed and revised (if necessary), to assure that the 244-CR facility activities of vapor space sampling, tank sampling, and cell and cell sump sampling are appropriately covered by those controls.

Figure 3-1. Node Diagram.

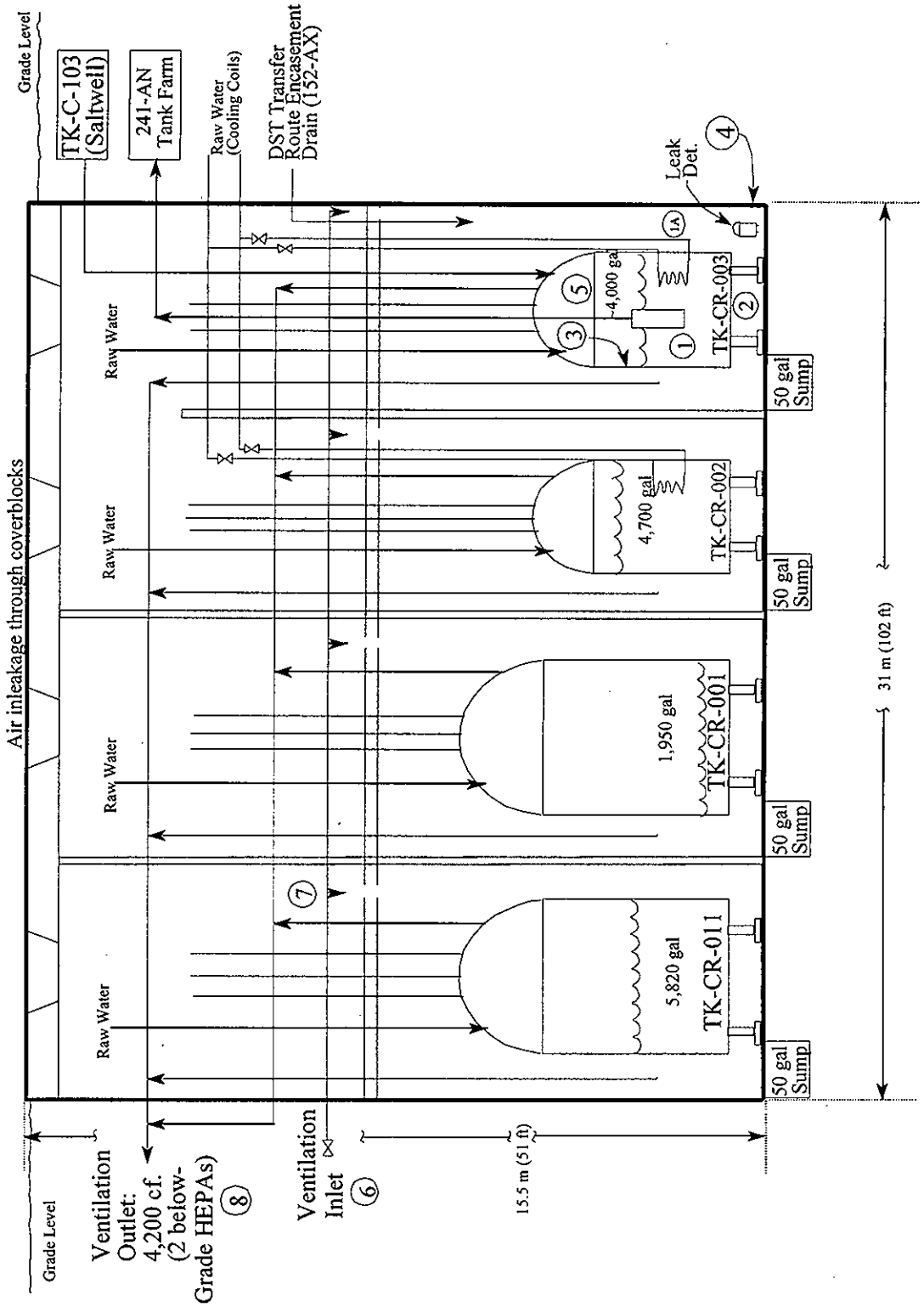

Table 3-1. HAZOP Process Variables and Deviation Guide Words.

Process Variables	Guide Words						
	NO, NOT, NONE	LESS, LOW, SHORT	MORE, HIGH, LONG	PART OF	AS WELL AS, ALSO	OTHER THAN	REVERSE
FLOW	No Flow	Low Rate, Low Total	High Rate, High Total	Missing Ingredient	Misdirection, Impurities	Wrong Material	Backflow
PRESSURE	Open to Atmosphere	Low Pressure	High Pressure				Vacuum
TEMPERATURE	Freezing	Low Temperature	High Temperature				Auto-refrigeration
LEVEL	Empty	Low Level	High Level	Low Interface	High Interface		
AGITATION	No Mixing	Poor Mixing	Excessive Mixing	Mixing Interruption	Foaming		Phase Separation
REACTION	No Reaction	Slow Reaction	Runaway Reaction	Partial Reaction	Side Reaction	Wrong Reaction	Decomposition
TIME PROCEDURE	Skipped or missing Step	Too Short, Too Little	Too Long, Too Much	Action(s) Skipped	Extra Action(s) (Shortcuts)	Wrong Action	Out of Order, Opposite
SPEED	Stopped	Too Slow	Too Fast	Out of Sync		Web or Belt Break	Backward
pH		Low pH	High pH		Additional Acid, Additional Base	Wrong Acid, Wrong Base	
CONCENTRATION		Low Concentration	High Concentration	Missing Ingredient		Additional Ingredient	
VISCOSITY		Low Viscosity	High Viscosity				
VOLTAGE	No Voltage	Voltage Low	Voltage High	Wrong Waveform	Interference Voltage	Wrong Frequency, AC instead of DC DC instead of AC	Wrong Polarity
CURRENT	No Current	Current High	Current Low			Current Fluctuating	Wrong Polarity
STATIC			Static Charge				
SPECIAL	Utility Failure	External Leak	External Rupture	Tube Leak	Tube Rupture	Startup, Shutdown, Maintenance	
STRUCTURAL STRENGTH	Structural Failure	Less Strength	More Strength				
SHIELDING		Less Shielding	More Shielding				

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4.0 CONCLUSIONS

The 244-CR vault HazOp identified 75 hazardous conditions having S2 consequences; there were no consequences greater than S2. Of these 75 hazardous conditions, five were found to have control allocation problems requiring further evaluation. Four of these accidents, designated CR-244-23A, -23B, -23C, and -23D, involve a leak from any of the 244-CR vault tanks into the associated cell sump, followed by the sump drying out and creating a release of dry particulate material. One accident, designated CR-244-81, has TSR applicability concerns, as the TSR recognizes only one (244-CR-003) of four tanks present in the facility.

In addition, it was noted that intrusive activities controls should be reviewed and revised (if necessary), to assure that the 244-CR facility activities of vapor space sampling, tank sampling, and cell and cell sump sampling are appropriately covered by those controls.

Based on the estimated radionuclides in the 244-CR tanks, Tanks CR-001, CR-002, and CR-011 would be classified as Hazard Category 3. Based on the results shown in Table 2-3, CR-002 would be classified as Hazard Category 2. However, if the BIO source term quantities are used all tanks would be classified as Hazard Category 2. Therefore it is concluded that the 244-CR Vault should be classified as a Hazard Category 2 facility. This is consistent with the general classification of Miscellaneous Inactive Storage Facilities as Hazard Category 2 in the BIO, Table 5.1-1.

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5.0 REFERENCES

AIChE, 1992, *Guidelines for Hazard Evaluation Procedures*, American Institute of Chemical Engineers, New York, New York.

DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*, U.S. Department of Energy, Washington, D.C.

HNF-SD-WM-BIO-001, 1999, *Tank Waste Remediation System Basis for Interim Operation*, Rev. 1, Fluor Daniel Hanford, Inc., Richland, Washington.

WHC-MR-0132, *A History of the 200 Area Tank Farms*, Westinghouse Hanford Company, 1990

HNF-SD-WM-ER-349, *Historical Tank Content Estimate for the Northwest Quadrant of the Hanford 200 East Area*, Westinghouse Hanford Company, 1990

HNF-SD-WM-ER-367, Rev. 1, *Tank Characterization Report for Single-shell Tank 241-C-110*, Fluor Daniel Hanford, Inc., 1997

HNF-SD-WM-ER-474, Rev. 0, *Tank Characterization Report for SST 241C-107*, Fluor Daniel Hanford, Inc., 1997

WHC-SD-WM-ER-651, Rev. 0A, *Preliminary Tank Characterization Report for Single-shell Tank 241-C-102: Best-basis Inventory*, Fluor Daniel Hanford, Inc., 1997

WHC-SD-WM-TI-764, Rev. 0, *Hazard Analysis Database Report*, Westinghouse Hanford Company, Richland, Washington, 1997

HNF-SD-WM-TSR-006, 1999, *Tank Waste Remediation System Technical Safety Requirements*, Rev. 0-Q, Fluor Daniel Hanford, Inc., Richland, Washington.

Rockwell International Co: Internal Memorandum #65452-84-093, dated 5/18/84.

TF-98-0785, 1998, *Unreviewed Safety Question, Potential Inadequacy In Authorization Basis (PIAB): To Evaluate Miscellaneous Facilities Listed In HNF-2503 And Not Addressed In The TWRS Authorization Basis*, Lockheed Martin Hanford Corporation, Richland, Washington

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Appendix A: HAZOP Team Biographical Information

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HAZOP Team Biographical Information

Victor C. Boyles – B.S., Mechanical Engineering. Team member for the 244-CR Vault HAZOP. More than 29 years of experience in a broad range of engineering activities and responsibilities including cog. engineer, cog. engineer manager and tank farm engineering. Involved with work on 244-CR vault during pumping of C farm single shell tanks during the 1990's.

John W. Bloom – DE&S Hanford – Senior Licensing Engineer: Mr. Bloom has more than 22 years experience in the nuclear industry with 19+ years at Hanford. His experience includes management positions in operations, production control, independent oversight, S/RIDS development, and 1-1/2 years on the BIO/FSAR development team in a lead position. He was the safety lead for the Hanford Tanks Initiative project for two years. He holds bachelor and masters degrees in chemistry.

Sohan S. Gahir – BS Mechanical Engineering, MS Industrial Engineering, Licensed Professional Engineer in the state of Washington and Pennsylvania. TWRS Licensing engineer for the retrieval projects. More than thirty-six of engineering experience at the commercial power plants and Hanford Site. Experience includes design engineering, Preliminary Safety Evaluation development, Safety Analysis Report development, Inactive miscellaneous storage facility risk evaluation, TWRS BIO implementation, Seismic upgrades at 100-N area, barrier doors design and installation at 100K, WRAP facility SAR review and many other projects at the Hanford Site.

William H. Grams – B.S., Mining Engineering; M. S. Mechanical Engineering. Experience includes: licensing engineer for TWRS, development and implementing Authorization Basis licensing strategies for new waste retrieval equipment and processes, preparation of Unreviewed Safety Question documentation, development and implementation of a low-level waste certification program including conduct of waste management audits, review and approval of certification plans, and direct assistance to waste generators; preparation of waste management disposal instructions including characterization requirements, packaging specifications, regulatory requirements; and evaluation and characterization of low-level waste streams.

Waldemar F. Hendrickson, BS, MS(CH. E.), MS(Nuc. E.), Ph.D.(ENG. Sci) – 37 years in nuclear field. Was Program Manager for INEL ICPP SAR, redo of FFTF Technical Specifications, FMEF partial FSAR, and Safety and Environmental documentation for closure of ferrocyanide safety issue.

David Himes – B.S., Engineering Physics, M.S. (Nuc. E.), Ph.D.(Nuc. E., minors E.E. & M.E.) - A total of 24 years experience in nuclear reactor and radioactive waste facility operations and analysis including health physics and safety. Includes 6 years experience in nuclear reactor operations (with 3 years as a nuclear submarine officer in the U.S. Navy), and over 20 years experience in the fields of reactor fuel testing and evaluation, analytical modeling, and radiological and toxicological safety analysis.

Randy Powers – B.S. Mechanical Engineering. Cognizant Engineer of 244-CR Tank Farm Facility. six years experience at Tank Farms Nuclear Waste Storage Facility located at the Hanford Site.

Milton V. Shultz, Jr. – B.S., Nuclear Engineering Technology. Facilitator for Tank 241-SY-101 waste transfer HAZOP. More than twenty-four years experience in a broad range of engineering and technical assignments at the Hanford Site. Experience includes leading Preliminary Hazards Analysis (PHAs) and HAZOPs for a variety of TWRS projects, including several for the TWRS FSAR and BIO efforts, contributor to the hazards analysis work for the TWRS BIO. Has performed independent Nuclear Safety evaluations of reactor plant design and operation at Hanford's N Reactor.

Randall G. Stickney - Duke Engineering and Services Hanford - Senior Engineer. Mr. Stickney is a Senior Engineer in the TWRS Nuclear Safety and Licensing organization. He is currently assigned as the licensing engineer for miscellaneous TWRS facilities. Mr. Stickney has experience in waste management, nuclear safety, program management and oversight and has been employed at the Hanford Site for 13 years. Mr. Stickney holds a Master of Science degree in Mechanical Engineering.

Appendix B: Hazard Evaluation Tables

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Appendix B

Table of Contents

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Date: 2/26/99
29 Pages

Table B-1. HAZOP Data - 244-CR Vault

Item ID	Node	Process Variable	Guide Word	Possible causes of deviation	Consequence	Hazardous Condition	Potential SSCs	Potential TSRs	Con Cat	Freq Cat	Env Cat	Remarks
Node1: Waste and waste level in Tank 244-CR-003												
CR-244-01	1	Temperature	Freezing	Not considered an issue in tank 244-CR-003	None identified.	None identified.	None identified.	None identified.	N/A	N/A	N/A	Facility is ~ 40 ft. underground; temperature tends to be about that of the soil at 20 ft. underground.
CR-244-02	1	Temperature	High	Radioactive decay heat	Pressurization of tank 244-CR-003 resulting in release of hazardous materials	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	Temperature sensors Ventilation system	Transfer controls	S2	F1	E2	Volume of tank may be too small to have sufficient inventory to reach saturated condition Current heat loads in tanks that could be transferred to CR-244 do not appear high enough to cause postulated hazardous condition
CR-244-03	1	Temperature	High	Incompatible transfer from 241-C-103 (contains organics that react with material already present)	Pressurization of tank 244-CR-003 resulting in release of hazardous materials Ignition of flammable organic vapors	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	None required due to low Frequency.	Waste compatibility controls Transfer controls	S2	F0	E2	F0 based on evaluations performed for rest of tank farms assuming typical waste
CR-244-04	1	Temperature	High	Fuel fire in cell due to ruptured fuel tank in vehicle	Pressurization of tank 244-CR-003 resulting in release of hazardous materials	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	None identified.	Vehicle fuel limits Vehicle access controls	S2	F1	E2	Most above-ground equipment which could puncture a fuel tank has been removed
CR-244-05	1	Temperature	High	Dead-headed pump and/or mixer heats waste	Pressurization of tank 244-CR-003 resulting in release of hazardous materials	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	None required due to low Frequency.	None required due to low Frequency.	S2	F0	E2	It was concluded by the team that insufficient energy was available from equipment in the tank to overpower ventilation

Date: 2/26/99
29 Pages

Table B-1. HAZOP Data - 244-CR Vault

Item ID	Node	Process Variable	Guide Word	Possible causes of deviation	Consequence	Hazardous Condition	Potential SSCs	Potential TSRs	Con Cat	Freq Cat	Env Cat	Remarks
CR-244-06	1	Temperature	Freezing	Not considered an issue in tank 244-CR-002	None identified.	None identified.	None identified.	None identified.	N/A	N/A	N/A	Facility is ~ 40 ft. underground; temperature tends to be about that of the soil at 20 ft. underground.
CR-244-07	1	Temperature	High	Radioactive decay heat	Pressurization of tank 244-CR-002 resulting in release of hazardous materials	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	Temperature sensors Ventilation system	Transfer controls	S2	F1	E2	Volume of tank may be too small to have sufficient inventory to reach saturated condition Current heat loads in tanks that could be transferred to CR-244 do not appear high enough to cause postulated hazardous condition
CR-244-08	1	Temperature	High	Incompatible transfer from 241-C-103 (contains organics that react with material already present)	Pressurization of tank 244-CR-002 resulting in release of hazardous materials Ignition of flammable organic vapors	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	None identified.	Waste compatibility controls Transfer controls	S2	F1	E2	F0 based on evaluations performed for rest of tank farms assuming typical waste
CR-244-09	1	Temperature	High	Fuel fire in cell due to ruptured fuel tank in vehicle	Pressurization of tank 244-CR-002 resulting in release of hazardous materials	Potential exposure of personnel to toxic or radioactive materials due to high temperature waste	None identified.	Vehicle fuel limits Vehicle access controls	S2	F1	E2	Most above-ground equipment which could puncture a fuel tank has been removed
CR-244-10	1	Temperature	High	Dead-headed pump and/or mixer heats waste	Pressurization of tank 244-CR-002 resulting in release of hazardous materials	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	None required due to low Frequency.	None required due to low Frequency.	S2	F0	E2	It was concluded by the team that insufficient energy was available from equipment in the tank to overpower ventilation

Date: 2/26/99
29 Pages

Table B-1. HAZOP Data - 244-CR Vault

Item ID	Node	Process Variable	Guide Word	Possible causes of deviation	Consequence	Hazardous Condition	Potential SSCs	Potential TSRs	Con Cat	Freq Cat	Env Cat	Remarks
CR-244-11	1	Temperature	Freezing	Not considered an issue in tank 244-CR-001	None identified.	None identified.	None identified.	None identified.	N/A	N/A	N/A	Facility is ~ 40 ft. underground; temperature tends to be about that of the soil at 20 ft. underground.
CR-244-12	1	Temperature	High	Radioactive decay heat	Pressurization of tank 244-CR-001 resulting in release of hazardous materials	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	Temperature sensors Ventilation system	Transfer controls	S2	F1	E2	Volume of tank may be too small to have sufficient inventory to reach saturated condition Current heat loads in tanks that could be transferred to CR-244 do not appear high enough to cause postulated hazardous condition
CR-244-13	1	Temperature	High	Incompatible transfer from 241-C-103 (contains organics that react with material already present)	Pressurization of tank 244-CR-001 resulting in release of hazardous materials Ignition of flammable organic vapors	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	None required due to low Frequency.	Waste compatibility controls Transfer controls	S2	F0	E2	F0 based on evaluations performed for rest of tank farms assuming typical waste
CR-244-14	1	Temperature	High	Fuel fire in cell due to ruptured fuel tank in vehicle	Pressurization of tank 244-CR-001 resulting in release of hazardous materials	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	None identified.	Vehicle fuel limits Vehicle access controls	S2	F1	E2	Most above-ground equipment which could puncture a fuel tank has been removed
CR-244-15	1	Temperature	High	Dead-headed pump and/or mixer heats waste	Pressurization of tank 244-CR-001 resulting in release of hazardous materials	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	None required due to low Frequency.	None required due to low Frequency.	S2	F0	E2	It was concluded by the team that insufficient energy was available from equipment in the tank to overpower ventilation

Date: 2/26/99
29 Pages

Table B-1. HAZOP Data - 244-CR Vault

Item ID	Node	Process Variable	Guide Word	Possible causes of deviation	Consequence	Hazardous Condition	Potential SSCs	Potential TSRs	Con Cat	Freq Cat	Env Cat	Remarks
CR-244-16	1	Temperature	Freezing	Not considered an issue in tank 244-CR-011	None identified.	None identified.	None identified.	None identified.	N/A	N/A	N/A	Facility is ~ 40 ft. underground; temperature tends to be about that of the soil at 20 ft. underground.
CR-244-17	1	Temperature	High	Radioactive decay heat	Pressurization of tank 244-CR-011 resulting in release of hazardous materials	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	Temperature sensors Ventilation system	Transfer controls	S2	F1	E2	Volume of tank may be too small to have sufficient inventory to reach saturated condition Current heat loads in tanks that could be transferred to CR-244 do not appear high enough to cause postulated hazardous condition
CR-244-18	1	Temperature	High	Incompatible transfer from 241-C-103 (contains organics that react with material already present)	Pressurization of tank 244-CR-011 resulting in release of hazardous materials Ignition of flammable organic vapors	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	None required due to low Frequency.	Waste compatibility controls Transfer controls	S2	F0	E2	F0 based on evaluations performed for rest of tank farms assuming typical waste
CR-244-19	1	Temperature	High	Fuel fire in cell due to ruptured fuel tank in vehicle	Pressurization of tank 244-CR-011 resulting in release of hazardous materials	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	None identified.	Vehicle fuel limits Vehicle access controls	S2	F1	E2	Most above-ground equipment which could puncture a fuel tank has been removed
CR-244-20	1	Temperature	High	Dead-headed pump and/or mixer heats waste	Pressurization of tank 244-CR-011 resulting in release of hazardous materials	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	None required due to low Frequency.	None required due to low Frequency.	S2	F0	E2	It was concluded by the team that insufficient energy was available from equipment in the tank to overpower ventilation

NOTE: Tank 244-CR-003 Level. No differences identified for tanks CR-001 or CR-011 or CR-002.

Date: 2/26/99
29 Pages

Table B-1. HAZOP Data - 244-CR Vault

Item ID	Node	Process Variable	Guide Word	Possible causes of deviation	Consequence	Hazardous Condition	Potential SSCs	Potential TSRs	Con Cat	Freq Cat	Env Cat	Remarks
CR-244-21A	1	Level	Low/Dry	Evaporation/leakage	Nitrate fire in tank 244-CR-003 and release of hazardous material	None identified.	None identified	Ignition source controls Moisture controls	S2	F0	E2	Temperature controls not applied to DCRTs. Nitrate fires not considered credible.
CR-244-21B	1	Level	Low/Dry	Evaporation/leakage	Nitrate fire in tank 244-CR-002 and release of hazardous material	None identified.	None required due to low Frequency.	Ignition source controls Moisture controls	S2	F0	E2	Temperature controls not applied to DCRTs. Nitrate fires not considered credible.
CR-244-21C	1	Level	Low/Dry	Evaporation/leakage	Nitrate fire in tank CR-001 and release of hazardous material	None identified.	None required due to low Frequency.	Ignition source controls Moisture controls	S2	F0	E2	Temperature controls not applied to DCRTs. Nitrate fires not considered credible.
CR-244-21D	1	Level	Low/Dry	Evaporation/leakage	Nitrate fire in tank 244-CR-011 and release of hazardous material	None identified.	None required due to low Frequency.	Ignition source controls Moisture controls	S2	F0	E2	Temperature controls not applied to DCRTs. Nitrate fires not considered credible.
CR-244-22A	1	Level	Low/Dry	Tank leak	Waste leaks from tank 244-CR-003 to sump and cell floor with potential for migration to soil	Release of waste to subsurface soil from tank leak followed by cell leak.	Leak detector CR-003 only Level monitor CR-003 only	None identified.	S0	F3	E1	Leak detector only operated during transfers
CR-244-22B	1	Level	Low/Dry	Tank leak	Waste leaks from tank 244-CR-002 to sump and cell floor with potential for migration to soil	Release of waste to subsurface soil from tank leak followed by cell leak.	None identified.	None identified.	S0	F3	E1	No operational sump leak detection for this cell.

Date: 2/26/99
29 Pages

Table B-1. HAZOP Data - 244-CR Vault

Item ID	Node	Process Variable	Guide Word	Possible causes of deviation	Consequence	Hazardous Condition	Potential SSCs	Potential TSRs	Con Cat	Freq Cat	Env Cat	Remarks
CR-244-22C	1	Level	Low/Dry	Tank leak	Waste leaks from tank 244-CR-001 to sump and cell floor with potential for migration to soil	Release of waste to subsurface soil from tank leak followed by cell leak.	None identified.	None identified.	S0	F3	E1	No operational sump leak detection for this cell.
CR-244-22D	1	Level	Low/Dry	Tank leak	Waste leaks from tank 244-CR-011 to sump and cell floor with potential for migration to soil	Release of waste to subsurface soil from tank leak followed by cell leak.	None identified.	None identified.	S0	F3	E1	No operational sump leak detection for this cell.
CR-244-23A	1	Level	Low/Dry	Tank leak	Waste leaks from tank 244-CR-003 to sump and cell floor and dries out creating dry particulate release	Release of waste to atmosphere from tank due to tank leak with a HEPA filter loaded with particulate.	Ventilation-stack CAM interlock	HEPA filter change-out controls	S2	F3	E2	Previously not evaluated in BIO
CR-244-23B	1	Level	Low/Dry	Tank leak	Waste leaks from tank 244-CR-002 to sump and cell floor and dries out creating dry particulate release	Release of waste to atmosphere from tank due to tank leak with a HEPA filter loaded with particulate.	Ventilation-stack CAM interlock	HEPA filter change-out controls	S2	F3	E2	Previously not evaluated in BIO
CR-244-23C	1	Level	Low/Dry	Tank leak	Waste leaks from tank 244-CR-001 to sump and cell floor and dries out creating dry particulate release	Release of waste to atmosphere from tank due to tank leak with a HEPA filter loaded with particulate.	Ventilation-stack CAM interlock	HEPA filter change-out controls	S2	F3	E2	Previously not evaluated in BIO

Date: 2/26/99
29 Pages

Table B-1. HAZOP Data - 244-CR Vault

Item ID	Node	Process Variable	Guide Word	Possible causes of deviation	Consequence	Hazardous Condition	Potential SSCs	Potential TSRs	Con Cat	Freq Cat	Env Cat	Remarks
CR-244-23D	1	Level	Low/Dry	Tank leak	Waste leaks from tank 244-CR-011 to sump and cell floor and dries out creating dry particulate release	Release of waste to atmosphere from tank due to tank leak with a HEPA filter loaded with particulate.	Ventilation-stack CAM interlock	HEPA filter change-out controls	S2	F3	E2	Previously not evaluated in BIO
CR-244-24A	1	Level	High	Cooling coil leak In CR-003	Waste in ventilation system and filling of other tanks in CR-244 Filling of CR-003, CR-002, CR-001, or CR-011 cells with leaks to ground	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Raw water flow totalizers	Operator training and procedures Emergency response procedures	S2	F3	E2	Leak/Level detection systems may not be operating since a transfer is not taking place Cooling coils for CR-002 and CR-003 have been blanked. Frequency may be much lower than indicated.
CR-244-24B	1	Level	High	Cooling coil leak CR-002	Waste in ventilation system and filling of other tanks in CR-244 Filling of CR-003, CR-002, CR-001, or CR-011 cells with leaks to ground	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Raw water flow totalizers	Operator training and procedures Emergency response procedures	S2	F3	E2	Leak/Level detection systems may not be operating since a transfer is not taking place Cooling coils for CR-002 and CR-003 have been blanked. Frequency may be much lower than indicated.

Date: 2/26/99
29 Pages

Table B-1. HAZOP Data - 244-CR Vault

Item ID	Node	Process Variable	Guide Word	Possible causes of deviation	Consequence	Hazardous Condition	Potential SSCs	Potential TSRs	Con Cat	Freq Cat	Env Cat	Remarks
CR-244-24C	1	Level	High	Raw water intrusion	Waste in ventilation system and filling of other tanks in CR-244 Filling of CR-003, CR-002, CR-001, or CR-011 cells with leaks to ground	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Raw water flow totalizers	Operator training and procedures Emergency response procedures	S2	F3	E2	Leak/Level detection systems may not be operating since a transfer is not taking place. Frequency may be much lower than indicated.
CR-244-25	1	Level	High	Rain water intrusion	Level increase in tank 244-CR-003, CR-002, CR-001, or CR-011 (slight)	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	None required due to low Frequency.	Periodic level measurements	S2	F0	E2	Rainwater intrusion was not determined to be a credible scenario. Minor level increase in tank is the most likely result, however, overfilling could occur
CR-244-26	1	Level	High	Waste mis-transfers	Waste in ventilation system and filling of other tanks in CR-244 Filling of CR-003, CR-002, CR-001, or CR-011 cells with leaks to ground	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	None identified.	Transfer controls Emergency response procedures	S2	F3	E2	Consequences greater than raw water event Accident occurs when facility is assumed to not be connected

Date: 2/26/99
29 Pages

Table B-1. HAZOP Data - 244-CR Vault

Item ID	Node	Process Variable	Guide Word	Possible causes of deviation	Consequence	Hazardous Condition	Potential SSCs	Potential TSRs	Con Cat	Freq Cat	Env Cat	Remarks
CR-244-27	1	Level	High	Transfer error	Waste in ventilation system and filling of other tanks in CR-244 Filling of CR-003, CR-002, CR-001, or CR-011 cells with leaks to ground	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Tank level detection system in tank 244-CR-003 only Stack CAM	Transfer controls Emergency response procedures	S2	F3	E2	Consequences same as CR-244-27.
CR-244-28A	1	pH	Low	Overflow of low pH waste from CR-002 to CR-003. Misroute must occur.	None identified.	None identified.	None identified.	None identified.	S0	F3	E0	Assume 002 contains low pH waste. 002 just as likely to overflow to other tanks.
CR-244-29A	1	pH	Low	Overflow of low pH waste from CR-002 to CR-001. Misroute must occur.	Degrade 001 tank and cause leak to cell/sump	Release of waste to surface or subsurface soil due to a misrouting followed by tank overflow and a cell leak.	None identified.	Transfer controls	S1	F3	E1	Assume CR-002 contains low pH waste. CR-002 just as likely to overflow to other tanks.
CR-244-30A	1	pH	Low	Overflow of low pH waste from CR-002 to CR-011. Misroute must occur.	Degrade CR-011 tank and cause leak to cell/sump	Release of waste to surface or subsurface soil due to a misrouting followed by tank overflow and a cell leak.	None identified.	Transfer controls	S1	F3	E1	Assume CR-002 contains low pH waste. CR-002 just as likely to overflow to other tanks.
NOTE: High pH not a concern for any of the tanks (CR-003, CR-002, CR-001, or CR-011)												
Node 1A: Cooling coil and raw water supply to tank cooling coils (Tanks 244-CR-002 and 244-CR-003. Cooling function is no longer required.)												
CR-244-31	1A	Flow	None	Desired condition	None identified.	None identified.	None identified.	None identified.	N/A	N/A	N/A	Cooling coils for CR-002 & CR-003 have been blanked.

Date: 2/26/99
29 Pages

Table B-1. HAZOP Data - 244-CR Vault

Item ID	Node	Process Variable	Guide Word	Possible causes of deviation	Consequence	Hazardous Condition	Potential SSCs	Potential TSRs	Con Cat	Freq Cat	Env Cat	Remarks
CR-244-32	1A	Flow	Any flow	Inadvertent mis-alignment of valves to raw water supply coupled with leaking coil in tank 244-CR-003.	Waste in ventilation system and filling of other tanks in CR-244 Filling of CR-003, CR-002, CR-001, or CR-011 cells with leaks to ground	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Raw water flow totalizers	Operator training and procedures Emergency response procedures	N/A	N/A	N/A	Cooling coils for CR-002 and CR-003 have been blanked.
CR-244-33	1A	Flow	Any flow	Inadvertent mis-alignment of valves to raw water supply coupled with leaking coil tank 244-CR-002.	Waste in ventilation system and filling of other tanks in CR-244 Filling of CR-003, CR-002, CR-001, or CR-011 cells with leaks to ground	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Raw water flow totalizers	Operator training and procedures Emergency response procedures	N/A	N/A	N/A	Tank 244-CR-002 has potential for low pH waste. Cooling coils for CR-002 and CR-003 have been blanked.
CR-244-34	1A	Flow	Reverse	Waste fills up cooling coil in tank 244-CR-003 or CR-002 through a leak	Contaminated cooling coil and potential for waste movement outside of tank.	None identified.	None required due to low Frequency.	None required due to low Frequency.	S0	F0	E0	HAZOP team concluded that siphoning waste through cooling coil supply piping not a plausible scenario. Maximum distance envisioned for movement would be confined to vault. Cooling coils for CR-002 and CR-003 have been blanked.

Date: 2/26/99
29 Pages

Table B-1. HAZOP Data - 244-CR Vault

Item ID	Node	Process Variable	Guide Word	Possible causes of deviation	Consequence	Hazardous Condition	Potential SSCs	Potential TSRs	Con Cat	Freq Cat	Env Cat	Remarks
CR-244-35	1A	Flow	Reverse	Waste fills up cooling coil in tank 244-CR-003 or CR-002 through a leak	Movement of contamination in coils to raw water discharge point due to inadvertent operation of raw water system.	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Raw water flow totalizers	Operating procedures for operating raw water system	S1	F1	E1	Unclear where discharge of raw water from cooling coils would exit. Cooling coils for CR-002 and CR-003 have been blanked.
Node 2: Tank cell for 244-CR-003 (including cell sump).												
CR-244-36	2	Pressure	High	Ignition of flammable gas produced by radiolysis of material in sump in CR-003 tank cell.	Failure of HEPA filters.	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Stack CAM and ventilation interlock Ventilation system.	Ignition source controls. Flammable gas monitoring. Active ventilation operation.	S2	F1	E2	Facility not leak tight.
CR-244-37	2	Pressure	High	Ignition of flammable gas produced by radiolysis of material in sump in CR-002 tank cell.	Failure of HEPA filters.	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Stack CAM and ventilation interlock Ventilation system.	Ignition source controls. Flammable gas monitoring. Active ventilation operation.	S2	F1	E2	Facility not leak tight.
CR-244-38	2	Pressure	High	Ignition of flammable gas produced by radiolysis of material in sump in CR-001 tank cell.	Failure of HEPA filters.	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Stack CAM and ventilation interlock Ventilation system.	Ignition source controls. Flammable gas monitoring. Active ventilation operation.	S2	F1	E2	Facility not leak tight.

Date: 2/26/99
29 Pages

Table B-1. HAZOP Data - 244-CR Vault

Item ID	Node	Process Variable	Guide Word	Possible causes of deviation	Consequence	Hazardous Condition	Potential SSCs	Potential TSRs	Con Cat	Freq Cat	Env Cat	Remarks
CR-244-39	2	Pressure	High	Ignition of flammable gas produced by radiolysis of material in sump in CR-011 tank cell.	Failure of HEPA filters.	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Stack CAM and ventilation interlock Ventilation system.	Ignition source controls. Flammable gas monitoring. Active ventilation operation.	S2	F1	E2	Facility not leak tight.
CR-244-40	2	Pressure	High	Ignition of vehicle fuel spilled in sump in CR-003 tank cell.	Failure of HEPA filters.	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Stack CAM and ventilation interlock Ventilation system.	Ignition source controls. Vehicle access controls.	S2	F1	E2	Facility not leak tight.
CR-244-41	2	Pressure	High	Ignition of vehicle fuel spilled in sump in CR-002 tank cell.	Failure of HEPA filters.	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Stack CAM and ventilation interlock Ventilation system.	Ignition source controls. Vehicle access controls	S2	F1	E2	Facility not leak tight.
CR-244-42	2	Pressure	High	Ignition of vehicle fuel spilled in sump in CR-001 tank cell.	Failure of HEPA filters.	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Stack CAM and ventilation interlock Ventilation system.	Ignition source controls. Vehicle access controls	S2	F1	E2	Facility not leak tight.

Date: 2/26/99
29 Pages

Table B-1. HAZOP Data - 244-CR Vault

Item ID	Node	Process Variable	Guide Word	Possible causes of deviation	Consequence	Hazardous Condition	Potential SSCs	Potential TSRs	Con Cat	Freq Cat	Env Cat	Remarks
CR-244-43	2	Pressure	High	Ignition of vehicle fuel spilled in sump in CR-011 tank cell.	Failure of HEPA filters.	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Stack CAM and ventilation interlock Ventilation system.	Ignition source controls. Vehicle access controls	S2	F1	E2	Facility not leak tight.
CR-244-44	2	Temperature	Low	No safety concern	None identified.	None identified.	None identified.	None identified.	N/A	N/A	N/A	Not a concern. Facility is ~ 40 ft. underground; temperature tends to be about that of the soil at 20 ft. underground.
CR-244-45A	2	Temperature	High	Ignition of vehicle fuel spilled in sump in CR-003 tank cell.	Failure of HEPA filters.	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Stack CAM and ventilation interlock Ventilation system.	Ignition source controls. Vehicle access controls.	S2	F1	E2	Facility not leak tight.
CR-244-45B	2	Temperature	High	Ignition of vehicle fuel spilled in sump in CR-002 tank cell.	Failure of HEPA filters.	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Stack CAM and ventilation interlock Ventilation system.	Ignition source controls. Vehicle access controls	S2	F1	E2	Facility not leak tight.

Date: 2/26/99
29 Pages

Table B-1. HAZOP Data - 244-CR Vault

Item ID	Node	Process Variable	Guide Word	Possible causes of deviation	Consequence	Hazardous Condition	Potential SSCs	Potential TSRs	Con Cat	Freq Cat	Env Cat	Remarks
CR-244-45C	2	Temperature	High	Ignition of vehicle fuel spilled in sump in CR-001 tank cell.	Failure of HEPA filters.	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Stack CAM and ventilation interlock Ventilation system.	Ignition source controls. Vehicle access controls	S2	F1	E2	Facility not leak tight.
CR-244-45D	2	Temperature	High	Ignition of vehicle fuel spilled in sump in CR-011 tank cell.	Failure of HEPA filters.	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Stack CAM and ventilation interlock Ventilation system.	Ignition source controls. Vehicle access controls	S2	F1	E2	Facility not leak tight.
CR-244-46	2	Level	Low/dry	Desired condition	Dry sump with radioactive material represents a potential source of airborne material.	Release of waste to atmosphere from tank due to tank leak with a HEPA filter loaded with particulate.	Ventilation-stack CAM interlock	HEPA filter change-out controls	S1	F3	E1	True for all four cells
CR-244-47	2	Level	Low/dry	Cell is not leak tight	Leakage from cell into soil	Release of waste to surface or subsurface soil due to tank leak followed by cell leak.	None identified.	None identified.	S0	F3	E1	No ability to detect or control condition on any of the four cells.

Date: 2/26/99
29 Pages

Table B-1. HAZOP Data - 244-CR Vault

Item ID	Node	Process Variable	Guide Word	Possible causes of deviation	Consequence	Hazardous Condition	Potential SSCs	Potential TSRs	Con Cat	Freq Cat	Env Cat	Remarks
CR-244-48	2	Level	High	Waste or raw water mis-route.	If the leak does not exceed the capacity of the cell, then liquids leak to soil. If the leak is large, then cell could overflow (surface pool) Potential to float tank with significant damage to facility.	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Raw water flow totalizers Cell CR-003 leak detector.	Transfer controls.	S2	F1	E2	Damage to facility by itself is D&D problem and would create operational problems. Same for all four cells with exception of leak detector in cell CR-003.
CR-244-49	2	Level	High	Transfer line failure with back-drainage to cell.	If the leak does not exceed the capacity of the cell, then liquids leak to soil. If the leak is large, then cell could overflow (surface pool) Potential to float tank with significant damage to facility.	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Transfer system leak detectors. Cell CR-003 leak detector.	Transfer controls.	S2	F1	E2	Damage to facility by itself is D&D problem and would create operational problems. Same for all four cells with exception of leak detector in cell CR-003.

Date: 2/26/99
29 Pages

Table B-1. HAZOP Data - 244-CR Vault

Item ID	Node	Process Variable	Guide Word	Possible causes of deviation	Consequence	Hazardous Condition	Potential SSCs	Potential TSRs	Con Cat	Freq Cat	Env Cat	Remarks
CR-244-50	2	Level	High	Rain water intrusion	If the leak does not exceed the capacity of the cell, then liquids leak to soil. If the leak is large, then cell could overflow (surface pool) Potential to float tank with significant damage to facility.	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Cell CR-003 leak detector.	None required due to low Frequency.	S2	F0	E2	Damage to facility by itself is D&D problem and would create operational problems. Same for all four cells with exception of leak detector in cell CR-003.
Node 3: Tank 244-CR-003 physical structure including supports.												
CR-244-51A	3	Structural strength	Less	Waste or raw water mis-route to cell CR-003.	Potential to float tank with significant damage to facility.	Release of waste to surface or subsurface soil due to cell filling followed by tank failure and a cell leak.	Raw water flow totalizers	Transfer controls.	S2	F1	E2	Damage to facility by itself is D&D problem and would create operational problems. Same for all four cells with exception of leak detector in cell CR-003.
CR-244-51B	3	Structural strength	Less	Transfer line failure with back-drainage to cell CR-003.	Potential to float tank with significant damage to facility.	Release of waste to surface or subsurface soil due to cell filling followed by tank failure and a cell leak.	Transfer system leak detectors. Cell CR-003 leak detector.	Transfer controls.	S2	F1	E2	Damage to facility by itself is D&D problem and would create operational problems. Same for all four cells with exception of leak detector in cell CR-003.

Date: 2/26/99
29 Pages

Table B-1. HAZOP Data - 244-CR Vault

Item ID	Node	Process Variable	Guide Word	Possible causes of deviation	Consequence	Hazardous Condition	Potential SSCs	Potential TSRs	Con Cat	Freq Cat	Env Cat	Remarks
CR-244-51C	3	Structural strength	Less	Transfer line failure with back-drainage to cell CR-003.	Potential to float tank with significant damage to facility.	Release of waste to surface or subsurface soil due to cell filling followed by tank failure and a cell leak.	Transfer system leak detectors. Cell CR-003 leak detector.	Transfer controls.	S2	F1	E2	Damage to facility by itself is D&D problem and would create operational problems. Same for all four cells with exception of leak detector in cell CR-003.
CR-244-52A	3	Structural strength	Less	High vacuum in tank 244-CR-003	No credible scenarios identified.	None identified.	None required due to low Frequency.	None identified.	S1	F0	E1	No credible scenarios identified. Same for all four tanks.
CR-244-52B	3	Structural strength	Less	High vacuum in tank 244-CR-002	No credible scenarios identified.	None identified.	None required due to low Frequency.	None identified.	S1	F0	E1	No credible scenarios identified. Same for all four tanks.
CR-244-52C	3	Structural strength	Less	High vacuum in tank 244-CR-001	No credible scenarios identified.	None identified.	None required due to low Frequency.	None identified.	S1	F0	E1	No credible scenarios identified. Same for all four tanks.
CR-244-52D	3	Structural strength	Less	High vacuum in tank 244-CR-011	No credible scenarios identified.	None identified.	None required due to low Frequency.	None identified.	S1	F0	E1	No credible scenarios identified. Same for all four tanks.
CR-244-53A	3	Structural strength	Less	Seismic event affecting CR-003	Leak to sump with potential for leakage of radioactive/toxic material to soil	Release of waste to surface or subsurface soil due to seismic-induced failure of tank and facility structure.	None identified.	Emergency preparedness.	S0	F2	E1	Apply normal seismic frequency for standard facilities. Same for all four tanks

Date: 2/26/99
29 Pages

Table B-1. HAZOP Data - 244-CR Vault

Item ID	Node	Process Variable	Guide Word	Possible causes of deviation	Consequence	Hazardous Condition	Potential SSCs	Potential TSRs	Con Cat	Freq Cat	Env Cat	Remarks
CR-244-53B	3	Structural strength	Less	Seismic event affecting CR-002	Leak to sump with potential for leakage of radioactive/toxic material to soil	Release of waste to surface or subsurface soil due to seismic-induced failure of tank and facility structure.	None identified.	Emergency preparedness.	S0	F2	E1	Apply normal seismic frequency for standard facilities. Same for all four tanks
CR-244-53C	3	Structural strength	Less	Seismic event affecting CR-001	Leak to sump with potential for leakage of radioactive/toxic material to soil	Release of waste to surface or subsurface soil due to seismic-induced failure of tank and facility structure.	None identified.	Emergency preparedness.	S0	F2	E1	Apply normal seismic frequency for standard facilities. Same for all four tanks
CR-244-53D	3	Structural strength	Less	Seismic event affecting CR-011	Leak to sump with potential for leakage of radioactive/toxic material to soil	Release of waste to surface or subsurface soil due to seismic-induced failure of tank and facility structure.	None identified.	Emergency preparedness.	S0	F2	E1	Apply normal seismic frequency for standard facilities. Same for all four tanks
CR-244-54A	3	Structural strength	Less	Hydrogen deflagration in head space of tank 244-CR-003.	Leak to sump with potential for leakage of radioactive/toxic material to soil Potential release from ventilation system or unfiltered pathways.	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Active ventilation system	Ignition source controls Flammable gas monitoring	S2	F3	E2	None.

Date: 2/26/99
29 Pages

Table B-1. HAZOP Data - 244-CR Vault

Item ID	Node	Process Variable	Guide Word	Possible causes of deviation	Consequence	Hazardous Condition	Potential SSCs	Potential TSRs	Con Cat	Freq Cat	Env Cat	Remarks
CR-244-54B	3	Structural strength	Less	Hydrogen deflagration in head space of tank 244-CR-002.	Leak to sump with potential for leakage of radioactive/toxic material to soil Potential release from ventilation system or unfiltered pathways.	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Active ventilation system	Ignition source controls Flammable gas monitoring	S2	F3	E2	None.
CR-244-54C	3	Structural strength	Less	Hydrogen deflagration in head space of tank 244-CR-001.	Leak to sump with potential for leakage of radioactive/toxic material to soil Potential release from ventilation system or unfiltered pathways.	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Active ventilation system	Ignition source controls Flammable gas monitoring	S2	F3	E2	None.
CR-244-54D	3	Structural strength	Less	Hydrogen deflagration in head space of tank 244-CR-011.	Leak to sump with potential for leakage of radioactive/toxic material to soil Potential release from ventilation system or unfiltered pathways.	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Active ventilation system	Ignition source controls Flammable gas monitoring	S2	F3	E2	None.

Date: 2/26/99
29 Pages

Table B-1. HAZOP Data - 244-CR Vault

Item ID	Node	Process Variable	Guide Word	Possible causes of deviation	Consequence	Hazardous Condition	Potential SSCs	Potential TSRs	Con Cat	Freq Cat	Env Cat	Remarks
CR-244-55A	3	Structural strength	Less	Corrosion of tank 244-CR-003 structure or supports	Tank support degrades and tank tips and ruptures Tank degrades and leaks	Release of waste to surface or subsurface soil due to tank leak followed by cell leak.	Leak detector in CR-003 vault sump.	None identified.	S0	F3	E1	Leak detector in cell CR-003 operative only during transfers. Carbon steel tanks have higher likelihood of failure than stainless steel tanks. The other three tanks do not have leak detectors in their cells.
CR-244-55B	3	Structural strength	Less	Corrosion of tank 244-CR-002 structure or supports	Tank support degrades and tank tips and ruptures Tank degrades and leaks	Release of waste to surface or subsurface soil due to tank leak followed by cell leak.	None identified.	None identified.	S0	F3	E1	Carbon steel tanks have higher likelihood of failure than stainless steel tanks. The other three tanks do not have leak detectors in their cells.
CR-244-55C	3	Structural strength	Less	Corrosion of tank 244-CR-001 structure or supports	Tank support degrades and tank tips and ruptures Tank degrades and leaks	Release of waste to surface or subsurface soil due to tank leak followed by cell leak.	None identified.	None identified.	S0	F3	E1	Carbon steel tanks have higher likelihood of failure than stainless steel tanks. The other three tanks do not have leak detectors in their cells.
CR-244-55D	3	Structural strength	Less	Corrosion of tank 244-CR-011 structure or supports	Tank support degrades and tank tips and ruptures Tank degrades and leaks	Release of waste to surface or subsurface soil due to tank leak followed by cell leak.	None identified.	None identified.	S0	F3	E1	Carbon steel tanks have higher likelihood of failure than stainless steel tanks. The other three tanks do not have leak detectors in their cells.
Node 4: Vault physical structure of tank cell CR-003 including cover blocks. (Applies to all four tanks).												
CR-244-56	4	Structural strength	Less	Seismic event	Release of radioactive/toxic aerosols (assume facility collapse and tank breach)	Release of waste to atmosphere due to seismic-induced failure of tank and facility structure.	None identified.	None identified.	S2	F1	E2	F1 frequency based on uncertainty of current structural condition.

Date: 2/26/99
29 Pages

Table B-1. HAZOP Data - 244-CR Vault

Item ID	Node	Process Variable	Guide Word	Possible causes of deviation	Consequence	Hazardous Condition	Potential SSCs	Potential TSRs	Con Cat	Freq Cat	Env Cat	Remarks
CR-244-57	4	Structural strength	Less	Deterioration due to aging	Release of radioactive/toxic aerosols (assume facility collapse and tank breach)	Release of waste to surface or subsurface soil due to failure of tank and facility structure.	None identified.	None identified.	S2	F1	E2	F1 frequency based on uncertainty of current structural condition.
CR-244-58	4	Structural strength	Less	Acid intrusion	Increased potential for leaks from cell structure to soil.	Release of waste to surface or subsurface soil due to tank leak followed by cell leak.	None identified.	Transfer controls. Waste compatibility controls.	S0	F1	E1	Higher potential in tank 244-CR-002 cell due to possible acid waste in tank.
CR-244-59	4	Structural strength	Less	Load drop while lifting cover block or equipment.	Release of radioactive/toxic aerosols (assume facility collapse and tank breach)	Release of waste to surface or subsurface soil due to failure of tank and facility structure.	None identified.	Critical lift procedures	S2	F3	E2	None.
CR-244-60	4	Structural strength	Less	Large static loads: parked vehicles; ashfall; snow load.	Release of radioactive/toxic aerosols (assume facility collapse and tank breach)	Release of waste to surface or subsurface soil due to failure of tank and facility structure.	None identified.	Vehicle access controls.	S2	F3	E2	Ashfall and snow loading are not concerns.
CR-244-61	4	Structural strength	Less	Excavations around facility	Release of radioactive/toxic aerosols due to breach of outer structure.	Release of waste to surface or subsurface soil due to failure of tank and facility structure.	None identified.	USQ process Work control procedures Excavation controls.	S1	F2	E1	HAZOP team unsure of applicability of excavation controls to this situation. This may not have been considered in BIO
CR-244-62	4	Structural strength	Less	Facility modifications	Release of radioactive/toxic aerosols due to breach of outer structure.	Release of waste to surface or subsurface soil due to failure of tank and facility structure.	None identified.	USQ process Work control procedures	S1	F1	E1	

Date: 2/26/99
29 Pages

Table B-1. HAZOP Data - 244-CR Vault

Item ID	Node	Process Variable	Guide Word	Possible causes of deviation	Consequence	Hazardous Condition	Potential SSCs	Potential TSRs	Con Cat	Freq Cat	Env Cat	Remarks
CR-244-63	4	Structural strength	Less	Aircraft crash	Release of radioactive/toxic aerosols (assume facility collapse and tank breach)	Release of waste to surface or subsurface soil due to failure of tank and facility structure.	None required due to low Frequency.	None required due to low Frequency.	S2	F0	E2	Aircraft crash considered not credible.
Node 5: Tank 244-CR-003 vapor space												
CR-244-64	5	Flow (head space atmosphere)	No	All inleakage paths sealed	Potential buildup of hydrogen with resultant deflagration if ignition source present.	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Ventilation path	Ignition source controls Flammable gas monitoring and controls	S2	F3	E2	It is not clear by what means the headspace flammable gas concentration is controlled in this tank since inleakage paths have not been positively identified and hydrogen production/diffusion has not been analyzed.
CR-244-65	5	Flow (head space atmosphere)	No	ventilation system shut down	Potential buildup of hydrogen with resultant deflagration if ignition source present.	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	None identified.	Ignition source controls	S2	F3	E2	Hydrogen production/diffusion has not been adequately analyzed.
CR-244-66	5	Flow (head space atmosphere)	Low	Possible desired condition (rate undefined)	None identified.	None identified.	None identified.	None identified.	N/A	N/A	N/A	Hydrogen production/diffusion has not been adequately analyzed.
CR-244-67	5	Flow (head space atmosphere)	High (much greater than currently)	Open riser	Dry out waste (see organic salt nitrate reactions)	None identified.	None required due to low Frequency.	None required due to low Frequency.	S2	F0	E2	Decay heat/ energy source does not appear to be adequate to support this reaction

Date: 2/26/99
29 Pages

Table B-1. HAZOP Data - 244-CR Vault

Item ID	Node	Process Variable	Guide Word	Possible causes of deviation	Consequence	Hazardous Condition	Potential SSCs	Potential TSRs	Con Cat	Freq Cat	Env Cat	Remarks
CR-244-68	5	Flow (head space atmosphere)	High (much greater than currently)	Open riser	Increased filter loading (see HEPA filter blow-out in waste dryout in cell)	Release of waste to atmosphere from tank due to tank leak with a HEPA filter loaded with particulate.	Ventilation-stack CAM interlock	HEPA filter change-out controls	S1	F3	E1	True for all four cells
CR-244-69	5	Flow (head space atmosphere)	High (much greater than currently)	Open riser	Potential for freezing liquids in cold weather.	Release of waste to subsurface soil from tank leak followed by cell leak.	None identified.	None identified.	S0	F2	E0	Could provide leak path out of tank through ruptured cooling coils. Cooling coils for CR-002 and CR-003 have been blanked.
CR-244-70	5	Pressure/ Temperature	Low	See node 3	None identified.	None identified.	None identified.	None identified.	N/A	N/A	N/A	Facility is ~ 40 ft. underground; temperature tends to be about that of the soil at 20 ft. underground.
CR-244-71	5	Pressure/ Temperature	High	Ignition of flammable gas in tank (see CR-244 -64 and CR-244 -65)	Pressure buildup due to deflagration damages ventilation system with release of radioactive/toxic material.	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Ventilation path	Ignition source controls Flammable gas monitoring and controls	S2	F3	E2	It is not clear by what means the headspace flammable gas concentration is controlled in this tank since inleakage paths have not been positively identified and hydrogen production/diffusion has not been analyzed.
CR-244-72	5	Pressure/ Temperature	High	Ignition of organics in tank (implies ignition source present B intrusive activities)	Pressure buildup due to organic fire damages ventilation system with release of radioactive/toxic material.	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	None identified.	Ignition source controls	S2	F1	E2	Burn would be severely oxygen limited.

Date: 2/26/99
29 Pages

Table B-1. HAZOP Data - 244-CR Vault

Item ID	Node	Process Variable	Guide Word	Possible causes of deviation	Consequence	Hazardous Condition	Potential SSCs	Potential TSRs	Con Cat	Freq Cat	Env Cat	Remarks
CR-244-73	5	Pressure/ Temperature	High	Heating from fire in cell	Pressure buildup due to fuel fire in cell damages ventilation system with release of radioactive/toxic material.	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	None identified.	Vehicle access controls	S2	F3	E2	Burn would be oxygen limited.
CR-244-74	5	Pressure/ Temperature	High	Chemical reaction in tank	Pressurization resulting in release of hazardous materials	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	None required due to low Frequency.	Waste compatibility controls Transfer controls	S2	F0	E2	F0 based on evaluations performed for rest of tank farms assuming typical waste
Node 6: 244-CR facility ventilation system inlet. (The filter cooling building inlet is blocked and therefore ventilation inflow is through cracks around cover blocks and other penetrations).												
CR-244-75	6	Flow	Low/No	Blockage of inlet flow pathways (undefined)	Potential for buildup of flammable gases/vapors and deflagration within the concrete vault structure if ignition source present	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	None identified.	Flammable gas monitoring Ignition source controls.	S2	F1	E2	This condition implies that material is present in sump which could produce flammable gases or vapors. It is the judgment of the HAZOP team that it would be very difficult to retain hydrogen within the vault structure
CR-244-76	6	Flow	Low/No	Blockage of outlet path or fan failure	None identified.	None identified.	None identified.	None identified.	N/A	N/A	N/A	This deviation will covered under node 8.

Date: 2/26/99
29 Pages

Table B-1. HAZOP Data - 244-CR Vault

Item ID	Node	Process Variable	Guide Word	Possible causes of deviation	Consequence	Hazardous Condition	Potential SSCs	Potential TSRs	Con Cat	Freq Cat	Env Cat	Remarks
CR-244-77	6	Flow	High	Creation of large open inlet pathway (such as removal of cover block)	Increased pick-up of dry material in cell leading to increased filter loading.	Release of waste to atmosphere due to creation of unfiltered air flowpath.	None identified.	Filter monitoring and change-out.	S1	F3	E1	High flow in one location implies low flow in another location since total flow is fixed. Assumes presence of unfixed particulate contamination in cell. Increased loading on filters requiring more frequent change-out with increase in personnel radiation exposure
CR-244-78	6	Flow	Reverse	N/A	No credible scenarios identified.	None identified.	None identified.	None identified.	N/A	N/A	N/A	HAZOP team could not identify any credible scenario to produce significant reverse ventilation flow.
Node 7: Ventilation distribution in vault 244-CR and tanks.												
CR-244-79	7	Flow	Unbalanced flow	Cover block removed	Potential stagnation of ventilation in one or more tanks allowing buildup of flammable gas with possible ignition.	High-energy release of toxic or radioactive materials to the atmosphere from a tank through an unfiltered flow path due to flammable vapor ignition.	Open ventilation path to all tanks. Ventilation system flow capacity.	Flammable gas controls Ignition source controls. Ventilation system operation requirements	S2	F2	E2	Unclear what the required ventilation flow rate from tank is to prevent buildup of flammable gas Current TSR only specifies tank 244-CR-003.
CR-244-80	7	Flow	Unbalanced flow	Local blockage in duct work	Potential stagnation of ventilation in one or more tanks allowing buildup of flammable gas with possible ignition.	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Open ventilation path to all tanks. Ventilation system flow capacity.	Flammable gas controls Ignition source controls. Ventilation system operation requirements	S2	F1	E2	Unclear what the required ventilation flow rate from tank is to prevent buildup of flammable gas Current TSR only specifies tank 244-CR-003.

Date: 2/26/99
29 Pages

Table B-1. HAZOP Data - 244-CR Vault

Item ID	Node	Process Variable	Guide Word	Possible causes of deviation	Consequence	Hazardous Condition	Potential SSCs	Potential TSRs	Con Cat	Freq Cat	Env Cat	Remarks
CR-244-81	7	Flow	Unbalanced flow	High water level in cell blocks ventilation exhaust for that cell	Potential stagnation of ventilation in one or more tanks allowing buildup of flammable gas with possible ignition.	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Open ventilation path to all tanks. Ventilation system flow capacity.	Flammable gas controls Ignition source controls. Ventilation system operation requirements	S2	F1	E2	Unclear what the required ventilation flow rate from tank is to prevent buildup of flammable gas Current TSR only specifies tank 244-CR-003.
Node 8: Ventilation exhaust downstream of fan. (Configuration/status of abandoned exhaust filter unknown).												
CR-244-82	8	Flow	Low/No	Fan shutdown/failure	Potential for buildup of flammable gases/vapors and deflagration within the concrete vault structure or tanks if ignition source present	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Redundant fan available Stack CAM/flow alarm.	Flammable gas monitoring Ignition source controls.	S2	F2	E2	This condition implies that material is present in sump which could produce flammable gases or vapors. It is the judgment of the HAZOP team that it would be very difficult to retain hydrogen within the vault structure or tank. The stack CAM has its own vacuum pump; a low stack flow may or may not set off the CAM Low Vacuum Alarm.

Date: 2/26/99
29 Pages

Table B-1. HAZOP Data - 244-CR Vault

Item ID	Node	Process Variable	Guide Word	Possible causes of deviation	Consequence	Hazardous Condition	Potential SSCs	Potential TSRs	Con Cat	Freq Cat	Env Cat	Remarks
CR-244-83	8	Flow	Low/No	Plugged HEPA filters	Potential for buildup of flammable gases/vapors and deflagration within the concrete vault structure or tanks if ignition source present	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Differential pressure gages Stack CAM/flow alarm.	Flammable gas monitoring Ignition source controls. HEPA filter differential pressure monitoring requirements	S2	F2	E2	This condition implies that material is present in sump which could produce flammable gases or vapors. It is the judgment of the HAZOP team that it would be very difficult to retain hydrogen within the vault structure or tank. The stack CAM has its own vacuum pump; a low stack flow may or may not set off the CAM Low Vacuum Alarm.
CR-244-84	8	Flow	Low/No	Damper failure or inadvertent closure which prevents flow	Potential for buildup of flammable gases/vapors and deflagration within the concrete vault structure or tanks if ignition source present	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Stack CAM/flow alarm.	Flammable gas monitoring Ignition source controls.	S2	F2	E2	This condition implies that material is present in sump which could produce flammable gases or vapors. It is the judgment of the HAZOP team that it would be very difficult to retain hydrogen within the vault structure or tank. The stack CAM has its own vacuum pump; a low stack flow may or may not set off the CAM Low Vacuum Alarm.

Date: 2/26/99
29 Pages

Table B-1. HAZOP Data - 244-CR Vault

Item ID	Node	Process Variable	Guide Word	Possible causes of deviation	Consequence	Hazardous Condition	Potential SSCs	Potential TSRs	Con Cat	Freq Cat	Env Cat	Remarks
CR-244-85	8	Flow	Low/No	Lack of inlet path.	Potential for buildup of flammable gases/vapors and deflagration within the concrete vault structure or tanks if ignition source present	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Stack CAM/flow alarm.	Flammable gas monitoring Ignition source controls.	S2	F1	E2	This condition implies that material is present in sump which could produce flammable gases or vapors. It is the judgment of the HAZOP team that it would be very difficult to retain hydrogen within the vault structure or tank. The stack CAM has its own vacuum pump; a low stack flow may or may not set off the CAM Low Vacuum Alarm.
CR-244-86	8	Flow	High	Duct breach due to vehicle impact or load drop	Potential for buildup of flammable gases/vapors and deflagration within the concrete vault structure or tanks if ignition source present	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Stack CAM/flow alarm.	Flammable gas monitoring Ignition source controls.	S2	F1	E2	This condition implies that material is present in sump which could produce flammable gases or vapors. It is the judgment of the HAZOP team that it would be very difficult to retain hydrogen within the vault structure or tank. High flow up the stack from duct breach B no flow in cells/tanks.
CR-244-87	8	Flow	High	Seismic event breaches duct	Potential for buildup of flammable gases/vapors and deflagration within the concrete vault structure or tanks if ignition source present	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Stack CAM/flow alarm.	Flammable gas monitoring Ignition source controls.	S2	F1	E2	This condition implies that material is present in sump which could produce flammable gases or vapors. It is the judgment of the HAZOP team that it would be very difficult to retain hydrogen within the vault structure or tank.. High flow up the stack from duct breach B no flow in cells/tanks.

Date: 2/26/99
29 Pages

Table B-1. HAZOP Data - 244-CR Vault

Item ID	Node	Process Variable	Guide Word	Possible causes of deviation	Consequence	Hazardous Condition	Potential SSCs	Potential TSRs	Con Cat	Freq Cat	Env Cat	Remarks
CR-244-88	8	Flow	High	Removal of cover blocks	Increased pick-up of dry material in cell leading to increased filter loading.	Release of waste to atmosphere due to creation of unfiltered air flowpath.	None identified.	Filter monitoring and change-out.	S1	F3	E1	High flow in one location implies low flow in another location since total flow is fixed. Assumes presence of unfixed particulate contamination in cell. Increased loading on filters requiring more frequent change-out with increase in personnel radiation exposure
CR-244-89	8	Flow	As well as (contamination present)	HEPA filter blowout and continued unfiltered release.	Unfiltered release to environment Radiation/toxic exposure to workers	Release of waste to atmosphere due to creation of unfiltered air flowpath.	Stack CAM interlock with ventilation fan Differential pressure gages on HEPA filters	Differential pressure monitoring of HEPA filters HEPA filter monitoring and change-out requirements Stack CAM TSRs	S2	F3	E2	Looks just like the BIO accident.
CR-244-90	8	Flow	As well as (contamination present)	HEPA filter failure. (includes external fire affects)	Unfiltered release to environment Radiation/toxic exposure to workers	Release of waste to atmosphere due to creation of unfiltered air flowpath.	Stack CAM interlock with ventilation fan.	HEPA filter monitoring and change-out requirements Stack CAM TSRs	S1	F3	E1	None.
CR-244-91	8	Flow	Backflow	None identified.	None identified.	None identified.	None identified.	None identified.	N/A	N/A	N/A	Covered under node 6.

Table B2. Hazardous Conditions With Potential Significant Onsite Consequences (S2)
7 Pages

Item ID	Hazardous Condition	Cause	Freq Cat	Env Cat
CR-244-02	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	Radioactive decay heat	F1	E2
CR-244-03	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition. Ignition of flammable organic vapors	Incompatible transfer from 241-C-103 (contains organics that react with material already present).	F0	E2
CR-244-04	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	Fuel fire in cell due to ruptured fuel tank in vehicle	F1	E2
CR-244-05	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	Dead-headed pump and/or mixer heats waste	F0	E2
CR-244-07	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	Radioactive decay heat	F1	E2
CR-244-08	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition. Ignition of flammable organic vapors	Incompatible transfer from 241-C-103 (contains organics that react with material already present)	F1	E2
CR-244-09	Potential exposure of personnel to toxic or radioactive materials due to high temperature waste	Fuel fire in cell due to ruptured fuel tank in vehicle	F1	E2
CR-244-10	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	Dead-headed pump and/or mixer heats waste	F0	E2
CR-244-12	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	Radioactive decay heat	F1	E2
CR-244-13	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition. Ignition of flammable organic vapors	Incompatible transfer from 241-C-103 (contains organics that react with material already present)	F0	E2
CR-244-14	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	Fuel fire in cell due to ruptured fuel tank in vehicle	F1	E2

Table B2. Hazardous Conditions With Potential Significant Onsite Consequences (S2)
7 Pages

Item ID	Hazardous Condition	Cause	Freq Cat	Env Cat
CR-244-15	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	Dead-headed pump and/or mixer heats waste	F0	E2
CR-244-17	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	Radioactive decay heat	F1	E2
CR-244-18	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition. Ignition of flammable organic vapors.	Incompatible transfer from 241-C-103 (contains organics that react with material already present)	F0	E2
CR-244-19	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	Fuel fire in cell due to ruptured fuel tank in vehicle	F1	E2
CR-244-20	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	Dead-headed pump and/or mixer heats waste	F0	E2
CR-244-21A	None identified.	Evaporation/ leakage	F0	E2
CR-244-21B	None identified.	Evaporation/ leakage	F0	E2
CR-244-21C	None identified.	Evaporation/ leakage	F0	E2
CR-244-21D	None identified.	Evaporation/ leakage	F0	E2
CR-244-23A	Release of waste to atmosphere from tank due to tank leak with a HEPA filter loaded with particulate.	Tank leak	F3	E2
CR-244-23B	Release of waste to atmosphere from tank due to tank leak with a HEPA filter loaded with particulate.	Tank leak	F3	E2
CR-244-23C	Release of waste to atmosphere from tank due to tank leak with a HEPA filter loaded with particulate.	Tank leak	F3	E2
CR-244-23D	Release of waste to atmosphere from tank due to tank leak with a HEPA filter loaded with particulate.	Tank leak	F3	E2
CR-244-24A	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Cooling coil leak In CR-003	F3	E2
CR-244-24B	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Cooling coil leak CR-002	F3	E2

Table B2. Hazardous Conditions With Potential Significant Onsite Consequences (S2)
7 Pages

Item ID	Hazardous Condition	Cause	Freq Cat	Env Cat
CR-244-24C	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Raw water intrusion	F3	E2
CR-244-25	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Rain water intrusion	F0	E2
CR-244-26	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Waste mis-transfers	F3	E2
CR-244-27	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Transfer error	F3	E2
CR-244-36	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Ignition of flammable gas produced by radiolysis of material in sump in CR-003 tank cell.	F1	E2
CR-244-37	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Ignition of flammable gas produced by radiolysis of material in sump in CR-002 tank cell.	F1	E2
CR-244-38	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Ignition of flammable gas produced by radiolysis of material in sump in CR-001 tank cell.	F1	E2
CR-244-39	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Ignition of flammable gas produced by radiolysis of material in sump in CR-011 tank cell.	F1	E2
CR-244-40	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Ignition of vehicle fuel spilled in sump in CR-003 tank cell.	F1	E2
CR-244-41	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Ignition of vehicle fuel spilled in sump in CR-002 tank cell.	F1	E2
CR-244-42	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Ignition of vehicle fuel spilled in sump in CR-001 tank cell.	F1	E2

Table B2. Hazardous Conditions With Potential Significant Onsite Consequences (S2)
7 Pages

Item ID	Hazardous Condition	Cause	Freq Cat	Env Cat
CR-244-43	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Ignition of vehicle fuel spilled in sump in CR-011 tank cell.	F1	E2
CR-244-45A	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Ignition of vehicle fuel spilled in sump in CR-003 tank cell.	F1	E2
CR-244-45B	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Ignition of vehicle fuel spilled in sump in CR-002 tank cell.	F1	E2
CR-244-45C	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Ignition of vehicle fuel spilled in sump in CR-001 tank cell.	F1	E2
CR-244-45D	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Ignition of vehicle fuel spilled in sump in CR-011 tank cell.	F1	E2
CR-244-48	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Waste or raw water mis-route.	F1	E2
CR-244-49	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Transfer line failure with back-drainage to cell.	F1	E2
CR-244-50	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Rain water intrusion	F0	E2
CR-244-51A	Release of waste to surface or subsurface soil due to cell filling followed by tank failure and a cell leak.	Waste or raw water mis-route to cell CR-003.	F1	E2
CR-244-51B	Release of waste to surface or subsurface soil due to cell filling followed by tank failure and a cell leak.	Transfer line failure with back-drainage to cell CR-003.	F1	E2
CR-244-51C	Release of waste to surface or subsurface soil due to cell filling followed by tank failure and a cell leak.	Transfer line failure with back-drainage to cell CR-003.	F1	E2
CR-244-54A	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Hydrogen deflagration in head space of tank 244-CR-003.	F3	E2

Table B2. Hazardous Conditions With Potential Significant Onsite Consequences (S2)
7 Pages

Item ID	Hazardous Condition	Cause	Freq Cat	Env Cat
CR-244-54B	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Hydrogen deflagration in head space of tank 244-CR-002.	F3	E2
CR-244-54C	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Hydrogen deflagration in head space of tank 244-CR-001.	F3	E2
CR-244-54D	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Hydrogen deflagration in head space of tank 244-CR-011.	F3	E2
CR-244-56	Release of waste to atmosphere due to seismic-induced failure of tank and facility structure.	Seismic event	F1	E2
CR-244-57	Release of waste to surface or subsurface soil due to failure of tank and facility structure.	Deterioration due to aging	F1	E2
CR-244-59	Release of waste to surface or subsurface soil due to failure of tank and facility structure.	Load drop while lifting cover block or equipment.	F3	E2
CR-244-60	Release of waste to surface or subsurface soil due to failure of tank and facility structure.	Large static loads: parked vehicles; ashfall; snow load.	F3	E2
CR-244-63	Release of waste to surface or subsurface soil due to failure of tank and facility structure.	Aircraft crash	F0	E2
CR-244-64	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	All inleakage paths sealed	F3	E2
CR-244-65	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	ventilation system shut down	F3	E2
CR-244-67	None identified.	Open riser	F0	E2
CR-244-71	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Ignition of flammable gas in tank (see CR-244 -64 and CR-244 -65)	F3	E2

Table B2. Hazardous Conditions With Potential Significant Onsite Consequences (S2)
7 Pages

Item ID	Hazardous Condition	Cause	Freq Cat	Env Cat
CR-244-72	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Ignition of organics in tank (implies ignition source present - intrusive activities)	F1	E2
CR-244-73	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Heating from fire in cell	F3	E2
CR-244-74	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Chemical reaction in tank	F0	E2
CR-244-75	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Blockage of inlet flow pathways (undefined)	F1	E2
CR-244-79	High-energy release of toxic or radioactive materials to the atmosphere from a tank through an unfiltered flow path due to flammable vapor ignition.	Cover block removed	F2	E2
CR-244-80	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Local blockage in duct work	F1	E2
CR-244-81	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	High water level in cell blocks ventilation exhaust for that cell	F1	E2
CR-244-82	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Fan shutdown/failure	F2	E2
CR-244-83	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Plugged HEPA filters	F2	E2
CR-244-84	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Damper failure or inadvertent closure which prevents flow	F2	E2

Table B2. Hazardous Conditions With Potential Significant Onsite Consequences (S2)
7 Pages

Item ID	Hazardous Condition	Cause	Freq Cat	Env Cat
CR-244-85	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Lack of inlet path.	F1	E2
CR-244-86	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Duct breach due to vehicle impact or load drop	F1	E2
CR-244-87	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Seismic event breaches duct	F1	E2
CR-244-89	Release of waste to atmosphere due to creation of unfiltered air flowpath.	HEPA filter blowout and continued unfiltered release.	F3	E2

Table B-3. Hazardous Conditions With Potential Significant Facility Worker Consequences (S1)

1 Page

Item ID	Hazardous Condition	Cause	Freq Cat	Env Cat
CR-244-29	Release of waste to surface or subsurface soil due to a misrouting followed by tank overflow and a cell leak.	Overflow of low pH waste from 002 to CR-001. Misroute must occur.	F3	E1
CR-244-30	Release of waste to surface or subsurface soil due to a misrouting followed by tank overflow and a cell leak.	Overflow of low pH waste from 002 to 011. Misroute must occur.	F3	E1
CR-244-35	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Waste fills up cooling coil in tank 244-CR-003 or CR-002 through a leak	F1	E1
CR-244-46	Release of waste to atmosphere from tank due to tank leak with a HEPA filter loaded with particulate.	Desired condition	F3	E1
CR-244-52A	None identified.	High vacuum in tank 244-CR-003	F0	E1
CR-244-52B	None identified.	High vacuum in tank 244-CR-002	F0	E1
CR-244-52C	None identified.	High vacuum in tank 244-CR-001	F0	E1
CR-244-52D	None identified.	High vacuum in tank 244-CR-011	F0	E1
CR-244-61	Release of waste to surface or subsurface soil due to failure of tank and facility structure.	Excavations around facility	F2	E1
CR-244-62	Release of waste to surface or subsurface soil due to failure of tank and facility structure.	Facility modifications	F1	E1
CR-244-68	Release of waste to atmosphere from tank due to tank leak with a HEPA filter loaded with particulate.	Open riser	F3	E1
CR-244-77	Release of waste to atmosphere due to creation of unfiltered air flowpath.	Creation of large open inlet pathway (such as removal of cover block)	F3	E1
CR-244-88	Release of waste to atmosphere due to creation of unfiltered air flowpath.	Removal of cover blocks	F3	E1
CR-244-90	Release of waste to atmosphere due to creation of unfiltered air flowpath.	HEPA filter failure. (includes external fire affects)	F3	E1

Table B-4. Hazardous Conditions With No Significant Consequences (S0)
2 Pages

Item ID	Hazardous Condition	Cause	Freq Cat	Env Cat
CR-244-22A	Release of waste to subsurface soil from tank leak followed by cell leak.	Tank leak	F3	E1
CR-244-22B	Release of waste to subsurface soil from tank leak followed by cell leak.	Tank leak	F3	E1
CR-244-22C	Release of waste to subsurface soil from tank leak followed by cell leak.	Tank leak	F3	E1
CR-244-22D	Release of waste to subsurface soil from tank leak followed by cell leak.	Tank leak	F3	E1
CR-244-28	None identified.	Overflow of low pH waste from 002 to 003. Misroute must occur.	F3	E0
CR-244-34	None identified.	Waste fills up cooling coil in tank 244-CR-003 or CR-002 through a leak	F0	E0
CR-244-47	Release of waste to surface or subsurface soil due to tank leak followed by cell leak.	Cell is not leak tight	F3	E1
CR-244-53A	Release of waste to surface or subsurface soil due to seismic-induced failure of tank and facility structure.	Seismic event affecting CR-003	F2	E1
CR-244-53B	Release of waste to surface or subsurface soil due to seismic-induced failure of tank and facility structure.	Seismic event affecting CR-002	F2	E1
CR-244-53C	Release of waste to surface or subsurface soil due to seismic-induced failure of tank and facility structure.	Seismic event affecting CR-001	F2	E1
CR-244-53D	Release of waste to surface or subsurface soil due to seismic-induced failure of tank and facility structure.	Seismic event affecting CR-011	F2	E1
CR-244-55A	Release of waste to surface or subsurface soil due to tank leak followed by cell leak.	Corrosion of tank 244-CR-003 structure or supports	F3	E1

Table B-4. Hazardous Conditions With No Significant Consequences (S0)
2 Pages

Item ID	Hazardous Condition	Cause	Freq Cat	Env Cat
CR-244-55B	Release of waste to surface or subsurface soil due to tank leak followed by cell leak.	Corrosion of tank 244-CR-002 structure or supports	F3	E1
CR-244-55C	Release of waste to surface or subsurface soil due to tank leak followed by cell leak.	Corrosion of tank 244-CR-001 structure or supports	F3	E1
CR-244-55D	Release of waste to surface or subsurface soil due to tank leak followed by cell leak.	Corrosion of tank 244-CR-011 structure or supports	F3	E1
CR-244-58	Release of waste to surface or subsurface soil due to tank leak followed by cell leak.	Acid intrusion	F1	E1
CR-244-69	Release of waste to subsurface soil from tank leak followed by cell leak.	Open riser	F2	E0

Table B-5. Controls From BIO SSCs AND TSRs That Potentially Address Hazardous Conditions For 244-CR With Potential S2 Consequences.
18 Pages

Item ID	MAR	Hazardous Condition	Cause	Potential Preventative SSC	Potential Mitigative SSC	Potential Preventative TSR	Potential Mitigative TSR	Remarks	Con Cat
Rep. Acc. 05: Flammable Gas Deflagrations - SST									
CR-244-03	SST waste from 241-C-103	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition. Ignition of flammable organic vapors (tank 244-CR-003)	Incompatible transfer from 241-C-103 (contains organics that react with material already present).	None.	None required	LCO: 3.2.4 DCRT Ventilation Systems (tank 244-CR-003 only) AC: 5.10 Ignition Controls AC: 5.11 Flammable Gas Monitoring Controls	AC: 5.18 HEPA Filter Controls (Source Term controls)	None applicable.	S2
CR-244-08	SST waste from 241-C-103	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition. Ignition of flammable organic vapors (tank 244-CR-001)	Incompatible transfer from 241-C-103 (contains organics that react with material already present)	None.	None required	LCO: 3.2.4 DCRT Ventilation Systems (tank 244-CR-003 only) AC: 5.10 Ignition Controls AC: 5.11 Flammable Gas Monitoring Controls	AC: 5.18 HEPA Filter Controls (Source Term controls)	None applicable.	S2
CR-244-13	SST waste from 241-C-103	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition. Ignition of flammable organic vapors (tank 244-CR-001)	Incompatible transfer from 241-C-103 (contains organics that react with material already present)	None.	None required	LCO: 3.2.4 DCRT Ventilation Systems (tank 244-CR-003 only) AC: 5.10 Ignition Controls AC: 5.11 Flammable Gas Monitoring Controls	AC: 5.18 HEPA Filter Controls (Source Term controls)	None applicable.	S2

Table B-5. Controls From BIO SSCs AND TSRs That Potentially Address Hazardous Conditions For 244-CR With Potential S2 Consequences.
18 Pages

Item ID	MAR	Hazardous Condition	Cause	Potential Preventative SSC	Potential Mitigative SSC	Potential Preventative TSR	Potential Mitigative TSR	Remarks	Con Cat
CR-244-18	SST waste from 241-C-103	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition. Ignition of flammable organic vapors. (tank 244-CR-001)	Incompatible transfer from 241-C-103 (contains organics that react with material already present)	None.	None required	LCO: 3.2.4 DCRT Ventilation Systems (tank 244-CR-003 only) AC: 5.10 Ignition Controls AC: 5.11 Flammable Gas Monitoring Controls	AC: 5.18 HEPA Filter Controls (Source Term controls)	None applicable.	S2
CR-244-54A	Saltwell waste from C Farm	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition. (tank 244-CR-003)	Hydrogen deflagration in head space of tank 244-CR-003.	None.	None required	LCO: 3.2.4 DCRT Ventilation Systems (tank 244-CR-003 only) AC: 5.10 Ignition Controls AC: 5.11 Flammable Gas Monitoring Controls	AC: 5.18 HEPA Filter Controls (Source Term controls)	None.	S2
CR-244-54B	Residual PAS	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition. (tank 244-CR-002)	Hydrogen deflagration in head space of tank 244-CR-002.	None.	None required	AC: 5.10 Ignition Controls AC: 5.11 Flammable Gas Monitoring Controls	AC: 5.18 HEPA Filter Controls (Source Term controls)	None.	S2
CR-244-54C	SST waste from C Farm	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition. (tank 244-CR-001)	Hydrogen deflagration in head space of tank 244-CR-001.	None.	None required	AC: 5.10 Ignition Controls AC: 5.11 Flammable Gas Monitoring Controls	AC: 5.18 HEPA Filter Controls (Source Term controls)	None.	S2

Table B-5. Controls From BIO SSCs AND TSRs That Potentially Address Hazardous Conditions For 244-CR With Potential S2 Consequences.
18 Pages

Item ID	MAR	Hazardous Condition	Cause	Potential Preventative SSC	Potential Mitigative SSC	Potential Preventative TSR	Potential Mitigative TSR	Remarks	Con Cat
CR-244-54D	Hot Semi-works decon. solution	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition. (tank 244-CR-011)	Hydrogen deflagration in head space of tank 244-CR-011.	None.	None required	AC: 5.10 Ignition Controls AC: 5.11 Flammable Gas Monitoring Controls	AC: 5.18 HEPA Filter Controls (Source Term controls)	None.	S2
CR-244-64	Combination of all 244-CR tanks' contents	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	All inleakage paths sealed	None.	None required	AC: 5.10 Ignition Controls AC: 5.11 Flammable Gas Monitoring Controls	AC: 5.18 HEPA Filter Controls (Source Term controls)	It is not clear by what means the headspace flammable gas concentration is controlled in this tank since inleakage paths have not been positively identified and hydrogen production/diffusion has not been analyzed.	S2
CR-244-65	Combination of all 244-CR tanks' contents	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	ventilation system shut down	None.	None required	LCO: 3.2.4 DCRT Ventilation Systems (tank 244-CR-003 only) AC: 5.10 Ignition Controls AC: 5.11 Flammable Gas Monitoring Controls	AC: 5.18 HEPA Filter Controls (Source Term controls)	Hydrogen production/diffusion has not been adequately analyzed.	S2
CR-244-71	Combination of all 244-CR tanks' contents	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Ignition of flammable gas in tank (see CR-244 -64 and CR-244 -65)	None.	None required	LCO: 3.2.4 DCRT Ventilation Systems (tank 244-CR-003 only) AC: 5.10 Ignition Controls AC: 5.11 Flammable Gas Monitoring Controls	AC: 5.18 HEPA Filter Controls (Source Term controls)	It is not clear by what means the headspace flammable gas concentration is controlled in this tank since inleakage paths have not been positively identified and hydrogen production/diffusion has not been analyzed.	S2

Table B-5. Controls From BIO SSCs AND TSRs That Potentially Address Hazardous Conditions For 244-CR With Potential S2 Consequences.
18 Pages

Item ID	MAR	Hazardous Condition	Cause	Potential Preventative SSC	Potential Mitigative SSC	Potential Preventative TSR	Potential Mitigative TSR	Remarks	Con Cat
CR-244-72	Combination of all 244-CR tanks' contents	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Ignition of organics in tank (implies ignition source present - intrusive activities)	None.	None required	LCO: 3.2.4 DCRT Ventilation Systems (tank 244-CR-003 only) AC: 5.10 Ignition Controls AC: 5.11 Flammable Gas Monitoring Controls	AC: 5.18 HEPA Filter Controls (Source Term controls)	Burn would be severely oxygen limited.	S2
CR-244-73	Combination of all 244-CR tanks' contents	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Heating from fire in cell	None.	None required	LCO: 3.2.4 DCRT Ventilation Systems (tank 244-CR-003 only) AC: 5.10 Ignition Controls AC: 5.11 Flammable Gas Monitoring Controls	AC: 5.18 HEPA Filter Controls (Source Term controls)	Burn would be oxygen limited.	S2
CR-244-74	Combination of all 244-CR tanks' contents	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Chemical reaction in tank	None.	None required	LCO: 3.2.4 DCRT Ventilation Systems (tank 244-CR-003 only) AC: 5.10 Ignition Controls AC: 5.11 Flammable Gas Monitoring Controls	AC: 5.18 HEPA Filter Controls (Source Term controls)	None applicable.	S2
CR-244-75	Combination of all 244-CR tanks' contents	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Blockage of inlet flow pathways (undefined)	None.	None required	LCO: 3.2.4 DCRT Ventilation Systems (tank 244-CR-003 only) AC: 5.10 Ignition Controls AC: 5.11 Flammable Gas Monitoring Controls	AC: 5.18 HEPA Filter Controls (Source Term controls)	This condition implies that material is present in sump which could produce flammable gases or vapors. It is the judgment of the HAZOP team that it would be very difficult to retain hydrogen within the vault structure	S2

Table B-5. Controls From BIO SSCs AND TSRs That Potentially Address Hazardous Conditions For 244-CR With Potential S2 Consequences.
18 Pages

Item ID	MAR	Hazardous Condition	Cause	Potential Preventative SSC	Potential Mitigative SSC	Potential Preventative TSR	Potential Mitigative TSR	Remarks	Con Cat
CR-244-79	Combination of all 244-CR tanks' contents	High-energy release of toxic or radioactive materials to the atmosphere from a tank through an unfiltered flow path due to flammable vapor ignition.	Cover block removed	None.	None required	LCO: 3.2.4 DCRT Ventilation Systems (tank 244-CR-003 only) AC: 5.10 Ignition Controls AC: 5.11 Flammable Gas Monitoring Controls	AC: 5.18 HEPA Filter Controls (Source Term controls)	Unclear what the required ventilation flow rate from tank is to prevent buildup of flammable gas Current TSR only specifies tank 244-CR-003.	S2
CR-244-80	Combination of all 244-CR tanks' contents	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Local blockage in duct work	None.	None required	LCO: 3.2.4 DCRT Ventilation Systems (tank 244-CR-003 only) AC: 5.10 Ignition Controls AC: 5.11 Flammable Gas Monitoring Controls	AC: 5.18 HEPA Filter Controls (Source Term controls)	Unclear what the required ventilation flow rate from tank is to prevent buildup of flammable gas Current TSR only specifies tank 244-CR-003.	S2
CR-244-81	Combination of all 244-CR tanks' contents	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	High water level in cell blocks ventilation exhaust for that cell	None.	None required	LCO: 3.2.4 DCRT Ventilation Systems (tank 244-CR-003 only) AC: 5.10 Ignition Controls AC: 5.11 Flammable Gas Monitoring Controls	AC: 5.18 HEPA Filter Controls (Source Term controls)	Unclear what the required ventilation flow rate from tank is to prevent buildup of flammable gas Current TSR only specifies tank 244-CR-003.	S2

Table B-5. Controls From BIO SSCs AND TSRs That Potentially Address Hazardous Conditions For 244-CR With Potential S2 Consequences.
18 Pages

Item ID	MAR	Hazardous Condition	Cause	Potential Preventative SSC	Potential Mitigative SSC	Potential Preventative TSR	Potential Mitigative TSR	Remarks	Con Cat
CR-244-82	Combination of all 244-CR tanks' contents	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Fan shutdown/failure	None.	None required	LCO: 3.2.4 DCRT Ventilation Systems (tank 244-CR-003 only) AC: 5.10 Ignition Controls AC: 5.11 Flammable Gas Monitoring Controls	AC: 5.18 HEPA Filter Controls (Source Term controls)	This condition implies that material is present in sump which could produce flammable gases or vapors. It is the judgment of the HAZOP team that it would be very difficult to retain hydrogen within the vault structure or tank. The stack CAM has its own vacuum pump; a low stack flow may or may not set off the CAM Low Vacuum Alarm.	S2
CR-244-83	Combination of all 244-CR tanks' contents	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Plugged HEPA filters	None.	None required	LCO: 3.2.4 DCRT Ventilation Systems (tank 244-CR-003 only) AC: 5.10 Ignition Controls AC: 5.11 Flammable Gas Monitoring Controls	AC: 5.18 HEPA Filter Controls (Source Term controls)	This condition implies that material is present in sump which could produce flammable gases or vapors. It is the judgment of the HAZOP team that it would be very difficult to retain hydrogen within the vault structure or tank. The stack CAM has its own vacuum pump; a low stack flow may or may not set off the CAM Low Vacuum Alarm.	S2

Table B-5. Controls From BIO SSCs AND TSRs That Potentially Address Hazardous Conditions For 244-CR With Potential S2 Consequences.
18 Pages

Item ID	MAR	Hazardous Condition	Cause	Potential Preventative SSC	Potential Mitigative SSC	Potential Preventative TSR	Potential Mitigative TSR	Remarks	Con Cat
CR-244-84	Combination of all 244-CR tanks' contents	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Damper failure or inadvertent closure which prevents flow	None.	None required	LCO: 3.2.4 DCRT Ventilation Systems (tank 244-CR-003 only) AC: 5.10 Ignition Controls AC: 5.11 Flammable Gas Monitoring Controls	AC: 5.18 HEPA Filter Controls (Source Term controls)	This condition implies that material is present in sump which could produce flammable gases or vapors. It is the judgment of the HAZOP team that it would be very difficult to retain hydrogen within the vault structure or tank. The stack CAM has its own vacuum pump; a low stack flow may or may not set off the CAM Low Vacuum Alarm.	S2
CR-244-85	Combination of all 244-CR tanks' contents	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Lack of inlet path.	None.	None required	LCO: 3.2.4 DCRT Ventilation Systems (tank 244-CR-003 only) AC: 5.10 Ignition Controls AC: 5.11 Flammable Gas Monitoring Controls	AC: 5.18 HEPA Filter Controls (Source Term controls)	This condition implies that material is present in sump which could produce flammable gases or vapors. It is the judgment of the HAZOP team that it would be very difficult to retain hydrogen within the vault structure or tank. The stack CAM has its own vacuum pump; a low stack flow may or may not set off the CAM Low Vacuum Alarm.	S2

Table B-5. Controls From BIO SSCs AND TSRs That Potentially Address Hazardous Conditions For 244-CR With Potential S2 Consequences.
18 Pages

Item ID	MAR	Hazardous Condition	Cause	Potential Preventative SSC	Potential Mitigative SSC	Potential Preventative TSR	Potential Mitigative TSR	Remarks	Con Cat
CR-244-86	Combination of all 244-CR tanks' contents	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Duct breach due to vehicle impact or load drop	None.	None required	LCO: 3.2.4 DCRT Ventilation Systems (tank 244-CR-003 only) AC: 5.10 Ignition Controls AC: 5.11 Flammable Gas Monitoring Controls	AC: 5.18 HEPA Filter Controls (Source Term controls)	This condition implies that material is present in sump which could produce flammable gases or vapors. It is the judgment of the HAZOP team that it would be very difficult to retain hydrogen within the vault structure or tank. High flow up the stack from duct breach – no flow in cells/tanks.	S2
CR-244-87	Combination of all 244-CR tanks' contents	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Seismic event breaches duct	None.	None required	LCO: 3.2.4 DCRT Ventilation Systems (tank 244-CR-003 only) AC: 5.10 Ignition Controls AC: 5.11 Flammable Gas Monitoring Controls	AC: 5.18 HEPA Filter Controls (Source Term controls)	This condition implies that material is present in sump which could produce flammable gases or vapors. It is the judgment of the HAZOP team that it would be very difficult to retain hydrogen within the vault structure or tank.. High flow up the stack from duct breach – no flow in cells/tanks.	S2
Rep. Acc. 07: Fire in Contaminated Area									
CR-244-04	Saltwell waste from C Farm	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste. (tank 244-CR-003)	Fuel fire in cell due to ruptured fuel tank in vehicle	None required	None required	AC: 5.10 Ignition Controls (Vehicle Controls)	AC: 5.14 Emergency Preparedness (Fire In Contaminated Area)	Most above-ground equipment which could puncture a fuel tank has been removed	S2
CR-244-09	Residual PAS	Potential exposure of personnel to toxic or radioactive materials due to high temperature waste (tank 244-CR-002)	Fuel fire in cell due to ruptured fuel tank in vehicle	None required	None required	AC: 5.10 Ignition Controls (Vehicle Controls)	AC: 5.14 Emergency Preparedness (Fire In Contaminated Area)	Most above-ground equipment which could puncture a fuel tank has been removed	S2

Table B-5. Controls From BIO SSCs AND TSRs That Potentially Address Hazardous Conditions For 244-CR With Potential S2 Consequences.
18 Pages

Item ID	MAR	Hazardous Condition	Cause	Potential Preventative SSC	Potential Mitigative SSC	Potential Preventative TSR	Potential Mitigative TSR	Remarks	Con Cat
CR-244-14	SST waste from C Farm	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste. (tank 244-CR-001)	Fuel fire in cell due to ruptured fuel tank in vehicle	None required	None required	AC: 5.10 Ignition Controls (Vehicle Controls)	AC: 5.14 Emergency Preparedness (Fire In Contaminated Area)	Most above-ground equipment which could puncture a fuel tank has been removed	S2
CR-244-19	Hot semi-works decon. solution	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste. (tank 244-CR-011)	Fuel fire in cell due to ruptured fuel tank in vehicle	None required	None required	AC: 5.10 Ignition Controls (Vehicle Controls)	AC: 5.14 Emergency Preparedness (Fire In Contaminated Area)	Most above-ground equipment which could puncture a fuel tank has been removed	S2
CR-244-36	Saltwell waste from C Farm	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition. (tank 244-CR-003)	Ignition of flammable gas produced by radiolysis of material in sump in CR-003 tank cell.	None required	None required	AC: 5.10 Ignition Controls (Vehicle Controls)	AC: 5.14 Emergency Preparedness (Fire In Contaminated Area)	Facility not leak tight.	S2
CR-244-37	Residual PAS	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition. (tank 244-CR-002)	Ignition of flammable gas produced by radiolysis of material in sump in CR-002 tank cell.	None required	None required	AC: 5.10 Ignition Controls (Vehicle Controls)	AC: 5.14 Emergency Preparedness (Fire In Contaminated Area)	Facility not leak tight.	S2
CR-244-38	SST waste from C Farm	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition. (tank 244-CR-001)	Ignition of flammable gas produced by radiolysis of material in sump in CR-001 tank cell.	None required	None required	AC: 5.10 Ignition Controls (Vehicle Controls)	AC: 5.14 Emergency Preparedness (Fire In Contaminated Area)	Facility not leak tight.	S2

Table B-5. Controls From BIO SSCs AND TSRs That Potentially Address Hazardous Conditions For 244-CR With Potential S2 Consequences.
18 Pages

Item ID	MAR	Hazardous Condition	Cause	Potential Preventative SSC	Potential Mitigative SSC	Potential Preventative TSR	Potential Mitigative TSR	Remarks	Con Cat
CR-244-39	Hot Semi-works decon. solution	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition. (tank 244-CR-011)	Ignition of flammable gas produced by radiolysis of material in sump in CR-011 tank cell.	None required	None required	AC: 5.10 Ignition Controls (Vehicle Controls)	AC: 5.14 Emergency Preparedness (Fire In Contaminated Area)	Facility not leak tight.	S2
CR-244-40	Saltwell waste from C Farm	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition. (tank 244-CR-003)	Ignition of vehicle fuel spilled in sump in CR-003 tank cell.	None required	None required	AC: 5.10 Ignition Controls (Vehicle Controls)	AC: 5.14 Emergency Preparedness (Fire In Contaminated Area)	Facility not leak tight.	S2
CR-244-41	Residual PAS	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition. (tank 244-CR-002)	Ignition of vehicle fuel spilled in sump in CR-002 tank cell.	None required	None required	AC: 5.10 Ignition Controls (Vehicle Controls)	AC: 5.14 Emergency Preparedness (Fire In Contaminated Area)	Facility not leak tight.	S2
CR-244-42	SST waste from C Farm	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition. (tank 244-CR-001)	Ignition of vehicle fuel spilled in sump in CR-001 tank cell.	None required	None required	AC: 5.10 Ignition Controls (Vehicle Controls)	AC: 5.14 Emergency Preparedness (Fire In Contaminated Area)	Facility not leak tight.	S2
CR-244-43	Hot Semi-works decon. solution	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition. (tank 244-CR-011)	Ignition of vehicle fuel spilled in sump in CR-011 tank cell.	None required	None required	AC: 5.10 Ignition Controls (Vehicle Controls)	AC: 5.14 Emergency Preparedness (Fire In Contaminated Area)	Facility not leak tight.	S2

Table B-5. Controls From BIO SSCs AND TSRs That Potentially Address Hazardous Conditions For 244-CR With Potential S2 Consequences.
18 Pages

Item ID	MAR	Hazardous Condition	Cause	Potential Preventative SSC	Potential Mitigative SSC	Potential Preventative TSR	Potential Mitigative TSR	Remarks	Con Cat
CR-244-45A	Saltwell waste from C Farm	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition. (tank 244-CR-003)	Ignition of vehicle fuel spilled in sump in CR-003 tank cell.	None required	None required	AC: 5.10 Ignition Controls (Vehicle Controls)	AC: 5.14 Emergency Preparedness (Fire In Contaminated Area)	Facility not leak tight.	S2
CR-244-45B	Residual PAS	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition. (tank 244-CR-002)	Ignition of vehicle fuel spilled in sump in CR-002 tank cell.	None required	None required	AC: 5.10 Ignition Controls (Vehicle Controls)	AC: 5.14 Emergency Preparedness (Fire In Contaminated Area)	Facility not leak tight.	S2
CR-244-45C	SST waste from C Farm	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition. (tank 244-CR-001)	Ignition of vehicle fuel spilled in sump in CR-001 tank cell.	None required	None required	AC: 5.10 Ignition Controls (Vehicle Controls)	AC: 5.14 Emergency Preparedness (Fire In Contaminated Area)	Facility not leak tight.	S2
CR-244-45D	Hot Semi-works decon. solution	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition. (tank 244-CR-011)	Ignition of vehicle fuel spilled in sump in CR-011 tank cell.	None required	None required	AC: 5.10 Ignition Controls (Vehicle Controls)	AC: 5.14 Emergency Preparedness (Fire In Contaminated Area)	Facility not leak tight.	S2
Rep. Acc. 09: Organic Solvent Fire/Organic Salt-Nitrate Reaction									
CR-244-21A	Saltwell waste from C Farm	None identified. (tank 244-CR-003)	Evaporation/ leakage	None required due to low estimated frequency.	None required due to low estimated frequency.	None required due to low estimated frequency.	None required due to low estimated frequency.	Temperature controls not applied to DCRTs. Nitrate fires not considered credible.	S2

Table B-5. Controls From BIO SSCs AND TSRs That Potentially Address Hazardous Conditions For 244-CR With Potential S2 Consequences.
18 Pages

Item ID	MAR	Hazardous Condition	Cause	Potential Preventative SSC	Potential Mitigative SSC	Potential Preventative TSR	Potential Mitigative TSR	Remarks	Con Cat
CR-244-21B	Residual PAS	None identified. (tank 244-CR-002)	Evaporation/ leakage	None required due to low estimated frequency.	None required due to low estimated frequency.	None required due to low estimated frequency.	None required due to low estimated frequency.	Temperature controls not applied to DCRTs. Nitrate fires not considered credible.	S2
CR-244-21C	SST waste from C Farm	None identified. (tank 244-CR-001)	Evaporation/ leakage	None required due to low estimated frequency.	None required due to low estimated frequency.	None required due to low estimated frequency.	None required due to low estimated frequency.	Temperature controls not applied to DCRTs. Nitrate fires not considered credible.	S2
CR-244-21D	Hot semi-works decon. solution	None identified. (tank 244-CR-011)	Evaporation/ leakage	None required due to low estimated frequency.	None required due to low estimated frequency.	None required due to low estimated frequency.	None required due to low estimated frequency.	Temperature controls not applied to DCRTs. Nitrate fires not considered credible.	S2
Rep. Acc. 12: Tank Failure due to Excessive Loads									
CR-244-59	Combination of all 244-CR tanks' contents	Release of waste to surface or subsurface soil due to failure of tank and facility structure.	Load drop while lifting cover block or equipment.	None required due to low estimated frequency.	None required	AC: 5.16 Dome Loading Controls (Hoisting and Lifting controls)	None required	None.	S2
CR-244-60	Combination of all 244-CR tanks' contents	Release of waste to surface or subsurface soil due to failure of tank and facility structure.	Large static loads: parked vehicles; ashfall; snow load.	None required due to low estimated frequency.	None required	AC: 5.16 Dome Loading Controls (Uniform and concentrated loads)	None required	Ashfall and snow loading are not concerns.	S2
CR-244-63	Combination of all 244-CR tanks' contents	Release of waste to surface or subsurface soil due to failure of tank and facility structure.	Aircraft crash	None required due to low estimated frequency.	None required	AC: 5.16 Dome Loading Controls (Hoisting and Lifting controls)	None required	Aircraft crash considered not credible.	S2
Rep. Acc. 13: Tank Failure due to Vacuum or Degradation									
CR-244-57	Combination of all 244-CR tanks' contents	Release of waste to surface or subsurface soil due to failure of tank and facility structure.	Deterioration due to aging	None required	None required	None required	None required	None applicable.	S2

Table B-5. Controls From BIO SSCs AND TSRs That Potentially Address Hazardous Conditions For 244-CR With Potential S2 Consequences.
18 Pages

Item ID	MAR	Hazardous Condition	Cause	Potential Preventative SSC	Potential Mitigative SSC	Potential Preventative TSR	Potential Mitigative TSR	Remarks	Con Cat
Rep. Acc. 14: Natural Phenomena - Seismic									
CR-244-56	Combination of all 244-CR tanks' contents	Release of waste to atmosphere due to seismic-induced failure of tank and facility structure.	Seismic event	None required	None required	None.	AC: 5.14 Emergency Preparedness (Seismic)	None applicable.	S2
Rep. Acc. 18B: Unfiltered Release									
CR-244-67	N/A	None identified.	Open riser	None required	SS: Ventilation CAM Interlock Systems	None required	LCO: 3.1.4 Ventilation Stack CAM Interlock Systems AC: 5.18 HEPA Filter Controls (Source Term Control)	Decay heat/ energy source does not appear to be adequate to support this reaction	S2
CR-244-89	Combination of all 244-CR tanks' contents	Release of waste to atmosphere due to creation of unfiltered air flowpath.	HEPA filter blowout and continued unfiltered release.	None required	SS: Ventilation CAM Interlock Systems	None required	LCO: 3.1.4 Ventilation Stack CAM Interlock Systems AC: 5.18 HEPA Filter Controls (Source Term Control)	Looks just like the BIO accident.	S2
Rep. Acc. 18BX: Resuspended Dry Particulate Material (chance of being differing source term)									
CR-244-23A	Saltwell waste from C Farm (tank 244-CR-003)	Release of waste to atmosphere from tank due to tank leak with a HEPA filter loaded with particulate.	Tank leak	None required	SS: Ventilation CAM Interlock Systems	None required	AC: 5.18 HEPA Filter Controls (Source Term Control)	Previously not evaluated in BIO	S2
CR-244-23B	Residual PAS (tank 244-CR-002)	Release of waste to atmosphere from tank due to tank leak with a HEPA filter loaded with particulate.	Tank leak	None required	SS: Ventilation CAM Interlock Systems	None required	AC: 5.18 HEPA Filter Controls (Source Term Control)	Previously not evaluated in BIO	S2

Table B-5. Controls From BIO SSCs AND TSRs That Potentially Address Hazardous Conditions For 244-CR With Potential S2 Consequences.
18 Pages

Item ID	MAR	Hazardous Condition	Cause	Potential Preventative SSC	Potential Mitigative SSC	Potential Preventative TSR	Potential Mitigative TSR	Remarks	Con Cat
CR-244-23C	SST waste from C Farm (tank 244-CR-001)	Release of waste to atmosphere from tank due to tank leak with a HEPA filter loaded with particulate.	Tank leak	None required	SS: Ventilation CAM Interlock Systems	None required	AC: 5.18 HEPA Filter Controls (Source Term Control)	Previously not evaluated in BIO	S2
CR-244-23D	Hot Semi-works decon. solution (tank 244-CR-011)	Release of waste to atmosphere from tank due to tank leak with a HEPA filter loaded with particulate.	Tank leak	None required	SS: Ventilation CAM Interlock Systems	None required	AC: 5.18 HEPA Filter Controls (Source Term Control)	Previously not evaluated in BIO	S2
Rep. Acc. 22: Evaporator Dump									
CR-244-02	Saltwell waste from C Farm	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste. (tank 244-CR-003)	Radioactive decay heat	None required	None required	None required	None required	Volume of tank may be too small to have sufficient inventory to reach saturated condition Current heat loads in tanks that could be transferred to CR-244 do not appear high enough to cause postulated hazardous condition	S2
CR-244-05	Saltwell waste from C Farm	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste. (tank 244-CR-003)	Dead-headed pump and/or mixer heats waste	None required	None required	None required	None required	It was concluded by the team that insufficient energy was available from equipment in the tank to overpower ventilation	S2
CR-244-07	Residual PAS	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste. (tank 244-CR-002)	Radioactive decay heat	None required	None required	None required	None required	Volume of tank may be too small to have sufficient inventory to reach saturated condition Current heat loads in tanks that could be transferred to CR-244 do not appear high enough to cause postulated hazardous condition	S2

Table B-5. Controls From BIO SSCs AND TSRs That Potentially Address Hazardous Conditions For 244-CR With Potential S2 Consequences.
18 Pages

Item ID	MAR	Hazardous Condition	Cause	Potential Preventative SSC	Potential Mitigative SSC	Potential Preventative TSR	Potential Mitigative TSR	Remarks	Con Cat
CR-244-10	Residual PAS	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste. (tank 244-CR-002)	Dead-headed pump and/or mixer heats waste	None required	None required	None required	None required	It was concluded by the team that insufficient energy was available from equipment in the tank to overpower ventilation	S2
CR-244-12	SST waste from C Farm	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste. (tank 244-CR-001)	Radioactive decay heat	None required	None required	None required	None required	Volume of tank may be too small to have sufficient inventory to reach saturated condition Current heat loads in tanks that could be transferred to CR-244 do not appear high enough to cause postulated hazardous condition	S2
CR-244-15	SST waste from C Farm	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste. (tank 244-CR-001)	Dead-headed pump and/or mixer heats waste	None required	None required	None required	None required	It was concluded by the team that insufficient energy was available from equipment in the tank to overpower ventilation	S2
CR-244-17	Hot semi-works decon. solution	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste. (tank 244-CR-011)	Radioactive decay heat	None required	None required	None required	None required	Volume of tank may be too small to have sufficient inventory to reach saturated condition Current heat loads in tanks that could be transferred to CR-244 do not appear high enough to cause postulated hazardous condition	S2

Table B-5. Controls From BIO SSCs AND TSRs That Potentially Address Hazardous Conditions For 244-CR With Potential S2 Consequences.
18 Pages

Item ID	MAR	Hazardous Condition	Cause	Potential Preventative SSC	Potential Mitigative SSC	Potential Preventative TSR	Potential Mitigative TSR	Remarks	Con Cat
CR-244-20	Hot semi-works decon. solution	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste. (tank 244-CR-011)	Dead-headed pump and/or mixer heats waste	None required	None required	None required	None required	It was concluded by the team that insufficient energy was available from equipment in the tank to overpower ventilation	S2
Rep. Acc. 26: Surface Leak Resulting in a Pool									
CR-244-24A	Saltwell waste from C Farm	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Cooling coil leak In CR-003	None.	SS: Tank level Detection Systems (tank 244-CR-003 only) SS: Service Water Flow Totalizers	None.	AC: 5.14 Emergency Preparedness (Surface Leak Resulting In Pool)	Leak/Level detection systems may not be operating since a transfer is not taking place Cooling coils for CR-002 and CR-003 have been blanked. Frequency may be much lower than indicated.	S2
CR-244-24B	Residual PAS	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Cooling coil leak CR-002	None.	SS: Tank level Detection Systems (tank 244-CR-003 only) SS: Service Water Flow Totalizers	None.	AC: 5.14 Emergency Preparedness (Surface Leak Resulting In Pool)	Leak/Level detection systems may not be operating since a transfer is not taking place Cooling coils for CR-002 and CR-003 have been blanked. Frequency may be much lower than indicated.	S2
CR-244-24C	Combination of all 244-CR tanks' contents	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Raw water intrusion	None.	SS: Tank level Detection Systems (tank 244-CR-003 only) SS: Service Water Flow Totalizers	None.	AC: 5.14 Emergency Preparedness (Surface Leak Resulting In Pool)	Leak/Level detection systems may not be operating since a transfer is not taking place. Frequency may be much lower than indicated.	S2

Table B-5. Controls From BIO SSCs AND TSRs That Potentially Address Hazardous Conditions For 244-CR With Potential S2 Consequences.
18 Pages

Item ID	MAR	Hazardous Condition	Cause	Potential Preventative SSC	Potential Mitigative SSC	Potential Preventative TSR	Potential Mitigative TSR	Remarks	Con Cat
CR-244-25	Combination of all 244-CR tanks' contents	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Rain water intrusion	None.	SS: Tank level Detection Systems (tank 244-CR-003 only)	None.	AC: 5.14 Emergency Preparedness (Surface Leak Resulting In Pool)	Rainwater intrusion was not determined to be a credible scenario. Minor level increase in tank is the most likely result, however, overfilling could occur	S2
CR-244-26	Waste being transferred	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Waste mis-transfers	None.	SS: Tank level Detection Systems (tank 244-CR-003 only)	None.	AC: 5.14 Emergency Preparedness (Surface Leak Resulting In Pool)	Consequences greater than raw water event Accident occurs when facility is assumed to not be connected	S2
CR-244-27	Waste being transferred	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Transfer error	None.	SS: Tank level Detection Systems (tank 244-CR-003 only)	None.	AC: 5.14 Emergency Preparedness (Surface Leak Resulting In Pool)	Consequences same as CR-244-27.	S2
CR-244-48	Combination of all 244-CR tanks' contents	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Waste or raw water mis-route.	None.	SS: Tank level Detection Systems (tank 244-CR-003 only) SS: Service Water Flow Totalizers	None.	AC: 5.14 Emergency Preparedness (Surface Leak Resulting In Pool)	Damage to facility by itself is D&D problem and would create operational problems. Same for all four cells with exception of leak detector in cell CR-003.	S2
CR-244-49	Waste being transferred, Combination of all 244-CR tanks' contents	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Transfer line failure with back-drainage to cell.	None.	SS: Tank level Detection Systems (tank 244-CR-003 only)	None.	AC: 5.14 Emergency Preparedness (Surface Leak Resulting In Pool)	Damage to facility by itself is D&D problem and would create operational problems. Same for all four cells with exception of leak detector in cell CR-003.	S2

Table B-5. Controls From BIO SSCs AND TSRs That Potentially Address Hazardous Conditions For 244-CR With Potential S2 Consequences.
18 Pages

Item ID	MAR	Hazardous Condition	Cause	Potential Preventative SSC	Potential Mitigative SSC	Potential Preventative TSR	Potential Mitigative TSR	Remarks	Con Cat
CR-244-50	Waste being transferred, Combination of all 244-CR tanks' contents	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Rain water intrusion	None.	SS: Tank level Detection Systems (tank 244-CR-003 only)	None.	AC: 5.14 Emergency Preparedness (Surface Leak Resulting In Pool)	Damage to facility by itself is D&D problem and would create operational problems. Same for all four cells with exception of leak detector in cell CR-003.	S2
CR-244-51A	Waste being transferred, Saltwell waste from C Farm	Release of waste to surface or subsurface soil due to cell filling followed by tank failure and a cell leak.	Waste or raw water mis-route to cell CR-003.	None.	SS: Tank level Detection Systems (tank 244-CR-003 only) SS: Service Water Flow Totalizers	None.	AC: 5.14 Emergency Preparedness (Surface Leak Resulting In Pool)	Damage to facility by itself is D&D problem and would create operational problems. Same for all four cells with exception of leak detector in cell CR-003.	S2
CR-244-51B	Waste being transferred, Saltwell waste from C Farm	Release of waste to surface or subsurface soil due to cell filling followed by tank failure and a cell leak.	Transfer line failure with back-drainage to cell CR-003.	None.	SS: Tank level Detection Systems (tank 244-CR-003 only)	None.	AC: 5.14 Emergency Preparedness (Surface Leak Resulting In Pool)	Damage to facility by itself is D&D problem and would create operational problems. Same for all four cells with exception of leak detector in cell CR-003.	S2
CR-244-51C	Waste being transferred, Saltwell waste from C Farm	Release of waste to surface or subsurface soil due to cell filling followed by tank failure and a cell leak.	Transfer line failure with back-drainage to cell CR-003.	None.	SS: Tank level Detection Systems (tank 244-CR-003 only)	None.	AC: 5.14 Emergency Preparedness (Surface Leak Resulting In Pool)	Damage to facility by itself is D&D problem and would create operational problems. Same for all four cells with exception of leak detector in cell CR-003.	S2

Table B-6. S2 Hazardous Conditions Sequenced By BIO Accident Section.

14 Pages

BIN	Item ID	MAR	Hazardous Condition	Cause	Freq Cat	Con Cat	Cause Grp	Rep Acc
HEPA Filter Failure - Exposure to High Temperature or Pressure (BIO Section 5.3.2.2)								
B-1-a	114SX-04.c.2.a	Radioactive aerosols contained in the tank headspace	Release of radioactive aerosols from Tank 241-SX-114 head space to atmosphere due to exhauster HEPA filter seal failure	HEPA filter seal failure	F3	S2	D07	18B
244-CR VAULT HAZARDOUS CONDITION								
C-1-a	CR-244-23D	Hot Semi-works decon. solution	Release of waste to atmosphere from tank due to tank leak with a HEPA filter loaded with particulate.	Tank leak	F3	S2	D12	18BX
C-1-a	CR-244-23C	SST waste from C Farm	Release of waste to atmosphere from tank due to tank leak with a HEPA filter loaded with particulate.	Tank leak	F3	S2	D12	18BX
C-1-a	CR-244-23B	Residual PAS	Release of waste to atmosphere from tank due to tank leak with a HEPA filter loaded with particulate.	Tank leak	F3	S2	D12	18BX
C-1-a	CR-244-23A	Saltwell waste from C Farm	Release of waste to atmosphere from tank due to tank leak with a HEPA filter loaded with particulate.	Tank leak	F3	S2	D12	18BX
B-1-a	CR-244-89	Combination of all 244-CR tanks' contents	Release of waste to atmosphere due to creation of unfiltered air flowpath.	HEPA filter blowout and continued unfiltered release.	F3	S2	D14	18BX
C-1-a	CR-244-67	N/A	None identified.	Open riser	F0	S2	D14	18BX

Table B-6. S2 Hazardous Conditions Sequenced By BIO Accident Section.

14 Pages

BIN	Item ID	MAR	Hazardous Condition	Cause	Freq Cat	Con Cat	Cause Grp	Rep Acc
Fire in Contaminated Area (BIO Section 5.3.2.3)								
A-1-a	CRN-05	Pits and risers inventory	Release of radioactive and/or toxic materials from pits and risers due to fuel tank fire in crane or support vehicle (see In-Tank Equipment Installation for tank fires)	Human error in positioning crane load	F3	S2	B26	07
244-CR VAULT HAZARDOUS CONDITION								
A-1-a	CR-244-04	Saltwell waste from C Farm	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	Fuel fire in cell due to ruptured fuel tank in vehicle	F1	S2	B09	07X
A-1-a	CR-244-09	Residual PAS	Potential exposure of personnel to toxic or radioactive materials due to high temperature waste	Fuel fire in cell due to ruptured fuel tank in vehicle	F1	S2	B09	07X
A-1-a	CR-244-14	SST waste from C Farm	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	Fuel fire in cell due to ruptured fuel tank in vehicle	F1	S2	B09	07X
A-1-a	CR-244-19	Hot semi-works decon. solution	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	Fuel fire in cell due to ruptured fuel tank in vehicle	F1	S2	B09	07X
A-1-a	CR-244-36	Saltwell waste from C Farm	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Ignition of flammable gas produced by radiolysis of material in sump in CR-003 tank cell.	F1	S2	B08	07X
A-1-a	CR-244-37	Residual PAS	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Ignition of flammable gas produced by radiolysis of material in sump in CR-002 tank cell.	F1	S2	B08	07X

Table B-6. S2 Hazardous Conditions Sequenced By BIO Accident Section.

14 Pages

BIN	Item ID	MAR	Hazardous Condition	Cause	Freq Cat	Con Cat	Cause Grp	Rep Acc
A-1-a	CR-244-38	SST waste from C Farm	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Ignition of flammable gas produced by radiolysis of material in sump in CR-001 tank cell.	F1	S2	B08	07X
A-1-a	CR-244-39	Hot Semi-works decon. solution	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Ignition of flammable gas produced by radiolysis of material in sump in CR-011 tank cell.	F1	S2	B08	07X
A-1-a	CR-244-40	Saltwell waste from C Farm	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Ignition of vehicle fuel spilled in sump in CR-003 tank cell.	F1	S2	B09	07X
A-1-a	CR-244-41	Residual PAS	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Ignition of vehicle fuel spilled in sump in CR-002 tank cell.	F1	S2	B09	07X
A-1-a	CR-244-42	SST waste from C Farm	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Ignition of vehicle fuel spilled in sump in CR-001 tank cell.	F1	S2	B09	07X
A-1-a	CR-244-43	Hot Semi-works decon. solution	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Ignition of vehicle fuel spilled in sump in CR-011 tank cell.	F1	S2	B09	07X
A-1-a	CR-244-45A	Saltwell waste from C Farm	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Ignition of vehicle fuel spilled in sump in CR-003 tank cell.	F1	S2	B09	07X
A-1-a	CR-244-45B	Residual PAS	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Ignition of vehicle fuel spilled in sump in CR-002 tank cell.	F1	S2	B09	07X

Table B-6. S2 Hazardous Conditions Sequenced By BIO Accident Section.

14 Pages

BIN	Item ID	MAR	Hazardous Condition	Cause	Freq Cat	Con Cat	Cause Grp	Rep Acc
A-1-a	CR-244-45C	SST waste from C Farm	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Ignition of vehicle fuel spilled in sump in CR-001 tank cell.	F1	S2	B09	07X
A-1-a	CR-244-45D	Hot Semi-works decon. solution	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Ignition of vehicle fuel spilled in sump in CR-011 tank cell.	F1	S2	B09	07X
Evaporator Dump (BIO Section 5.3.2.4)								
C-1-a	102AW-02-PRES 102AW-02-TEMP	DCRT tank vapor/aerosols	Release of radioactive aerosols from Tank 241-AW-102 due to pressurization	Evaporator dump when intrusive activity is occurring which causes pressurization	F3	S2	D01	22
244-CR VAULT HAZARDOUS CONDITION								
B-1-a	CR-244-02	Saltwell waste from C Farm	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	Radioactive decay heat	F1	S2	D02	22X
B-1-a	CR-244-05	Saltwell waste from C Farm	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	Dead-headed pump and/or mixer heats waste	F0	S2	D02	22X
B-1-a	CR-244-07	Residual PAS	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	Radioactive decay heat	F1	S2	D02	22X
B-1-a	CR-244-10	Residual PAS	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	Dead-headed pump and/or mixer heats waste	F0	S2	D02	22X
B-1-a	CR-244-12	SST waste from C Farm	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	Radioactive decay heat	F1	S2	D02	22X

Table B-6. S2 Hazardous Conditions Sequenced By BIO Accident Section.

14 Pages

BIN	Item ID	MAR	Hazardous Condition	Cause	Freq Cat	Con Cat	Cause Grp	Rep Acc
B-1-a	CR-244-15	SST waste from C Farm	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	Dead-headed pump and/or mixer heats waste	F0	S2	D02	22X
B-1-a	CR-244-17	Hot semi-works decon. solution	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	Radioactive decay heat	F1	S2	D02	22X
B-1-a	CR-244-20	Hot semi-works decon. solution	Release of toxic or radioactive materials to the atmosphere from a tank due to high temperature waste.	Dead-headed pump and/or mixer heats waste	F0	S2	D02	22X
Tank Failure Due to Excessive Loads (BIO Section 5.3.2.13)								
B-1-a	CRN-03	Tank inventory	Release of radioactive and/or toxic materials from tank due to dome collapse	Human error results in excessive weight on dome	F3	S3	C10	12A
B-1-a	CRN-04	Tank inventory	Release of radioactive and/or toxic materials from tank due to dome collapse	Crane or rigging failures drop load resulting in large impact to dome	F3	S3	C10	12B
B-1-a	CRN-11	Tank inventory	Radioactive or toxic material release from tank due to boom failure and tank/equipment damage and dome collapse	Human error: improper load assembly, rigging, crane overloaded	F3	S3	C10	12C
244-CR VAULT HAZARDOUS CONDITION								
C-3-b	CR-244-59	Combination of all 244-CR tanks' contents	Release of waste to surface or subsurface soil due to failure of tank and facility structure.	Load drop while lifting cover block or equipment.	F3	S2	D10	12X
C-3-b	CR-244-60	Combination of all 244-CR tanks' contents	Release of waste to surface or subsurface soil due to failure of tank and facility structure.	Large static loads: parked vehicles; ashfall; snow load.	F3	S2	D10	12X

Table B-6. S2 Hazardous Conditions Sequenced By BIO Accident Section.

14 Pages

BIN	Item ID	MAR	Hazardous Condition	Cause	Freq Cat	Con Cat	Cause Grp	Rep Acc
C-3-b	CR-244-63	Combination of all 244-CR tanks' contents	Release of waste to surface or subsurface soil due to failure of tank and facility structure.	Aircraft crash	F0	S2	D23	12X
Tank Failure Due to Excessive Loads (Section 5.3.2.13)								
B-1-a	114SX-06.a.3	Radioactive material contained in the tank (this tank has a dry crust which may be composed of easily disturbed dusty material)	Release of radioactive aerosols from Tank 241-SX-114 waste to the atmosphere due to dome collapse caused by loss of strength due to aging	Long term aging resulting in tank degradation	F1	S3	C12	13
244-CR VAULT HAZARDOUS CONDITION								
C-3-b	CR-244-57	Combination of all 244-CR tanks' contents	Release of waste to surface or subsurface soil due to failure of tank and facility structure.	Deterioration due to aging	F1	S2	D12	13X
Flammable Gas Deflagrations (BIO Section 5.3.2.14)								
A-1-a	XS-01-FLOW03	SST and DCRT tank contents	Release of liquids, solids and/or vapors from single shell tank due to dome collapse and DCRT pressurization caused by flammable gas fire/explosion propagating from DCRT to single shell tank	Pipeline connecting single shell tank and DCRT fills with flammable gas; loss of ventilation flow in DCRT so that a flammable gas atmosphere is ignited by the ventilation outlet heater	F2	S3	B07	05
244-CR VAULT HAZARDOUS CONDITION								
A-1-a	CR-244-03	SST waste from 241-C-103	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition. Ignition of flammable organic vapors	Incompatible transfer from 241-C-103 (contains organics that react with material already present).	F0	S2	D02	05X

Table B-6. S2 Hazardous Conditions Sequenced By BIO Accident Section.

14 Pages

BIN	Item ID	MAR	Hazardous Condition	Cause	Freq Cat	Con Cat	Cause Grp	Rep Acc
A-1-a	CR-244-08	SST waste from 241-C-103	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition. Ignition of flammable organic vapors	Incompatible transfer from 241-C-103 (contains organics that react with material already present)	F1	S2	B08	05X
A-1-a	CR-244-13	SST waste from 241-C-103	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition. Ignition of flammable organic vapors	Incompatible transfer from 241-C-103 (contains organics that react with material already present)	F0	S2	B08	05X
A-1-a	CR-244-18	SST waste from 241-C-103	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition. Ignition of flammable organic vapors.	Incompatible transfer from 241-C-103 (contains organics that react with material already present)	F0	S2	B08	05X
A-1-a	CR-244-54A1	Saltwell waste from C Farm	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Hydrogen deflagration in head space of tank 244-CR-003.	F3	S2	B08	05X
A-1-a	CR-244-54A2	Saltwell waste from C Farm	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Hydrogen deflagration in head space of tank 244-CR-003.	F3	S2	B08	05X
A-1-a	CR-244-54B1	Residual PAS	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Hydrogen deflagration in head space of tank 244-CR-002.	F3	S2	B08	05X
A-1-a	CR-244-54B2	Residual PAS	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Hydrogen deflagration in head space of tank 244-CR-002.	F3	S2	B08	05X

Table B-6. S2 Hazardous Conditions Sequenced By BIO Accident Section.

14 Pages

BIN	Item ID	MAR	Hazardous Condition	Cause	Freq Cat	Con Cat	Cause Grp	Rep Acc
A-1-a	CR-244-54C1	SST waste from C Farm	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Hydrogen deflagration in head space of tank 244-CR-001.	F3	S2	B08	05X
A-1-a	CR-244-54C2	SST waste from C Farm	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Hydrogen deflagration in head space of tank 244-CR-001.	F3	S2	B08	05X
A-1-a	CR-244-54D1	Hot Semi-works decon. solution	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Hydrogen deflagration in head space of tank 244-CR-011.	F3	S2	B08	05X
A-1-a	CR-244-54D2	Hot Semi-works decon. solution	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Hydrogen deflagration in head space of tank 244-CR-011.	F3	S2	B08	05X
A-1-a	CR-244-64	Combination of all 244-CR tanks' contents	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	All inleakage paths sealed	F3	S2	D07	05X
A-1-a	CR-244-65	Combination of all 244-CR tanks' contents	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	ventilation system shut down	F3	S2	D07	05X
A-1-a	CR-244-71	Combination of all 244-CR tanks' contents	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Ignition of flammable gas in tank (see CR-244 -64 and CR-244 -65)	F3	S2	B08	05X
A-1-a	CR-244-72	Combination of all 244-CR tanks' contents	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Ignition of organics in tank (implies ignition source present - intrusive activities)	F1	S2	D04	05X

Table B-6. S2 Hazardous Conditions Sequenced By BIO Accident Section.

14 Pages

BIN	Item ID	MAR	Hazardous Condition	Cause	Freq Cat	Con Cat	Cause Grp	Rep Acc
A-1-a	CR-244-73	Combination of all 244-CR tanks' contents	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Heating from fire in cell	F3	S2	B09	05X
A-1-a	CR-244-74	Combination of all 244-CR tanks' contents	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Chemical reaction in tank	F0	S2	B01	05X
A-1-a	CR-244-75	Combination of all 244-CR tanks' contents	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Blockage of inlet flow pathways (undefined)	F1	S2	D07	05X
A-1-a	CR-244-79	Combination of all 244-CR tanks' contents	High-energy release of toxic or radioactive materials to the atmosphere from a tank through an unfiltered flow path due to flammable vapor ignition.	Cover block removed	F2	S2	D14	05X
A-1-a	CR-244-80	Combination of all 244-CR tanks' contents	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Local blockage in duct work	F1	S2	D07	05X
A-1-a	CR-244-81	Combination of all 244-CR tanks' contents	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	High water level in cell blocks ventilation exhaust for that cell	F1	S2	D19	05X
A-1-a	CR-244-82	Combination of all 244-CR tanks' contents	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Fan shutdown/failure	F2	S2	D07	05X
A-1-a	CR-244-83	Combination of all 244-CR tanks' contents	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Plugged HEPA filters	F2	S2	D07	05X

Table B-6. S2 Hazardous Conditions Sequenced By BIO Accident Section.

14 Pages

BIN	Item ID	MAR	Hazardous Condition	Cause	Freq Cat	Con Cat	Cause Grp	Rep Acc
A-1-a	CR-244-84	Combination of all 244-CR tanks' contents	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Damper failure or inadvertent closure which prevents flow	F2	S2	D07	05X
A-1-a	CR-244-85	Combination of all 244-CR tanks' contents	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Lack of inlet path.	F1	S2	D07	05X
A-1-a	CR-244-86	Combination of all 244-CR tanks' contents	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Duct breach due to vehicle impact or load drop	F1	S2	D10	05X
A-1-a	CR-244-87	Combination of all 244-CR tanks' contents	High-energy release of toxic or radioactive materials to the atmosphere from a tank due to flammable vapor ignition.	Seismic event breaches duct	F1	S2	D18	05X
Organic Salt-Nitrate Reaction (BIO Section 5.3.2.17)								
A-1-a	I-222S-1-CMP-E	Aerosols from receiver tank or 244-S	Release of radioactive aerosols to the atmosphere from 244 S or receiver tank due to over pressurization of tank caused by organic fire	Human error - upset of 222-S Lab operations	F3	S3	B01	09
244-CR VAULT HAZARDOUS CONDITION								
A-1-a	CR-244-21A	Saltwell waste from C Farm	None identified.	Evaporation/ leakage	F0	S2	B08	09X
A-1-a	CR-244-21B	Residual PAS	None identified.	Evaporation/ leakage	F0	S2	B08	09X
A-1-a	CR-244-21C	SST waste from C Farm	None identified.	Evaporation/ leakage	F0	S2	B08	09X
A-1-a	CR-244-21D	Hot semi-works decon. solution	None identified.	Evaporation/ leakage	F0	S2	B08	09X

Table B-6. S2 Hazardous Conditions Sequenced By BIO Accident Section.

14 Pages

BIN	Item ID	MAR	Hazardous Condition	Cause	Freq Cat	Con Cat	Cause Grp	Rep Acc
Surface Leak Resulting in Pool (BIO Section 5.3.2.18)								
C-2-b	W058-PRES01	Amount of slurry transferred (20,000 to 1,000,000 gallons)	Release of radioactive slurry to the soil surface from overflow in the SY-A or SY-B valve pit due to piping system leak (pool)	Water hammer plus mitigative features failure	F3	S2	D17	26
244-CR VAULT HAZARDOUS CONDITION								
C-3-b	CR-244-24A1	Saltwell waste from C Farm	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Cooling coil leak In CR-003	F3	S2	D06	26X
C-3-b	CR-244-24A2	Saltwell waste from C Farm	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Cooling coil leak In CR-003	F3	S2	D06	26X
C-3-b	CR-244-24B1	Residual PAS	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Cooling coil leak in CR-002	F3	S2	D06	26X
C-3-b	CR-244-24B2	Residual PAS	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Cooling coil leak in CR-002	F3	S2	E06	26X
C-3-b	CR-244-24C1	Combination of all 244-CR tanks' contents	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Raw water intrusion	F3	S2	E06	26X
C-3-b	CR-244-24C2	Combination of all 244-CR tanks' contents	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Raw water intrusion	F3	S2	E06	26X
C-3-b	CR-244-24D1	Combination of all 244-CR tanks' contents	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Raw water intrusion/Cooling coil leak	F3	S2	E06	26X
C-3-b	CR-244-24D2	Combination of all 244-CR tanks' contents	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Raw water intrusion/Cooling coil leak	F3	S2	E06	26X
C-3-b	CR-244-25	Combination of all 244-CR tanks' contents	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Rain water intrusion	F0	S2	E06	26X

Table B-6. S2 Hazardous Conditions Sequenced By BIO Accident Section.

14 Pages

BIN	Item ID	MAR	Hazardous Condition	Cause	Freq Cat	Con Cat	Cause Grp	Rep Acc
C-3-b	CR-244-26A	Waste being transferred	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Waste mis-transfers	F3	S2	E06	26X
C-3-b	CR-244-26B	Waste being transferred	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Waste mis-transfers	F3	S2	E06	26X
C-3-b	CR-244-27A	Waste being transferred	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Transfer error	F3	S2	E06	26X
C-3-b	CR-244-27B	Waste being transferred	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Transfer error	F3	S2	E06	26X
C-3-b	CR-244-48A	Combination of all 244-CR tanks' contents	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Waste or raw water mis-route.	F1	S2	E06	26X
C-3-b	CR-244-48B	Combination of all 244-CR tanks' contents	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Waste or raw water mis-route.	F1	S2	E06	26X
C-3-b	CR-244-48C	Waste being transferred, Combination of all 244-CR tanks' contents	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Waste or raw water mis-route.	F1	S2	E06	26X
C-3-b	CR-244-49A	Waste being transferred, Combination of all 244-CR tanks' contents	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Transfer line failure with back-drainage to cell.	F1	S2	D12	26X
C-3-b	CR-244-49B	Waste being transferred, Combination of all 244-CR tanks' contents	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Transfer line failure with back-drainage to cell.	F1	S2	D12	26X
C-3-b	CR-244-49C	Waste being transferred, Combination of all 244-CR tanks' contents	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Transfer line failure with back-drainage to cell.	F1	S2	D12	26X

Table B-6. S2 Hazardous Conditions Sequenced By BIO Accident Section.

14 Pages

BIN	Item ID	MAR	Hazardous Condition	Cause	Freq Cat	Con Cat	Cause Grp	Rep Acc
C-3-b	CR-244-50A	Waste being transferred, Combination of all 244-CR tanks' contents	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Rain water intrusion	F0	S2	D19	26X
C-3-b	CR-244-50B	Waste being transferred, Combination of all 244-CR tanks' contents	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Rain water intrusion	F0	S2	D19	26X
C-3-b	CR-244-50C	Waste being transferred, Combination of all 244-CR tanks' contents	Release of waste to surface or subsurface soil due to tank overflow followed by cell leak.	Rain water intrusion	F0	S2	D19	26X
C-3-b	CR-244-51A	Waste being transferred, Saltwell waste from C Farm	Release of waste to surface or subsurface soil due to cell filling followed by tank failure and a cell leak.	Waste or raw water mis-route to cell CR-003.	F1	S2	E06	26X
C-3-b	CR-244-51B	Waste being transferred, Saltwell waste from C Farm	Release of waste to surface or subsurface soil due to cell filling followed by tank failure and a cell leak.	Transfer line failure with back-drainage to cell CR-003.	F1	S2	D12	26X
C-3-b	CR-244-51C	Waste being transferred, Saltwell waste from C Farm	Release of waste to surface or subsurface soil due to cell filling followed by tank failure and a cell leak.	Transfer line failure with back-drainage to cell CR-003.	F1	S2	D12	26X

Natural Phenomena - Seismic (BIO Section 5.3.2.23.3)								
B-1-a	NP-07	Multiple tanks and ventilation systems inventories, 204-AR tanker spill	Radioactive and hazardous material releases from tanks and ventilation systems due to seismic event	Seismic event collapses domes	F1	S3	D18	14
244-CR VAULT HAZARDOUS CONDITION								
C-3-b	CR-244-56	Combination of all 244-CR tanks' contents	Release of waste to atmosphere due to seismic-induced failure of tank and facility structure.	Seismic event	F1	S2	D18	14X

Appendix C: Peer Review Checklist

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Practice 134 290 1112
Publication Date 01May97
Attachment 01 - Sheet 1 of 1

FLUOR DANIEL NORTHWEST

SENIOR ANALYSTS ADVISORY GROUP

CHECKLIST FOR PEER REVIEW

Document Reviewed: Hazard Evaluation For 244-CR Vault

Scope of Review: Entire Document

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

[X] [ ] [ ] Document approved.

David J. Braun David J Braun 3/29/99
Reviewer (Printed Name and Signature) Date

* Any calculations, comments, or notes generated as part of this review should be signed, dated and attached to this checklist. Such material should be labeled and recorded in such a manner as to be intelligible to a technically qualified third party.

NUCLEAR ENGINEERING

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