Doc. (2) S

JUN 27 2000

ENGINEERING DATA TRANSMITTAL

Page 1 of 1

1. EDT 618566

2. To: (Receiving Organization)	3. From: (Originating Organization)	4. Related EDT No.:
CHG Nuclear Safety & Licensing	FFS Safety Analysis	N/A
5. Proj./Prog./Dept./Div.:	6. Design Authority/Design Agent/Cog. Engr.:	7. Purchase Order No.:
Tank Farms	G. W. Ryan	N/A
8. Originator Remarks:		9. Equip./Component No.:
The attached document reflects the results of the control decision process for the revised analysis of Waste Transfer Leaks.		N/A
		10. System/Bldg./Facility:
		Tank Farms
11. Receiver Remarks:	11A. Design Baseline Document? ☐ Yes ☒ No	12. Major Assm. Dwg. No.:
None.		N/A
		13. Permit/Permit Application No.:
		N/A
		14. Required Response Date:
		June 26, 2000

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Desig-nator	(G) Reason for Trans-mittal	(H) Origi-nator Dispo-sition	(I) Receiv-er Dispo-sition
1	RPP-6295	N/A	0	Waste Transfer Leaks	N/A	1	1	1
				Control Decision Record				

16. KEY

Approval Designator (F)	Reason for Transmittal (G)	Disposition (H) & (I)
E, S, Q, D OR N/A (See WHC-CM-3-5, Sec. 12.7)	1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION
(See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN
		Design Authority						Licensing Eng. J. M. Grigsby			R1-44
		Design Agent	G. W. Ryan	6/26/00					J. M. Grigsby	6/26/00	
1	1	Cog. Eng. G. W. Ryan			B4-47						
1	1	Cog. Mgr. R. J. Cash	R. J. Cash	6/26/00							
		QA									
		Safety									
		Env.									

18.	19.	20.	21. DOE APPROVAL (if required)
G. W. Ryan 6/26/00 Signature of EDT Originator — Date	J. M. Grigsby 6/26/00 Authorized Representative for Receiving Organization — Date	R. J. Cash 6/26/00 Design Authority/ Cognizant Manager — Date	Ctrl No. _____ ☐ Approved ☐ Approved w/comments ☐ Disapproved w/comments

BD-7400-172-2 (10/97)

BD-7400-172-1

Waste Transfer Leaks Control Decision Record

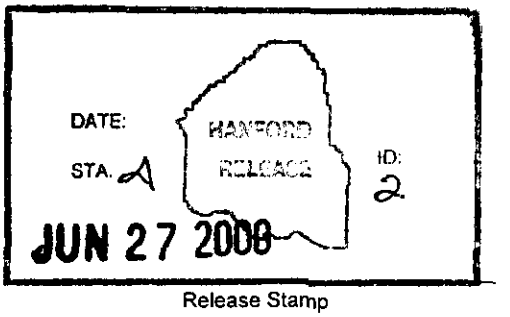
G. W. Ryan
Fluor Federal Services
Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-99RL14047

EDT/ECN: 618566 UC: 510
Cost Center: 403 Charge Code: 109310/BB20
B&R Code: N/A Total Pages: 101

Key Words: controls, safety SSCs, TSRs, Technical Safety Requirements, control decision record, waste transfer leaks

Abstract: The document summarizes the results of a control decision meeting that was conducted to establish revised controls for Waste Transfer Leak accidents.

Release Approval 6/27/00 Date



Release Stamp

Approved For Public Release

Waste Transfer Leaks Control Decision Record

June 2000

This page intentionally left blank.

Table of Contents

List of Tables

List of Terms

AB	Authorization Basis
AC	Administrative Control
AWF	Aging Waste Facility
CAM	continuous air monitor
CM	configuration management
DCRT	double-contained receiver tank
dP	differential pressure
DST	double-shell tank
FSAR	Final Safety Analysis Report
HEPA	high-efficiency particulate air (filter)
LCO	Limiting Condition for Operation
MEI	maximally exposed individual
MPSS	master pump shutdown system
OGT	overground transfer (system)
OR	operating requirement
ORP	Office of River Protection
PI	Performance Incentive
RCSTS	Replacement Cross-Site Transfer System
SSC	structure, system, and component
SST	single-shell tank
TSR	Technical Safety Requirement
TWRS	Tank Waste Remediation System

1.0 INTRODUCTION

Control decision meetings for Waste Transfer Leaks were held on April 24, 25, 26, and 27, 2000. The agenda for the control decision meetings is included in Appendix A, and attendee lists are included in Appendix B.

The purpose of the control decision meetings was to review and revise previously selected controls for the prevention or mitigation of waste transfer leak accidents. Re-evaluation of the controls is warranted due to revisions in the hazard and accident analysis for these Tank Farm events. In particular, calculated radiological consequences are significantly reduced from those currently reported in the Final Safety Analysis Report (FSAR). Revised hazard and accident analysis and a revised control recommendation will be reflected in an Authorization Basis Amendment to be submitted at the Department of Energy, Office of River Protection's (ORP's) request by June 30, 2000 to satisfy ORP Performance Incentive (PI) 2.1.1, Revision 1, "Authorization Basis Management Process Efficiency Improvement".

The scope of the control decision meetings was to address all waste transfer leak-related hazardous conditions identified in the Tank Farm hazard analysis database, excluding those associated with the use of the Replacement Cross-Site Transfer System (RCSTS) slurry line and sluicing of Tank 241-C-106, which is addressed in FSAR Addendum 1. The scope of this control decision process does include future waste feed delivery waste transfer operations.

The control decision meetings were conducted in accordance with the established and approved process and criteria described in the Tank Waste Remediation System (TWRS) FSAR (HNF-SD-WM-SAR-067). A summary of the control decision process and criteria was presented at the start of the control decision meetings and is included in Appendix C. Control decisions were based on the best available information from the hazard and accident analyses and on the technical expertise and experience of the meeting participants. Decisions were made by consensus.

Section 2.0 of this report is an overview of the control decision meeting presentations on April 24, 25, 26, and 27, 2000. The presentations consisted mainly of revised accident analysis results and the controls that are currently established to either prevent or mitigate waste leak accidents.

Section 3.0 of this report is a summary of the control decision discussion on the hazard and accident analysis that was considered at the April 24, 25, 26, and 27, 2000 meetings. The discussion summary identifies the controls that were considered and the reasons why specific controls were (or were not) selected. Also included in this report is documentation of control suite modifications that were made subsequent to the April 24, 25, 26, and 27, 2000 meetings. These revisions were made as a result of finalizing analysis sensitivity calculations, performing the hazard analysis control allocation, and the development and review of the Waste Transfer Leaks Authorization Basis (AB) amendment.

Section 4.0 of this report provides a listing of the references that are cited in the preceding sections.

2.0 OVERVIEW OF CONTROL DECISION MEETING PRESENTATIONS

Revised accident analysis results and potential controls were reviewed during the control decision meetings that were held on April 24, 25, 26, and 27, 2000. The agenda for the proceedings is included in Appendix A.

After an introduction, the results of the hazard and accident analyses were presented to the group. A total of five accident analysis cases were evaluated. These were numbered according the development of a new representative accident (i.e., #33, Waste Transfer Leaks) and are as follows:

Case 33A: Waste leaks occurring in waste transfer-associated structures.

Case 33B: Waste leaks directly to the environment (e.g., subsurface leaks).

Case 33C: Waste leaks directly to the soil surface or atmosphere, due to excavations, drilling, and other external events such as seismic phenomenon.

Case 33D: Waste leaks that occur due to mis-routing of waste into tanks, uncontrolled waste transfer lines, raw water systems or the 204-AR Waste Unloading Facility.

Case 33E: Spray leaks occurring inside actively ventilated waste tanks (or other similar facilities).

It was noted to the team that the hazard analysis entries currently in the database were re-binned according to Cases 33A, 33B, 33C, and 33D. Because in-tank (or in-facility) spray leaks are not currently represented in the hazard analysis database, no existing hazardous conditions are allocated to Case 33E. Subsequent hazard analysis activities have added in-tank (or in-facility) spray leaks as represented conditions. A separate hazard analysis activity was conducted and documented to address in-tank spray leak hazards (see RPP-5990, *Hazard Evaluation for In-Tank Spray Leak*).

The stochastic results of each accident analysis case were presented in succession and are included in Appendix D. The detail accompanying the summary results included in Appendix D is documented in RPP-5667, *Stochastic Consequence Analysis for Waste Transfer Leaks*.

This page intentionally left blank.

3.0 CONTROL DECISION DISCUSSION SUMMARY

Based on the hazard and accident analyses related to waste transfer leak accidents, control decisions were made. The approach that was used to arrive at the controls selected for each analyzed case is discussed in this section.

Table 1 presents a tabular listing of all the transfer-related controls that are currently in place to either prevent or mitigate waste transfer leaks and also includes a few additional proposed controls. During the control decision meetings each control listed in Table 1 was evaluated with respect to its ability to either prevent or mitigate the accident of concern. Appendix D includes the accident analysis results that were presented during the control decision meetings. It is important to note that for all cases, the stochastic results showed that at no time did the postulated consequences either approach or exceed the offsite risk evaluation guideline of 1.0 E-03 Sv (1.0 E-01 rem). Therefore, all safety structures, systems, and components (SSCs) selected to either mitigate or prevent the accidents of concern will be Safety-Significant.

Each of the cases are briefly described in Section 2.0 of this report. For each case, the results were presented by the accident analyst and then the group evaluated each control in Table 1 for applicability and potential benefit. The following rating system was used to evaluate each control in the context of the accident analysis case being reviewed:

P = Preventive; the control was viewed by the group to prevent the accident (i.e., reduces frequency of accident with controls to beyond extremely unlikely).

M = Mitigative; the control provided a mechanism to reduce the consequences to the onsite receptor and is therefore required as part of minimum adequate mitigation for the onsite receptor.

B = Beneficial; the control may provide a mechanism to either reduce the frequency or the consequences of the accident with controls, however, the control is not required as part of the minimum adequate mitigation for the onsite receptor. In some cases if the control was considered by the group to provide either more or less benefit (relative to other available controls) a plus (+) or minus (-) notation was added to reflect team consensus.

FW = Significant Facility Worker Protection; the control was considered by the team to add significant protection to the facility worker.

N/A = Not applicable; the control for the case being reviewed was considered by the team to be not applicable.

More that one designation could be applied to the same control.

Footnotes to Table 1 entries have been included for each control/case to reflect remarks or discussion that occurred during the control decision meetings. Note that the controls shown in Table 1 in ***bold and italics*** are proposed new controls (or new safety functions).

As an example of the process, the results of the method used are detailed here for the safety SSC, "OGT system encasements and connections". For Cases 33B, 33D, and 33E, this safety SSC was considered to not be applicable (N/A). However, for Case 33A, the control was considered by the team to be mitigative (M) and for Case 33C, the safety SSCs was considered to be beneficial with the notation that requirements currently exist to ensure that OGT systems are qualified for seismic forces and high winds.

Each control listed in Table 1 was evaluated for each successive case in a similar manner. Team discussion is captured as footnotes for each control discussed, as applicable. The intent of this process was to complete the control evaluation for all cases and then review the aggregate results to determine the final control set.

Table 2 represents the aggregate results. Note that the "N/A" entries shown in Table 1 have been omitted for clarity. Alternate coding showing which control packages could be allocated to each case are now included in Table 2. The control packages considered are defined as follows:

P1 = Leak is prevented by eliminating possibility of pressurized waste transfer lines (transfer pump under administrative lock) [same as current FSAR/TSR controls].

P2 = Prevents waste leak due to vehicle collisions with OGT: OGT protective devices (e.g., concrete shielding, steel covers) [similar to current FSAR/TSR controls but more flexible for how to accomplish].

P3 = Tank overflow due to service water intrusion is prevented by monitoring service water flow totalizers or waste tank levels and stopping service water intrusion [same as current FSAR/TSR controls].

P4 = 204-AR Waste Unloading Facility only – Prevents waste leakage into the service water system in the 204-AR Waste Unloading Facility mechanical equipment room: backflow preventer [same as current FSAR/TSR/controls].

P5 = Prevents waste leak directly to ground surface through an encasement test riser by preventing a waste leak from pressurizing the encasement: encasement seal loop controls [same as current FSAR/TSR/controls].

P6 = Prevents overflow of DST annulus due to waste mis-route: primary tank leak detection system [same as current FSAR/TSR/controls].

M1 = Leak detection system and emergency response (detect leakage, alarm, operators stop pump and move workers): encasements, encasement drains open, leak detectors, alarms, emergency response [same as current FSAR/TSR/controls].

M1A = Leak detection system and emergency response (detect leakage and alarm, interlock stops pump and operators move workers): encasements, encasement drains open, leak detectors, alarms, master pump shutdown system (MPSS), emergency response.

M2 = deleted/not used.

M3 = Radiation surveys detect leakage and emergency response (detect leakage, operators stop pump and move workers): periodic radiation surveys and emergency response [same as current FSAR/TSR/controls].

M4 = Leakage immediately and easily observed and emergency response (detect leakage, operators stop pump and move workers): workers present at leak initiation and emergency response.

M5 = deleted/not used.

M6 = Pressure detection system (e.g., service water pressure detection system) detects leakage into clean system, alarms, pump is stopped, workers are removed if needed: two isolation valves, pressure switch and alarm on high pressure [same as current FSAR/TSR/controls].

M7 = 204-AR Waste Unloading Facility building confinement (building, roll-up door closed, active ventilation system CAM or HEPA high/low dP interlock system), limits aerosol release [if leak path factor is sufficient without HEPA filters, CAM and HEPA dP can be deleted from M7].

M8 = This is an alternate control package to M7. 204-AR Waste Unloading Facility Unloading Area CAM detects waste leak, alarms, transfer is stopped and operators moved from area (including onsite workers).

M9 = Leak is observed after seismic event (and other severe natural phenomena or external event) and pump is stopped, workers are moved. Facility inspection is conducted prior to restart of operations.

M – FW = Mitigates facility worker exposure to aerosol and direct radiation from a waste leak to waste transfer-associated structure.

Table 1. Waste Transfer Leak Control Integration Matrix. (8 sheets)

Control[1]	Applicable facilities[2]	Case 33A	Case 33B	Case 33C	Case 33D	Case 33E
Safety SSCs						
OGT System encasements and connections – directs leakage to leak detector, reduces aerosol releases	OGTSs	M	N/A	B[3]	N/A	N/A
OGT shielding – prevents leak caused by vehicle impact	OGTSs	N/A	N/A	P[4], B[5]	N/A	N/A
Pipe encasements – directs leakage to leak detector	Encased lines	M	N/A	N/A	N/A	N/A
Pressure switch alarm/interlock – detects mis-route into service water or flush systems	Systems connected to primary transfer piping	N/A	N/A	N/A	M	N/A
Backflow preventers – prevents mis-route into service water or flush systems	Systems connected to primary transfer piping	N/A	N/A	N/A	B	N/A
Primary tank leak detection system – detects mis-route into DST annulus	DSTs	N/A	N/A	N/A	B-[6]	N/A
Transfer system leak detection system – detects leakage and alarms, detects mis-routes	Encased lines	M	N/A	B-[7]	M	N/A

[1] Note that the controls shown in ***bold and italics*** are proposed new controls (or new safety functions).
[2] Control is generally applicable Tank Farm-wide, as appropriate, unless otherwise noted.
[3] Requirements currently exist to ensure that OGT systems are qualified for seismic forces and high winds.
[4] This control was considered to be preventive (P) for vehicle impacts.
[5] This control was considered to be beneficial in the event of natural phenomena events.
[6] This control would provide indication of leak into annulus due to misroute. It is not necessary to rely upon this control as primary mitigation for this Case.
[7] Leak detection, if it works in this Case, would be beneficial to early detection.

Table 1. Waste Transfer Leak Control Integration Matrix. (8 sheets)

Control[1]	Applicable facilities[2]	Case 33A	Case 33B	Case 33C	Case 33D	Case 33E
Transfer system covers and RCSTS entry doors and seals – reduces aerosol release, provides shielding for facility worker	--	B[8], FW	N/A	N/A	B[9], FW	N/A
Vent stack CAM (or ***HEPA dP switch***) interlock – detects in-tank spray and shuts down ventilation system	--	N/A	N/A	N/A	N/A	B+, M[10]
204-AR Waste Unloading Facility Structure – reduces aerosol release	204-AR	B	N/A	N/A	M	M
Above grade portions of pits, etc. – reduces aerosol releases, reduces leakage to soil surface, provides shielding for facility workers	--	B-[11], FW	N/A	B-, FW	B-[12], FW	N/A
Supplemental covers – reduces aerosol releases	--	B[13]	N/A	N/A	B	N/A
204-AR backflow prevention systems – prevents waste flow into service water system	--	N/A	N/A	N/A	P	N/A
Salt well flow totalizer – used in material balance	--	B[14]	B[15]	B+[16]	B[17]	N/A

[8] There was much discussion during the control decision meeting regarding the appropriate level of control for coverblocks. It was stated that radiation work controls and Industrial Hygiene controls are currently part of the program that is used to control work around open pits. The team consensus was that this control was beneficial, but not part of the minimum adequate mitigation for this case.

[9] This control is a "nice to have" to reduce gamma dose. However, it is not required for this Case.

[10] For the 204-AR Waste Unloading Facility only.

[11] Abovegrade portions of waste transfer-associated structures are passive design features and are not removable, thereby providing a significant protection to the facility worker (FW). This control was selected as beneficial because of its ability to mitigate the release of material from the pit (B).

[12] This control is a "nice to have" to reduce gamma dose. However, it is not required for this Case.

[13] This control was viewed by the team as beneficial because it reduces the splash/splatter consequence component of the total dose.

[14] This control was credited as beneficial by the team because it could be an alternate to leak detection. This control was also considered as a mitigative control (M).

[15] This control may provide a mitigative effect, however, the criteria for leak detection and material balance needs to be defined.

[16] This control could be mitigative for those accident initiators that are not required to be detected immediately.

[17] This control could be mitigative for those accident initiators that are not required to be detected immediately.

Table 1. Waste Transfer Leak Control Integration Matrix. (8 sheets)

Control[1]	Applicable facilities[2]	Case 33A	Case 33B	Case 33C	Case 33D	Case 33E
Tank level detection systems – used in material balance, used to detect mis-routes, detects service water intrusion	--	B[18]	B[19]	B+[20]	B[21]	N/A
Service water flow totalizers – detects service water intrusions	--	N/A	N/A	B[22]	P	N/A
Isolation valves – prevents mis-route to uncontrolled facility	--	N/A	N/A	N/A	P	N/A
Master Pump Shutdown System – stops transfer pump upon leak detection by transfer system leak detection system reducing leak volume	--	M[23]	N/A	N/A	B[24] M[25]	N/A
Technical Safety Requirements						
LCO 3.1.1 Transfer System Covers – reduces aerosol release, provides shielding for facility worker	--	B[26], FW	N/A	N/A	B, FW	N/A
LCO 3.1.2 Service Water Pressure Detection Systems - detects mis-route into uncontrolled facility	--	N/A	N/A	N/A	M	N/A

[18] For material balance aspect only, this control was credited as beneficial by the team because it could be an alternate to leak detection. This control was also considered as a mitigative control (M).

[19] When this control is used for material balance a mitigative effect may be realized.

[20] This control could be mitigative for those accident initiators that are not required to be detected immediately.

[21] This control could be mitigative for those accident initiators that are not required to be detected immediately.

[22] This control could be mitigative for those accident initiators that are not required to be detected immediately.

[23] This control was viewed as mitigative because it could automatically shutdown the transfer pump upon leak detection and allow for quicker response time and reduced consequences (i.e., less waste released and quicker evacuation.)

[24] Chosen as beneficial because of its ability to stop the transfer pump upon leak detection.

[25] Chosen as mitigative because of the indication it provides regarding proper isolation valve position.

[26] There was much discussion during the control decision meeting regarding the appropriate level of control for coverblocks. It was stated that radiation work controls and Industrial Hygiene controls are currently part of the program that is used to control work around open pits. The team consensus was that this control was beneficial, but not part of the minimum adequate mitigation for this case.

Table 1. Waste Transfer Leak Control Integration Matrix. (8 sheets)

Control[1]	Applicable facilities[2]	Case 33A	Case 33B	Case 33C	Case 33D	Case 33E
LCO 3.1.3 Transfer Leak Detection Systems - detects leakage and alarms, detects mis-routes	--	M	N/A	B-[27]	M	N/A
LCO 3.1.4 Ventilation Stack CAM Interlock System – detects in-tank spray and shuts down ventilation system	--	N/A	N/A	N/A	N/A	B+, M[28]
LCO 3.1.6 204-AR Backflow Prevention System - prevents mis-route to 204-AR facility	204-AR	N/A	N/A	N/A	P	N/A
LCO 3.2.6 Primary Tank Leak Detection Systems - detects mis-route into DST annulus	--	N/A	N/A	N/A	B-[29]	N/A
AC 5.12 Transfer Controls						
CM – control status of as-built and jumpers – prevents mis-routes	--	N/A	N/A	N/A	B	N/A
CM – approved procedures – prevents mis-routes	--	N/A	N/A	N/A	B	N/A
CM – independently verify transfer route – prevents mis-routes, ***prevents blocked discharge (pump shutoff) conditions***	--	B[30]	B	N/A[31]	B	B-
CM – OGT vehicle restriction or OGT shielding – prevents leaks caused by vehicle collisions	OGTs	N/A	N/A	P	N/A	N/A
CM – aboveground labeling of unencased lines – improves leak detection by manual rad surveys, improves implementation of excavation controls	Unencased lines	N/A	M	P[32]	N/A	N/A

[27] Leak detection, if it works for this case, would be beneficial to early accident detection.
[28] For the 204-AR Waste Unloading Facility only.
[29] Leak detection, if it works for this case, would be beneficial to early accident detection.
[30] This control would reduce potential consequences thereby creating a benefit. "B" is for blocked discharge condition. "N/A" for mis-routes.
[31] This is a low frequency event – a blocked line during a transfer and a concurrent excavation accident.
[32] This control is cited as preventative (P) for excavation controls portion only.

Table 1. Waste Transfer Leak Control Integration Matrix. (8 sheets)

Control[1]	Applicable facilities[2]	Case 33A	Case 33B	Case 33C	Case 33D	Case 33E
CM – Sealing of open nozzles – prevents high flowrate leaks due to mis-routes	--	DELETE[33]	N/A	N/A	B[34]	N/A
CM – leak test newly installed jumpers – prevents jumper leaks	--	B[35]	N/A	N/A	B-	N/A
CM – AWF waste transfer only through AWF structures – reduces aerosol releases	AWF	DELETE[36]	N/A	N/A	N/A	N/A
CM – 204-AR rollup door closed – reduces aerosol releases	204-AR	B[37]	N/A	N/A	M[38]	M
OR – Material balance – detects gross leakage from active route and detects mis-routes	--	B[39], M	B[40]	B+	B	N/A
OR – monitor tank waste level in physically connected tanks – detects leakage and mis-routes when preventive controls fail	--	M[41]	N/A	N/A	M	N/A
OR – ground level rad surveys – detects leakage from unencased transfer lines	Unencased lines	N/A	M	N/A	M	N/A
OR – prohibit transfers into SSTs	SSTs	DELETE[42]	N/A	N/A	N/A	N/A

[33] This control is deleted because prior analysis assumption is not credited in the new analysis. In the prior analysis, this control protected against high flowrate leaks.
[34] This control is not required for mitigation of this Case.
[35] This control provides a level of safety to prevent high volume waste leaks due to loose connections.
[36] This control is deleted because prior analysis assumption is not credited in the new analysis. In the prior analysis, this control was selected to keep potential consequences below the risk guidelines.
[37] This control would reduce the potential consequences of an aerosol release from the 204-AR Waste Unloading Facility.
[38] This control reduces gamma dose.
[39] This control was credited as beneficial by the team because it could be an alternate to leak detection.
[40] This control may provide a mitigative effect, however, the criteria for leak detection and material balance needs to be defined.
[41] This control was considered by the team to be mitigative for catch tanks only and was considered "N/A" for the remainder of the transfer facilities.
[42] This control is not carried forward because it is not credited in the consequence analysis.

Table 1. Waste Transfer Leak Control Integration Matrix. (8 sheets)

Control[1]	Applicable facilities[2]	Case 33A	Case 33B	Case 33C	Case 33D	Case 33E
OR – catch Tanks < 50% full – reduces frequency of overflowing a catch tank.	--	B[43]	N/A	N/A	B-	N/A
OR – Verify that all pit drains on cross-site transfer route are open -- reduce likelihood of overflowing pits due to large drain-back volume	--	DELETE[44]	N/A	N/A	N/A	N/A
AC 5.13 Encasement Seal Loop Controls – ensures encasements can direct leakage to a leak detector, ***prevents pressurizing test risers***	--	M	N/A	P	M	N/A
AC 5.14 Emergency Preparedness – moves onsite workers from pool shine,	--	M[45]	M	M	M	N/A
AC 5.17 Excavation Controls – prevents leaks due to excavation damage to transfer lines during transfers	--	N/A	N/A	B, M	B, M	N/A
AC 5.18 HEPA Filters in RCSTS structures – filters aerosol release from waste leaks in structures	6241-A, 6341-V	DELETE[46]	N/A	N/A	N/A	N/A
AC 5.20 Transfer Pump Admin Locks – prevents leaks when control are not in place	--	P[47]	P	P	P	P
AC 5.21 Tank Service Water Intrusion – mitigates tank overflow due to service water intrusion, ***prevents undermining of transfer lines***	--	N/A	N/A	B[48]	P	N/A
AC 5.22 Transfer System Cover Removal Controls – detects leaks from mis-routes into uncovered pits	--	B-, M, FW	N/A	N/A	B, M, FW	N/A

[43] This control provides available storage space for waste to be held during leak accidents, thereby limiting the amount released to the environment. Future use of this control should consider upgrading the status of the level monitoring to ensure that it is operable when needed. Another option to consider is to make the leak detection system in connecting catch tank pump pits a credited safety control.

[44] This control is deleted because prior analysis assumption is not credited in the new analysis. In the prior analysis, this control was selected to prevent pits on the cross-site transfer system from overflowing.

[45] This control may require declaration of assumed response time in the AC.

[46] This control is deleted because prior analysis assumption is not credited in the new analysis.

[47] This control allows flexibility for Operations.

[48] This control could be beneficial for those accident initiators that are not required to be detected immediately.

Table 1. Waste Transfer Leak Control Integration Matrix. (8 sheets)

Control[1]	Applicable facilities[2]	Case 33A	Case 33B	Case 33C	Case 33D	Case 33E
Defense-in-Depth Controls						
Hydrostatic testing of direct buried or bermed piping – prevents leaks	--	N/A	B	N/A	N/A	N/A
Drains in transfer associated structures – prevents overflow of structures	--	B	N/A	N/A	B	N/A
DCRT/catch tank vault leak detection systems – detects overflow of DCRTs or catch tanks	--	B	N/A	N/A	B	N/A
Encasement leak detection systems – detect leaks from primary piping	Where available	B	N/A	N/A	N/A	N/A
244-AR Cell liquid level monitors – prevents positive tank buoyancy	--	N/A	N/A	N/A	B-	N/A
Waste tank high level alarms – detect service water intrusion	--	N/A	N/A	N/A	B	N/A
Service water freeze protection – minimize service water pipe breaks	--	N/A	N/A	N/A[49]	B	N/A
Service pit leak detectors – detect service water line breach, detects leaks of waste back into service pit	--	N/A	N/A	N/A	B	N/A
OGT heat tracing and insulation – prevent pipe rupture due to freezing	--	B	N/A	N/A	N/A	N/A
Direct buried line heat tracing and insulation – prevent pipe rupture due to freezing	--	N/A	B	N/A	N/A	N/A
Valve position limit switches/interlocks – prevents backflow of waste into service water system	--	N/A	N/A	N/A	B	N/A
Saltwell/service water check valves – prevents backflow into service water system	--	N/A	N/A	N/A	B	N/A

[49] It would take freezing and breaking an underground line to undermine a transfer line due to the high flowrate required. This was not considered possible by the team because the high flow portions of the service water system are buried below the freeze line. Abovegrade portions of the service water system that might freeze would result in lesser flows, if broken, and would not be capable of undermining an underground waste transfer line.

Table 1. Waste Transfer Leak Control Integration Matrix. (8 sheets)

Control[1]	Applicable facilities[2]	Case 33A	Case 33B	Case 33C	Case 33D	Case 33E
204-AR ventilation system, deentrainers, heater, and HEPA filters – reduce aerosol release	--	Defer to Case 33E	N/A	N/A	B-	B
204-AR unloading area CAMs – detect leaks	--	Defer to Case 33E	N/A	N/A	B-	M
204-AR HEPA high dP and low dP interlocks – reduce aerosol releases	--	N/A	N/A	N/A	B	M
Active ventilation systems, deentrainers, heater, and HEPA filters – reduce aerosol release for in-tank spray accidents	--	N/A	N/A	N/A	B	B
Active ventilation system HEPA high dP and low dP interlocks – reduce aerosol releases for in-tank spray accidents	--	N/A	N/A	N/A	B	B+

P – Preventative
M – Mitigative (required as part of minimum adequate mitigation for MEI)
B – Beneficial, but not part of minimum adequate mitigation for MEI
FW – Significant to protecting the facility worker
For additional terms used in the table see the main text listing.

Table 2. Aggregate Results - Waste Transfer Leak Control Integration Matrix. (7 sheets)

Control[50]	Applicable facilities[51]	Case 33A	Case 33B	Case 33C	Case 33D	Case 33E
Safety SSCs						
OGT System encasements and connections – directs leakage to leak detector, reduces aerosol releases	OGTSs	M1, M1A		B[52]		
OGT shielding – prevents leak caused by vehicle impact	OGTSs			P[53], B[54]		
Pipe encasements – directs leakage to leak detector	Encased lines	M1, M1A				
Pressure switch alarm/interlock – detects mis-route into service water or flush systems	Systems connected to primary transfer piping				M6	
Backflow preventers – prevents mis-route into service water or flush systems	Systems connected to primary transfer piping				B	
Primary tank leak detection system – detects mis-route into DST annulus	DSTs				P6	
Transfer system leak detection system – detects leakage and alarms, detects mis-routes	Encased lines	M1		B-	M1	
Transfer system covers and RCSTS entry doors and seals – reduces aerosol release, provides shielding for facility worker	--	B, FW			B, FW	
Vent stack CAM (or ***HEPA dP switch***) interlock – detects in-tank spray and shuts down ventilation system	--					B+, M7[55]

[50] Note that the controls shown in ***bold and italics*** are proposed new controls (or new safety functions).
[51] Control is generally applicable Tank Farm-wide, as appropriate, unless otherwise noted.
[52] (B) selected for natural phenomena events. These are considered to be controlled/mitigated by control set M9.
[53] This control was considered to be preventive (P) for vehicle impacts.
[54] This control was considered to be beneficial in the event of natural phenomena events. These are considered to be controlled/mitigated by control set M9.
[55] M7 for the 204-AR Waste Unloading Facility only.

Table 2. Aggregate Results - Waste Transfer Leak Control Integration Matrix. (7 sheets)

Control[50]	Applicable facilities[51]	Case 33A	Case 33B	Case 33C	Case 33D	Case 33E
204-AR Waste Unloading Facility Structure – reduces aerosol release	204-AR	B			M7[56]	M7[57]
Above grade portions of pits, etc. – reduces aerosol releases, reduces leakage to soil surface, provides shielding for facility workers	--	B-, FW[58]		B-, FW	B-, FW[59]	
Supplemental covers – reduces aerosol releases	--	B			B	
204-AR backflow prevention systems – prevents waste flow into service water system	--				P4[60]	
Salt well flow totalizer – used in material balance	--	B	B	B+	B	
Tank level detection systems – used in material balance, used to detect mis-routes, detects service water intrusion	--	B	B	B+	B	
Service water flow totalizers – detects service water intrusions	--			B	P3[61]	
Isolation valves – prevents mis-route to uncontrolled facility	--				P	
Master Pump Shutdown System – stops transfer pump upon leak detection by transfer system leak detection system reducing leak volume	--	M1A			B[62], M1A[63]	

[56] Non-Safety Design Feature.
[57] Non-Safety Design Feature.
[58] Non-Safety Design Feature.
[59] Non-Safety Design Feature.
[60] This control is equivalent to the M67 control set (i.e., service water pressure detection system and backflow prevention). This is why it is a "P" here.
[61] "P3" for service water overflow conditions.
[62] For isolation valve function.
[63] For leak detection function.

Table 2. Aggregate Results - Waste Transfer Leak Control Integration Matrix. (7 sheets)

Control[50]	Applicable facilities[51]	Case 33A	Case 33B	Case 33C	Case 33D	Case 33E
Technical Safety Requirements						
LCO 3.1.1 Transfer System Covers – reduces aerosol release, provides shielding for facility worker	--	B, FW			B, FW	
LCO 3.1.2 Service Water Pressure Detection Systems - detects mis-route into uncontrolled facility	--				M6	
LCO 3.1.3 Transfer Leak Detection Systems - detects leakage and alarms, detects mis-routes	--	M1		B-	M1	
LCO 3.1.4 Ventilation Stack CAM Interlock System – detects in-tank spray and shuts down ventilation system	--					B+, M[64]
LCO 3.1.6 204-AR Backflow Prevention System - prevents mis-route to 204-AR facility	204-AR				P	
LCO 3.2.6 Primary Tank Leak Detection Systems - detects mis-route into DST annulus	--				P6	
AC 5.12 Transfer Controls						
CM – control status of as-built and jumpers – prevents mis-routes	--				B	
CM – approved procedures – prevents mis-routes	--				B	
CM – independently verify transfer route – prevents mis-routes, ***prevents blocked discharge (pump shutoff) conditions***	--	B			B	B-
CM – OGT vehicle restriction or OGT shielding – prevents leaks caused by vehicle collisions	OGTs			P2		

[64] M7 for the 204-AR Waste Unloading Facility only.

Table 2. Aggregate Results - Waste Transfer Leak Control Integration Matrix. (7 sheets)

Control[50]	Applicable facilities[51]	Case 33A	Case 33B	Case 33C	Case 33D	Case 33E
CM – aboveground labeling of unencased lines – improves leak detection by manual rad surveys, improves implementation of excavation controls	Unencased lines		M3	B, M4[65]		
CM – Sealing of open nozzles – prevents high flowrate leaks due to mis-routes	--				B	
CM – leak test newly installed jumpers – prevents jumper leaks	--	B			B-	
CM – AWF waste transfer only through AWF structures – reduces aerosol releases	AWF					
CM – 204-AR rollup door closed – reduces aerosol releases	204-AR	B			M7	M7
OR – Material balance – detects gross leakage from active route and detects mis-routes	--	B	B	B+	B	
OR – monitor tank waste level in physically connected tanks – detects leakage and mis-routes when preventive controls fail	--	M1[66]			M8	
OR – ground level rad surveys – detects leakage from unencased transfer lines	Unencased lines		M3		M3	
OR – prohibit transfers into SSTs	SSTs					
OR – catch Tanks < 50% full – reduces frequency of overflowing a catch tank.	--	B			B-	
OR – Verify that all pit drains on cross-site transfer route are open – reduce likelihood of overflowing pits due to large drain-back volume	--					

[65] Event is mitigated by M4, leak detected by direct observation, stop pump, move workers. Excavation control is a benefit "B".

[66] This control was considered by the team to be mitigative for catch tanks only and was considered "N/A" for the remainder of the transfer facilities.

Table 2. Aggregate Results - Waste Transfer Leak Control Integration Matrix. (7 sheets)

Control[50]	Applicable facilities[51]	Case 33A	Case 33B	Case 33C	Case 33D	Case 33E
AC 5.13 Encasement Seal Loop Controls – ensures encasements can direct leakage to a leak detector, ***prevents pressurizing test risers***	--	M1, M1A		P5 (for test risers)	M1	
AC 5.14 Emergency Preparedness – moves onsite workers from pool shine,	--	M1, M3, M4	M1, M3, M4	M1, M3, M4	M1, M3, M4	
AC 5.17 Excavation Controls – prevents leaks due to excavation damage to transfer lines during transfers	--	N/A		B, M4[67]	B, M4[68]	
AC 5.18 HEPA Filters in RCSTS structures – filters aerosol release from waste leaks in structures	6241-A, 6341-V					
AC 5.20 Transfer Pump Admin Locks – prevents leaks when control are not in place	--	P1	P1	P1	P1	P1
AC 5.21 Tank Service Water Intrusion – mitigates tank overflow due to service water intrusion, ***prevents undermining of transfer lines***	--			B[69]	P3[70]	
AC 5.22 Transfer System Cover Removal Controls – detects leaks from mis-routes into uncovered pits	--	B, M-FW			B, M-FW	
Defense-in-Depth Controls						
Hydrostatic testing of direct buried or bermed piping – prevents leaks	--		B			
Drains in transfer associated structures – prevents overflow of structures	--	B			B	
DCRT/catch tank vault leak detection systems – detects overflow of DCRTs or catch tanks	--	B			B	

[67] Event is mitigated by M4, leak detected by direct observation, stop pump, move workers. Excavation control is a benefit "B".
[68] Event is mitigated by M4, leak detected by direct observation, stop pump, move workers. Excavation control is a benefit "B".
[69] For undermining hazardous conditions.
[70] "P3" for service water overflows.

Table 2. Aggregate Results - Waste Transfer Leak Control Integration Matrix. (7 sheets)

Control[50]	Applicable facilities[51]	Case 33A	Case 33B	Case 33C	Case 33D	Case 33E
Encasement leak detection systems – detect leaks from primary piping	Where available	B				
244-AR Cell liquid level monitors – prevents positive tank buoyancy	--				B-	
Waste tank high level alarms – detect service water intrusion	--				B	
Service water freeze protection – minimize service water pipe breaks	--				B	
Service pit leak detectors – detect service water line breach, detects leaks of waste back into service pit	--				B	
OGT heat tracing and insulation – prevent pipe rupture due to freezing	--	B				
Direct buried line heat tracing and insulation – prevent pipe rupture due to freezing	--		B			
Valve position limit switches/interlocks – prevents backflow of waste into service water system	--				B	
Saltwell/service water check valves – prevents backflow into service water system	--				B	
204-AR ventilation system, deentrainers, heater, and HEPA filters – reduce aerosol release	--				B-	B
204-AR unloading area CAMs – detect leaks	--				B-	M8
204-AR HEPA high dP and low interlocks – reduce aerosol releases	--				B	M7
Active ventilation systems, deentrainers, heater, and HEPA filters – reduce aerosol release for in-tank spray accidents	--				B	B
Active ventilation system HEPA high dP and low dP interlocks – reduce aerosol releases for in-tank spray accidents	--				B	B+

Table 2. Aggregate Results - Waste Transfer Leak Control Integration Matrix. (7 sheets)

Control[50]	Applicable facilities[51]	Case 33A	Case 33B	Case 33C	Case 33D	Case 33E

P – Preventative
M – Mitigative (required as part of minimum adequate mitigation for MEI)
B – Beneficial, but not part of minimum adequate mitigation for MEI
FW – Significant to protecting the facility worker
For additional terms used in the table see the main text listing.

The final disposition of each control is detailed below.

Safety SSCs:

Overground Transfer System - Encasement and Connections: This control was considered by the team to provide a mitigative function in both the M1 and M1A control sets for Case 33A. For Case 33C, this control was considered to be beneficial for natural phenomena events. However, as noted in the table, natural phenomena events are considered to be controlled/mitigated by the M9 control set. This control was retained by the team for its currently established safety function of directing the flow of leaked waste from the primary line to a waste transfer-associated structure for detection.

Overground Transfer System – Barriers: This control was considered by the team to provide a preventive function for Case 33C in the P2 control set (i.e., for vehicle impacts). Additionally, for the same Case, this control was considered to be beneficial for natural phenomena events. However, as noted in the table, natural phenomena events are considered to be controlled/mitigated by the M9 control set. This control was retained by the team to satisfy the safety function of protecting the primary line from vehicle impacts. It is also noted that the revised title and safety function of this control provides more flexibility for implementation because it does not prescribe the type of protective cover that must be used. Previously, this control cited concrete barriers as the control that would be used to protect the primary line.

Pipe Encasements: Similar to the **Overground Transfer System - Encasement and Connections**, pipe encasements were considered by the team to provide a mitigative function in both the M1 and M1A control sets for Case 33A. This control was retained by the team for its currently established safety function of directing the flow of leaked waste from the primary line to a waste transfer-associated structure for detection.

Pressure Switch Interlock or Alarm Systems (e.g., Service Water Lines): This control was considered to provide a mitigative function for Case 33D in the M6 control set. This control exists in the current control set for Tank Farms, however, as a result of this re-analysis effort the safety function has been slightly modified. The safety function of this control credited in the analysis is to detect backflow into piping systems physically connected to the waste transfer route and to alarm to alert operators to take mitigate action to shutdown the transfer pump (or other motive force) and move workers. Control allocation activities (conducted after the control decision meetings) determined that this control is preventive if the transfer pump is interlocked with the system and the transfer system has integrity. See Appendix E for the specific safety functions credited for this safety item.

Backflow Preventers: This control was viewed by the team as only beneficial for Case 33D. Team consensus therefore was not to select this control as either preventive or mitigative. The other controls selected to prevent and/or mitigate the consequences of Case 33D (e.g., **Pressure Switch Interlock or Alarm Systems** and **Transfer System Leak Detection Systems**) are discussed individually.

Primary Tank Leak Detection System: This control was considered by the team to be preventive for Case 33D (see control set P6). In the event that waste is mis-routed DST annulus, this safety system would detect the mis-routed waste and coupled with response actions, prevent an overflow of the annulus space. The safety function of this control is to detect the leaked waste and alert operators within a period of 12 hours. The 12 hour timeframe is based on a mis-route flow rate of less than 200 gpm and an available annulus volume of 150,000 gal. Subsequent control allocation activities determined that this control was not necessary because the waste transfer leak detection systems (with leak detectors installed in the pits above the waste tanks) would be adequate to detect the overflow of waste tanks. Therefore, this control was not allocated or credited to any waste transfer leak-associated accident or hazardous condition.

Transfer System Leak Detection System: This control was considered by the team to provide a mitigative function for both Cases 33A and 33D in control set M1. Additionally, this control was viewed as slightly beneficial for Case 33C. Therefore, it was the consensus of the team to retain this control for the safety function of detecting waste transfer system leaks and provide an alarm to alert operators to take mitigative action to shutdown the transfer pump (or other motive force) and move workers.

Transfer System Covers and RCSTS Entry Doors and Seals: This control is not required to mitigate consequences to below the risk evaluation guidelines, however, for Cases 33A and 33C this control was viewed by the team to be a beneficial part of a control scheme and also to provide a significant benefit to the facility worker. Transfer system covers (and the RCSTS entry doors and seals) have been identified as non-safety Design Features to reduce potential aerosol releases and provide shielding for facility workers for waste leaks routed to a waste transfer-associated structure. These items are currently captured in Appendix B of HNF-SD-WM-TSR-006 and will be retained.

Ventilation Stack CAM Interlock: This control was viewed by the team as providing a mitigative function for Case 33E in the M7 control set. Note that the M7 control set addresses only the 204-AR Waste Unloading Facility. The consequences for the large underground waste storage tanks showed that a leak path factor (LPF) for these actively ventilated structures was extremely low and consequences from in-tank spray leaks for these facilities did not exceed the risk evaluation guidelines (see RPP-5667). For the 204-AR Waste Unloading Facility a similar case was made in RPP-5667 (consequences significantly below the risk evaluation guidelines). Therefore, it was not necessary to credit this control for any tank waste facility or structure. It should be noted that the **204-AR Waste Unloading Facility Structure** has been identified as a non-safety Design Feature and the **TSR control to keep the roll-up and west exterior doors closed** (see AC 5.12 discussion) has been retained. The identification of these two controls results in an acceptable control suite to mitigate aerosol releases from this facility.

204-AR Waste Unloading Facility Structure: Similar to the **Ventilation Stack CAM Interlock**, this control was viewed by the team as providing a mitigative function in the M7 control set for both Cases 33D and 33E. This passive feature was selected as a non-safety Design Feature in place to limit the quantity of aerosols released from the facility in the event of a mis-route. This facility is already included in the Design Features (Appendix B) of HNF-SD-WM-TSR-006.

Abovegrade Portions of Waste Transfer-Associated Structures: This control is not required to mitigate consequences to below the risk evaluation guidelines, however, for Cases 33A , 33C, and 33D this control was viewed by the team to be a beneficial part of a control scheme and also to provide a significant benefit to the facility worker. As such, abovegrade portions of waste transfer-associated structures have been identified as non-safety Design Features to reduce potential aerosol releases and provide shielding for facility workers for waste leaks routed to a waste transfer-associated structure. It was determined that no specific TSR is required to perform surveillances on these systems. Damage to these systems severe enough to diminish the non-safety Design Feature functions of these systems is judged to be very unlikely (e.g., major vehicle accident or crane impact) and would be expected to be easily detected during routine operator rounds. These facility structures are currently captured in Appendix B of HNF-SD-WM-TSR-006 and will be retained.

Supplemental Covers: This control was not retained by the team because it was not considered to provide either a required preventive or mitigative function for any of the waste leak accident cases.

204-AR Backflow Prevention Systems: This control was determined by the team to provide a preventive function in the P4 control set for Case 33D. In the event of a 204-AR waste mis-route into the raw water system, this control would provide the currently established safety function of preventing a backflow of waste into the raw water system or other service system leading to the Mechanical Equipment Room where a potential leak could occur. The safety function of this control will be implemented through **LCO 3.1.6, 204-AR Backflow Prevention System**.

Saltwell Flow Totalizers: This control was considered by the team to be universally beneficial in supporting material balances during waste transfers. Instead of crediting this system as a Safety-Significant SSC, the team chose to address the implementation of equipment used for material balances through **AC 5.19, Process Instrumentation and Measuring and Test Equipment**. AC 5.19 is currently established and is in place to ensure that the equipment used to measure waste flowrates/totals, tank levels, and other important process parameters is properly maintained and calibrated.

Tank Level Detection Systems: Similar to **Saltwell Flow Totalizers**, this control was considered by the team to be universally beneficial in supporting material balances during waste transfers. Instead of crediting this system as a Safety-Significant SSC, the team chose to address the implementation of equipment used for material balances through **AC 5.19, Process Instrumentation and Measuring and Test Equipment**. AC 5.19 is currently established and is in place to ensure that the equipment used to measure waste flowrates/totals, tank levels, and other important process parameters is properly maintained and calibrated.

Service Water Flow Totalizers: This control was considered by the team to provide a mitigative function in the P3 control set for Case 33D. In the event of a service water mis-route to a waste tank, this control would be used in conjunction with AC 5.21, **Tank Service Water Intrusion Monitoring Program** to prevent a tank overflow due to the introduction of service water. Instead of crediting this system as a Safety-Significant SSC, the team chose to address the implementation of equipment used for material balances through **AC 5.19, Process Instrumentation and Measuring and Test Equipment**. AC 5.19 is currently established and is in place to ensure that the equipment used to measure waste or service water flowrates/totals, tank levels, and other important process parameters is properly maintained and calibrated.

Isolation Valves: This control is not currently a credited control in the AB, however, it was considered as an option to physically disconnect portions of the waste transfer system. Because the Tank Farm transfer systems are highly interconnected, there are many transfer configurations that require all applicable safety controls (e.g., transfer system leak detection) to be operable throughout the facility. This approach is expensive and inefficient. Therefore, efforts were undertaken to consider alternate methods of disconnecting portions of the facility when those portions are not necessary for the planned transfer operation. Acceptable methods of disconnecting portions of the transfer system include:

(1) installing a blind flange in the transfer route,

(2) providing an air gap (e.g., removing a transfer system jumper),

(3) providing two isolation valves in the closed position with a Safety-Significant interlock or alarm system (the pressure switch detects leakage and the alarm alerts operators to stop the motive force [e.g., transfer pump]), or

(4) two Safety-Significant isolation valves, independently verified to be in the closed position, and performance of a transfer material balance.

The first three options prevent any misroute leakage, but because valves can leak, double valve isolation only limits the misroute leakage. Material balance may not be accurate enough to detect small leakage rates or small leaked volumes but would detect misroutes that are due to isolation valve failure or misroutes due to grossly mispositioned isolation valves. Additional protection for misrouting through two Safety-Significant isolation valves is provided by control of the removal of transfer system covers (see discussion provided on **AC 5.22, Transfer System Cover Removal Controls**) and the Safety Management Programs discussed in AC 5.24.

The credited safety function of the isolation valves is to limit the mis-route of waste from the physically connected transfer routes to uncontrolled (or physically disconnected) portions of the facility.

Master Pump Shutdown System: This control is not currently a credited control in the AB, however, it was considered as an option to stop the transfer pump(s) upon leak detection by the **Transfer System Leak Detection System**. This control was considered by the team to be a control that provides a mitigative function in the M1A control set for Cases 33A and 33D. Three specific safety functions were identified for this control: (1) detect waste transfer system leaks, (2) provide an interlock to shutdown the transfer pump, and (3) provide an alarm to alert operators to take response actions to limit exposure to onsite and facility workers. All of these identified safety functions will limit the volume of the waste leak and decrease the consequences of the event.

Technical Safety Requirements:

LCO 3.3.1 – Transfer System Covers and Entry Doors: This control was not retained because the Transfer System Covers were not carried forward as a necessary mitigative feature in the revised accident analysis.

LCO 3.1.2 – Service Water Pressure Detection Systems: This control implements the safety functions of the Safety-Significant **Service Water Pressure Detection Systems** discussed earlier. This control is established in the current AB and will be retained.

LCO 3.1.3 – Transfer Leak Detection Systems: This control implements the safety functions of the Safety-Significant **Transfer Leak Detection Systems** discussed earlier. This control is established in the current AB and will be retained.

LCO 3.1.4 – Ventilation Stack CAM Interlock Systems: Analysis of in-tank (or in-facility) spray leaks showed that this control was not necessary to mitigate the release of aerosols that may be generated as a result of a waste mis-route for any Tank Farm facility (including the 204-AR Waste Unloading Facility). Therefore, this control was not selected to address the risk associated with waste transfer leaks.

LCO 3.1.6 – 204-AR Backflow Prevention System: This control implements the safety functions of the Safety-Significant **204-AR Backflow Prevention Systems** discussed earlier. This control is established in the current AB and will be retained.

LCO 3.1.7 – Supplemental Covers: This control was not retained because the Transfer System Covers were not carried forward as a necessary mitigative feature in the revised accident analysis.

LCO 3.2.6 – Primary Tank Leak Detection Systems: This control was retained by the team to implement the safety functions of the Safety-Significant **Primary Tank Leak Detection Systems** defined above. However, subsequent control allocation activities determined that this control was not necessary because the waste transfer leak detection systems (with leak detectors installed in the pits above the waste tanks) would be adequate to detect the overflow of waste tanks. Therefore, this control was not allocated or credited to any waste transfer leak-associated accident or hazardous condition.

AC 5.12 – Transfer Controls (each bulleted item is detailed below):

Transfer System Configuration Management

- **Establish and Maintain Controlled Status of the Waste Transfer Systems As-Built and Jumper Configuration:** This control was not selected by the team as a necessary control. For Case 33D this control was considered to be beneficial, but it would not either prevent or mitigate a waste transfer leak. This control is currently an established practice within the operations of Tank Farms. Because this control is addressed in lower-level procedures and it would neither prevent nor mitigate a waste transfer leak, the team did not feel it was necessary to select this control.

- **Perform Waste Transfer System Operations by Approved Procedures:** This control was not selected as a necessary control by the team. For Case 33D this control was considered to be beneficial, but it would neither prevent nor mitigate a waste transfer leak. This control is currently an established practice within the operations of Tank Farms. Because this control is addressed in lower-level procedures and it would neither prevent nor mitigate a waste transfer leak, the team did not feel it was necessary to select this control.

- **Independently Verify That the Planned Waste Transfer Route is Proper for the Intended Transfer; Piping is in Place per Configuration Status Controls; Correct and Operable Pumps are Specified; and Valves are Properly Aligned Prior to Transfer:** This control was not selected by the team as a necessary control. For Cases 33A, 33D, and 33E this control was considered to be beneficial, but it would neither prevent nor mitigate a waste transfer leak. This control is currently an established practice within the operations of Tank Farms. Because this control is addressed in lower-level procedures and it would neither prevent nor mitigate a waste transfer leak, the team did not feel it was necessary to select this control.

- **Prior to Waste Transfer Through Overground Waste Transfer Piping, Verify That Either Vehicle Restrictions (i.e., Vehicle Access Limitations To The Tank Farm) Or Concrete Shielding Systems Surrounding The Overground Transfer Line Portions Of The Transfer Route Are In Place:** This control was retained by the team for the safety function of preventing damage to OGT line. This control was left as is except for allowing options other than concrete shielding systems for physical protection of the transfer line. "Concrete shielding systems" will be changed to "barriers".

- **Single-Walled Direct Buried/Bermed Waste Transfer Lines Outside Of The Tank Farm Boundaries Shall Be Identified With Permanent Aboveground Labels. Single-Walled Direct Buried/Bermed Waste Transfer Lines Within The Tank Farm Boundary Shall Be Identified With Either (1) Permanent Aboveground Labels, (2) Temporary Aboveground Labels In Place During Waste Transfer Through The Associated Lines, Or (3) A Marker System And Status Drawing Available For Operator Use:** This control was not retained by the team for the mitigative functions credited in control sets M3 and M4 for Cases 33B and 33C, respectively. Rather, this control was viewed as an implementation action necessary to conduct the required ground-level radiation surveys. This control was considered by the team to be better addressed in lower-level implementing procedures (e.g., HNF-IP-1266).

- **Open Nozzles Physically Connected To Waste Transfer Lines Shall Be Sealed With Caps, Process Blanks, Or Equivalent To Prevent Misroutes Of Waste:** This control was not selected by the team as a necessary control. For Case 33D this control was considered to be beneficial, but it would neither prevent nor mitigate a waste transfer leak. Therefore, the team did not feel it was necessary to select this control.

- **Newly Installed Jumpers Shall be Leak Tested Prior to Use:** This control was not selected by the team as a necessary control. For Cases 33A and 33D this control was considered to be beneficial, but it would neither prevent nor mitigate a waste transfer leak. Therefore, the team did not feel it was necessary to select this control.

- **AWF Tank Waste (i.e., AWF Tank Liquids and AWF Tank Solids) Shall Only be Transferred Through AWF Transfer-Associated Structures:** This control was not selected by the team as a necessary control. The modeling performed for the waste transfer leaks addressed the full range of wastes available for transfer and consequences were calculated without respect to any artificial waste segregation, therefore there is no need to retain this control.

- <u>204-AR Waste Unloading Facility</u>. **Verify That The West Exterior Rollup Door And The West Exterior Personnel Access Door Are Closed When The 204-AR Waste Unloading Facility Is Physically Connected To An Active Waste Transfer Pump Not Under Administrative Lock:** This control was retained for the currently established safety function of mitigating aerosol releases from leaks inside the facility. This control, in conjunction with the previously discussed **204-AR Waste Unloading Facility Structure** (as a non-safety Design Feature), was considered by the team to provide the stated mitigative function in accident analysis Cases 33D and 33E. This control was retained by the team.

Transfer System Operating Requirements

- **Perform Material Balance Calculations During Each Waste Transfer through the Waste Transfer System. Calculations Shall Be Performed At 30 And 60 Minutes Following Waste Transfer Initiation And Each 2 Hours Thereafter Until The Transfer Is Complete. This Requirement Does Not Apply To The Waste Retrieval Sluicing System Operations (W-320):** This control was identified as a beneficial control for Cases 33A through 33E. Leak detection is a key element to the mitigation of waste transfer leaks and it was identified that in many instances performing a material balance could be an acceptable form of leak detection. While material balances may not be accurate enough to detect small leakage rates or small leaked volumes it is expected that performing a material balance would be able to detect larger leak rates and leak volumes that could result in significant consequences to facility and onsite worker. This control will be re-worked in the TSRs to describe that material balance monitoring criteria should be documented in lower-level working procedures or process plans. No specific times for the performance of a material balance will be included in the TSR control. This approach will allow flexibility for operations with specific necessary surveillance times being added to HNF-IP-1266.

- **Monitor For Increasing Level In All Tanks (Including Catch Tanks) Physically Connected To Waste Transfer Route, During Waste Transfer Through A Waste Transfer System. Monitoring Shall Be Performed At 30 And 60 Minutes Following Waste Transfer Initiation And Each 2 Hours Thereafter Until The Transfer Is Complete. This Requirement Does Not Apply To The Waste Retrieval Sluicing System Operations (W-320):** This control was identified as being beneficial by the team because it was identified as having a significant mitigative function in the M1 and M8 control sets in Cases 33A and 33D, respectively. Monitoring tank level provides indication to prevent overflowing the tanks due to a waste transfer or mis-route event. It was decided during the control decision meeting to add some flexibility to this control by adding the option of performing the stated control OR performing a material balance. Performance of a material balance will provide alternate indication of the transferred waste volume and indication of a mis-route event, thus preventing overflowing the tanks. Since a control on material balance was upgraded to a required control for all transfers, the requirement to monitor tank level was downgraded to a good practice. Additionally, the specific monitoring frequency will be moved to lower-level implementing documentation (e.g., HNF-IP-1266) to provide additional flexibility.

- **Perform Ground-Level Radiation Surveys Of Any Single-Walled, Direct Buried/Bermed Line That Are Part Of The Waste Transfer Route Every 12 Hours During Salt Well Pumping (Maximum Of 4 Gal/Min), And Every 30 Minutes During Submersible Pumping (Maximum Of 50 Gal/Min). This Requirement Does Not Apply To The Waste Retrieval Sluicing System Operations (W-320) And The 242-A Evaporator Drain Line DR-343.**

  Ground Level Radiation Surveys Shall Be Performed Based On Baseline Criteria. If Radiation Surveys Indicated A Variance That Exceeds The Criteria, Actions Shall Be Taken To Investigate Whether Transfer Line Leakage Is Confirmed, Response Actions Shall Be Taken According To Procedures: This control was retained by the team because it was identified as having a significant mitigative function in the M3 control set in Cases 33B and 33D. Periodic radiation surveillance provides detection of leaks that are not routed to waste transfer system structures and their contained leak detection systems. There is a unique hazardous condition that exists for some transfer systems that involve steel pipe encasements that do not penetrate through the concrete wall of pits, diversion boxes or concrete encasements but rather terminate at the outside (soil side) of these walls. The primary line penetrates the structure wall and the penetration is typically sealed with grout or other sealing material. A leak in the primary line that occurs within the structure wall may migrate into the pit where it can be detected by the transfer leak detection system. If however, the leak migrates into the soil rather than the pit, the leak would not be detected by the transfer leak detection system. Therefore, performance of a material balance has been selected to detect this leak-to-soil scenario. Material balance may not be accurate enough to detect small leakage rates or small leaked volumes but would detect larger leak rates and leak volumes that could result in significant consequences to facility and onsite worker.

- **Waste Transfers are Prohibited into SSTs:** This control was not retained by the control decision team because it is not required to either mitigate or prevent the consequences of waste transfer leaks. The model used in the re-analysis effort does not preclude waste transfers into SSTs and therefore addresses transfers into SSTs (even though they are not performed nor expected). This control may be retained in the TSRs, but not for a transfer system related safety function.

- **Verify Physically Connected Catch Tanks That are Not in the Direct Transfer Route are < 50% Full Prior to Waste Transfer:** This control was not retained by the control decision team because it is not required to either mitigate or prevent the consequences of waste transfer leaks. The original intent of this control was to ensure that catch tanks would not overflow in the event of a waste leak draining into the catch tank. In the revised control scheme monitoring of all physically connected catch tanks is performed.

- **Verify That All Pit Drains Associated with the Cross-Site Transfer Route Have and Open Flow Path to Allow Drainage Prior to a Cross-Site Waste Transfer:** This control was not retained by the control decision team because it is not required to either mitigate or prevent the consequences of waste transfer leaks. This control was originally selected to ensure that pits on the cross-site transfer route would not overflow as a result of drainback after the transfer pump was stopped. This control was determined to not be applicable for any of the accident analysis Cases because the waste transfer leak model addressed the full range of potential drainback volumes and pool due to overflow are mitigated by leak detection and emergency response.

- **Verify That the Vent Valves Are Open on COB-AW-2, COB-AW-4, COB-AW-6, COB-AW-8, and COB-AW-10 When the COB is Physically Connected To An Active Transfer Pump, Not Under Administrative Lock or When There is Waste in the 242-A Evaporator Vessel:** This control was not selected during the control decision meetings but was determined to be necessary later. In finalizing the accident analysis for the waste transfer leak accidents, it was determined that a control was necessary to ensure that the COB vent line isolation valve is open on COBs that could pressurize if a leak overfilled them. The specific applicability of the control was determined during the development of the AB amendment package information.

AC 5.13 – Encasement Seal Loop Controls: This control was retained for the currently established safety function of ensuring that the encasement drains are open such that primary pipe leaks are directed to leak detection in waste transfer-associated structures. This control also prevents waste leaks from encasement risers by ensuring that the encasement cannot be pressurized in the event of a primary transfer line leak.

AC 5.14 – Emergency Preparedness: This control was retained by the control decision team. Emergency preparedness is a key element in the revised analysis as a feature that is used to limit the exposure to receptors. This program was considered as a necessary mitigative control for each of the analyzed cases.

AC 5.17 – Excavation Controls: This control was not retained by the control decision team because it was determined that the key elements included in this program are already addressed by other requirements (e.g., environmental compliance) within Tank Farms. It was discussed during the meeting how there are numerous other requirements (outside of the AB) that already address what is outlined in AC 5.17. It was the consensus of the team therefore, to downgrade this control to a good practice and remove it from the TSRs. The key element of AC 5.17 regarding the establishment of communications will be relocated to AC 5.14. It was also decided that the radiation protection program cited in AC 5.24 (see later discussion) would be included as a requirement for Case 33C to mitigate waste transfer leaks.

AC 5.18 – HEPA Filters in RCSTS Structures: This control was not retained by the control decision team because it is not required to either mitigate or prevent the consequences of waste transfer leaks. It was determined to not be applicable for any of the accident analysis Cases because modeling assumptions did not credit the HEPA filters as controls.

AC 5.20 – Transfer Pump Administrative Lock Controls: This control was retained by the control decision team because it was considered to be a preventive control (control set P1) for each accident analysis case. This control prevents leaks by eliminating the possibility of pressurized waste transfer lines.

AC 5.21 – Tank Service Water Intrusion Program: This control was retained by the control decision team for its ability to prevent tank overflow due to service water intrusion. The specific surveillance period discussed in the control (i.e., every 24 hours) will be moved to lower-level implementing documentation (i.e., HNF-IP-1266).

AC 5.22 – Transfer System Cover Removal Controls: This control was retained by the control decision team for the safety function of reducing exposure of facility and onsite workers to waste aerosols and direct radiation (shine and skyshine doses) due to leaks into transfer system structures. The existing control will be modified to provide Radiation Protection and Industrial Health and Safety measures when cover blocks are removed to protect facility workers from direct radiation and aerosol release due to potential waste leaks being routed to a waste transfer structure. This control was selected at the request of the Radiation Protection and Industrial Health and Safety organizations to provide Operations with a direct AB requirement to be addressed in work packages and operating procedures.

AC 5.24 – Safety Management Programs: This control is not currently part of the explicitly credited control suite for waste transfer leak-type accidents. However, in the discussion of control selection for Cases 33C and 33E this control was specifically cited as necessary in the control set. For Case 33C, this control was credited for the radiation protection program features that are in place to ensure that worker protection is maintained during excavation activities. For Case 33E, this control was credited for detecting an upset condition where aerosols may be exhausted through an active ventilation system. It was stated during the meeting that if an in-tank or in-facility spray leak was occurring and being exhausted through an active ventilation system, it would be reasonable to expect that normal contamination surveys would detect the condition and corrective actions would be initiated to mitigate further releases. Therefore, AC 5.24 was credited in this new analysis with detecting small leaks that may not be detected by material balances. Detection methods addressed by AC 5.24 may include periodic tank farm radiation surveys, personnel surveys (e.g., use of personnel contamination monitors) when leaving a radiological area, and spill response upon visual observation. These elements are all part of the current safety management programs; therefore no specific TSR or specific AC 5.24 key elements are required.

Summary

Appendix E summarizes the control suites that were selected for Cases 33A through 33E. A table summarizing the non-safety Design Features discussed earlier is also included in Appendix E.

This page intentionally left blank.

4.0 REFERENCES

HNF-IP-1266, 2000, *Tank Farm Operations Administrative Controls*, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-5667, 2000, *Stochastic Consequence Analysis for Waste Transfer Leaks*, Rev. 0, Fluor Federal Services, Richland, Washington.

RPP-5990, 2000, *Hazard Evaluation for In-Tank Spray Leak*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

This page intentionally left blank.

Appendix A

Control Decision Meetings Agenda

This page intentionally left blank.

Waste Transfer Leak
Control Selection Board Meeting
Agenda

Introduction (Mike Grigsby)
- Purpose
- Scope
- Process

Hazard Analysis Overview (Milt Shultz)
- Rebinning under 5 rep accidents
- In-tank spray leak hazard analysis

Brief Accident Analysis Approach Overview (Brit Hey)
- "Reasonably conservative" analysis
- 5 Representative accidents
- Cases without controls, cases with controls and cases with failed controls

Current Control Approach Overview (Mike Grigsby)

Accident Analysis Results and Control Options – Case 33A – Leaks into Pits (Brit Hey/Mike Grigsby)
- Results without controls (Brit Hey)
- Current FSAR/TSR controls (Mike Grigsby)
- Candidate revised controls and results with controls (Brit Hey)
- Key sensitivities
- Discussion of preferred control approach including cost/benefit (group)

Accident Analysis Results and Control Options – Case 33B – Leaks into Soil (Brit Hey/Mike Grigsby)
- Results without controls and with failed controls (Brit Hey)
- Current FSAR/TSR controls (Mike Grigsby)
- Candidate revised controls and results with controls (Brit Hey)
- Discussion of preferred control approach including cost/benefit (group)
- Key sensitivities
- Discussion of preferred control approach including cost/benefit (group)

Accident Analysis Results and Control Options – Case 33C – Leaks Directly onto Ground (Brit Hey/Mike Grigsby)
- Results without controls and with failed controls (Brit Hey)
- Current FSAR/TSR controls (Mike Grigsby)
- Candidate revised controls and results with controls (Brit Hey)
- Key sensitivities

- Discussion of preferred control approach including cost/benefit (group)

Accident Analysis Results and Control Options – Case 33D – Mis-routes (Brit Hey/Mike Grigsby)

- Results without controls and with failed controls (Brit Hey)
- Current FSAR/TSR controls (Mike Grigsby)
- Candidate revised controls and results with controls (Brit Hey)
- Key sensitivities
- Discussion of preferred control approach including cost/benefit (group)

Accident Analysis Results and Control Options – Case 33E – In-tank Leaks (Brit Hey/Mike Grigsby)

- Results without controls and with failed controls (Brit Hey)
- Current FSAR/TSR controls (Mike Grigsby)
- Candidate revised controls and results with controls (Brit Hey)
- Key sensitivities
- Discussion of preferred control approach including cost/benefit (group)

Control Integration Across All Rep Accidents (Grigsby/group)

- Two birds with one stone
- Defense in depth
- Integrated cost/benefit

Control Allocation (unique situations) – (Milt Shultz/Mike Grigsby)

- Check that all hazardous conditions have adequate controls

Appendix B

Control Decision Meeting Attendee Lists

This page intentionally left blank.

Waste Transfer Leak Accident Control Decision Board Meeting
Attendance Sheet

Date: April 24, 2000

Name	Organization
MIKE GRIGSBY	NS&L
RD RAVEN	PROJECTS
DG BALDE	DST ENG.
T.L. Moore	Plant Eng.
J.M FERGUSON	NS&L
D.H. Slutford	Plant ENG
GRANT W. RYAN	NS&L
LAWRENCE J. KAMM	NS&L
SURYA N. MARUVADA	NS&L
GREGORY L. JONES	MACTEC
Gary Gault	NS&L
TOM GOETZ	NS&L
CHERYL MYOTT for Susan Alexander	Safety
PAUL KISON	SST ENG
MIKE SUTEY	TFFO-WASTE TRANSFERS
Dave Foust	Rad Eng

Waste Transfer Leak Accident Control Decision Board Meeting
Attendance Sheet

Date: ~~[illegible]~~ April 25, 2000

Name	Organization
Mike Grigsby	NS&L
Gary Duncan	Retrieval Ops
RP Raven	OPS
Milt Shultz	FFS
Jennifer Stewart	FFS/NS&L
T.L. Moore	M&R Eng.
Grant W. Ryan	NS&L/FFS
Gregory L. Jones	MACTEC/NS&L
Lisa Dominguez-Rauch	DST Engineering
Tom Goetz	NS&L
Lawrence T. Krians	NS&L
Bruce Zimmerman	NS&L
Paul Kison	SST Engr.
Dave Foust	Rad Eng / Work Planning

Waste Transfer Leak Accident Control Decision Board Meeting
Attendance Sheet

Date: April 26, 2000

Name	Organization
MIKE GRIGSBY	NS&L
GRANT W. RYAN	NS&L/FFS
DAN REBERGER	DST ENGINEERING
RP RAVEN	CHG RET OPS
Jennifer Stewart	FFS/NS&L
Tom Goetz	NS&L
LAWRENCE J KRIPPS	NSTL
SURYA MARUVADA	NS&L
BRUCE ZIMMERMAN	NS&L
MIKE SUTEY	TFFO - WASTE TRANSFERS
GREGORY L. JONES	MACTEC/NS&L
Tom Moore	M&RE
Brit He	FFS
Rich Hanson	SST Eng'rg

Waste Transfer Leak Accident Control Decision Board Meeting
Attendance Sheet

Date: APRIL 27, 2000

Name	Organization
MIKE GRIGSBY	NS&L
BRUCE ZIMMERMAN	NS&L
RP RAVEN	CHG RET OPS
Brit Hey	FFS
LISA DOMNOSKE-RAUCH	DST ENGINEERING
GREGORY C. JONES	MACTEC/NS&L
SURYA MARUVADA	NS&L
GRANT W. RYAN	NS&L/FFS
LAWRENCE J. KRIPS	NS&L
Jennifer Stewart	FFS/NS&L
Tom Goetz	NS&L
Tom Moore	CHG M&RE
PAUL KISON	SST - ENGR
MIKE SUTEY	TFFO - WASTE TRANSFERS

Appendix C

Control Decision Meetings Process and Criteria

This page intentionally left blank.

CONTROL DECISION MEETING TO ADDRESS WASTE TRANSFER LEAK HAZARDS

Note: Controls include safety-class and safety-significant structures, systems, and components (SSCs); technical safety requirements (TSRs); and other controls that provided defense-in-depth or environmental protection.

Purpose:

The purpose of the control decision meeting is to review and revise previously selected controls for the prevention or mitigation of waste transfer leak accidents. Reevaluation of control is warranted due to revisions in the hazard and accident analysis for these hazards. In particular, calculated radiological consequences are significantly reduced from those currently reported in the FSAR. Revised hazard and accident analysis and revised control recommendations will be reflected an AB Amendment to be submitted at ORP's request by June 30, 2000 in satisfaction of ORP PI 2.1.1

Scope:

The scope of the control decision meeting covers all waste transfer leak related hazardous conditions identified in the Tank Farm hazard analysis database, excluding those associated with use of the RCSTS slurry line and slucing of Tank 241-C-106 addressed in FSAR Addendum 1. The scope does include waste feed delivery waste transfer operations.

Process:

The control decision process and the criteria for control decisions are described in the FSAR (HNF-SD-WM-SAR-067) along with the methodology for the hazard and accident analyses whose results are used to identify controls. Control decision criteria are summarized in Attachment I.

Control decisions will be based on the best available information from the hazard and accident analyses and on the technical expertise and experience of the meeting participants. Decisions will be made by consensus.

Required participants in the DCRT and waste transfer system flammable gas hazard control decision meeting are representatives from operations, engineering (including SST and DST Design Authority and cognizant engineers), interim stabilization, process engineering, and nuclear safety and licensing. Control decision meeting participants may also include representatives from waste retrieval, nuclear regulatory compliance support, radiological control, safety and emergency preparedness, environmental, and quality assurance. Personnel responsible for developing the information or performing the analysis supporting control decisions will be present at the control decision meeting. U.S. Department of Energy (DOE) Office of River Protection (ORP) staff have been invited to observe the control decision meeting.

The control decision meeting discussions will be documented, including the control decisions (see Attachment II). This documentation will be included or referenced in an amendment to the Authorization Basis (i.e., FSAR and TSRs) containing the proposed basis and control revisions to close the Flammable Gas USQ for DCRTs and waste transfer systems. DOE review and approval of the Authorization Basis amendment will be required.

Attachment I

SUMMARY OF CONTROL DECISION CRITERIA

Note: FSAR Section 3.3.1.5, "Controls Identification," contains a complete discussion of control decision criteria.

Control decision criteria are based on the following documents

DOE 5480.23,' *Nuclear Safety Analysis*

DOE 5480.22,. *Technical Safety Requirements*

DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports*

WHC-CM-4-46, *Nonreactor Facility Safety Analysis Manual*, Section 6, "Technical Safety Requirements," Rev. 1, and Section 9, "Safety Classification of Structures, Systems, and Components,: Rev. 2.

Risk Evaluation Guidelines:

Radiological Risk Guidelines

Frequency category	Frequency range (yr-1)	Effective dose equivalent (rem)	
		Onsite	Offsite
Anticipated	$>10^{-2}$ to $\leq 10^{0}$	0.5	0.1
Unlikely	$>10^{-4}$ to $\leq 10^{-2}$	5	0.5
Extremely unlikely	$>10^{-6}$ to $\leq 10^{-4}$	10	4

Toxicological Risk Guidelines

Frequency category	Frequency range (yr-1)	Primary concentration guidelines	
		Onsite	Offsite
Anticipated	$>10^{-2}$ to $\leq 10^{0}$	≤ERPG-1	≤PEL-TWA
Unlikely	$>10^{-4}$ to $\leq 10^{-2}$	≤ERPG-2	≤ERPG-1
Extremely unlikely	$>10^{-6}$ to $\leq 10^{-4}$	≤ERPG-3	≤ERPG-2

ERPG = Emergency Response Planning Guideline
PEL-TWA = permissible exposure limit – time-weighted average

Additional criteria to guide control decisions are the following

- Control preferences are as follows:
  1. Controls that prevent the accident versus those that mitigate its consequences
  2. Passive engineered versus active engineered controls
  3. Engineered controls versus administrative controls
- Controls providing significant defense-in-depth are classified as safety SSCs or are elevated to a TSR control
- TSR controls are not developed for postulated accidents resulting in only environmental consequences
- SSCs are not classified safety-class or safety-significant solely for preventing or mitigating postulated accidents resulting in environmental consequences

Other criteria that are important considerations in control decisions are listed below

- Control reliability, availability, and maintainability
- Control effects on facility workers (i.e., increased radiation doses or toxicological exposures – ALARA issues)
- Control optimization and integration
- Control cost/benefit
- Control human factors impacts
- Control impacts on TWRS mission

Attachment II

CONTROL DECISION RECORD

HAZARD/ACCIDENT TITLE:

Structures, Systems, and Components (SSCs)

Structures, Systems, and Components	Classification		Safety Function	Comments
	SC*	SS*		

* SC is safety class
SS is safety significant

Technical Safety Requirements (TSRs)

Control	Safety Function	Comments

Defense-in Depth Controls

Control	Safety Function	Comments

Appendix D

Accident Analysis Results

This page intentionally left blank.

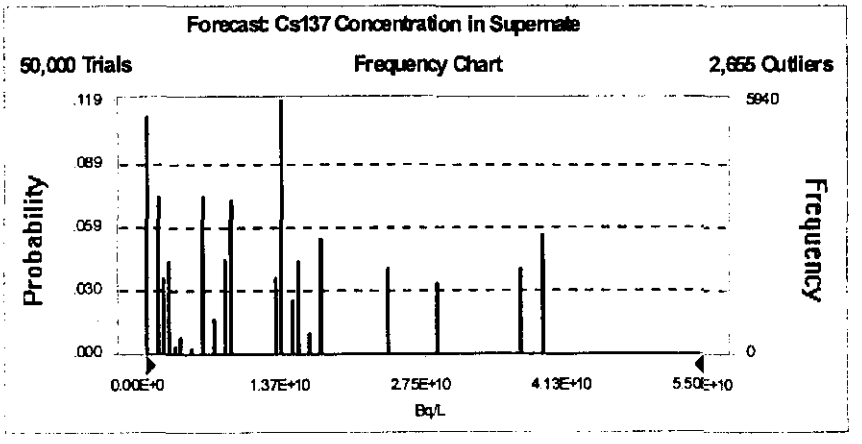
33a-normal-rpt.xls

Forecast: Cs137 Concentration in Supernate **Cell: B23**

Summary:

Display Range is from 0.00E+0 to 5.50E+10 Bq/L
Entire Range is from 1.32E+8 to 5.88E+10 Bq/L
After 50,000 Trials, the Std. Error of the Mean is 6.80E+7

Statistics:	Value
Trials	50000
Mean	1.48E+10
Median	1.31E+10
Mode	5.96E+09
Standard Deviation	1.52E+10
Variance	2.31E+20
Skewness	1.46
Kurtosis	4.51
Coeff. of Variability	1.03
Range Minimum	1.33E+08
Range Maximum	5.88E+10
Range Width	5.87E+10
Mean Std. Error	6.80E+07



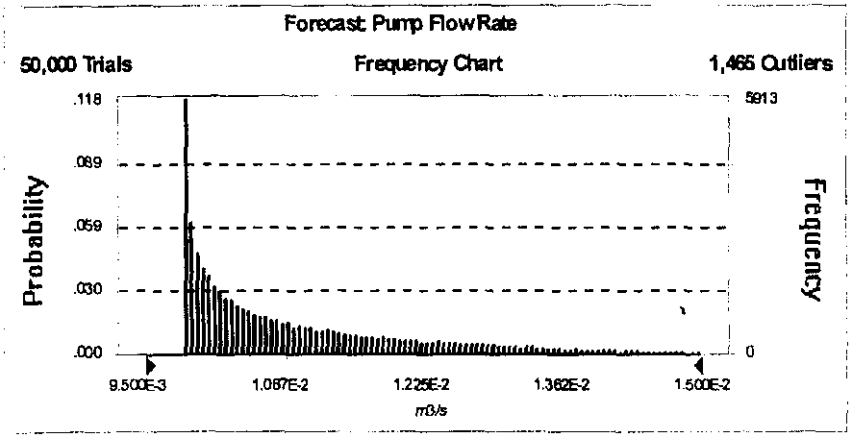
33a-normal-rpt.xls

Forecast: Pump Flow Rate **Cell: B134**

Summary:

Display Range is from 9.500E-3 to 1.500E-2 m3/s
Entire Range is from 9.886E-3 to 1.816E-2 m3/s
After 50,000 Trials, the Std. Error of the Mean is 6.545E-6

Statistics:	Value
Trials	50000
Mean	1.115E-02
Median	1.060E-02
Mode	9.887E-03
Standard Deviation	1.463E-03
Variance	2.142E-06
Skewness	1.75
Kurtosis	6.18
Coeff. of Variability	0.13
Range Minimum	9.886E-03
Range Maximum	1.816E-02
Range Width	8.273E-03
Mean Std. Error	6.545E-06



33a-normal-rpt.xls

Forecast: Leak Area **Cell: B116**

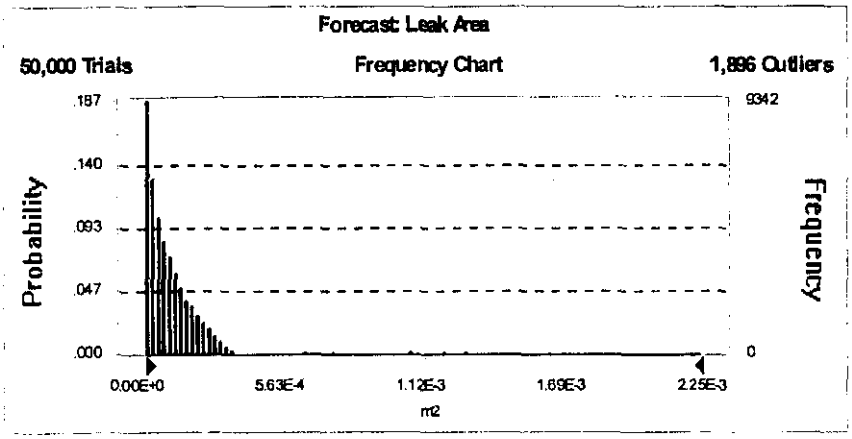
Summary:

Display Range is from 0.00E+0 to 2.25E-3 m2

Entire Range is from 1.00E-9 to 4.67E-3 m2

After 50,000 Trials, the Std. Error of the Mean is 2.97E-6

Statistics:	Value
Trials	50000
Mean	3.08E-04
Median	8.91E-05
Mode	---
Standard Deviation	6.65E-04
Variance	4.42E-07
Skewness	3.43
Kurtosis	15.08
Coeff. of Variability	2.16
Range Minimum	1.00E-09
Range Maximum	4.67E-03
Range Width	4.67E-03
Mean Std. Error	2.97E-06



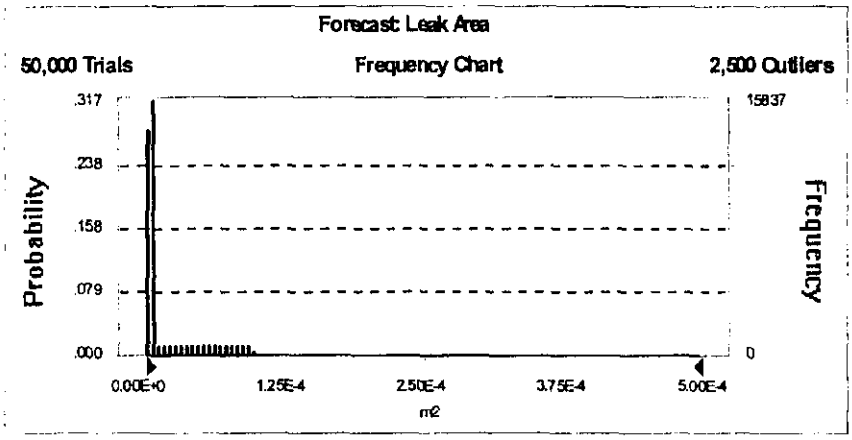
33c-1a-rpt.xls

Forecast: Leak Area **[33c-1a.xls]Main - Cell: B130**

Summary:

Display Range is from 0.00E+0 to 5.00E-4 m2
Entire Range is from 8.07E-7 to 6.45E-4 m2
After 50,000 Trials, the Std. Error of the Mean is 7.00E-7

Statistics:	Value
Trials	50000
Mean	8.53E-05
Median	8.24E-06
Mode	---
Standard Deviation	1.57E-04
Variance	2.45E-08
Skewness	2.14
Kurtosis	6.40
Coeff. of Variability	1.84
Range Minimum	8.07E-07
Range Maximum	6.45E-04
Range Width	6.44E-04
Mean Std. Error	7.00E-07



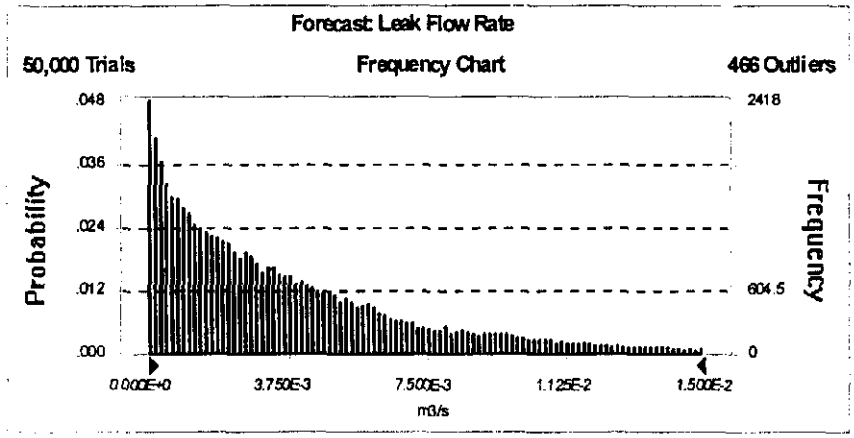
33a-normal-rpt.xls

Forecast: Leak Flow Rate **Cell: B142**

Summary:

Display Range is from 0.000E+0 to 1.500E-2 m3/s
Entire Range is from 5.740E-10 to 1.748E-2 m3/s
After 50,000 Trials, the Std. Error of the Mean is 1.575E-5

Statistics:	Value
Trials	50000
Mean	3.799E-03
Median	2.753E-03
Mode	---
Standard Deviation	3.521E-03
Variance	1.240E-05
Skewness	1.29
Kurtosis	4.22
Coeff. of Variability	0.93
Range Minimum	5.740E-10
Range Maximum	1.748E-02
Range Width	1.748E-02
Mean Std. Error	1.575E-05



33a-normal-rpt.xls

Forecast: Gamma Dose at Max Onsite Exposure Time **Cell: B235**

Summary:

Display Range is from 0.00E+0 to 1.50E-1 Sv
Entire Range is from 0.00E+0 to 5.57E-1 Sv
After 50,000 Trials, the Std. Error of the Mean is 1.92E-4

Statistics:	Value
Trials	50000
Mean	2.30E-02
Median	7.06E-03
Mode	0.00E+00
Standard Deviation	4.29E-02
Variance	1.84E-03
Skewness	4.15
Kurtosis	27.23
Coeff. of Variability	1.87
Range Minimum	0.00E+00
Range Maximum	5.57E-01
Range Width	5.57E-01
Mean Std. Error	1.92E-04

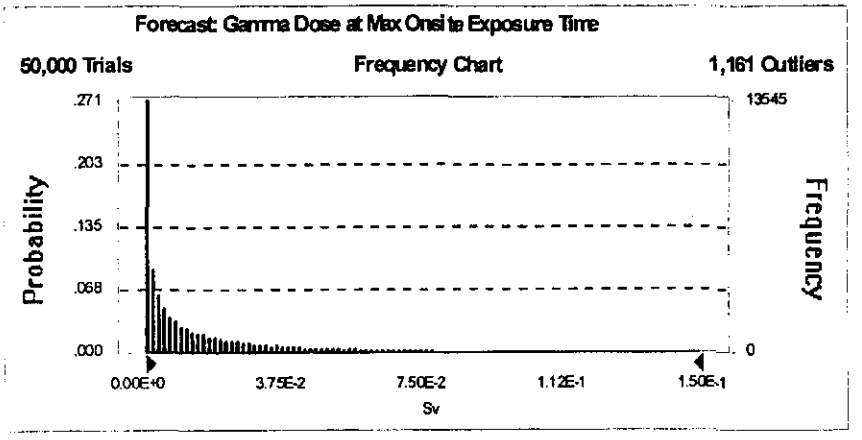


Table 4. 33A: Important Intermediate Results (Uncontrolled)

Intermediate Result	Mean	5 %	50%	95 %	Outlier
Waste Density in kg/L	1.17	1.12	1.16	1.23	1.26
Eff. slurry viscosity in cp	15	5.5	15	28	46
Pump flow rate in m3/s (gpm)	1.1E-02 (174)	9.9E-03 (157)	1.1E-02 (174)	1.4E-02 (222)	1.8E-02 (285)
Pump pressure in N/m2 (psig)	3.1E+6 (450)	1.9E+6 (275)	3.3E+6 (478)	3.6E+06 (522)	3.8E+6 (551)
Leak pressure in N/m2 (psig)	1.1E+6 (159)	2.4E+04 (3.5)	8.8E+05 (128)	2.8E+6 (406)	3.7E+6 (537)
Leak flow rate m3/s (gpm)	3.9E-03 (62)	1.6E-4 (2.5)	2.8E-03 (44)	1.1E-2 (174)	1.7E-02 (269)
Leak area m2 (in2)	3.06E-4 (0.47)	5.29E-6 (0.008)	8.92E-5 (0.14)	1.88E-3 (2.9)	4.72E-3 (7.3)
Total leak volume (12 hrs) in m3 (gal)	1.6E+02 (42,000)	7.0E+00 (1,800)	1.2E+2 (32,000)	4.9E+2 (130,000)	7.5E+2 (200,000)
Pit air volume in m3	1.45E+1	1.53E-1	1.31E+1	3.91E+1	1.48E+2
Effective pool volume (12 hrs) in m3	1.5E+2	0	1.1E+2	4.8E+2	7.4E+2
Effective pool radius (12 hrs) in m	33	0	32	68	85
Pit fill time in hrs	230	7.0E-3	9.2E-1	2.3E+1	1.5E+6
Inhalation ULD in Sv/L	7.2E+2	3.2E+1	2.1E+2	2.0E+3	2.0E+4
Cs-137 in supernate (Bq/L)	1.5E+10	4.9E+8	1.3E+10	5.9E+10	5.9E+10
Cs-137 in solids (Bq/L)	7.8E+9	1.2E+7	6.9E+9	2.1E+10	4.9E+10
ARF * RF (for splash/splatter)	4.04E-5	1.00E-5	3.16E-5	1.00E-4	1.13E-3
Resp. spray rate in m3/s	6.6E-8	2.7E-13	2.5E-9	2.2E-7	1.9E-5
Onsite X/Q in s/m3	2.78E-3	2.02E-4	2.23E-03	7.98E-03	1.27E-02
Offsite X/Q in s/m3	2.72E-6	3.82E-08	1.15E-06	1.23E-05	2.99E-05

Table 5. 33A: Onsite Dose Consequence Results in Sv with Covers Off and Onsite MEI leaves 12 Hours After Start of Leak (Normal Operating Conditions)

	50 %	95 %
Gamma shine	6.9E-3	1.0E-1
Spray release	7.0E-7	6.5E-4
Splash/splatter	6.7E-5	3.2E-3
Wet entrainment	3.2E-8	5.7E-6
Total of above	8.0E-3	1.1E-1
Dry entrainment	3.2E-7	3.6E-4

Table 6. 33A: Offsite Dose Consequence Results in Sv with Covers Off and Offsite MEI Exposed for 24 Hours After Start of Leak (Normal Operating Conditions)

	50 %	95 %
Spray release	3.0E-10	4.7E-7
Splash/splatter	3.6E-8	3.2E-6
Wet entrainment	9.6E-11	1.7E-8
Total of above	5.6E-8	5.0E-6
Dry entrainment	7.4E-10	6.5E-7

Stochastic Leak Analysis - Proposed Rep. Acc. Binning and Consequence Cases - 4/23/00

Rep. Acc. Description	Causes	Uncontrolled Cases	Controlled Cases	Sensitivity Cases
33A - Ex-tank waste transfer leak into structure or encasement that results in release to environment from structure.	• Corrosion • Erosion • Gasket failure • Jumper leaks (seal failure or misalignment) • Water hammer • High temperature waste • In-pipe flammable gas deflagration • Seismic events	• Normal Operation Uncontrolled - gamma, spray, splash/splatter, wet entrainment • Discharge Blocked Uncontrolled - gamma, spray, splash/splatter, wet entrainment but discharge blocked • Dry entrainment Note - Onsite/offsite exposure starts at leak inception and continues for 12/24 hrs.	• Normal Operation Controlled 1 - gamma, spray, splash/splatter, wet entrainment, no covers • Normal Operation Controlled 2 - gamma, pit air, wet entrainment, covers installed • Discharge Blocked Controlled 1 - same as Normal Operation Controlled 1 but discharge blocked • Discharge Blocked Controlled 2 - same as Normal Operation Controlled 2 but discharge blocked Note - Onsite/offsite exposure starts at leak inception. Leak detected when pit 5% filled. Pump stopped 30 min. after leak detection (LD). Onsite evacuated 4 hrs after LD.	• pit size = 0 • transfer line length varied • leak size varied to evaluate effects of: - water hammer - deflagration - freezing - seismic - high temp. - uncertainty • viscosity increased Note - The above sensitivity cases are applied only to the uncontrolled normal operating pressure case.

Waste Transfer Accident Consequence Summary
04/23/00

Control	Function	Onsite Dose (Sv)	Offsite Dose (Sv)
Case 33A – Leak to structure (pit, COB, etc.)			
No controls		**0.17**	1.1 E-5
Independently verify route	Prevents blocked line (pump deadhead)	**0.11**	5.0 E-6
Indep. ver. and leak detection at 5%, evac at +4hrs	Prevents blocked line, auto leak detection at 5% pit fill, removes MEI from pool shine	**3.0E-2**	5.4E-6
Indep. ver. and leak detection at 5%, evac at +2hrs	Prevents blocked line, auto leak detection at 5% pit fill, removes MEI from pool shine (174 gpm leakage for 1 hr is 10,400 gal)	< 5 E-3	-
Leak detection at 5% and evac at + 1.7 hrs, pit covers on	Auto leak detection at 5% pit fill, removes MEI from pool shine (206 gpm leakage for 0.7 hr is 8,600 gal)	4.9E-3	4.0E-8
Indep. ver. and leak detection at 5%, pump shutoff at +30 min and evac at +4hrs	Prevents blocked line, auto leak detection at 5% pit fill, reduces leak flow rate and volume and removes MEI from pool shine	2.7 E-3	-
Indep. ver. and leak detection at 5%, pump shutoff at +30 min and evac at +4hrs, pit covers on	Prevents blocked line, auto leak detection at 5% pit fill, reduces leak flow rate and volume and removes MEI from pool shine, knocks down spray	1.5 E-3	2.0 E-8

Onsite REG for anticipated events is 5 E-3 Sv
Offsite REG for anticipated events is 1 E-4 Sv

Rep. Acc. Description	Causes	Uncontrolled Cases	Controlled Cases	Sensitivity Cases
33B - Ex-tank waste transfer leak directly into soil. Leak may remain subsurface or may result in pool on soil surface.	• Corrosion • Erosion • Mechanical stress (heavy equipment and seismic) • In-pipe flammable gas deflagration • Bermed line failure	• Normal Operation Uncontrolled - gamma, wet entrainment but with pit size = 0 • Discharge Blocked Uncontrolled - gamma, wet entrainment but with pit size = 0, discharge blocked Note - Onsite/offsite exposure starts when leak reaches surface and continues for 12/24 hrs.	• Normal Operation Controlled 1 - gamma, wet entrainment but with pit size = 0 • Discharge Blocked Controlled 1 - same as above but with discharge blocked Note - Onsite/offsite exposure starts when leak reaches surface. LD in 1.4 hrs. Pump stopped 30 min after LD. Onsite evacuated 1 hr after LD.	None

Waste Transfer Accident Consequence Summary
04/23/00

Case 33B – Leak under soil (DST case)			
No controls		**0.18**	3.9 E-8
Independent verification of route	Prevents blocked line (pump deadhead)	**0.11**	1.9 E-8
Leak detection at 1.4 hrs, stop pump at +30 min and evac at +1 hr.	Reduces leak flow and removes the MEI from the pool shine (leakage at detection is 17,300 gal)	4.6 E-3	-
Independent verification, leak detection at 1.4 hrs, stop pump at +30 min, and evac at +1 hr	Prevents blocked line (pump deadhead), reduces leak flow and removes the MEI from the pool shine (leakage at detection is 14,600 gal)	3.0 E-3	-
Case 33B – Leak under soil (SWP case)			
No controls		-	-
Leak detection (LD) varies with transfer rate. Evac at LD +1hr. Transfer Rate (gpm) / Detection Time (hrs) / Leaked Amt (gal) 4 / 12 / 2880 8 / 8 / 3840 12 / 7 / 5040 20 / 6 / 7200	Removes the MEI from the pool shine	< 5 E-3	-

Onsite REG for anticipated events is 5 E-3 Sv
Offsite REG for anticipated events is 1 E-4 Sv

Rep. Acc. Description	**Causes**	**Uncontrolled Cases**	**Controlled Cases**	**Sensitivity Cases**
33C - Ex-tank waste transfer leak directly to the soil surface or atmosphere.	• Excavation • Drilling • Cone Penetrameter • OGT Failures (vehicle impact or seismic) • Test Riser leaks • Unsupported lines due to undermining • Seismic events • External events • Concurrent leak and coverblock failure	• Normal Operation Uncontrolled - gamma, spray, splash/splatter, wet entrainment but pit size = 0 Note - Onsite/offsite exposure starts at leak inception and continues for 12/24 hrs.	• Normal Operation Controlled 1 - gamma, spray, splash/splatter, wet entrainment but pit size = 0 • Discharge Blocked Controlled 1 - same as above but with discharge blocked Note - Onsite/offsite exposure starts at leak inception. LD immediately. Pump stopped in 30 min. Onsite evacuated 3 hrs after LD.	• Leak size distribution varied to represent leak causes Note - The above sensitivity cases are applied to the uncontrolled case.

Waste Transfer Accident Consequence Summary
04/23/00

Case 33C – Leak directly to soil surface			
No controls		**0.21**	6.5 E-5
Independent verification of route	Prevents blocked line (pump deadhead)	**0.13**	2.6 E-5
Leak detection immediate, evac at +1.2 hrs.	Removes the MEI from the pool shine (206 gpm leakage for 0.2 hrs is 2,470 gal)	4.9E-3	3.9E-8
Leak detection immediate, stop pump at +30 min and evac at +3 hrs.	Reduces leak flow and removes the MEI from the pool shine	4.9 E-3	-
Independent verification of route, leak detection immediate, stop pump at +30 min and evac at +3 hrs	Prevents blocked line (pump deadhead), reduces leak flow and removes the MEI from the pool shine	2.9 E-3	-
Independent verification of route, leak detection on ??? gal mass imbalance, stop pump at +30 min and evac at +1 hr	Prevents blocked line (pump deadhead), reduces leak flow and removes the MEI from the pool shine	<5 E-3	-

Onsite REG for anticipated events is 5 E-3 Sv
Offsite REG for anticipated events is 1 E-4 Sv

Rep. Acc. Description	Causes	Uncontrolled Cases	Controlled Cases	Sensitivity Cases
33D - Misroute of waste into tanks, uncontrolled waste systems, clean systems, or 204-AR waste unloading facility.	• Tank overflows (misroutes, material balance errors, service or fire water intrusion) • Back-flow into clean systems • Full pipe diameter flows into pits due to misroutes • 204-AR leak situations • Pressurization of isolated systems	• Unisolated Closed System - gamma, spray, splash/splatter, wet entrainment, pit size = 0, discharge blocked (same case as 33C DBC1) • Unisolated Open System - gamma, splash/splatter, wet entrainment, pit size = 0, discharge blocked, leak size = full pipe diameter Note - For the above cases the onsite/offsite exposure starts at leak inception and continues for 12/24 hrs. • Tank Overflow Uncontrolled - gamma, wet entrainment, pit size = tank head space, discharge blocked, leak size = full pipe diameter Note - For the above case the onsite/offsite exposure starts at point of tank overflow and continues for 12/24 hrs.	• Isolated System - gamma, spray, splash/splatter, wet entrainment, pit size = 0, discharge blocked, isolation valve leaks X gpm at max. pressure Note - For the above case the onsite/offsite exposure starts at leak inception and continues for 12 hr (for onsite) and 24 hrs (for offsite). • Tank Overflow Controlled - gamma, wet entrainment, discharge blocked, unintended receiving tank volume = DST and DCRT head space, misroute flow rate = max. for given transfer line length, misrouted volume limited to X gal. Note - Onsite/offsite exposure starts at point of tank overflow and continues for 12 hr (for onsite) and 24 hrs (for offsite).	None

Waste Transfer Accident Consequence Summary
04/23/00

Case 33D – Mis-route of waste to DST or DCRT half full			
No controls		**0.35**	7.0 E-5
Double valve isolation	Limits leakage to 4 gpm per valve or 2.8 gpm into the uncontrolled facility (2016 gal over 12 hrs)	4.3 E-3	-
Material balance	Limits mis-route to a tank (DST or DCRT) to 20,000 gal	4.6 E-3	-

Onsite REG for anticipated events is 5 E-3 Sv
Offsite REG for anticipated events is 1 E-4 Sv

Rep. Acc. Description	Causes	Uncontrolled Cases	Controlled Cases	Sensitivity Cases
33E - In-tank spray	• Failures during pumping	• Normal pressure case - spray, pit size = infinite, LPF established by separate model • Discharge blocked case - spray, pit size = infinite, intended receiver tank isolated Note - For the above case the onsite/offsite exposure starts at leak inception and continues for 12/24 hrs.	None - Uncontrolled onsite/offsite 95% consequences expected to be well below guidelines.	Discharge blocked case - leak size distribution varied to represent uncertainty

Waste Transfer Accident Consequence Summary
04/23/00

Case 33E – In-tank leak			
No controls (DST)		7.9 E-4	1.0 E-6
No controls (DCRT)		TBD	TBD

Onsite REG for anticipated events is 5 E-3 Sv
Offsite REG for anticipated events is 1 E-4 Sv

Appendix E

Control Decision Records

This page intentionally left blank.

CONTROL DECISION RECORD

Hazard/Accident title: Waste leak accident, Case 33A –Waste transfer leak into structure or encasement that results in release to the environment from the structure.

Structures, Systems, and Components (SSCs)			
Structures, Systems, and Components	Safety Classification	Safety Function	Comments
Overground Transfer System –Encasement and Connections	Safety-Significant	The safety function of the OGT system encasement and connections is to direct the flow of leaked waste from the primary line to a waste transfer-associated structure for detection, thus decreasing the consequences of the Waste Transfer Leak accident.	--
Pipe encasements	Safety-Significant	The safety function of the waste transfer system pipe encasement is to direct the flow of leaked waste from the primary line to a waste transfer-associated structure for detection, thus decreasing the consequences of the Waste Transfer Leak accident.	The safety function provided by this control works in conjunction with the Transfer System Leak Detection Systems.
Transfer leak detection systems	Safety-Significant	The safety function of the transfer leak detection system is to detect waste transfer system leaks in waste-transfer associated structures and to provide an alarm to alert operators to take mitigative action to shut down the transfer pump (or other motive force) and to take response actions to limit exposure to onsite and facility workers, thus limiting the volume of waste leaked and the time that workers are exposed to the leaked waste, thereby decreasing the consequences of the Waste Transfer Leak accident.	The safety function provided by this control works in conjunction with the Pipe Encasements.

Structures, Systems, and Components (SSCs)			
Structures, Systems, and Components	Safety Classification	Safety Function	Comments
Master pump shutdown system	Safety-Significant	The safety functions of the master pump shutdown system are to: (1) detect waste transfer system leaks via the transfer leak detectors; (2) provide an interlock to shut down the transfer pump; and (3) provide an alarm to alert onsite and facility workers to take response actions to limit exposure, thus limiting the volume of the waste leak and the amount of time that workers are exposed to leaked waste thereby decreasing the consequences of the Waste Transfer Leak accident. Additional safety functions of the master pump shutdown system are to: (1) detect waste backflows via the pressure switch interlock or alarm system; (2) provide an interlock to shut down the transfer pump; and (3) provide an alarm to alert onsite and facility workers to take response actions to limit exposure thus preventing or mitigating a waste transfer leak from the waste transfer system, decreasing the frequency or consequences of the Waste Transfer Leak accident.	Transfer leaks are detected by transfer leak detection systems and pressure switch interlock systems. The master pump shutdown system is considered a Safety-Significant SSC only when it is being credited with shutting down the transfer pump in lieu of operator action.

Technical Safety Requirements (TSRs)		
Control	Safety Function	Comments
LCO 3.1.3 Transfer Leak Detection Systems	Ensure operability of the transfer leak detection systems.	--

Technical Safety Requirements (TSRs)		
Control	Safety Function	Comments
AC 5.12 Transfer Controls • Transfer System Configuration Management – Verify that the vent valves are open on COB-AW-2, COB-AW-4, COB-AW-6, COB-AW-8, and COB-AW-10 when the COB is physically connected to an active transfer pump, not under administrative lock or when there is waste in	Ensures the vent isolation valve on the COB is open to prevent a waste leak pressurizing the COB and causing a spray of waste from the cover (e.g., through the flange gasket).	Waste leaking through the vent line can cause aerosol generation due to splash and splatter, which is analyzed in the accident analysis. Pressurized waste spray from a narrow slit (e.g., gasket leak) may cause aerosol release that exceeds guidelines.
• Operating requirements - Monitor for increasing level in all catch tanks (including the catch tank in 204-AR Waste Unloading Facility) when physically connected to the waste transfer route, during a waste transfer	Monitoring tank levels provides a means to detect transfer line leaks or misroutes into catch tanks. Monitoring the level in the catch tank in 204-AR provides indication of a leak in the waste unloading area during waste unloading operations or due to a misroute back to the facility.	--
- Perform material balances during waste transfer	Periodic material balances provide a means to detect transfer line leaks or misroutes.	Material balance criteria and response actions are defined in the transfer procedures and are based on the transfer configuration and potential leak rates. Material balance may or may not be accurate enough to detect small leakage rates or small leaked volumes but it would detect larger leak rates and leak volumes that could result in significant consequences to facility and onsite workers. Material balances prevent overflowing larger tanks and structures and limit the quantity of material leaked to structures, the soil, or the atmosphere. A material balance is adequate leak detection for the waste leaks that may occur through the primary pipe where it penetrates the concrete wall of pits and concrete encasements, when the leakage migrates into the soil rather than into the pit or encasement.
AC 5.13 Encasement Seal Loop Controls	Ensure that if the primary pipe leaks during waste transfer, the encasement will drain to the waste transfer-associated structure. Prevents pressurizing the encasement thus preventing waste leaks directly to atmosphere through test risers.	--

Technical Safety Requirements (TSRs)		
Control	Safety Function	Comments
AC 5.14 Emergency Preparedness	Mitigate the consequences of a waste transfer leak (i.e., pool on or near the ground surface) by moving workers away from the waste pool.	Reducing exposure time and increasing the distance between workers and the hazard mitigates exposure to radiation and toxic chemicals.
AC 5.19 Process Instrumentation and Measuring and Test Equipment	Ensure that instruments used to perform material balance, tank level monitoring, or service water monitoring are calibrated.	An effective material balance requires accurate instrumentation.
AC 5.20 Transfer Pump Administrative Lock Controls	Eliminates motive force, thus preventing unplanned transfers	Provides a safe condition when waste transfer controls are not operable.
AC 5.22 Transfer System Cover Removal Controls	Reduce exposure of facility and onsite workers to waste aerosols and direct radiation (shine and skyshine) due to leaks into transfer system structures.	Radiation protection practices would detect contamination in structures, thus limiting exposure.
AC 5.24 Safety Management Programs	Detect ground contamination from small leaks not detected by material balance.	Radiation protection practices would detect contamination on the soil thus limiting exposure.

CONTROL DECISION RECORD

Hazard/Accident title: Waste leak accident, Case 33B – Waste transfer leak directly into soil. Leak may remain subsurface or may result in pool on the soil surface.

Structures, Systems, and Components (SSCs)			
Structures, Systems, and Components	Safety Classification	Safety Function	Comments
Pipe encasements	Safety-Significant	The safety function of the waste transfer system pipe encasement is to direct the flow of leaked waste from the primary line to a waste transfer-associated structure for detection, thus decreasing the consequences of the Waste Transfer Leak accident.	The safety function provided by this control works in conjunction with the Transfer System Leak Detection Systems.
Transfer leak detection systems	Safety-Significant	The safety function of the transfer leak detection system is to detect waste transfer system leaks in waste-transfer associated structures and to provide an alarm to alert operators to take mitigative action to shut down the transfer pump (or other motive force) and to take response actions to limit exposure to onsite and facility workers, thus limiting the volume of waste leaked and the time that workers are exposed to the leaked waste, thereby decreasing the consequences of the Waste Transfer Leak accident.	The safety function provided by this control works in conjunction with the Pipe Encasements.

Structures, Systems, and Components (SSCs)			
Structures, Systems, and Components	Safety Classification	Safety Function	Comments
Master pump shutdown system	Safety-Significant	The safety functions of the master pump shutdown system are to: (1) detect waste transfer system leaks via the transfer leak detectors; (2) provide an interlock to shut down the transfer pump; and (3) provide an alarm to alert onsite and facility workers to take response actions to limit exposure, thus limiting the volume of the waste leak and the amount of time that workers are exposed to leaked waste thereby decreasing the consequences of the Waste Transfer Leak accident. Additional safety functions of the master pump shutdown system are to: (1) detect waste backflows via the pressure switch interlock or alarm system; (2) provide an interlock to shut down the transfer pump; and (3) provide an alarm to alert onsite and facility workers to take response actions to limit exposure thus preventing or mitigating a waste transfer leak from the waste transfer system, decreasing the frequency or consequences of the Waste Transfer Leak accident.	Transfer leaks are detected by transfer leak detection systems and pressure switch interlock systems. The master pump shutdown system is considered a Safety-Significant SSC only when it is being credited with shutting down the transfer pump in lieu of operator action.

Technical Safety Requirements (TSRs)		
Control	Safety Function	Comments
LCO 3.1.3 Transfer Leak Detection Systems	Ensure operability of the transfer leak detection systems.	--

Technical Safety Requirements (TSRs)		
Control	Safety Function	Comments
AC 5.12 Transfer Controls • Operating requirements - Monitor for increasing level in all catch tanks (including the catch tank in 204-AR Waste Unloading Facility) when physically connected to the waste transfer route, during a waste transfer	Monitoring tank levels provides a means to detect transfer line leaks or misroutes into catch tanks. Monitoring the level in the catch tank in 204-AR provides indication of a leak in the waste unloading area during waste unloading operations or due to a misroute back to the facility.	--
- Perform ground-level radiation surveillance on single-walled, direct-buried lines physically connected to the waste transfer route.	Periodic radiation surveillance provides detection of leaks.	Ground-level radiation surveys are not required for encased lines including the portion of the transfer lines where the encasement does not penetrate the waste transfer system concrete wall (pits, diversion boxes, and concrete encasements).
- Perform material balances during waste transfer	Periodic material balances provide a means to detect transfer line leaks or misroutes.	Material balance criteria and response actions are defined in the transfer procedures and are based on the transfer configuration and potential leak rates. Material balance may or may not be accurate enough to detect small leakage rates or small leaked volumes but it would detect larger leak rates and leak volumes that could result in significant consequences to facility and onsite workers. Material balances prevent overflowing larger tanks and structures and limit the quantity of material leaked to structures, the soil, or the atmosphere. A material balance is adequate leak detection for the waste leaks that may occur through the primary pipe where it penetrates the concrete wall of pits and concrete encasements, when the leakage migrates into the soil rather than into the pit or encasement.
AC 5.13 Encasement Seal Loop Controls	Ensure that if the primary pipe leaks during waste transfer, the encasement will drain to the waste transfer-associated structure. Prevents pressurizing the encasement thus preventing waste leaks directly to atmosphere through test risers.	--
AC 5.14 Emergency Preparedness	Mitigate the consequences of a waste transfer leak (i.e., pool on or near the ground surface) by moving workers away from the waste pool.	Reducing exposure time and increasing the distance between workers and the hazard mitigates exposure to radiation and toxic chemicals.

Technical Safety Requirements (TSRs)		
Control	Safety Function	Comments
AC 5.19 Process Instrumentation and Measuring and Test Equipment	Ensure that instruments used to perform material balance, tank level monitoring, or service water monitoring are calibrated.	An effective material balance requires accurate instrumentation.
AC 5.20 Transfer Pump Administrative Lock Controls	Eliminates motive force, thus preventing unplanned transfers	Provides a safe condition when waste transfer controls are not operable.
AC 5.24 Safety Management Programs	Detect ground contamination from small leaks not detected by material balance.	Radiation protection practices would detect contamination on the soil thus limiting exposure.

CONTROL DECISION RECORD

Hazard/Accident title: Waste leak accident, Case 33C – Waste transfer leak directly to the soil surface or atmosphere.

Structures, Systems, and Components (SSCs)			
Structures, Systems, and Components	Safety Classification	Safety Function	Comments
Overground Transfer System – Barriers	Safety-Significant	The safety function of the OGT barriers is to protect the integrity of the primary and encasement lines from vehicle impacts, thus decreasing the frequency of the Waste Transfer Leak accident.	--
Overground Transfer System – Encasement and Connections	Safety-Significant	The safety function of the OGT system encasement and connections is to direct the flow of leaked waste from the primary line to a waste transfer-associated structure for detection, thus decreasing the consequences of the Waste Transfer Leak accident.	--
Transfer leak detection systems	Safety-Significant	The safety function of the transfer leak detection system is to detect waste transfer system leaks in waste-transfer associated structures and to provide an alarm to alert operators to take mitigative action to shut down the transfer pump (or other motive force) and to take response actions to limit exposure to onsite and facility workers, thus limiting the volume of waste leaked and the time that workers are exposed to the leaked waste, thereby decreasing the consequences of the Waste Transfer Leak accident.	The safety function provided by this control works in conjunction with the Pipe Encasements.

Structures, Systems, and Components (SSCs)			
Structures, Systems, and Components	Safety Classification	Safety Function	Comments
Master pump shutdown system	Safety-Significant	The safety functions of the master pump shutdown system are to: (1) detect waste transfer system leaks via the transfer leak detectors; (2) provide an interlock to shut down the transfer pump; and (3) provide an alarm to alert onsite and facility workers to take response actions to limit exposure, thus limiting the volume of the waste leak and the amount of time that workers are exposed to leaked waste thereby decreasing the consequences of the Waste Transfer Leak accident. Additional safety functions of the master pump shutdown system are to: (1) detect waste backflows via the pressure switch interlock or alarm system; (2) provide an interlock to shut down the transfer pump; and (3) provide an alarm to alert onsite and facility workers to take response actions to limit exposure thus preventing or mitigating a waste transfer leak from the waste transfer system, decreasing the frequency or consequences of the Waste Transfer Leak accident.	Transfer leaks are detected by transfer leak detection systems and pressure switch interlock systems. The master pump shutdown system is considered a Safety-Significant SSC only when it is being credited with shutting down the transfer pump in lieu of operator action.

Technical Safety Requirements (TSRs)		
Control	Safety Function	Comments
LCO 3.1.3 Transfer Leak Detection Systems	Ensure operability of the transfer leak detection systems.	--
AC 5.12 Transfer Controls • Transfer System Configuration Management - Before waste transfer through overground waste transfer piping, verify that either vehicle restrictions (i.e., vehicle access limitations to the tank farm) or OGT system barriers are in place.	Ensure the OGT line is protected from vehicle impacts that could result in a loss of integrity of the primary and encasement pipes.	--
AC 5.13 Encasement Seal Loop Controls	Ensure that if the primary pipe leaks during waste transfer, the encasement will drain to the waste transfer-associated structure. Prevents pressurizing the encasement thus preventing waste leaks directly to atmosphere through test risers.	--

Technical Safety Requirements (TSRs)		
Control	Safety Function	Comments
AC 5.14 Emergency Preparedness	Mitigate the consequences of a waste transfer leak (i.e., pool on or near the ground surface) by moving workers away from the waste pool.	Reducing exposure time and increasing the distance between workers and the hazard mitigates exposure to radiation and toxic chemicals.
AC 5.20 Transfer Pump Administrative Lock Controls	Eliminates motive force thus, preventing unplanned transfers	Provides a safe condition when waste transfer controls are not operable.
Safety Management Programs	Detect ground contamination from small leaks not detected by material balance.	Radiation protection practices would detect contamination on the soil thus limiting exposure.

This page intentionally left blank.

CONTROL DECISION RECORD

Hazard/Accident title: Waste leak accident, Case 33D – Misroute of waste into tanks or uncontrolled waste transfer systems.

Structures, Systems, and Components (SSCs)			
Structures, Systems, and Components	Safety Classification	Safety Function	Comments
Pressure Switch Interlock or Alarm Systems (Service Water Lines)	Safety-Significant	If the system pressure boundary integrity is tested to full transfer system pressure, the safety function is to detect backflow into the piping systems physically connected to the waste transfer route, and to either interlock, or alarm to alert operators to take action to shut down the transfer pump (or other motive force), thus preventing a waste leak from the transfer system, and thereby decreasing the frequency of a Waste Transfer Leak accident. If the system pressure boundary integrity is tested to a pressure less than the full transfer system pressure, then leakage from the system cannot be assured. In this situation the safety function is to detect backflow into the piping systems physically connected to the waste transfer route and to either interlock or alarm to alert operators to take action to shut down the transfer pump (or other motive force), and alarm to alert operators to take response actions to limit exposure to onsite and facility workers, thus decreasing the consequences of a Waste Tank Leak accident.	This control detects backflow should valves leak, should valves be incorrectly aligned, or should a transfer pump be inadvertently turned on during flushing operations.
Transfer Leak Detection Systems	Safety-Significant	The safety function of the transfer leak detection system is to detect waste transfer system leaks in waste-transfer associated structures and to provide an alarm to alert operators to take mitigative action to shut down the transfer pump (or other motive force) and to take response actions to limit exposure to onsite and facility workers, thus limiting the volume of waste leaked and the time that workers are exposed to the leaked waste, thereby decreasing the consequences of the Waste Transfer Leak accident.	The safety function provided by this control works in conjunction with the Pipe Encasements.

Structures, Systems, and Components (SSCs)			
Structures, Systems, and Components	Safety Classification	Safety Function	Comments
Isolation Valves	Safety-Significant	The safety function of the isolation valves is to limit the misroute of waste from the physically connected transfer routes to physically disconnected portions of the facility, thus decreasing the consequences of the Waste Transfer Leak accident.	Maximum total allowed leakage from two valves in series is 10.6 L/min (2.8 gal/min). Isolation valves are designated as Safety-Significant only when credited for "double valve isolation."
Master pump shutdown system	Safety-Significant	The safety functions of the master pump shutdown system are to: (1) detect waste transfer system leaks via the transfer leak detectors; (2) provide an interlock to shut down the transfer pump; and (3) provide an alarm to alert onsite and facility workers to take response actions to limit exposure, thus limiting the volume of the waste leak and the amount of time that workers are exposed to leaked waste thereby decreasing the consequences of the Waste Transfer Leak accident. Additional safety functions of the master pump shutdown system are to: (1) detect waste backflows via the pressure switch interlock or alarm system; (2) provide an interlock to shut down the transfer pump; and (3) provide an alarm to alert onsite and facility workers to take response actions to limit exposure thus preventing or mitigating a waste transfer leak from the waste transfer system, decreasing the frequency or consequences of the Waste Transfer Leak accident.	Transfer leaks are detected by transfer leak detection systems and pressure switch interlock systems.
Backflow prevention systems in the 204-AR Waste Unloading Facility waste unloading room	Safety-Significant	The safety function of the backflow prevention systems located in the 204-AR Waste Unloading Facility (waste unloading room) is to prevent a backflow of waste into the raw water or other service systems leading to the Mechanical Equipment Room where a leak could occur, thus decreasing the frequency of the Waste Transfer Leak accident.	Prevents backflow should isolation valves leak.

Technical Safety Requirements (TSRs)		
Control	Safety Function	Comments
LCO 3.1.2 Service Water Pressure Detection Systems	Ensure operability of pressure switch interlock or alarm systems.	Include the pressure switch/waste transfer pump interlock systems used for connections to the permanent service water system and for pressure switch interlock systems used for connections to temporary, above-grade service water systems. Temporary above-grade water lines are used for flushing and priming of SST salt well systems.
LCO 3.1.3 Transfer Leak Detection Systems	Ensure operability of the transfer leak detection systems.	--
LCO 3.1.6 204-AR Backflow Prevention System in the Waste Unloading Room	Ensures operability of the 204-AR Waste Unloading Facility backflow prevention system in the waste unloading room.	--

Technical Safety Requirements (TSRs)		
Control	Safety Function	Comments
AC 5.12 Transfer Controls		
• Transfer System Configuration Management		
- When crediting isolation valves to disconnect from the transfer route, independently verify that two Safety-Significant isolation valves are in the closed position.	Two closed, Safety-Significant isolation valves limit misroute leakage to less than or equal to the maximum allowable quantity into the uncontrolled facility. Independent verification that the credited valves are closed prevents misroutes greater than the allowable leakage due to valve mis-positioning. Material balance is used to detect misroute leakage.	--
- Verify that the west exterior roll-up door and the west exterior personnel access door are closed during waste transfers physically connected to the 204-AR Waste Unloading Facility.	Ensures doors are closed to mitigate the effects of potential aerosol releases due to waste transfer leaks inside the unloading room of the 204-AR Waste Unloading Facility.	--
• Operating requirements		
- Monitor for increasing level in all catch tanks (including the catch tank in 204-AR Waste Unloading Facility) when physically connected to the waste transfer route, during a waste transfer	Monitoring tank levels provides a means to detect transfer line leaks or misroutes into catch tanks. Monitoring the level in the catch tank in 204-AR provides indication of a leak in the waste unloading area during waste unloading operations or due to a misroute back to the facility.	--
- Perform ground-level radiation surveillance on single-walled, direct-buried lines physically connected to the waste transfer route.	Periodic radiation surveillance provides detection of leaks.	Ground-level radiation surveys are not required for encased lines including the portion of the transfer lines where the encasement does not penetrate the waste transfer system concrete wall (pits, diversion boxes, and concrete encasements).

Technical Safety Requirements (TSRs)		
Control	Safety Function	Comments
- Perform material balances during waste transfer	Periodic material balances provide a means to detect transfer line leaks or misroutes.	Material balance criteria and response actions are defined in the transfer procedures and are based on the transfer configuration and potential leak rates. Material balance may or may not be accurate enough to detect small leakage rates or small leaked volumes but it would detect larger leak rates and leak volumes that could result in significant consequences to facility and onsite workers. Material balances prevent overflowing larger tanks and structures and limit the quantity of material leaked to structures, the soil, or the atmosphere. A material balance is adequate leak detection for the waste leaks that may occur through the primary pipe where it penetrates the concrete wall of pits and concrete encasements, when the leakage migrates into the soil rather than into the pit or encasement.
AC 5.13 Encasement Seal Loop Controls	Ensure that if the primary pipe leaks during waste transfer, the encasement will drain to the waste transfer-associated structure. Prevents pressurizing the encasement thus preventing waste leaks directly to atmosphere through test risers.	--
AC 5.14 Emergency Preparedness	Mitigate the consequences of a waste transfer leak (i.e., pool on or near the ground surface) by moving workers away from the waste pool.	Reducing exposure time and increasing the distance between workers and the hazard mitigates exposure to radiation and toxic chemicals.
AC 5.19 Process Instrumentation and Measuring and Test Equipment	Ensure that instruments used to perform material balance, tank level monitoring, or service water monitoring are calibrated.	An effective material balance requires accurate instrumentation.
AC 5.20 Transfer Pump Administrative Lock Controls	Eliminates motive force thus, preventing unplanned transfers	Provides a safe condition when waste transfer controls are not operable.
AC 5.21 Tank Service Water Intrusion Monitoring Program – Periodically monitor service water usage or tank levels to detect leaks – Procedures shall identify required operator responses to the detection of a service water leak	Prevents tank overflow from service water leaks.	Includes visual surveillance and surveillance of service water flow totalizers or tank level systems.
AC 5.22 Transfer System Cover Removal Controls	Reduce exposure of facility and onsite workers to waste aerosols and direct radiation (shine and skyshine) due to leaks into transfer system structures.	Radiation protection practices would detect contamination in structures, thus limiting exposure.

Technical Safety Requirements (TSRs)		
Control	Safety Function	Comments
AC 5.24 Safety Management Programs	Detect ground contamination from small leaks not detected by material balance.	Radiation protection practices would detect contamination on the soil thus limiting exposure.

CONTROL DECISION RECORD

Hazard/Accident title: Waste leak accident, Case 33E – In-tank (or in-facility) spray.

Structures, Systems, and Components (SSCs)			
Structures, Systems, and Components	Safety Classification	Safety Function	Comments
None identified.			

Technical Safety Requirements (TSRs)		
Control	Safety Function	Comments
AC 5.12 Transfer Controls • Transfer System Configuration Management - Verify that the west exterior roll-up door and the west exterior personnel access door are closed during waste transfers physically connected to the 204-AR Waste Unloading Facility. • Operating requirements - Monitor for increasing level in all catch tanks (including the catch tank in 204-AR Waste Unloading Facility) when physically connected to the waste transfer route, during a waste transfer	Ensures doors are closed to mitigate the effects of potential aerosol releases due to waste transfer leaks inside the unloading room of the 204-AR Waste Unloading Facility. Monitoring tank levels provides a means to detect transfer line leaks or misroutes into catch tanks. Monitoring the level in the catch tank in 204-AR provides indication of a leak in the waste unloading area during waste unloading operations or due to a misroute back to the facility.	-- --

Technical Safety Requirements (TSRs)		
Control	Safety Function	Comments
- Perform material balances during waste transfer	Periodic material balances provide a means to detect transfer line leaks or misroutes.	Material balance criteria and response actions are defined in the transfer procedures and are based on the transfer configuration and potential leak rates. Material balance may or may not be accurate enough to detect small leakage rates or small leaked volumes but it would detect larger leak rates and leak volumes that could result in significant consequences to facility and onsite workers. Material balances prevent overflowing larger tanks and structures and limit the quantity of material leaked to structures, the soil, or the atmosphere. A material balance is adequate leak detection for the waste leaks that may occur through the primary pipe where it penetrates the concrete wall of pits and concrete encasements, when the leakage migrates into the soil rather than into the pit or encasement.
AC 5.24 Safety Management Programs	Mitigate facility worker and onsite worker consequences due to in-tank waste leaks.	Radiation protection practices would detect contamination or in structures thus limiting exposure.

CONTROL DECISION RECORD
Non-Safety Design Features

Design Features – Transfer system covers – Transfer system abovegrade structures – 204-AR Waste Unloading Facility Building Structure	Reduce waste aerosol release by providing an impaction surface to prevent the direct spray of waste into the atmosphere and provides a tortuous path for aerosol release from the structure.	Mitigate radiological and toxicological exposure consequences to the facility worker and toxicological exposure consequences to the onsite receptor.

This page intentionally left blank.

DISTRIBUTION SHEET

To	From	Page 1 of 1
Distribution	G. W. Ryan	Date June 26, 2000
Project Title/Work Order		EDT No. 618566
RPP-6295, Waste Transfer Leaks Control Decision Record, Rev. 0		ECN No. N/A

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
R. J. Cash	R1-44	X			
G. W. Gault	R1-44	X			
T. G. Goetz	R1-49	X			
J. M. Grigsby (2)	R1-44	X			
B. E. Hey	B4-47	X			
L. J. Kripps	R1-44	X			
G. W. Ryan (2)	B4-47	X			
Central Files (Original + 1)	A3-01	X			

A-6000-135 (10/97)