0050005

Meeting Minutes Transmittal/Approval
Tank Waste Remediation System
Tri-Party Agreement Project Manager's Meeting
Federal Building, Room 269
Richland, Washington

May 28, 1998

Approval: for [signature] Date: 7/16/98
Suzanne Dahl, TWRS Program Manager
Washington State Department of Ecology

Approval: Carolyn C Haass Date: 7/16/98
Carolyn Haass, TWRS TPA Program Manager
U.S. Department of Energy, Richland Operations Office

Approval: Lynne Roeder-Smith Date: 7/16/98
L. Roeder-Smith, Coordinator
Jacobs Engineering Group Inc.

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Meeting Minutes are attached. Minutes are comprised of the following:

- Attendance and Meeting Minutes Summary/Action Items
- Agenda and Presentation Package
- Project W-320 Safety Class and Safety Significant Equipment Engineering Evaluation (HNF-2050), April 1998.
- HTI Program Review, May 1998

Attendance:

DOE
Pete Furlong
Carolyn Haass
Ben Harp
Jim Navarro
Bruce Nicoll
Lina Pacheco
Jim Poppiti
Mike Royack
Nancy Welliver
Wendell Wrzesinski

ECOLOGY
Dave Dougherty
Scott McKinney (via telephone)
Alex Stone

CONTRACTORS
Doug Evans, JEG
Mary Ann McLaughlin, FDH
Marc Stevenson, FDH
Bill Stokes, MACTEC

Action Items Generated:

ACTION	ACTIONEE	DUE DATE
Provide to Ecology a copy of the draft change package for M-40-07	Carolyn Haass	June 1, 1998
Set up meeting to discuss issues surrounding M-40-09 completion	Dennis Irby	Undetermined
Set up meeting for June 3, 1998 (tentative) to discuss SY-101 issues	Dennis Irby	June 1, 1998
Arrange meeting for June 9, 1998 (tentative) to receive general briefing on interim stabilization	Scott McKinney	June 2, 1998
Check with OEA on anticipated date for SX-104 press release and provide to Alex Stone	Mike Royack	Undetermined
Have Phil LaMont contact Ecology (R. Julian) to discuss reason why M-90-03 was included in presentation package	Bruce Nicoll	Undetermined
Have B. Lober send S. McKinney a copy of the meeting minutes from the April 16 – 17, 1998 Retrieval Performance Evaluation Working Group Meeting	Wendell Wrzesinski	Undetermined

INTRODUCTION - CAROLYN HAASS, DOE-RL

A. Stone will be acting for S. Dahl during her maternity leave for the next 90 days. Matters normally brought to S. Dahl's attention should be directed to A. Stone during this time. On routine matters DOE-RL Project Managers should continue working through their Ecology counterparts.

ACTION: C. Haass will provide Ecology a copy of DOE-RL's draft change package for M-40-07 prior to next Tuesday's meeting between DOE-RL and Ecology to discuss the M-40-07 resolution strategy.

FY 1998 COST AND SCHEDULE PERFORMANCE OVERVIEW (Page 2) - CAROLYN HAASS, DOE-RL

The TPA Milestone Statistics table on page 1 of the presentation package contains an error. The column showing milestones under dispute should indicate there is one milestone under dispute for milestone M-45-00 (related to C-106).

The two "recoverable" M-43 milestones related to the Cross-Site Transfer System (see presentation package page 15) should be complete this week, meeting the May 31, 1998 due date. The notification letter might not be transmitted until next Monday.

The format for the DOE-RL Multi-Year Work Plan (MYWP) is changing. The MYWP will now provide more detail than in the past.

M-32-00 - DANGEROUS WASTE TANK CORRECTIVE ACTIONS (Page 18) - CAROLYN HAASS, DOE-RL

Negotiations for additional milestones are currently on hold pending Ecology's naming of a replacement for L. Cusack. DOE-RL is ready to continue discussion when the replacement is named. A. Stone stated that Ecology is still working through the reorganization and it is likely that the TWRS program will be split into two parts.

M-40-00 - SAFETY ISSUE RESOLUTION (Page 18) - DENNIS IRBY, DOE-RL

Thirteen Standard Hydrogen Monitoring Systems (SHMS) were installed last year and 3 SHMS have been installed this year. No more SHMS are scheduled for installation this year. A total of 34 SHMS are now operating.

A. Stone requested that for future meetings the presentation package (see page 18) be revised to indicate that the "Resolution of Flammable Gas Safety Issue" pertains to the major milestone (M-40-00). D. Irby stated that by the end of this summer (August 1998 timeframe) the extent of the delay related to the flammable gas safety issue should be known. Reasons for the delay are purely budgetary.

A meeting between DOE-RL and Ecology is scheduled for next Tuesday (June 2, 1998) at noon to resolve the change package for M-40-07.

DOE-RL now plans to meet the September 30, 1998 due date for M-40-09 and will not be submitting a change request for this milestone. **ACTION:** D. Irby to set up meeting with Ecology to discuss strategy and issues surrounding M-40-09 completion.

OTHER: TANK 241-SY-101 (Page 27) – MIKE ROYACK, DOE-RL

DOE-RL has received the path forward plan from the contractor and has authorized the contractor to perform the work. A. Stone requested to see a description of the path forward. The description should include the contractor's deliverables and a list of what work is being done, what data will be generated/collected, and when. **ACTION:** D. Irby to set up a meeting with Ecology tentatively for June 3, 1998 to discuss SY-101 issues.

M-43-11 - TANK FARM UPGRADES (Page 20) - JIM NAVARRO, DOE-RL

DOE-RL is considering a proposed change to the transfer pipe route. The new line is to be RCRA compliant, double contained. The purpose of the new route is to reduce worker exposures and lower costs. The new route will not affect milestone completion.

M-41-00 - INTERIM STABILIZATION (Page 19) – BEN HARP, DOE-RL

Beginning next week, B. Harp will be transferring to a new organization and Lina Pacheco will be taking over as DOE-RL project manager for interim stabilization milestones.

Hydro tests for Tanks T-104 and T-110 are to be done this week.

The NOC for Tank SX-106 is now in concurrence.

The letter to Ecology on the drainback issue is to be transmitted next week. This issue and the contents of the letter have previously been discussed with S. Dahl and C. Ruud. DOE-RL anticipates Ecology sending a letter in response that states Ecology has no objections to the addition of flush water to SSTs. S. McKinney asked how much waste has been pumped fiscal year to date. B. Harp responded that 2,000 gallons have been pumped. **ACTION:** S. McKinney to call L. Pacheco to arrange a general briefing on interim stabilization, to include flush water dilution volumes, FY 1999 schedule and budget, and the Hanlon report (Waste Tank Summary Report, HNF-EP-0182). The tentative date for the meeting is June 9, 1998. Ecology attendees should include C. Ruud.

M-43-07 - TANK FARM UPGRADES (Page 19) – BEN HARP, DOE-RL

The letter to Ecology stating the system is operational should be transmitted today or tomorrow. Only the supernatant line is to be operational, not the slurry line. The slurry line will not be needed until privatization operations are ready to begin.

OTHER: PROJECT W-030 UPDATE (Page 28) – CAROLINA PACHECO, DOE-RL

No record comments during the discussion.

OTHER: TANK 241-SX-104 (Page 28) – MIKE ROYACK, DOE-RL

A study on the potential for tank leakage is ongoing. The study is looking specifically at the potential for leakage through the center bottom of the tank. Fluids in this tank solidify below 100 degrees so the tank is considered self-sealing. DOE-RL is preparing

a letter to Ecology stating the tank is not leaking. A press release is also being prepared and Ecology will be given the customary advance notice. **ACTION:** M. Royack to check with OEA on anticipated date for press release and provide to A. Stone.

OTHER: PERMITTING (Page 25) – CAROLYN HAASS, DOE-RL

A status was provided on Clean Air Act and Resource Conservation and Recovery Act permitting activity. DOE-RL is still on schedule for June 1, 1999 completion of DST Part B Permit Application.

OTHER: FSAR (Page 26) – CAROLYN HAASS, DOE-RL

DOE-RL wants to implement a Tier III Review in FY 1999 but currently there is no funding for it. DOE-RL is looking into a way around this issue.

OTHER: VADOSE ZONE (Page 26) – CAROLYN HAASS, DOE-RL

Undersecretary Ernest Moniz is expected to be in attendance at the expert panel review to be held in Richland in June 1998.

OTHER: PUBLIC INVOLVEMENT (Page 27) – CAROLYN HAASS, DOE-RL

An e-mail announcement for the new TWRS Web site will be distributed soon.

M-44-00A, TANK WASTE CHARACTERIZATION (Page 21) – JIM POPPITI, DOE-RL

DOE-RL is still on schedule to deliver 16 new and 10 revised TCRs. DOE-RL has provided the contractor with direction on requirements to support Privatization. DOE-RL is still on schedule for delivery of FY 1999 WIRD.

M-90-00, INTERIM STORAGE AND DISPOSAL OF LAW AND INTERIM STORAGE OF HLW (Page 24) – BRUCE NICOLL, DOE-RL

ACTION: A. Stone requested that P. LaMont contact R. Julian to discuss M-90-03. Why was this item included in the presentation package under "Planned Activities" (see page 25) at this time when due date is 2001?

M-45-00 - SINGLE-SHELL TANK CLOSURE (Page 22) - WENDELL WRZESINSKI, DOE-RL

ACTION: W. Wrzesinski to have B. Lober send S. McKinney a copy of the meeting minutes from the April 16 – 17, 1998 Retrieval Performance Evaluation Working Group Meeting.

It looks like the initial feed tanks will be in the C Tank Farm. S. McKinney requested that Ecology and DOE-RL continue their ongoing discussions regarding development and transmittal of the SST retrieval sequence and the impacts of privatization on SST retrieval logic.

The Safety Class and Safety Significant Engineering Evaluation is now undergoing DOE-RL review. W. Wrzesinski provided a copy of this document to A. Stone to provide to S. McKinney.

DOE-RL is still working toward a September 1998 completion date for the C-106 sluicing project. Approximately $1.8M to $2.0M is to be added to this project to address ORR concerns.

W. Wrzesinski provided A. Stone with a copy of the presentation materials from the May 20, 1998 HTI Program Review, which contains a summary of the current HTI status.

M-50, 51, 60, 61-00, TREATMENT AND IMMOBILIZATION OF HANFORD TANK WASTE (Page 23) – PETE FURLONG, NANCY WELLIVER, DOE-RL

LMAES has not been given Authorization to Proceed into Part B. It is important to note that at this point neither has BNFL. However, the contract with BNFL has been extended 2 months in order to continue discussions that could lead to BNFL being given an Authorization to Proceed into Part B.

N. Welliver provided a status on the DQOs related to these milestones. A letter to Ecology for the HLW DQO is now in concurrence and should be transmitted tomorrow. DOE-RL is planning to issue an update to the LAW DQO in the next several months due to contract changes.

Tank Waste Remediation System

Tri-Party Agreement Project Manager's Meeting

Tri-Party Agreement

U.S. Department of Energy
U.S. Environmental Protection Agency
Washington State Department of Ecology

May 28, 1998

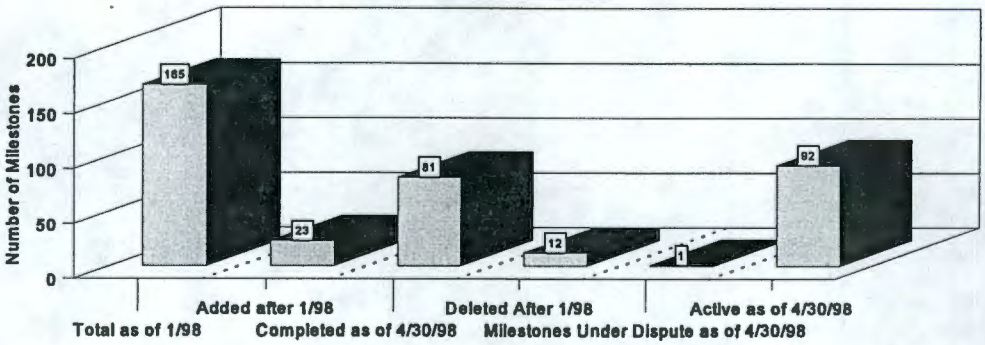
Agenda

Tank Waste Remediation System Tri-Party Agreement Project Manager's Meeting
May 28, 1998
Federal Building Room 269
8am - 12pm

TOPIC	DISCUSSION LEADS	TIME
Introduction	Carolyn Haass	8:00
FY 1998 Cost, Schedule, and Tri-Party Agreement Milestone Performance Overview	Carolyn Haass	8:10
FY 1998 TWRS Tri-Party Agreement Milestones Status/Issues/Planned Activities		8:20
M-32-00, Complete Identified Dangerous Waste Tank Corrective Actions	Carolyn Haass/ Suzanne Dahl	8:30
M-40-00, Safety Issue Resolution	Dennis Irby/ Alex Stone	8:40
M-41-00, Interim Stabilization	Ben Harp/ Casey Ruud	9:00
M-43-07, Tank Farm Upgrades	Ben Harp/ Dick Heggen	9:20
M-43-11, Tank Farm Upgrades	Jim Navarro/ Dick Heggen	9:45
M-44-00, Tank Waste Characterization	Jim Poppiti/ Dave Dougherty	10:00
M-45-00, Single Shell Tank Closure • HTI Update	Wendell Wrzesinski/ Scott McKinney	10:15
M-46-00, Double Shell Tank Space Evaluation	Mark Ramsay/ Scott McKinney	10:40
M-50, 51, 60, 61-00, Treatment and Immobilization of Hanford Tank Waste	Pete Furlong/ John Grantham	10:45
M-90-00, Complete Acquisition of Facilities for Interim Storage of IHLW and storage/disposal of ILAW	Phil LaMont/ Bob Julian	11:15
Other • Permitting (RCRA, CAA) • FSAR • Vadose Zone • Public Involvement • 241-SY-101 Update • 241-SX-104 Update • Project W-030 Update	Carolyn Haass/ Suzanne Dahl	11:30
Closing Comments / Action Item Recap	Carolyn Haass	11:55

TPA Milestone Statistics

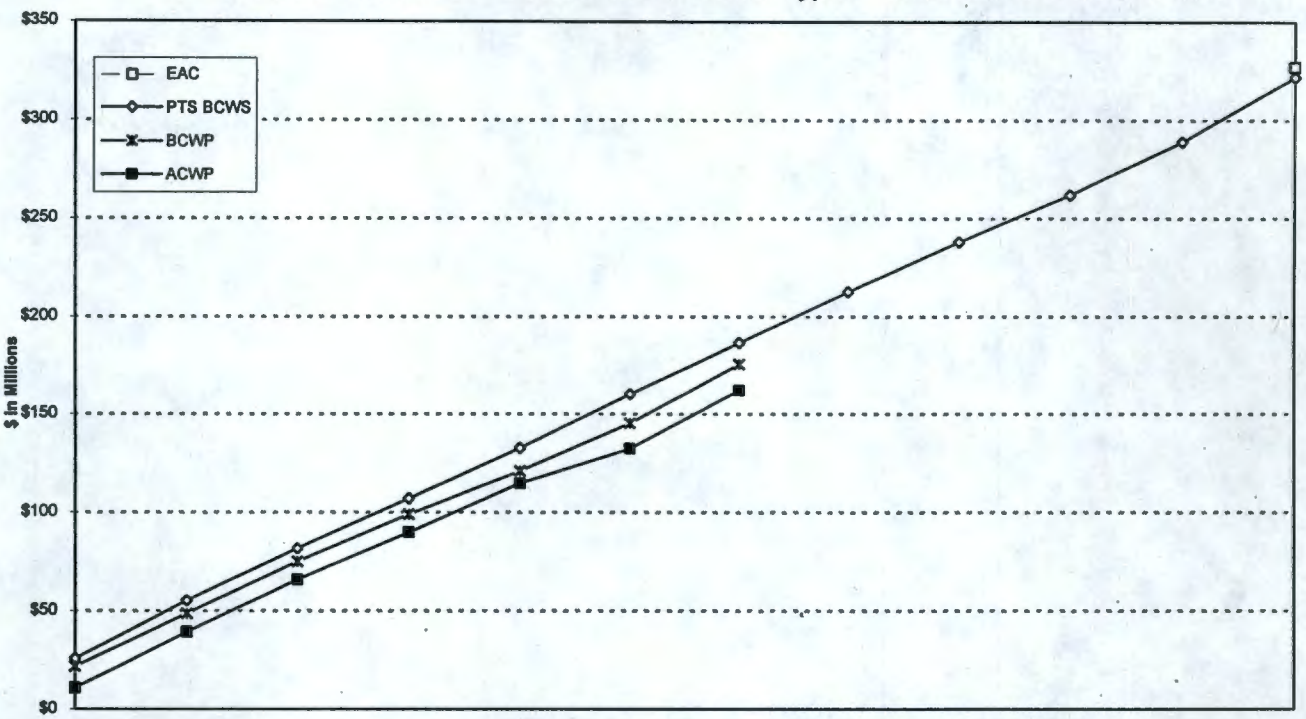
(Major and Interim Milestones)



	Milestone Completion Date	Total Milestones as of 1/98	Milestones Added After 1/98	Milestones Completed as of 4/30/98	Milestones Deleted After 1/98	Milestones Under Dispute as of 4/30/98	Milestones Active as of 4/30/98
M-40-00 Mitigate/Resolve Tank Safety Issues for High Priority Watch List Tanks	9/30/2001	19	0	16	0	1	3
M-41-00 Complete Single Shell Tank Interim Stabilization	9/30/2000	22	0	12	0	0	7
M-43-00 Complete Tank Farm Upgrades	6/30/2005	20	0	11	0	0	9
M-44-00 Double and Single Shell Tank Characterization	9/30/2002	23	23	15	12	0	19
M-45-00 Complete Closure of all Single Shell Tank Farms	9/30/2024	29	0	8	0	0	21
M-46-00 Double Shell Tank Space Evaluation	9/30/1998	20	0	8	0	0	12
M-50-00 Complete Pretreatment Processing of Hanford Tank Wastes	9/30/2024	4	0	2	0	0	2
M-51-00 Complete Vitrification of Hanford High Level Tank Waste	12/31/2028	4	0	1	0	0	3
M-60-00 Complete Pretreatment and Immobilization of Hanford Low Activity Tank Waste	12/31/2024	12	0	7	0	0	5
M-61-00 Complete Pretreatment and Immobilization of Hanford Low Activity Tank Waste	12/31/2028	4	0	0	0	0	4
M-90-00 Interim Storage and Disposal of LAW and Interim Storage of HLW	TBD	8	0	1	0	0	7
Total		165	23	81	12	1	92

Tank Waste Remediation System

FY 1998 Cost/Schedule Performance - All Fund Types -- Cumulative to Date Status



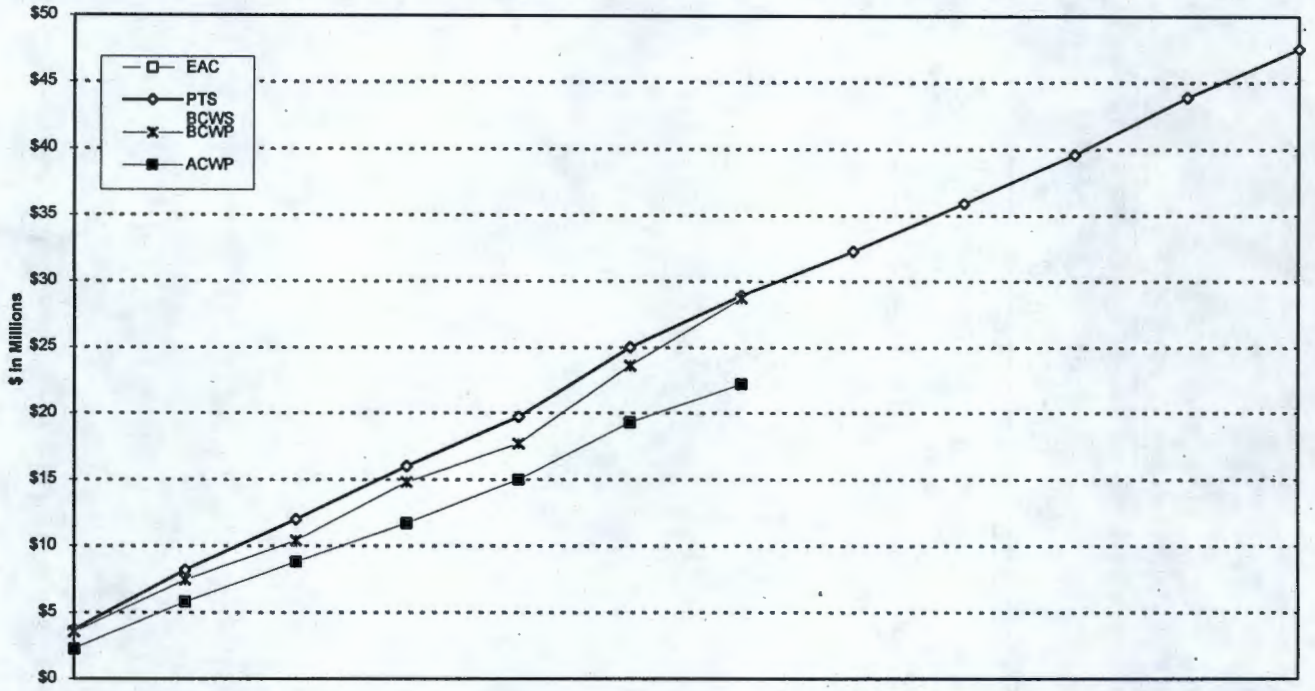
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
EAC												327.2
MYWP	31.3	55.9	84.7	113.4	138.7	166.6	194.4	218.9	245.5	271.0	295.8	321.2
PTS BCWS	26.0	55.2	81.6	106.9	132.5	160.3	186.6	212.7	238.0	262.0	289.0	321.8
BCWP	22.0	48.7	74.9	98.9	120.9	145.2	175.7					
ACWP	11.0	39.4	65.8	89.8	114.6	132.2	162.2					
SV	(3.9)	(6.5)	(6.6)	(8.0)	(11.6)	(8.9)	(10.9)					
CV	11.0	9.3	9.2	9.1	6.4	9.5	13.5					

FY 1998 Cost & Schedule Performance

				FYTD					PTS		
				BCWS	BCWP	ACWP	SV	CV	MYWP	BCWS	EAC
1.1.1.1	TWRS Management Support		Expense	21.6	20.4	18.2	(1.2)	2.2	36.6	40.6	
TW10			CENRTC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
			GPP/LI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
		Subtotal 1.1.1.1		21.6	20.4	18.2	(1.2)	2.2	36.6	40.6	
WASTE STORAGE											
1.1.2.1	Tank Farm Operations		Expense	50.5	49.7	51.6	(0.6)	(1.9)	87.9	87.9	
TW03			CENRTC	0.4	0.4	0.2	0.0	0.1	0.6	0.6	
			GPP/LI	13.5	11.1	10.5	(2.3)	0.7	27.4	27.4	
		Subtotal 1.1.2.1		64.4	61.2	62.3	(2.9)	(1.1)	115.9	115.9	
1.1.2.2	Tank Safety Issue Resolution		Expense	16.3	16.0	13.7	(0.3)	2.3	28.5	28.5	
TW02			CENRTC	2.0	2.2	1.4	0.2	0.7	2.5	2.5	
			GPP/LI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
		Subtotal 1.1.2.2		18.3	18.2	15.1	(0.1)	3.0	31.0	31.0	
1.1.2.4	Tank Waste Characterization		Expense	28.9	28.7	22.2	(0.2)	6.5	48.1	48.0	
TW01			CENRTC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
			GPP/LI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
		Subtotal 1.1.2.4		28.9	28.7	22.2	(0.2)	6.5	48.1	48.0	
TOTAL WASTE STORAGE			Expense	95.7	94.4	87.5	(1.3)	6.9	164.5	164.4	
			CENRTC	2.3	2.5	1.7	0.2	0.8	3.1	3.1	
			GPP/LI	13.5	11.1	10.5	(2.3)	0.7	27.4	27.4	
		Total Waste Storage		111.5	108.0	99.7	(3.4)	8.4	195.0	194.9	
WASTE DISPOSAL											
1.1.3.1	Retrieval		Expense	29.2	24.8	25.1	(4.4)	(0.3)	46.5	46.7	
TW04			CENRTC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
			GPP/LI	6.8	7.0	3.8	0.2	3.2	15.2	15.2	
		Subtotal 1.1.3.1		36.0	31.8	28.9	(4.2)	2.9	61.7	61.9	
1.1.3.4	Immobilized Tank Waste		Expense	5.8	4.2	5.0	(1.5)	(0.7)	10.5	10.5	
TW09	Storage & Disposal		CENRTC	0.2	0.2	0.0	0.0	0.2	0.2	0.3	
			GPP/LI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
		Subtotal 1.1.3.4		6.0	4.4	5.0	(1.5)	(0.5)	10.7	10.8	
1.1.3.5	Process Waste Support		Expense	9.0	8.6	6.0	(0.4)	0.6	8.3	14.8	
TW05			CENRTC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
			GPP/LI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
		Subtotal 1.1.3.5		9.0	8.6	6.0	(0.4)	0.6	8.3	14.8	
1.1.3.6	TWRS Privatization		Expense	0.0	0.0	0.0	0.0	0.0	6.3	0.0	
			CENRTC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
			GPP/LI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
		Subtotal 1.1.3.6		0.0	0.0	0.0	0.0	0.0	6.3	0.0	
WASTE DISPOSAL			Expense	44.0	37.6	38.1	(6.3)	(0.5)	71.6	72.1	
			CENRTC	0.2	0.2	0.1	0.0	0.2	0.2	0.3	
			GPP/LI	6.8	7.0	3.8	0.2	3.2	15.2	15.2	
		Total Waste Disposal		51.0	44.8	42.0	(6.1)	2.9	87.0	87.6	
	HTI		Expense	2.5	2.3	2.3	(0.2)	0.0	7.2	7.0	
			CENRTC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
			GPP/LI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
		Subtotal HTI		2.5	2.3	2.3	(0.2)	0.0	7.2	7.0	
TANK WASTE REMEDIATION SYSTEMS			Expense	163.8	154.7	146.1	(9.0)	8.6	279.9	284.1	
			CENRTC	2.5	2.8	1.8	0.2	1.0	3.3	3.4	
			GPP/LI	20.3	18.2	14.3	(2.1)	3.9	42.6	42.6	
		TWRS Total		186.6	175.7	162.2	(10.9)	13.5	325.8	330.1	

Tank Waste Characterization

FY 1998 Cost/Schedule Performance - All Fund Types -- Cumulative to Date Status



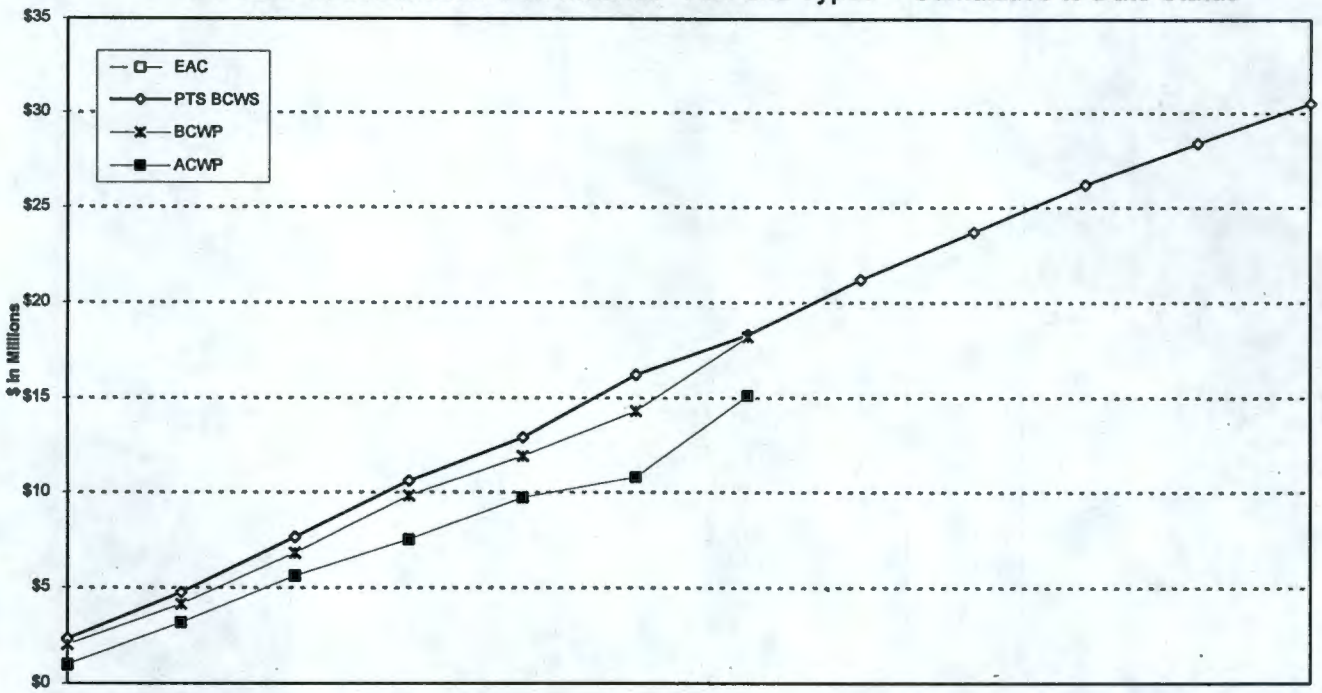
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
EAC												
MYWP	4.6	8.3	12.6	16.7	20.3	24.5	28.5	32.2	36.2	40.0	43.8	47.5
PTS BCWS	3.7	8.2	12.0	16.0	19.7	25.0	28.9	32.3	35.9	39.6	43.9	47.5
BCWP	3.5	7.4	10.4	14.8	17.7	23.6	28.7					
ACWP	2.3	5.8	8.8	11.7	15.0	19.3	22.2					
SV	(0.2)	(0.7)	(1.6)	(1.2)	(1.9)	(1.4)	(0.2)					
CV	1.3	1.6	1.6	3.1	2.7	4.2	6.5					

			FYTD					PTS		
ADS			BCWS	BCWP	ACWP	SV	CV	MYWP	BCWS	EAC
1130-0		Expense	28.9	28.7	22.2	(0.2)	6.5	48.1	48.0	
		CENRTC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
		GPP/LI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total 1130-0			28.9	28.7	22.2	(0.2)	6.5	48.1	48.0	

$ in Millions

Tank Safety Issue Resolution

FY 1998 Cost/Schedule Performance - All Fund Types -- Cumulative to Date Status



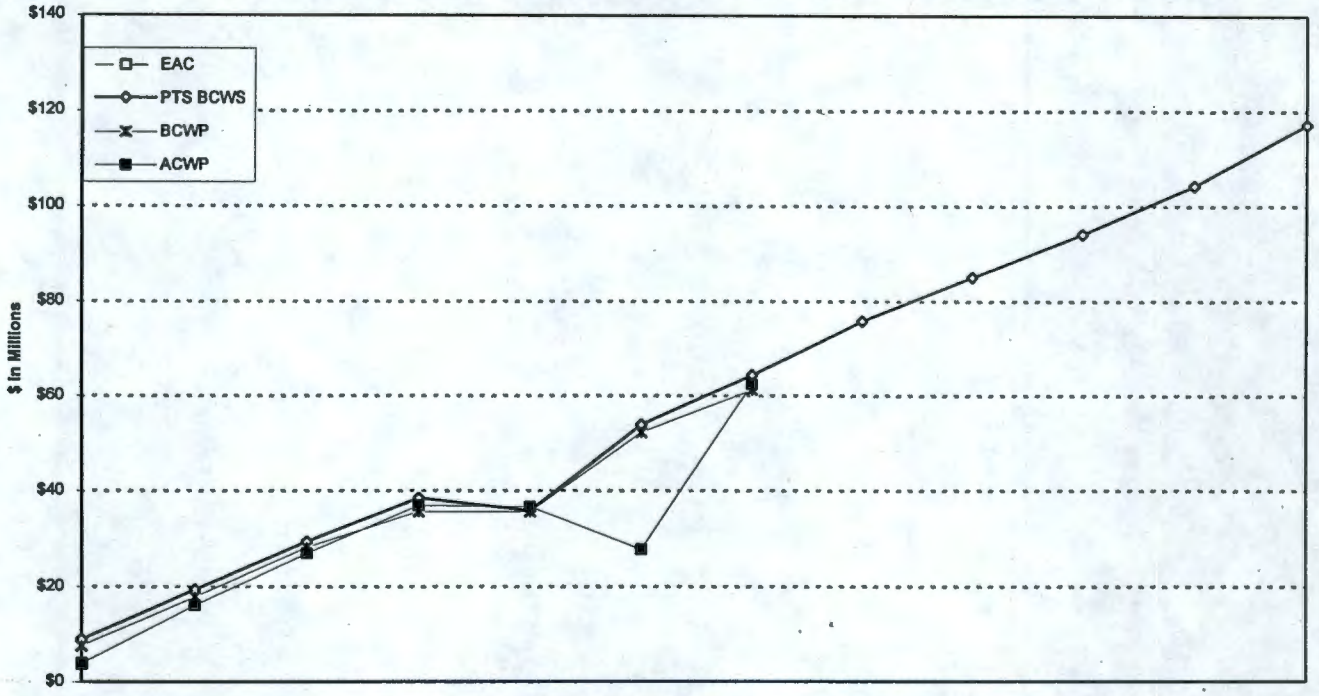
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
EAC												
MYWP	2.8	5.3	8.3	11.3	14.0	17.0	19.8	22.1	24.4	26.7	28.7	30.5
PTS BCWS	2.3	4.7	7.6	10.6	12.9	16.2	18.3	21.2	23.7	26.2	28.4	30.5
BCWP	2.0	4.1	6.8	9.8	11.9	14.3	18.2					
ACWP	1.0	3.2	5.6	7.5	9.7	10.8	15.1					
SV	(0.3)	(0.6)	(0.8)	(0.8)	(1.0)	0.0	(0.1)					
CV	1.0	1.0	1.2	2.3	2.2	3.5	3.0					

					FYTD						PTS	
					BCWS	BCWP	ACWP	SV	CV	MYWP	BCWS	EAC
ADS												
1110-0				Expense	16.3	16.0	13.7	(0.3)	2.3	28.5	28.5	
				CENRTC	2.0	2.2	1.4	0.2	0.7	2.5	2.5	
				GPP/LI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
		Total 1110-0			18.3	18.2	15.1	(0.1)	3.0	31.0	31.0	

$ in Millions

Tank Farms Operations

FY 1998 Cost/Schedule Performance - All Fund Types -- Cumulative to Date Status

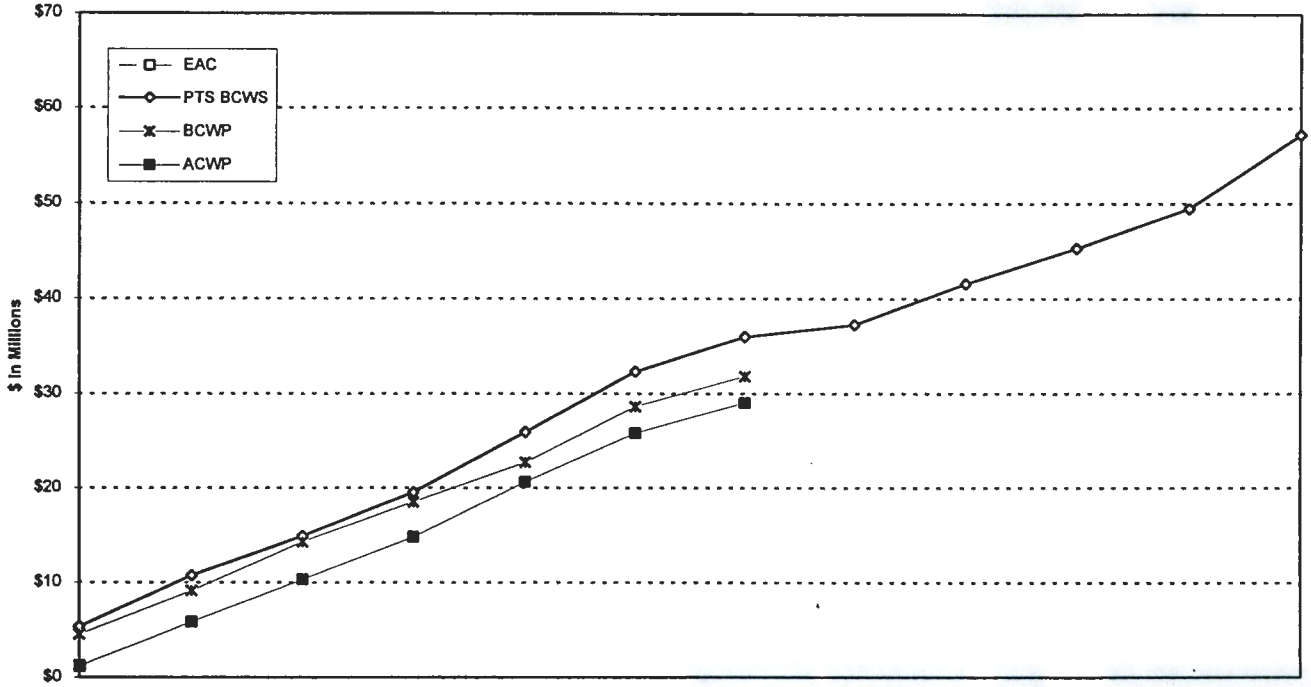


	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
EAC												
MYWP	11.4	20.1	30.1	40.5	49.3	59.3	69.7	78.9	88.8	98.4	107.8	116.8
PTS BCWS	8.9	19.4	29.3	38.4	35.8	53.8	64.4	75.8	85.1	94.1	104.3	117.1
BCWP	7.6	17.8	28.2	35.6	35.6	52.2	61.2					
ACWP	3.9	16.1	26.9	36.9	36.6	27.7	62.4					
SV	(1.3)	(1.5)	(1.1)	(2.8)	0.0	(1.6)	(3.2)					
CV	3.7	1.8	1.3	(1.3)	(1.0)	(0.5)	(1.2)					

					FYTD						PTS	
					BCWS	BCWP	ACWP	SV	CV	MYWP	BCWS	EAC
ADS												
1100-0				Expense	46.6	45.4	48.0	(1.0)	(2.6)	85.4	82.6	
				CENRTC	0.4	0.4	0.2	0.0	0.1	0.5	0.6	
				GPP/LI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
		Subtotal 1100-0			47.0	45.8	48.2	(1.0)	(2.5)	85.9	83.2	
1100-1				Expense	1.1	0.9	0.7	(0.2)	0.2	2.3	2.3	
				CENRTC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
				GPP/LI	8.2	5.6	4.5	(2.6)	1.2	20.9	22.2	
		Subtotal 1100-1			9.3	6.5	5.2	(2.8)	1.4	23.2	24.5	
1120-0				Expense	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
				CENRTC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
				GPP/LI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
		Subtotal 1120-0			0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1120-2				Expense	2.0	2.3	1.8	0.4	0.5	2.0	2.0	
				CENRTC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
				GPP/LI	3.0	3.2	3.1	0.2	0.1	2.4	3.0	
		Subtotal 1120-2			5.0	5.5	4.9	0.6	0.6	4.4	5.0	
1120-4				Expense	1.1	1.1	1.1	0.0	0.0	1.1	1.1	
				CENRTC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
				GPP/LI	2.3	2.3	2.9	0.0	(0.6)	2.3	2.3	
		Subtotal 1120-4			3.4	3.4	4.0	0.0	(0.6)	3.4	3.4	
1.1.2.1	Tank Farms Operations			Expense	50.5	49.7	51.6	(0.6	(1.9)	87.9	87.9	
				CENRTC	0.4	0.4	0.2	0.0	0.1	0.6	0.6	
				GPP/LI	13.5	11.1	10.5	(2.3)	(0.7)	27.4	27.4	
		Subtotal TW03			64.4	61.2	62.3	(3.2)	(2.5)	115.9	115.9	

Retrieval

FY 1998 Cost/Schedule Performance - All Fund Types -- Cumulative to Date Status

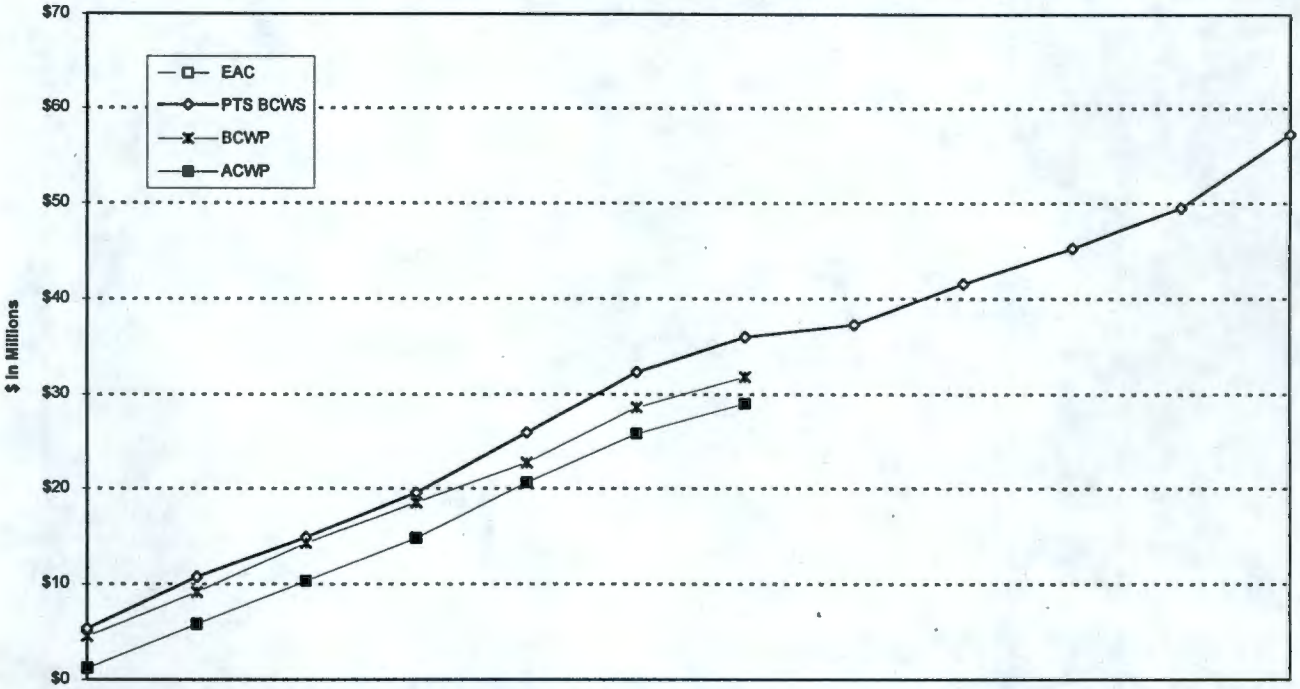


	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
EAC												
MYWP	5.9	10.5	16.0	21.3	26.2	30.7	35.1	39.0	43.2	47.2	51.3	57.2
PTS BCWS	5.3	10.7	14.9	19.5	25.9	32.3	36.0	37.3	41.6	45.3	49.5	57.2
BCWP	4.5	9.1	14.3	18.5	22.7	28.6	31.8					
ACWP	1.2	5.8	10.3	14.8	20.6	25.8	29.0					
SV	(0.8)	(1.6)	(0.6)	(1.0)	(3.1)	(3.7)	(4.2)					
CV	3.3	3.3	4.0	3.7	2.2	2.8	2.9					

					FYTD						PTS	
					BCWS	BCWP	ACWP	SV	CV	MYWP	BCWS	EAC
ADS												
1210-0				Expense	16.4	12.7	13.0	(3.7)	(0.3)	25.5	29.7	
				CENRTC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
				GPP/LI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
		Subtotal 1210-0			16.4	12.7	13.0	(3.7)	(0.3)	25.5	29.7	
1210-2				Expense	0.3	0.1	0.1	(0.2)	0.1	0.3	0.4	
				CENRTC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
				GPP/LI	0.0	0.0	(0.2)	0.0	0.2	0.0	0.0	
		Subtotal 1210-2			0.3	0.1	(0.1)	(0.2)	0.2	0.3	0.4	
1210-3				Expense	0.9	0.9	0.5	0.0	0.3	1.5	1.5	
				CENRTC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
				GPP/LI	6.8	7.0	4.0	0.2	3.1	15.1	15.2	
		Subtotal 1210-3			7.7	7.9	4.5	0.2	3.4	16.6	16.7	
1210-4				Expense	11.6	11.1	11.6	(0.5)	(0.5)	14.9	14.9	
				CENRTC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
				GPP/LI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
		Subtotal 1210-4			11.6	11.1	11.6	(0.5)	(0.5)	14.9	14.9	
1.1.3.1	Waste Retrieval			Expense	29.2	24.8	25.1	(4.4)	(0.3)	46.5	46.7	
				CENRTC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
				GPP/LI	6.8	7.0	3.8	0.2	3.2	15.2	15.2	
		Subtotal TW04			36.0	31.8	29.0	(4.2)	2.9	61.7	61.9	

Process Waste Support

FY 1998 Cost/Schedule Performance - All Fund Types -- Cumulative to Date Status

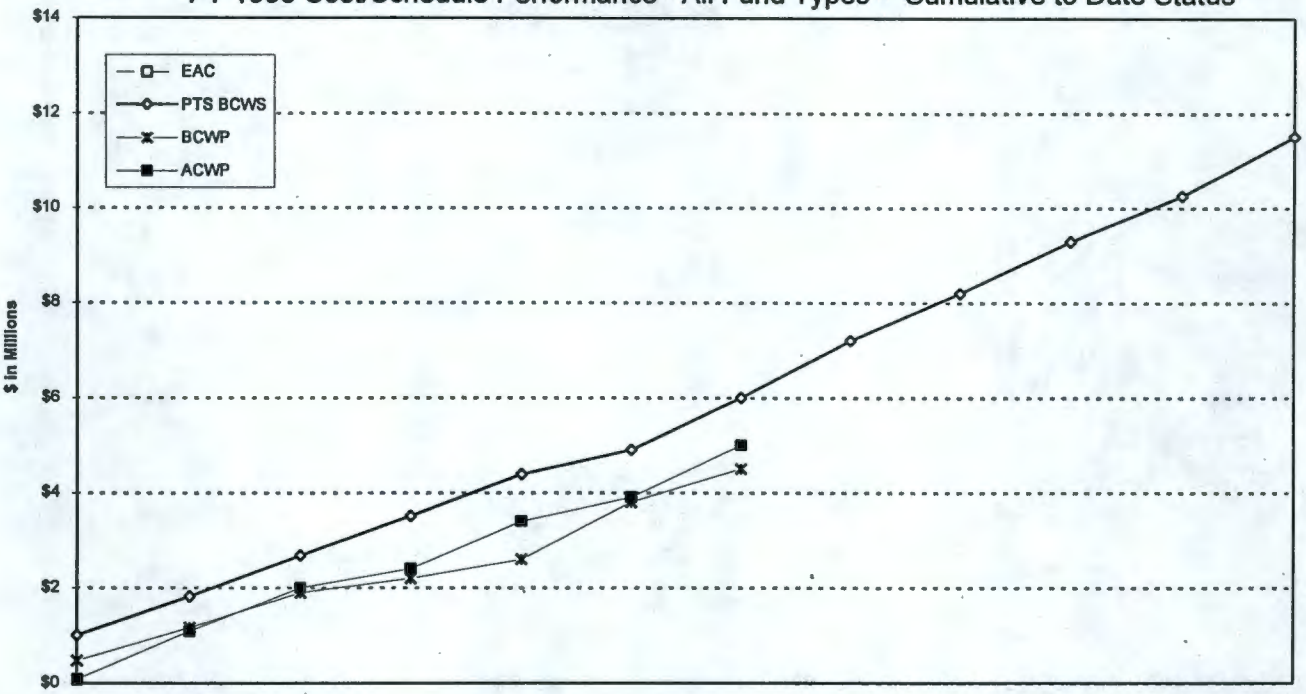


	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
EAC												
MYWP	1.0	1.7	2.5	3.3	4.1	4.8	5.6	6.3	7.1	7.5	7.9	8.3
PTS BCWS	1.4	2.9	4.2	5.4	6.6	8.7	9.0	10.7	11.7	12.6	13.7	14.6
BCWP	0.8	2.2	3.3	4.8	6.2	7.5	8.6					
ACWP	0.6	1.9	3.1	4.3	5.5	5.7	6.0					
SV	(0.6)	(0.7)	(0.9)	(0.6)	(0.5)	(0.6)	(0.4)					
CV	0.2	0.3	0.2	0.5	0.7	0.5	0.6					

					FYTD					PTS		
					BCWS	BCWP	ACWP	SV	CV	MYWP	BCWS	EAC
1.1.3.5	Process Waste Support			Expense	9.0	8.6	6.0	(0.4)	0.6	8.3	14.8	
				CENRTC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
				GPP/LI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
		Subtotal TW05			9.0	8.6	6.0	(0.4)	2.6	8.3	14.8	

Immobilized Tank Waste Storage & Disposal

FY 1998 Cost/Schedule Performance - All Fund Types -- Cumulative to Date Status



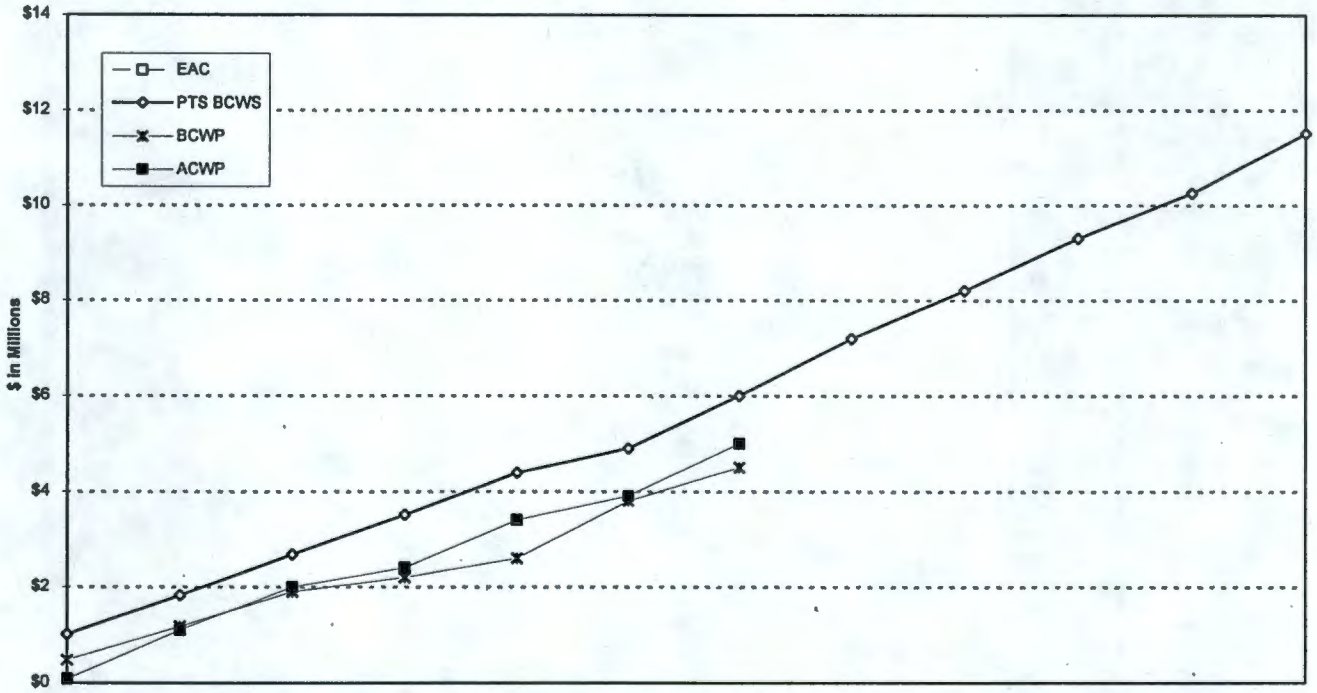
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
EAC												
MYWP	1.0	1.7	2.5	3.3	4.2	5.1	6.1	7.2	8.2	9.4	10.5	11.5
PTS BCWS	1.0	1.8	2.7	3.5	4.4	4.9	6.0	7.2	8.2	9.3	10.3	11.5
BCWP	0.5	1.2	1.9	2.2	2.6	3.8	4.5					
ACWP	0.1	1.1	2.0	2.4	3.4	3.9	5.0					
SV	(0.5)	(0.7)	(0.8)	(1.3)	(1.8)	(1.1)	(1.5)					
CV	0.4	0.1	(0.1)	(0.2)	(0.7)	(0.1)	(0.5)					

					FYTD						PTS	
					BCWS	BCWP	ACWP	SV	CV	MYWP	BCWS	EAC
ADS												
1250-0				Expense	5.8	4.2	5.0	(1.5)	(0.7)	10.5	10.5	
				CENRTC	0.2	0.2	0.0	0.0	0.2	0.2	0.3	
				GPP/LI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
		Total 1250-0			6.0	4.4	5.0	(1.5)	(0.5)	10.7	10.8	

$ in Millions

TWRS Project Management

FY 1998 Cost/Schedule Performance - All Fund Types -- Cumulative to Date Status



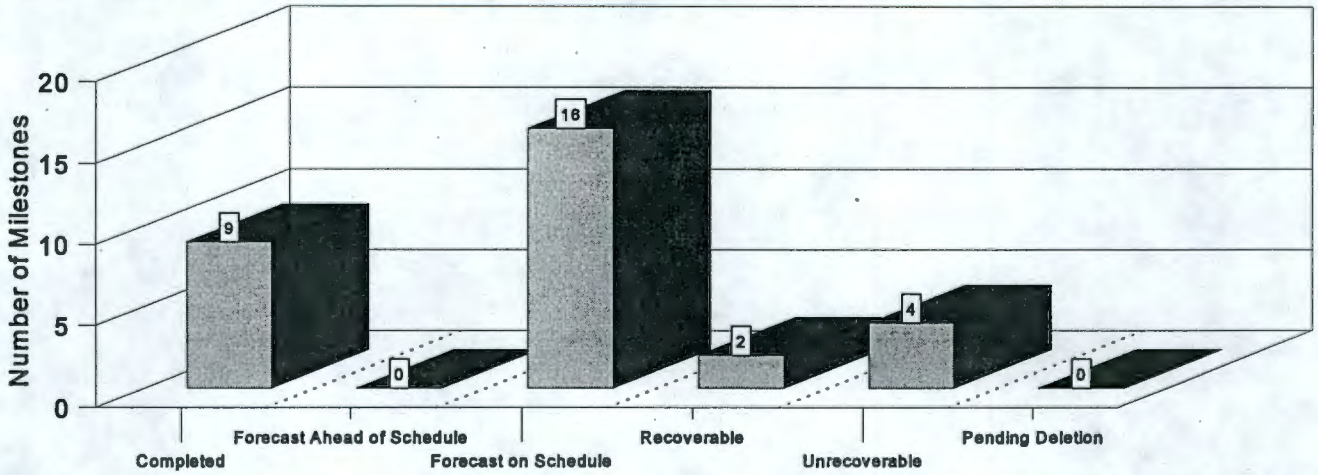
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
EAC												
MYWP	3.6	6.4	9.7	13.0	15.7	18.9	22.0	24.8	28.0	30.9	33.7	35.9
PTS BCWS	2.9	6.5	9.7	12.7	15.9	19.4	21.6	25.5	28.5	31.1	34.2	36.6
BCWP	2.6	6.0	6.9	12.0	15.0	18.2	20.4					
ACWP	2.3	5.8	8.6	11.3	14.4	16.2	18.2					
SV	(0.2)	(0.5)	(0.8)	(0.7)	(0.8)	(1.0)	(1.2)					
CV	0.3	0.2	0.3	0.7	0.6	2.0	2.2					

					FYTD						PTS	
					BCWS	BCWP	ACWP	SV	CV	MYWP	BCWS	EAC
ADS												
1200-0				Expense	21.6	20.4	18.2	(1.2)	2.2	36.6	40.6	
				CENRTC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
				GPP/LI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
		Total 1200-0			21.6	20.4	18.2	(1.2)	2.2	36.6	40.6	

$ in Millions

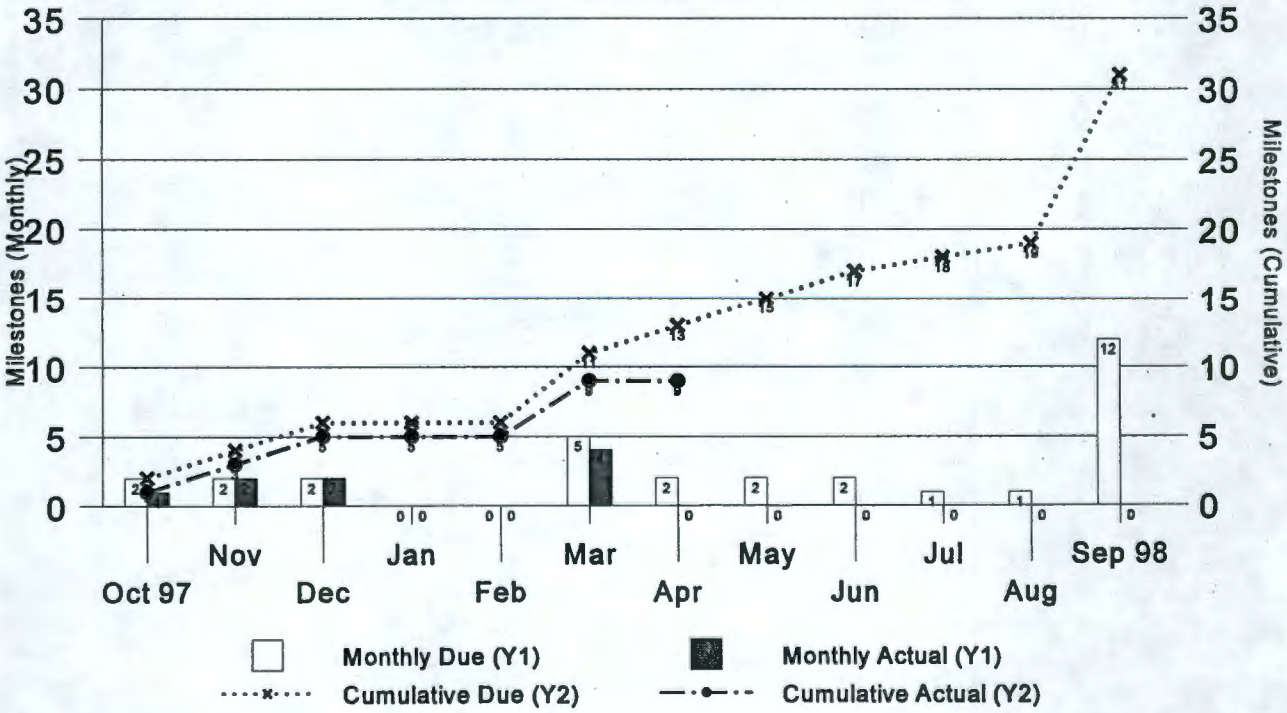
FY 1998 Milestone Performance

(Major & Interim Milestones)



FY 1998 Milestone Plan

(Major & Interim Milestones)



Fiscal Year 1998 Tri-Party Agreement Milestone Status

Milestone	Description	Due Date	Completed	Forecast		Recoverable	Unrecoverable	Pending Deletion
				Ahead of Schedule	On Schedule			
M-43-07B	Complete construction of W-058	10/31/97	X					
M-45-03A	Initiate sluicing retrieval of C-106. Initiate sluicing retrieval of Tank 241-C-106 to resolve the high-heat safety issue and demonstrate waste retrieval Status: Change Request M-45-97-06 was issued May 6, 1997. Currently at PCHB level.	10/31/97					X	
M-46-01D	Concurrence of additional tank acquisition.	11/30/97	X					
M-60-14-T01	Submit approved DQOs for LAW feed staging	11/30/97	X					
M-32-02-T02	Upgrade existing transfer lines to meet secondary containment requirements	12/31/97	X					
M-90-01	Submit interim storage and disposal ILAW, and interim storage IHLW Project Management Plans (PMP) to Ecology.	12/31/97	X					
M-43-01	Complete Project W-030 Tank Farm ventilation upgrades.	3/31/98	X					
M-43-01C	Begin operation of W-030	3/31/98	X					

Fiscal Year 1998 Tri-Party Agreement Milestone Status

Milestone	Description	Due Date	Completed	Forecast		Recoverable	Unrecoverable	Pending Deletion
				Ahead of Schedule	On Schedule			
M-41-23	Start interim stabilization of 8 single-shell tanks Status: Schedule slippage on Milestone M-41-22 will impact completion of this milestone.	3/31/98					X	
M-50-03	Complete evaluation of enhanced sludge washing to determine whether advanced sludge separation processes are required	3/31/98	X					
M-50-04-T01	Submit conceptual design of HLW pretreatment facility Status: The W-211 Title I design is planned to be used to complete this target date.	3/31/98	X					
M-43-07	Complete Project W-058 Replacement of Cross-Site Transfer System (see M-43-07C)	5/31/98				X		
M-43-07C	Cross-Site Transfer System Operational Status: Change Package M-43-98-01 approved 4/28/98. Extends due date from 4/30/98 to 5/31/98.	5/31/98				X		
M-51-04A-T01	Submit approved DQOs for HLW feed staging	5/31/98			X			
M-60-15-T01	Submit approved DQOs for LAW feed staging	5/31/98			X			
M-44-13B	Submit draft WIRD to Ecology for FY 1999.	6/30/98			X			
M-90-02-T01	Complete ILAW interim storage facility conceptual design	6/30/98			X			
M-60-10	Select two (2) COCO contractors and issue DOE signed authorizations to proceed with Part B.	7/31/98			X			

Fiscal Year 1998 Tri-Party Agreement Milestone Status

Milestone	Description	Due Date	Completed	Forecast		Recoverable	Unrecoverable	Pending Deletion
				Ahead of Schedule	On Schedule			
M-44-14B	Submit Final WIRD to Ecology for FY 1999.	8/31/98			X			
M-40-09	Close all unreviewed safety questions (USQ) for double-shell and single-shell tanks	9/30/98			X			
M-41-24	Start interim stabilization of 9 single-shell tanks Status: Schedule slippage on Milestone M-41-22 will impact completion of this milestone.	9/30/98					X	
M-41-27-T03	Complete salt well pumping of 8 single-shell tanks	9/30/98					X	
M-43-11	Provide the W-314 project construction schedule to Ecology	9/30/98			X			
M-44-15B	Issue Characterization Deliverables consistent with WIRD Developed for FY 1998.	9/30/98			X			
M-44-16B	Complete input of WIRD.	9/30/98			X			
M-45-02C	Submit annual update of SST retrieval sequence document for Ecology approval	9/30/98			x			
M-45-09C	Submit annual progress reports on the development of waste tank leak monitoring/detection and mitigation activities in support of M-45-08.	9/30/98			X			
M-46-00E	Double-shell tank space evaluation	9/30/98			X			
M-51-02	Complete melter tests and select reference melter	9/30/98			X			
M-51-03-T01	Submit conceptual design (to include selected capacity and process) of HLW vitrification facility	9/30/98			X			
M-60-16-T01	Submit approved DQOs for LAW feed staging	9/30/98			X			
TOTAL			9	0	16	2	4	0

Change Request M-41-97-01	Denied. Recovery plan/schedule being developed. Due date 4/15/98.
Change Request M-41-97-02	Denied. Recovery plan/schedule being developed. Due date 4/15/98.
Change Request M-45-97-06	Final determination received by Ecology on October 8, 1997. RL disagrees with Ecology's findings, and is pursuing review of Ecology's determination through appeal to the Pollution Control Hearings Board.
Change Request M-43-98-01	Approved 4/28/98 to extend due date for M-43-07 and M-43-07C from 4/30/98 to 5/31/98.

Milestone M-32-00, "Complete Identified Dangerous Waste Tank Corrective Actions"

Status:

- Ownership of milestone transferred from EAP to TWRS
- Completed M-32-02-T02, upgrade existing transfer lines to meet secondary containment requirements (12/97).

Issues:

- Partnering group established between DOE, Ecology and PHMC to negotiate new milestones for DST Integrity Assessment.

Planned Activities:

Milestone M-40-00, "Mitigate/Resolve Tank Safety Issues for High Priority Watch List Tanks"

Status:

- Worked on Closure Document for the Organic Complexant Safety Issue
- Thirty-four SHMS now operating
- Completed field installation of SHMS on 3 additional taks
- Continue final phase of lightning protection project .

Issues:

- Resolution of Flammable Gas Safety Issue
  - Extent of Delay: In review
  - Current Planning indicates 1-2 year delay, depending on budgets
- M-40-07 dispute resolution elevated to the IAMIT.

Planned Activities:

- Finalize and issue Organic Solvent Safety document
- Continue accelerated closure of the Organic Complexant Safety Issue
- Close Flammable Gas USQ to meet M-40-09
- Continue turnover of SHMS for beneficial use to Operations
- Continue to develop the analysis tool and framework for DST and SST safety issue resolution
- Provide twenty-one TMACS connections on Watch List Tanks
- Complete the final phase of the lightning protection project.

Milestone M-41-00, "Complete Single Shell Tank Interim Stabilization"

Status:

- Interim stabilization now complete for 119 tanks and intrusion prevention complete for 102 tanks
- RL determination on drainback issue - saltwell proceeding
- Recovery plan completed and transmitted for major Milestone M-41-00
- Tank 241-T-104 ready to pump. Pumpable liquids estimated at 42K gallons (to date pumped 125K gallons)
- 241-T-110 is ready to pump. Pumpable liquids estimated at 25K gallons (to date pumped 13K gallons)
- Restart of both tanks dependent upon incorporation of cleanout box JCO into procedures, hydrotest of transfer lines, compatibility assessment
- 241-SX-104 is being prepared for pumping

Issues:

- TWRS Saltwell Pumping
- TPA Major and Interim Milestones
- M-41-00 (9/20/00); M-41-22 (9/30/97); M-41-23 (3/31/98)
- M-41-24 (9/30/98); M-41-25 (3/31/99)
- M-41-26 (9/30/99); M-41-27 (9/30/00).

Planned Activities:

- Initiate/restart pumping of tanks 241-SX-104; 241-T-110; 241-T-104
- Prepare tank SX-106 for pumping
- Prepare S-Farm tanks for FY-99 pumping
- Complete Management Assessment of Safety Document - May 31, 1998
- Obtain Ecology concurrence on RL determination - drainback issue
- Continue activities that focus on:
  - Reduction of cost for SST stabilization
  - Implementation of recovery plan.

Milestone M-43-00, "Tank Farm Upgrades"

- M-43-07, "Complete Project W-058, Replacement of Cross-Site Transfer System" (5/31/98)

  Status:
  - Contractor Readiness Assessment completed 4/6/98
  - DOE Readiness Assessment initiated 4/8/98
  - Remaining punchlist item (Pump vibration) - resolved.

Issues:

- Anticipated to be operational by 5/31/98
- New RL RA Team Lead assigned - medical condition.

Planned Activities:

- Complete M&I and DOE Readiness Assessment by 5/21/98
- Complete Readiness Assessment pre-start findings 5/27/98
- Complete Tri-Party Agreement Milestone M-043-07C, "Cross Site Transfer System Operational", by 5/31/98
- Complete Tri-Party Agreement Milestone M-43-07, "Complete Project W-058" by 5/31/98
- Complete OAC Section III sign-off and the Construction Completion Cost Closure Statement for project closeout.

- M-43-11, "Provide the W-314 Project Construction Schedule to Ecology" (9/30/98)

Status:

- AN Valve Pit Upgrades design completed 11/97
- 200E Upgrades design completed 3/98
- AY Tank Farm Upgrades design in process - completion planned 5/98
- Master Pump Shutdown Upgrades design in process - completion planned 12/98
- AN Valve Pit Upgrades construction initiated 3/98
- Obtained approval from DOH and EPA on the Project W-314 Initial Phase Notice of Construction for approval
- Started construction activities on the AN Valve Pit Upgrades.

Issues:

- A proposed change to the transfer pipe route is being considered by RL; this has halted the start of construction on the 200E upgrades package. The new route provides improved operating efficiencies, reduction in worker exposure, and a cost savings during construction phase.

Planned Activities:

- AZ Tank Farm Upgrades design planned to start 4/98
- AW Valve Pit Upgrades design planned to start 6/98
- AY Tank Farm Upgrades construction planned to start 6/98.

Milestone M-44-00, "Issue Tank Characterization Reports (TCRs) Based on Process Knowledge, Prior Characterization Data, and Validated empirical Data Acquired After May 1989 for 177 Hanford High Level Waste Tanks."

Status:

- Completed sampling and analysis data entry for the month per the FY 97-98 WIRD.
- Obtained core samples for tanks SX-103, S-111, and U-109. Obtained grab samples for tanks AN-107 and AW-101. Sampling status as of 5/17/98 is as follows:

	Tanks Scheduled/Completed	Samples Scheduled/Completed	FY-98 Commitment
Auger	1/1	2/4	2
Push	5/5	7/7	28
Rotary	7/6	12/11	
Vapor	10/10	10/10	10
Grab	21/19	21/19	30

- Received draft tank characterization report (TCR) for tank BX-111 for review.
- New TCRs for tanks B-107, BX-111, and S-106 were issued.
- Plan to deliver 16 new and 10 revised TCRs. Status as of 5/7/98 is as follows:

	FY-98 Commitment	Completed to Date
New TCRs	16	9
Revised TCRs	10	1

Issues:

- The sample volumes and analysis requirements to support the Privatization Project were identified and transmitted to the Contractor on April 1, 1998. Because sample volumes and analysis requirements were identified late in the fiscal year, this places the Characterization Project at risk to complete the Privatization Project's 12 grab samples and tank AZ-102 core sample. Large sample volumes pose an ALARA (radiation exposure) concern for sampling crews. Additional guidance was issued on May 7, 1998, providing clarification of Privatization Project requirements and identification of replacement tanks. The schedule and resources to support this effort are being discussed with the Contractor. Data quality objective approval and follow-up tank sampling and analysis plan to begin core sampling of tank AZ-102 is forthcoming (F/C 5/30/98).

Planned Activities:

- Partnering meeting to continue discussions on automated/electronic TCRs, WIRD change control process, and format and content of quarterly report updates is scheduled for 6/11/98.
- Draft WIRD for FY 1999 (M-44-13B) due 6/30/98.
- Final WIRD for FY 1999 (M-44-14B) due 8/31/98.
- Issue Status Report on FY 1998 WIRD deliverables (M-44-15B) due 9/30/98.
- Input FY 1998 Characterization Sampling and Analysis Information into Electronic Database (M-44-16B) due 9/30/98.

M-45-00, "Complete Closure of All Single-Shell Tank Farms"

Status:

- SST Retrieval Working Group Meeting held May 15, 1998
  - Ecology/DOE Values for SST Retrieval
  - SST Retrieval Strategy
  - Risk Definition
  - Leakage Input (W-320) Memorandum
- Retrieval Performance Evaluation Working Group Meeting held April 16-17, 1998
- M-45-02C: SST Retrieval Sequence
  - Options for Milestone Completion:
    - Submittal along with TWRS Systems and Operations Plan on January 1999
    - Complete Sequence based on Revised SST Logic on Schedule
- M-45-03A: C-106 Sluicing
  - Official Acceptance of Construction complete on May 21, 1998
  - Safety Class and Safety Significant Engineering Evaluation
  - Operational Testing of In-Tank Imaging System Complete
  - Operational Testing of Pump, Winch Assembly, and Transfer System in Process
  - Project Currently on Schedule and Budget
- M-60-15-T01: Submit DQO Representing Retrieval Needs Supporting Privatization Phase 1
  - Submitted Correspondence to Ecology on May 22, 1998 meeting milestone.

Issues:

- Pollution Control Hearing Board hearing in mid-June (M-45-03A)
- C-106 Sluicing added funding to address Operation Readiness Review concerns.

Planned Activities:

- Retrieval Working Group Meeting, May 28, 1998
- Retrieval Technology Workshop, Oak Ridge, June 9-10, 1998
- C-106 Sluicing Contingency Plan for Off-Normal Events, June 30, 1998
- Submittal of SST Retrieval Mission Analysis and Logic, June 30, 1998

Milestone M-46-00, "Double-Shell Tank Space Evaluation" (9/97)

Status:

- M-46-01D, "Concurrence of Additional Tank Acquisition" completed 11/30/97.

Issues:

Planned Activities:

- Data collection for the next few months.

Milestone M-50-00, "Complete Pretreatment Processing of Hanford Tank Wastes"

Milestone M-51-00, "Complete Vitrification of Hanford High Level Tank Wastes"

Milestone M-60-00, "Complete Vitrification of Hanford Low Level Tank Wastes"

Milestone M-61-00, "Complete Pretreatment and Immobilization of Hanford Low Activity Tank Wastes"

Status:

- M-50-04-T01, Submit a Conceptual Design of HLW Pretreatment Facility" (3/31/98)
  - Project W-211 installs mixer pumps in certain DSTs. These mixer pumps will allow for the pretreatment of HLW for the Phase I Private Contractors
  - RL received a letter from Ecology stating that Ecology did not concur with the notification of completion since inadequate information was provided to document successful milestone completion. RL believes that an Authorization to Proceed notification should provide sufficient data to allow the target milestone to be completed.
- Privatization Review Board Meetings continue to be held. The next meeting is scheduled for the week of June 1.
- Meetings with DOE-HQ personnel to discuss how RL will:
  - Prepare the Secretarial Decision Package
  - Determine the price reasonableness of the contractors' proposal
  - Develop the recommendation for the Secretary.
- Meetings with Office of Management and Budget (OMB)
  - There have been two meetings with OMB regarding funding needs for TWRS Privatization. Both meetings went well.

- OMB is enthusiastic about Privatization
- Significant work is still required to obtain the necessary funding for Privatization and the support projects. Other site budgets have an impact on the funding for RL.

- TPA Milestone M-60-10 select two (2) COCO contractors and issue DOE signed Authorization to Proceed with Part B (as defined in the Request for Proposals or subsequently negotiated contracts) work for LAW pretreatment and immobilization.
  - Summary of events for the low-activity waste (LAW) feed data quality objectives (DQO) for Phase 1 Privatization (TPA target date M-60-14-T01).

Issues:

- Schedule continues to be very aggressive
  - LMAES has not been given Authorization To Proceed into Part B
  - Discussions continue with BNFL working to obtain an agreement that could lead to an Authorization To Proceed
  - RL is working to have the Secretarial Decision in time to support the TPA Milestone date of July 31, 1998 and the expiration date of the contracts
  - Congressional Review Process (30 days) needs to be completed by July 31, 1998
    - Requires the preparation of a Congressional Report to respond to specific questions
    - The Secretary will approve the Congressional Report at the same time as the Authorization to Proceed decision is made.

Planned Activities:

- June
  - RL provides the Secretarial Decision Package and Congressional Report to the Secretary
  - Secretary makes a decision regarding the Authorization to Proceed into Phase IB
  - Secretary signs the Congressional Report and forwards it to Congress.
- July
  - Possible Congressional Hearings on the Secretarial Decision Package.

Milestone M-90-00, "Complete acquisition of new facilities, modifications of existing facilities, and/or modifications of planned facilities, as necessary to conduct interim storage of Immobilized High Level Waste and storage/disposal of Immobilized Low Activity Tank Waste"

Status:

- M-90-01, Submit Interim Storage and Disposal ILAW and Interim Storage IHLW PMPs to Ecology" (12/97)
  - Project Management Plans were completed and delivered to Ecology in December 1997
  - Responses to comments from Ecology have been prepared

- Ecology and DOE have agreed to update the PMP following the rebaselining to the privatization contract
- M-90-02T, Complete ILAW interim storage facility conceptual design (6/98)
  - Conceptual design is complete and being prepared for delivery to Ecology
- M-90-05T, Submit final ILAW disposal facility Performance Assessment to Ecology for review (12/01)
  - Performance Assessment is being prepared for official transmittal to DOE-HQ and Ecology
- M-90-07T, Complete ILAW disposal facility conceptual design (6/00)
  - Conceptual design started March 1998
- M-20-00, Submit Part B Permit Applications
  - M-20-57, Submit interim ILAW facility Part B permit application to Ecology (12/2000)
    - Project W-465 ILAW Interim Storage Facility NOI drafted for review. The NOI is being held pending a decision on Project W-465 scope (storage and disposal).

Issues:

- Change request drafted for Ecology consideration. M-90 and M-20 milestones changed to reflect W-465 scope changing from storage to disposal.
- Letters are being drafted to DOH requesting sealed source determination for IHLW and ILAW canisters.

Planned Activities:

- Submit M-90 and M-20 change request for Ecology consideration
- M-90-03, Initiate ILAW interim storage facility construction (6/01)
- Project validation decision is pending further guidance
- M-90-05T, Submit final ILAW disposal facility Performance Assessment to Ecology for review (12/01)
  - Submittal of the Performance Assessment to DOE-HQ is scheduled for May 1998. The document was informally provided to Ecology for review and comment dispositions have been prepared
  - Borehole drilled for vadose zone characterization, also used as RCRA groundwater monitoring well.

Other

- Permitting

  Clean Air Act
  - Project W-030, successfully started up March 1998 meeting NESHAP FFCA milestone for 296-A-42 stack.
  - Project W-030, closure of 296-A-17 and 296-P-26 stack sampling/monitoring systems. Regulatory notifications sent March 1998.
  - Notice of construction approval for Guzzler excavation and backfilling in support of 200 Area A Farm received January 1998.

- Project W-314, notice of construction approval was received March 1998. Startup pending conditions and limitations discussions.
- SX-104 NOC for saltwell pumping approved by WDOH March 1998.

Resource Conservation and Recovery Act Activities

- Hanford Facility RCRA Permit
  - Permit condition II.U.W, which required mapping and marking of waste piping outside the fences enclosing 200 East and 200 West Areas (CSTS), was completed (9/97).
- Double-Shell Tank RCRA Part B Permit Application
  - On schedule to be completed June 1, 1999
  - 8 chapters completed (Chapters 1, 5, 6, 8, 9, 10, 12, and 13)
  - 7 chapters still outstanding (Chapters 2, 3, 4, 6, 11, 14, and 15)
  - Discussions being held with Ecology on a monthly basis

- Final Safety Analysis Report (FSAR)
  - Final FSAR currently under Tier II review by TWRS
  - Approval authority has been delegated from DOE-HQ to RL
  - Approval planned for completion in FY 1998
  - Implementation planned for FY 1999.
- Vadose Zone

  Status:
  - Continued work with the Interagency Team (e.g., Ecology, ODOE, Tribal Nations) on the TWRS vadose zone program plan
  - Supported the Sitewide Vadose Zone/Groundwater Integration initiative
  - Continued data collection and analysis of existing boreholes under the spectral gamma logging program.

  Issues:
  - Sitewide Vadose Zone/Groundwater Integration initiative continues to expand its understanding of TWRS program activities and decisions. A thorough understanding is required to ensure that vadose zone data and analysis is completed to meet TWRS programmatic and regulatory needs based on the Tri-Party Agreement.
  - Concerns with contaminant transport modeling and risk assessments based, in part, on vadose zone data, pose potential risks to near-term TWRS program activities such as the PA for the ILAW facilities.

  Planned Activities:
  - Continue to completion development of the vadose zone program plan
  - Continue to completion the spectral gamma logging effort

- Support development of the September 1998 Sitewide Vadose Zone/Groundwater Integration Program Plan
- Reconvene the Vadose Zone Expert Panel to address progress to date on Panel recommendations
- Support development and implementation of Science and Technology proposals to address specific issues of concern regarding contaminant transport.

- Public Involvement
  - Budget workshops held in March 1998
  - Privatization briefing to the State of Oregon, May 28, 1998, Richland
  - TPA Public Involvement Quarterly, June 3, 1998, Richland
  - Health Safety and Waste Management Committee
    - March 13, 1998, Portland
    - April 8, 1998, Seattle
    - May 13, 1998, Richland
    - June 29, 1998, Richland
  - Dollars and Sense Committee
    - April 23, 1998, Richland
    - May 15, 1998, Richland
    - June 30, 1998, Richland
  - Hanford Advisory Board
    - June 4-5, 1998, Richland
    - July 9-10, 1998, Spokane
  - Privatization Public Forum
    - June 29, 1998, Richland
  - New website online.

- Tank 241-SY-101
  - This tank is exhibiting a slow rise in surface level
  - Gas is most likely accumulating in or under the floating crust
  - Current tank surface level response to mixer pump operation is not consistent with behavior assumed in safety analysis
  - A USQ was declared on February 26
  - Detailed planning on the path forward is in progress.

- Tank 241-SX-104
  - Anomalous level readings on Tank 241-SX-104 resulted in an extensive investigation to determine if the tank is leaking
  - Review of the delta level/delta pressure, installation of a video camera, and dry well testing is complete
  - Preliminary findings are that Tank 241-SX-104 is not leaking
  - Additional analysis is being conducted.

- Project W-030 Update, "Tank Farm Ventilation Upgrades"

  Status:
  - Tri-Party Agreement regulatory scope of work (M-43-01) complete

  Issues:
  - None

  Planned Activities:
  - Conduct Operational Test Procedure, forecasted for June 1998.
  - Complete Authorization Basis and ORR post-start actions
  - Complete Official Acceptance of Construction (OAC) Section II exceptions
  - Complete OAC Section III sign-off and the Construction Completion Cost Closure Statement for project closeout.

Project Manager's Meeting: TWRS Single and Double Shell Tanks
Storage, Treatment and Disposal
TPA Milestones M-40 through M-46, M-50, M-51, M-60, M-61 and M-90
May 28, 1998

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PROJECT W-320 SAFETY CLASS AND SAFETY-SIGNIFICANT EQUIPMENT ENGINEERING EVALUATION (SEL)

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U.S. Department of Energy Contract DE-AC06-96RL13200

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Abstract: Project W-320 Safety Equipment List (SEL)

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Project W-320 Safety Class and Safety-Significant Equipment Engineering Evaluation

Prepared for the U.S. Department of Energy
Office of Tank Waste Remediation System

Fluor Daniel Hanford, Inc.
Richland, Washington

Hanford Management and Integration Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

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LIST OF TERMS

BIO	Basis for Interim Operations
CAM	continuous air monitor
DOP	dioctylphthalate
ENRAF	Enraf-Nonius Series 854
HEME	high-efficiency mist eliminator
HEMF	high-efficiency metal filter
HEPA	high-efficiency particulate air
HVAC	heating, ventilation, and air conditioning
LCO	limited condition for operation
LFL	lower flammability limit
MIT	multi-functional instrument tree
NEMA	National Electrical Manufacturers' Association
NFPA	National Fire Protection Association
ORR	Operations Readiness Review
RL	U.S. Department of Energy, Richland Operations Office
SC	Safety Class
SEL	Safety Equipment List
SQ	Safety and Quality Assurance
SS	safety significant
SSC	systems, structures, and components
TMACS	Tank Monitoring and Control System
TSR	technical safety requirement
TWRS	Tank Waste Remediation System
WRSS	Waste Retrieval Sluicing System

PROJECT W-320 SAFETY CLASS AND SAFETY-SIGNIFICANT EQUIPMENT ENGINEERING EVALUATION

1.0 PURPOSE

This report provides the engineering analysis required by the Waste Retrieval Sluicing System (WRSS) Authorization Basis. The Authorization Basis for the WRSS is HNF-SD-WM-BIO-001, *Tank Waste Remediation System Basis for Interim Operations*, Addendum 1 (BIO) (Noorani 1997). The WRSS Authorization Basis was approved on September 17, 1997, after most of the equipment had been installed. The Authorization Basis resulted in some reclassification of systems, structures, and components (SSC) for the WRSS. The Authorization Basis requires performance of an engineering analysis before the initiation of WRSS operations to ensure the system's safety functions can be performed. Specifically, Section 4.2 of the Authorization Basis states the following.

"The existing WRSS SSCs that are designated as safety class and safety significant in this Addendum, were not designed and constructed to meet safety class criteria.

An engineering analysis will be performed for each safety class and safety significant system of the WRSS to ensure that it is able to perform its safety function and fulfill its reliability before start up of WRSS operations. The engineering analysis will include as a minimum, the following: (1) failure modes and effects analysis, (2) allowed outage times, (3) reliability criteria, (4) spare parts requirements, (5) provision of fail-safe modes of operation or alarm, (6) an updated Fire Hazards Analysis, and (7) operational attributes and critical characteristics. Acceptance testing will be performed, where practical to demonstrate that safety functions and requirements can be met. This approach will be used to demonstrate that systems that are not built to specific SC requirements can perform their safety functions.

Upon completion of the engineering analysis, a cost/risk benefit determination will be made that (1) the system is acceptable "as-is," (2) the system needs upgrade or spare parts availability, or (3) waivers or deviations requested as necessary."

The items (1 through 7) requested above are contained in various Project documents. Items 1, 2, & 7 are included in this document (HNF2050). Item 3 were done only for the Tank 241-AY-102 primary and annulus and the 241-C-106 ventilation systems. The results of the comparative reliability studies are contained in Braun 1997, for 241-AY-102 Primary Ventilation System, Braun 1998a for the 241-AY-102 Annulus Ventilation System and Braun 1998b for the 241-C-106 Primary Ventilation System. Items 4 are contained in the Project Spare Parts document HNF2404. Item 5 is contained in HNF-SD-W320-FDC-001, Item 6 is contained in the Project updated Fire Analysis HNF-SD-WM-FHA-020, Rev. OB, addendum #1.

The approved U.S. Department of Energy, Richland Operations Office (RL) Safety Evaluation Report [Nelson 1997] that is a part of the Authorization

Basis contained an open issue (Issue 1) that applies to the safety classification. It states the following:

"1. Some of the existing systems are not labeled as Safety Class but are required to perform Safety Class functions. For example, the Ventilation Upgrade system (Project W-030) is classified as Safety Significant although required to be a Safety Class system on the basis of the Project W-320 Safety Analysis. Additional systems include the annulus leak detection system (Tank 241-AY-102), the transfer line pipe-in-pipe system, the transfer line leak detection systems, the pit cover blocks, and the stack continuous air monitor and interlock to the exhaust fan. An engineering evaluation shall be performed to demonstrate that the systems can perform their safety function or be modified accordingly. This evaluation shall be supplied to RL/TWRS [Tank Waste Remediation System] for information.

The successful completion of this evaluation will be verified during the RL Operations Readiness Review (ORR) prior to commencement of sluicing operations."

This evaluation (HNF2050) examines each safety class (SC) and safety significant (SS) systems of the WRSS, provided by Project W-320, to ensure they are able to perform their safety function. The evaluation (1) defines the project strategy for meeting the system safety function(s), (2) evaluates the system compliance with the safety design requirements based on the strategy developed in (1), and (3) develops a project Safety Equipment List (SEL).

2.0 SYSTEM SAFETY STRATEGY

The discussions in Section 5.0 evaluate the suitability of each SC and safety significant (SS) system to perform the safety functions specified by the BIO and the BIO, Addendum 1. Each section has a system strategy that gives an rationale for how the safety system fulfills the required safety function.

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3.0 COMPLIANCE WITH SAFETY REQUIREMENTS

A system description and an evaluation of the system to DOE Order 6430.1A SC design requirements is provided for each system. DOE Order 6430.1A, *General Design Criteria* (DOE 1989), Section 1300-3 establishes SC criteria for systems performing SC functions. DOE Order 6430.1A identifies criteria to be considered in the design of SC components and systems to ensure the system or component can perform its identified safety function. These criteria include quality assurance, single-failure criterion and redundancy, environmental considerations, maintenance, and testing. Safety systems are required to be designed, fabricated, erected, and tested to standards and quality requirements commensurate with the hazards and potential consequences associated with the facility and the role of each system and component in mitigating the consequence of design basis accidents.

This evaluation reviews the SC criteria in DOE Order 6430.1A but does not evaluate the systems against all codes and standards. Evaluation of the codes and standards specified for the systems was not considered appropriate for this evaluation because construction was complete, or being completed, for the WRSS systems when this evaluation was initiated. The evaluations consider the ability of the safety systems to perform their credited safety functions given they were constructed with the codes and standards specified by the Project W-320 functional design criteria.

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4.0 PROJECT SAFETY EQUIPMENT LIST DEVELOPMENT

The methodology and rationale for component safety classification is consistent with the process established in HNF-PRO-704, *Hazard and Accident Analysis Process* and HNF-IP-0842, *TWRS Administration* (Gibson 1997), Volume IV, Sections 5.2 and 5.9. The rationale identifies the design, installation, testing, and quality assurance requirements for the SEL components. Consideration was given to the identified safety function and the capability to restore the safety function in the event of component failure. For each system of interest, the following evaluation was performed.

1. The SC and SS function(s) performed by the safety system or the supporting system(s) are identified. Included is a reference to the applicable accident(s) establishing the required safety function.

2. The system critical characteristics are identified in the system portion of the Appendix. Each system which is required to perform a safety function, is translated into system critical characteristics. These characteristics are identifiable and measurable attributes or variables of the system that are critical to the system's safety function.

Within each system, the minimum number of components necessary to support the system safety function(s) is identified. The approach used for this identification is a failure modes and effects analysis using the following as guidance: DOE-STD-1027, Hazards Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports. The evaluations are intended to be a qualitative evaluation of the system interactions and effects of the individual component failure. The failure mode and effects analysis is appropriate for systems in which the relationship between components and the effects of their failure on the system operability is clear. The SC functions for Project W-320 do not involve complex systems. The component interactions and the effect of component failure on the system safety function can be readily established using the failure modes and effects analysis approach.

4.1 FAILURE MODES AND EFFECTS ANALYSIS APPROACH

In this approach, each system is analyzed to a level of detail sufficient to support procurement, testing, operation, and maintenance of the components within the system. The component function and failure mode(s) were identified. For each failure mode, the effect of component failure (assuming credible failures of other non-safety systems and components) on the system safety functions is examined. All failure modes are considered but only those with the potential to affect the safety function(s) are listed in the Appendix.

If failure of a single component could result in the loss of the safety function, the component was assigned the appropriate safety classification. The factor considered in the selection of safety components was the reliability required to achieve an acceptable level of risk. Engineered features were preferred to administrative controls, passive components were

preferred over active components, primary barriers (those close to the hazard) were preferable to secondary barriers, and barriers that provide protection from a spectrum of accidents were preferred to minimize the total number of safety components. In accordance with HNF-PRO-704, the capability to restore the component function (recovery time) is not a sufficient rationale to permit the component to be designated as "general service" because this implies that the component has no safety function. However, recovery time is credited in relaxing design, procurement and installation requirements.

The W-320 Project SEL is contained in the Appendix. This SEL will be added to the TWRS SEL via an Engineering Change Notice once this document is approved and released.

5.0 SYSTEM EVALUATION

This section discusses the systems in the WRSS determined to be SC or SS by the BIO or the BIO, Addendum 1. This section also discusses any existing system altered by Project W-320.

5.1 TANK 241-AY-102 ANNULUS VENTILATION SYSTEM (SAFETY CLASS)

The following discussion evaluates the suitability of the Project W-320 WRSS Annulus Ventilation System for tank 241-AY-102 to perform the safety function(s) specified for the system by the BIO and the BIO, Addendum 1.

5.1.1 Strategy Summary

The Authorization Basis credits the Tank 241-AY-102 Annulus Ventilation System with performing two distinct SC functions: waste temperature control and primary tank leak detection (see Section 5.2). No SS functions are identified for the system.

The Annulus Ventilation System is an existing tank farm system designated SC by the BIO and the BIO, Addendum 1. The components of the system above grade, except for the ducting, filter housing and transition pieces were designed and installed to general service requirements. These components are not expected to survive a design basis accident. The components of the system below grade and the above-grade ducting to the equipment pads were designed and installed to SC requirements and are expected to survive a design basis accident. The filter housing and the transition pieces were designed to SS. The Project W-320 strategy for maintaining the system safety function takes this into account. The project expects the Annulus Ventilation System to fail during a design basis accident. Following a design basis accident, the system damage will be assessed and a decision will be made to repair the permanent system or deploy a portable exhauster. Based on the most recent thermal analysis (assuming the technical safety requirement [TSR] temperature limits are maintained), the system could be down for a maximum of 25 days before the tank temperature would become a concern.

5.1.2 System Description

The Tank 241-AY-102 Annulus Ventilation System is an existing tank farm ventilation system that consists of ventilation supply and exhaust components. The ventilation system provides filtered air to the annulus to maintain dry conditions within the annulus as a corrosion protection measure, provide supplemental heat removal from the tank, and provide a means of primary tank leak detection.

The operation of the annulus ventilation system (also referred to as the K-2 Annulus System) is similar to that of other aging waste tanks. Outside air enters the Annulus Ventilation System through the louver intake assembly. To prevent frost damage to the supply filters, 2.5-kW radiant heaters are

mounted inside the louver intake. Intake air passes through dual pre-filters, a manual butterfly valve, and a second electric air intake heater. The second air intake heater is out-of-service. The air is then distributed throughout the annulus from a central point beneath the primary tank via underground ductwork.

Air is distributed to the annulus by eight drop legs, which connect to the supply duct. Four six-in. drop legs provide air to the midpoint of the annulus. Project W-320 blocked these legs to enhance tank bottom cooling. The remaining four drop legs deliver air to the tank bottom distribution plenum and into the air distribution grid work system (floor slots) beneath the primary tank.

Six ducts that merge into an underground vent header draw exhaust air out of the annulus. The exhaust air passes through an inactive electric heater and dual HEPA filter housings. Filtered air then exits the ventilation system through the exhaust fan and is discharged to the atmosphere via the 296-A-19 exhaust stack.

A continuous air monitor (CAM) and a record sampler monitor the Annulus Ventilation System. The CAM provides a means for primary tank leak detection by monitoring the annulus exhaust air, before filtration, for an increased presence of radionuclides. Downstream of the HEPA filters, a portion of the exhaust stream is drawn into the record sample cabinet and passed through a sample filter. The sample filter is collected periodically and sent to the laboratory for analysis.

In 1988, Project B-672 replaced all below-grade Annulus Ventilation System ducting associated with tank 241-AY-102. This upgrade was required due to excessive corrosion of the original unprotected ductwork.

Project W-320 also has performed several modifications of the Tank 241-AY-102 Annulus Ventilation System to enhance tank waste cooling. The modifications include blocking of the four drop legs which provide air to the midpoint of the tank annulus wall, replacement of the exhaust heater ducting, and replacement of pressure instrumentation. The annulus exhaust fan speed has been modified to provide an airflow rate of approximately 1,350 ft^3/min through the floor slots below the primary tank bottom. These modifications may be adequate to maintain waste temperatures within established limits to accommodate the complete removal of waste from tank 241-C-106. However, uncertainties in the waste parameters may require further modification of the system to include an inlet fan and an air intake chiller to increase the heat removal capability. These modifications may not be necessary until a decision is made to transport the entire sludge volume. The modifications to the annulus can then be made before the final batch of sludge is transported to tank 241-AY-102.

The Tank 241-AY-102 Annulus Ventilation System waste temperature control SC function, outage time, and design requirements associated with waste temperature control are addressed in the following discussions.

It should be noted that the BIO, Addendum 1, Table 4-1, identifies the Annulus Leak Detection System as performing an SC function in preventing the "Subsurface Leak Resulting in Pool" accident. This has been identified as an

error because the associated accident analysis does not credit the system with performing a safety function. Additionally, the BIO, Addendum 1, Table 3.4.2.15-1, incorrectly identifies the Primary Tank Leak Detection System as performing an SS function (it should have been noted as performing an SC function). Both of these inconsistencies will be corrected in the annual update to the BIO, Addendum 1.

This document does not evaluate the primary tank leak detection function because the leak detection system is a common tank farms system previously identified as SC by the BIO. Section 5.2 of this document briefly describes the tank leak detection system.

5.1.3 System Safety Functions

The Tank 241-AY-102 Annulus Ventilation System SC function associated with waste temperature control is to maintain tank waste temperatures below the local saturation temperature, thereby preventing the tank bump accident described in the BIO, Addendum 1, Section 3.4.2.11. Maintaining a tank waste temperature below the local saturation temperature also prevents an organic salt-nitrate reaction, addressed in the BIO, Section 5.3.2.17. However, the organic salt-nitrate reaction accident analysis does not specifically identify the Annulus Ventilation System as performing an SC function (temperature monitoring and active primary ventilation are the only safety systems identified).

To ensure local waste saturation temperatures are not reached, HNF-SD-WM-TSR-006 (Noorani 1997a) establishes double-shell tank waste temperature limits of 195 °F for the top 15 ft of waste and 215 °F for waste below 15 ft (see HNF-SD-WM-TSR-006, Limited Condition for Operation [LCO] 3.2.6). These temperatures are based on a local saturation temperature of 220 °F at atmospheric pressure for the supernate (based on the dissolved salt content of the waste) with the temperature adjusted to 240 °F for waste below 15 ft to compensate for the pressure differential. Both the 195 and 215 °F temperatures include a 25 °F subcool margin. This includes a 10 °F margin to account for temperature-monitoring instrument inaccuracies, and a 15 °F margin to allow response time to prevent the saturation temperature from being reached.

The SC functions of the annulus ventilation system credited in the BIO, Addendum 1 tank bump accident scenario are based on HNF-SD-W320-ER-004, *Project W-320 SAR and Process Control Thermal Analysis* (Sathyanarayana and Fryer 1997). This report concludes that primary ventilation (Project W-030 configuration) with no annulus ventilation flow will provide adequate cooling to maintain waste temperatures below the local saturation temperature following a 2-ft waste transfer. Therefore, it can be concluded that the Tank 241-AY-102 Annulus Ventilation System does not perform a safety cooling function until more than 2 ft of tank 241-C-106 waste have been transferred to tank 241-AY-102. This is further supported by TSR Temperature Control LCO 3.3.3, which requires the Annulus Ventilation System be verified operable during operation and limited modes only following the transfer of 2 ft of sludge into tank 241-AY-102.

Following the transfer of more than 2 ft of waste into tank 241-AY-102, the Annulus Ventilation System is relied on to provide cooling to maintain waste temperatures below the local saturation temperature. Assuming optimistic waste thermal parameters, a minimum of 1,000 to 1,200 ft^3/min slot flow through the annulus is estimated to be required to maintain waste temperatures below TSR limits following a 6-ft waste transfer. If it is determined during sluicing that additional cooling is necessary to maintain tank waste temperature below established limits, the annulus ventilation system performance requirements will be evaluated and modifications to the system will be made to provide the necessary enhanced cooling.

5.1.4 Allowable Outage Time

The Tank 241-AY-102 Annulus Ventilation System does not perform an SC function until more than 2 ft of waste have been transferred from tank 241-C-106 to tank 241-AY-102. Therefore, until more than 2 ft of waste are received at tank 241-AY-102, the Annulus Ventilation System is not required to be operational for waste temperature control and may be out of service for unlimited durations. When the Annulus Ventilation System is not operating, the CAM which is used to detect leaks into the annulus, is incapable of detecting leaks. However a second system of leak detection, the conductivity probes, is still capable of detecting leaks into the annulus.

Following transfer of more than 2 ft of tank 241-C-106 waste into tank 241-AY-102, the Annulus Ventilation System is required to be operational to maintain tank waste temperatures within established limits. System operation is required before and after a design basis accident; however, continuous uninterrupted operation is not required for the system to fulfill its credited safety function.

Sathyanarayana and Fryer (1997) calculate the time to reach the waste saturation temperature following a loss of annulus ventilation after 6 ft of waste have been transferred from tank 241-C-106 to tank 241-AY-102 (full waste transfer). Assuming waste temperatures are maintained at or below the 25 °F subcool margin (i.e., 195 and 215 °F TSR temperature limits are maintained), it is estimated that the tank waste would not reach the local saturation temperature for at least 25 days. The 25-day period to reach the waste saturation temperature considers a total loss of tank ventilation (primary and annulus) and is also bounding for a reduced supernate level (i.e., total waste volume in tank 241-AY-102 following a 6-ft waste transfer less than 15 ft).

It is anticipated that the waste temperature will be maintained at a temperature below the maximum allowable temperature, which will increase the available outage time. However, uncertainties associated with waste physical properties and the final Annulus Ventilation System operating configuration make it difficult to accurately project the maximum waste temperature expected following the 6-ft waste transfer. Therefore, the available outage time for the Annulus Ventilation System is conservatively established as 25 days.

5.1.5 System Design Evaluation

The Annulus Ventilation System has been evaluated to identify components that perform a safety function associated with system operation during normal and off-normal conditions. Individual components of the system relied on to preserve the system safety function are identified in the Appendix. Each of the SC criterion as applicable to the annulus ventilation system are addressed below.

5.1.5.1 Quality Assurance. Quality assurance requirements have been specified for all work performed on the Annulus Ventilation System. Underground ducting installed by Project B-672 was designed and fabricated according to ANSI B31.3-1987 (ANSI 1987) requirements for piping systems. Weld records were prepared for all welds and all pressure-containing welds, and attachment welds were visually inspected and subjected to nondestructive testing. Following fabrication, system pressure testing also was performed and independently verified.

Modifications (section 5.2.1) to the Annulus Ventilation System performed by Project W-320 also were conducted in accordance with the required quality controls. All work was designated as "SQ" and therefore was reviewed by Safety and Quality Assurance. Reviewers included Quality Assurance, Quality Control, and an Authorized Inspector (AI). Weld records were prepared for all welding, and all welds were subject to visual examination and enhanced nondestructive examination. System pressure testing also was performed and independently verified where applicable.

5.1.5.2 Single-Failure Criteria and Redundancy. The Tank 241-AY-102 Annulus Ventilation System design, as modified by Project W-320, provides redundancy to ensure that a single failure does not result in a loss of capability of the system to perform its required safety function. It is unlikely the permanent Annulus Ventilation System would fail such that the system was not restorable to an operable condition within the available recovery time. To ensure the system can sustain its credited safety function, a Portable Exhaust System has been provided as a backup to the permanent Annulus Ventilation System.

The Portable Exhaust System (section 5.7) provides redundancy for most above-grade components of the Annulus Ventilation System (active and passive components). The portable exhauster system will however, bypass and disable the annulus leak detection CAM. In addition the annulus ventilation system record sampler will no longer be functional. Below-grade components (drop legs and the distribution plenum) include only the Annulus Ventilation System ductwork, which does not perform an active function (passive function only). The below-grade components are designed in accordance with requirements for SC design loads and as such are relied on to remain intact following design basis accidents.

The Portable Exhaust System (section 5.7) includes a portable skid-mounted exhauster, a portable generator, air intake ducting and prefilter, ducting for connecting components to the underground ductwork, and other miscellaneous components required for system installation. All components of the Portable Exhaust System are maintained in an operable condition and can be installed within the 25 days established as the available system recovery time. An installation work package, startup testing procedures, and operating

and maintenance procedures have been prepared and are available to support the emergency deployment of the equipment should the need arise.

Upon detection of failure of the Annulus Ventilation System, a damage and failure assessment will be performed. A team consisting of Operations, Maintenance and Engineering personnel will be assembled to assess the damage. The assessment will consider the tank temperature, the extent of damage, and the estimated recovery time to repair the system to an operable condition. If it is determined that a repair cannot be made within the available recovery time, all or a portion of the portable annulus exhaust system (as required) will be deployed.

The components of the Portable Exhaust System are designed to maintain annulus slot flow estimated to keep waste temperatures below limits and all components are deployable within the allowable recovery time established for the system. The Portable Exhaust System provides a redundant means to maintain the cooling function of the annulus exhaust system.

5.1.5.3 Equipment Environmental Considerations. The Annulus Ventilation System is designed for the environmental conditions (temperature, humidity, and radiation) appropriate for the tank farms. The cooling function can be restored by repair of the Annulus Ventilation System or deployment of the portable exhauster in the unlikely event of failure resulting from environmental conditions. This ensures that tank waste temperatures will be maintained at or below established temperature limits following all postulated accident scenarios.

For the following discussion, components of the Annulus Ventilation System have been grouped into two systems: the below-grade ducting and the above-grade mechanical and electrical components. Equipment environmental considerations and qualifications are discussed below for each system."

5.1.5.3.1 Below-Grade Components. The Tank 241-AY-102 Annulus Ventilation System below-grade ductwork, including drop legs and distribution plenum as installed, is compliant with the SC environmental requirements specified in DOE Order 6430.1A, *General Design Criteria* (DOE 1989). The system was specifically designed for operation in the environment associated with storage of high-heat radioactive waste and can withstand the evaluation basis earthquake.

In 1988, Project B-672 completely replaced the below-grade ducting associated with the Annulus Ventilation System with new corrosion-resistant ducting. In addition, Project B-672 replaced all existing supply and exhaust ducting from the underground annulus tie-in connections at the tank to the equipment pads. Work was performed following functional design criteria SD-672-FDC-001 (RHO 1986) and Construction Specification B-672-C2 (KEH 1988).

The below-grade ductwork installed under Project B-672 was specifically designed to operate in an environment associated with the storage of high-heat radioactive waste. The design preserved the original operating parameters established for the system and considered heat loads resulting from "worst-case" high-heat radioactive wastes.

The below-grade ductwork was classified as Category I and designed and analyzed for the safe shutdown earthquake as outlined in Hanford Plant Standard Design Criteria SDC-4.1, "Standard Arch-Civil Design Criteria," Revision 10 (horizontal ground acceleration of 0.25 g) (RL 1993). SDC 4.1, Revision 10 Category I criteria were applicable to nuclear reactors and structures for the storage of plutonium, and represented the highest level of seismic protection specified for U.S. Department of Energy facilities at the time.

In *Natural Phenomena Hazard Design and Evaluation Criteria for Department of Energy Facilities* (DOE 1994), the DOE provides guidance for facility-appropriate design accelerations to be used in seismic evaluations. Use of the specific guidance depends on the facility hazard category and performance category of the equipment. For existing Hazard Category 2 facilities with Performance Category 3 equipment such as the underground storage tanks, a peak horizontal ground acceleration of 0.19 g is used as the evaluation basis for accident analysis. This value (0.19 g) was used in the accident analysis included in the BIO, Section 5.3.2.23 to evaluate the effects of a postulated seismic event on the facility and represents the evaluation basis earthquake. This analysis concludes that tank failures, major structure collapse, and pipe ruptures would not be expected to occur following the evaluation basis earthquake.

As previously noted, the Tank 241-AY-102 Annulus Ventilation System below-grade ducting was designed in accordance with SDC 4.1, Category I criteria. These criteria impose a horizontal ground acceleration of 0.25 g, which exceeds the 0.19 g ground acceleration considered in the BIO accident analysis. It can therefore be concluded that the below-grade ducting will remain intact and in an operable condition following the evaluation basis earthquake.

5.1.5.3.2 Above-Grade Components. The above-grade mechanical and electrical components associated with the Tank 241-AY-102 Annulus Ventilation System perform an active SC function in maintaining tank waste temperatures below established limits. Although the SC components are required to perform their safety functions following a design basis accident, 25 days of recovery time are available to repair the system and reestablish operation following a system failure.

The filter housings and the transition pieces were designed, fabricated and installed to safety significant requirements (Jennings 1995). The balance of the above-grade mechanical and electrical components were designed, fabricated, and installed following standards and regulations applicable for general service equipment. Although the equipment was specifically designed for the extreme environmental conditions appropriate for the tank farms, the design of the components did not consider SC loads resulting from natural phenomena (i.e., wind, seismic, ashfall, etc.).

Following a design basis accident, all above-grade mechanical components are assumed to fail. If it is determined the system cannot be restored to an operable condition within the recovery time available, the Portable Exhaust System can be installed as required to restore active ventilation. The Portable Exhaust System includes all components necessary to connect the Portable Exhaust System to the annulus supply and exhaust the annulus by

connecting to riser 19B. A separate portable generator has been identified for electrical power to the portable exhauster. The entire system or a portion of the system may be deployed as needed to restore the annulus airflow required to maintain tank waste temperatures.

5.1.5.4 Maintenance. The design of the Annulus Ventilation system provides for routine maintenance of the system components. All components designated as SC/SS, as well as other components that could be subject to failure, are located above grade in locations that facilitate maintenance to the maximum extent possible. The system design considered the potential to become contaminated and incorporated contamination control features where feasible. All exhaust air is filtered.

5.1.5.5 Testing. The Tank 241-AY-102 Annulus Ventilation System includes provisions for periodic testing of monitoring, surveillance, and alarm systems. Instrumentation is calibrated at a frequency based on the function the instrument serves. System functional testing also is performed periodically to verify proper system operation and response as required to maintain the system SC function.

5.1.6 Reliability

The reliability of the Annulus Ventilation System has been assessed (Braun et al. 1998a) using reliability block diagram methods. Evaluation of historical on line time of the annulus exhaust system was not performed. An allowed time for recovery of 14 days was used for the reliability study. Fourteen days were used to bound the outage time. When the reliability study was being done, the outage time varied between 19 and 31 days. Fourteen days were used as a conservative outage time to establish a bounding outage time for the system. Evaluations have been made considering the K2 annulus system alone and in combination with the portable exhauster and backup diesel generators (see Table 5-1). Assuming a general service design basis, a reliability of 94.88% was calculated for the K2 system alone, and the reliability is 98.96% with the K2 system in combination with the portable exhauster.

The contribution of component failures due to seismic or high wind events to total ventilation system reliability is small. Accordingly, the significance of qualifying certain components to SC will provide minimal improvement in the reliability of any of the ventilation systems or configurations (less than 0.5%). The reliability of the K2 system with an SC design basis is 95.35%. The reliability of the K2 system in conjunction with the portable exhauster with both systems as SC is 99.10%. Upgrading the systems to SC can not be shown to be cost effective based on increased reliability.

Table 5-1. Annulus Exhaust Ventilation System Reliabilities.

System combinations and design bases		Calculated system reliability
K2 Annulus Ventilation System	Portable exhauster	
General service	--	94.88%
Safety class	--	95.35%
General service	Safety significant	98.96%
Safety class	Safety class	99.10%

5.2 PRIMARY TANK LEAK DETECTION SYSTEM (SAFETY CLASS)

The primary tank leak detection function is not addressed in this document because the leak detection system is a common tank farms system previously identified as SC by the BIO. The transfer of waste from tank 241-C-106 to tank 241-AY-102 does not change the previous SC function of the Primary Tank Leak Detection System, nor does it influence the system performance requirements. Therefore, this evaluation does not address the associated SC functions and system requirements.

The system consists of two methods of leak detection (the annulus conductivity probes and the annulus exhaust CAM). Only one of these method is required to be in operation at any given time.

Functional requirements and characteristics for the Primary Tank Leak Detection System are defined in HNF-SD-WM-TSR-006, Bases B 3.2.6 (Noorani 1997a) and WHC-SD-WM-RD-057, *Tank Waste Remediation System Safety Structures, Systems, and Components: Requirements and Characteristics* (Smith-Fewell 1997). The safety classifications for the individual components of the Primary Tank Leak Detection System are identified in HNF-SD-WM-SEL-040, *TWRS Safety Equipment List* (Jensen 1998).

5.3 TANK 241-AY-102 PRIMARY TANK VENTILATION SYSTEM (SAFETY CLASS)

The following discussion evaluates the suitability of the Project W-320 WRSS Primary Tank 241-AY-102 Ventilation System to perform the safety function(s) specified for the system by the BIO, Addendum 1.

5.3.1 Strategy Summary

The safety function of the primary ventilation system is to dilute gases released from the waste in a steady-state manner such that flammable gas concentrations in the dome spaces remain below 25% of the lower flammability limit (LFL) (25% LFL) and aid in heat removal to maintain the tank waste temperatures below the saturation temperature.

Project W-030 recently built the primary ventilation system for tank 241-AY-102 to ventilate all four tanks in the Aging Waste Facility. Designated SC by the BIO and the BIO, Addendum 1, the system was originally designed and constructed as SC 2 in accordance with the original project criteria. Project W-030 has produced documentation that evaluates the equipment against SC criteria, including procurement, quality assurance, design, and reliability. This evaluation concludes that, owing to the degree of reliability already inherent in the system, and because much of the equipment actually meets SC requirements as procured and designed, additional upgrades or engineering will not provide a significant benefit and the system should be dedicated, without modification, as SC.

The U.S. Department of Energy (RL) has accepted this project assessment and allowed the system to continue operation as constructed based on this recommendation.The system provides the safety functions necessary to support operation of the WRSS. As a contingency, Project W-030 is also developing the design media, procedures, and other documentation necessary to install and operate an emergency backup exhauster to ventilate tank 241-AY-102 within a reasonable outage duration, providing additional redundancy to the existing system.

The bounding accident is a tank bump due to an increase in tank temperature. Based on thermal analyses of the system, it is estimated that primary ventilation can be down for a maximum of 50 days, with 2 ft of waste transferred and 2 ft of supernate covering the waste, before waste temperature becomes a concern, provided the annulus ventilation system is still running. The outage time for a 2-ft waste transfer is 130 days with a full supernate pool.

The system is also credited with maintaining the flammable gas concentrations below 25% LFL. The tank is expected to reach 25% LFL in 7.7 days following loss of ventilation. The time to reach 25% LFL is not the bounding condition. There is no immediate threat to safety as long as ignition controls are in place in accordance with TSR A.C. 5-10. Recovery work activities around the tank would become restricted following a loss of ventilation, due to a potential accumulation of flammable gas in the tank vapor space. Work activities are also restricted whenever vapor space confinement is lost, based on a need for radiological protection of onsite personnel.

5.3.2 System Description

The AZ-702 ventilation system provides primary ventilation for all four Aging Waste Facility tanks, including tank 241-AY-102. The system is housed in a new building, 241-AZ-702, and was constructed under Project W-030 to replace the existing 702-A Aging Waste Facility ventilation system, which had exceeded its design life and was no longer considered reliable. The new system and its operation are described in detail in the BIO, Addendum 3, and in HNF-1903, *Project W-030 Tank Farm Ventilation Upgrade System Descriptions* (Briggs 1997).

The new system provides ventilation, heat removal, and radiological confinement for all four Aging Waste Facility tanks. Ventilation and confinement are provided by a common exhaust system with a condenser, high-efficiency mist eliminator (HEME), and two redundant air cleanup filter trains with fans that exhaust through a common stack. A recirculation ventilation cooling loop on each tank removes heat from the ventilation airstream and, in turn, from the tank waste, by circulating the tank atmosphere through a chiller and condenser system by means of a closed loop of ductwork. Some heat removal also can be achieved by the common exhaust system if one or more of the recirculation cooling loops is bypassed.

The common exhaust system is connected to the tank header system. The tank header is connected to all four tanks. The header mixes the individual tank exhaust. The mixing of the four tank exhausts minimizes the potential flammable gas accumulation. The recirculation loops and intake flow control and filter systems on individual tanks have been evaluated on a component level and modified to meet the Ignition Control Set #2 (Noorani 1997a) for normal continuous operation in an intrusive location. Some of the equipment in these tank-specific systems, including inlet heaters and heat tracing, must be deenergized before conducting any waste-disturbing activities in the tanks (including WRSS operations) because it does not meet the more stringent controls for such activities. This limitation does not adversely affect the safety functions of the ventilation system or any of its components.

A portable exhauster (see Section 5.7) is available for installation, as part of a recovery plan, in the event that the 241-AZ-702 system is lost due to an accident or natural phenomenon and cannot be brought back on line in the allowable outage time. A riser has been identified and dedicated for this use, and the design media, procedures, installation work packages, and other necessary documentation have been prepared in advance to enable the exhauster to be installed and put in service within 7 days if needed.

5.3.3 System Safety Functions

Primary ventilation of tank 241-AY-102 is credited with preventing a flammable gas deflagration or a tank bump during waste retrieval from tank 241-C-106 and subsequent storage in tank 241-AY-102 (BIO, Addendum 1, Sections 3.4.2.8 and 3.4.2.11, respectively). Both accidents classify the primary ventilation system as SC. The associated safety functions are (1) to maintain the flammable gas concentration in the tank vapor space to 25% or less of the LFL by a process of continuous dilution; and (2) to help provide sufficient waste cooling, by drawing warm air from the tank by once-through or recirculation ventilation, to maintain the waste temperature below the TSR limits. The primary ventilation system alone is sufficient to maintain waste temperatures within limits for the first 2 ft of waste transfer from tank 241-C-106. Thermal analyses (Sathyanarayana and Fryer 1997) have shown annulus ventilation to be a more effective means of heat removal than the primary system. The primary system augments the annulus system heat removal safety function after the transfer of more than 2 ft of waste from tank 241-C-106. After the transfer of 2 ft of waste, the main function of the primary ventilation system becomes dilution of flammable gases in the tank vapor space since the annulus ventilation system is relied upon for heat removal.

Tank 241-AY-102 primary ventilation is required to be operable at all times in accordance with LCO 3.2.1 (Noorani 1997a). The primary ventilation system also provides confinement, for radiological protection of onsite workers, by HEPA filtration and by maintaining a negative pressure in the tank. Ventilation is described in the BIO, Section B2.4.3.7, and the relevant analyses and controls for HEPA filters are discussed in the BIO, Section 5.3.2.2.

5.3.4 Allowable Outage Time

An estimate of allowable outage time for the tank 241-AY-102 primary ventilation system may be based on either of its two safety functions: dilution of flammable gases or waste cooling. After a loss of primary ventilation, the concentration of the flammable gases in the dome space and the temperature of the waste will gradually increase over time. Waste temperature will ultimately define the allowable outage time for primary ventilation.

After a loss of ventilation, LCO 3.2.1 specifies corrective actions that must be initiated to avoid a TSR violation. These required actions are compensatory measures that allow work activities (e.g., to restore the ventilation) to continue on a restricted basis. These actions are as follows.

- Immediately stop all waste-disturbing activities.
- Immediately start work on restoring active primary ventilation, or developing an approved recovery plan to do so.
- Monitor the tank vapor space within 72 hours, and repeatedly at 72-hour intervals, to verify the flammable gas concentration is below 25% LFL.

The rate of forced ventilation required to maintain the flammable gas concentration in the tank within acceptable limits is very small, on the order of a few standard cubic feet per minute. However, if forced primary ventilation is completely lost, flammable gases will accumulate in the tank vapor space and eventually reach 25% LFL. Based on a theoretical model and limited field data, the rate of flammable gas accumulation in the tank 241-AY-102 dome space will vary somewhat depending on the stage of waste retrieval or the depth of waste in the tank (i.e., pre-sluicing vs post-sluicing) (Estey 1997). Table 5-2 presents the results of these calculations.

Table 5-2. Time (Days) to Reach 25% and 100% of Lower Flammability Limit.

Tank 241-AY-102 (status)	Time (days)	
	25% LFL	100% LFL
Pre-sluicing	10	46
Post-sluicing	8	34

LFL = lower flammability limit

These results suggest that the vapor space in tank 241-AY-102 could reach a hydrogen concentration of 25% LFL in little more than a week following a complete loss of active primary ventilation, with the tank only passively "breathing" (i.e., ventilated by variations in barometric pressure). After verifying, by gas monitor, that the concentration of flammable gas has reached 25% LFL, restoration of the ventilation system can continue. However, additional procedural restraints will be imposed due to the flammable gas concentration exceeding 25% LFL. These activities include an immediate stop to staffed activities at intrusive locations (unless necessary and approved as part of restoring the ventilation) and deenergizing the equipment that does not meet Ignition Source Control Set 2 requirements (Noorani 1997a). Given these controls, work can progress to restore ventilation. The standby portable exhausters meet the ignition source control requirements and may still be operated at this point. From the standpoint of work restrictions, monitoring requirements, or ignition controls, there is little difference whether the tank vapor space is at 25% or 100% LFL.

In the case of waste heating, following a 2 ft. transfer, if primary ventilation is not restored the waste temperature will gradually increase and could eventually exceed the safety limit for the tank structure.

A combination of annulus and primary ventilation cools the waste. A loss of either system will lead to a gradual rise in waste temperature, ultimately reaching the saturation temperature and resulting in a tank bump. Section 5.1 discusses the allowable outage time following a loss of annulus ventilation. Based on the results of HNF-SD-W320-ER-004, *Project W-320 SAR and Process Control Thermal Analyses* (Sathyanarayana and Fryer 1997), an estimated allowable outage time for the primary system would be 250 days, given the planned 6 ft of high-heat waste has been transferred from tank 241-C-106 to tank 241-AY-102 (and provided the annulus system continues to operate). In a pre-sluicing condition, or with up to 2 ft of waste transferred from tank 241-C-106 to tank 241-AY-102 (i.e., before a requirement for active ventilation of the annulus), the primary ventilation system may be relied upon alone to provide cooling to prevent a tank bump. At this stage, a loss of primary ventilation will also result in an increase in waste temperature, but the increase will not be as great or as rapid as in the case following a transfer of 6 ft of high-heat waste from tank 241-C-106. A loss of primary ventilation

for a 2-ft transfer of waste with a 2-ft supernate pool (annulus ventilation not needed for 2-ft transfer) results in the waste temperature reaching saturation in 50 days. A loss of primary ventilation for a 2-ft transfer of waste with a full supernate pool results in the waste temperature reaching saturation in 130 days.

Therefore, based on the results of the thermal analyses (Sathyanarayana and Fryer 1997) conducted for Project W-320, and given the fact that recovery work can continue on a restricted basis following a loss of primary ventilation, 50 days may be considered a reasonable bound for estimated outage time. The restrictions previously discussed are compensatory measures to allow work to progress to restore active ventilation, either by repairing the existing tank 241-AZ-702 equipment or installing a portable exhauster, while minimizing the possibility of a flammable gas deflagration. As discussed in Section 5.3.2, the portable exhauster provides a means of recovery which can prevent flammable gas build up as well as a tank bump while corrective maintenance/replacement activity is carried out to restore the primary ventilation system. If the existing (permanent) equipment can be repaired, within the allowable outage time, the portable exhauster will not be necessary.

5.3.5 System Design Evaluation

5.3.5.1 Quality Assurance. The 241-AZ-702 ventilation system was procured and designed to meet SC 2, or SS, requirements in accordance with the original Project W-030 criteria. Procurement of safety-related equipment was in accordance with appropriate quality assurance requirements, including test and inspection documentation, supplier qualifications, certified data on materials used, and certification of compliance with project specifications. The same procurement requirements apply in large part to SC equipment. Any future maintenance, parts replacements, or modifications will be performed in accordance with the appropriate quality assurance requirements.

5.3.5.2 Single-Failure Criteria and Redundancy. There is considerable redundancy designed into the tank 241-AY-102 primary (702-AZ) ventilation system. Fans and HEPA filters are arranged in parallel trains with crossover lines enabling various equipment combinations to run. Although the recirculation loops, primary condenser, and HEME are not redundant, they can be bypassed and taken off line for maintenance with no immediate adverse affects on overall system operation. Instrumentation and controls are designed to enable local manual operation of the system in the event of a loss of the control room or automatic controls. Normal electrical power is backed up by a permanently installed diesel-powered generator of adequate capacity to power the entire system.

In most cases, a single failure of any component will not result in a loss of required safety functions. In cases where it does, operations can rely upon allowable outage time, along with portable exhausters, generators, and various spare parts, in addition to hardware redundancy, to ensure system reliability. Project W-320 is developing contingency plans to ensure suitable portable equipment is available for installation following a design basis natural phenomena event in which power or ventilation is lost.

Reliability studies and other documents produced by Project W-030 (e.g., HNF-SD-WM-CN-123, *Reliability Study of the 702-A and 702-AZ Ventilation Systems* [Braun 1997]; HNF-SD-W030-ANAL-003, *Reliability Evaluation of the Electrical Power Distribution System for Tank Farm Ventilation System Primary Exhaust Fans in Building 241-AZ-702* (Kriskovich 1997a); and HNF-1788, *Project W-030 Safety Class Upgrade Summary Report* [Kriskovich 1998]) concluded that the 702-AZ ventilation system has a high degree of reliability as constructed, and meets the criteria for an SC system.

5.3.5.3 Equipment Environmental Considerations. The 702-AZ ventilation system was procured and designed to be compatible with the anticipated environmental conditions, as defined in project design basis documentation. Both external conditions and properties of the exhaust stream were considered. Most major components were classified and procured as safety-related equipment. The environmental qualifications were verified as part of the procurement process, using testing, analysis, or other methods as appropriate. Environmental qualification of components is documented with submittals in the project files, and summarized in HNF-SD-2030-RPT-001, *Project W-030 Safety Equipment Evaluation* (Kriskovich 1997b).

5.3.5.4 Maintenance. The 702-AZ ventilation system was designed for maintainability. All maintenance on the new system can be performed above ground, minimizing worker exposure. Control valves and major components can be bypassed without interrupting system operation. The HEME has remote flushing capability. The HEME is a system design feature that minimizes the spread of contamination to the downstream ductwork and primary filter trains. The system has been turned over to operations with a complete set of verified maintenance and calibration procedures.

5.3.5.5 Testing. The 702-AZ ventilation system was designed to enable regular testing of system functions, including surveillance and alarms, while the system is operating. The filter train is designed for in-place testing of HEPA filters in compliance with ASME N510-1989, *Nuclear Air-Cleaning Systems* (ANSI/ASME 1989b).

5.4 TANK 241-C-106 PRIMARY TANK VENTILATION SYSTEM (SAFETY CLASS)

The following discussion evaluates the suitability of the Project W-320 WRSS Primary Tank 241-C-106 Ventilation System to perform the safety function(s) specified for the system by the BIO and the BIO, Addendum 1.

5.4.1 Strategy Summary

The safety function of the primary ventilation system is to dilute gases released from the waste in a steady-state manner such that flammable gas concentrations in the dome spaces remain below 25% LFL and to remove heat to maintain the tank waste temperatures below the TSR limit for waste temperature.

The tank 241-C-105 and 241-C-106 ventilation system includes the existing 296-P-16 exhaust system, the new 296-C-006 ventilation system and a portable

exhauster. The 296-C-006 and the portable exhauster were provided as part of Project W-320. The function of the 296-P-16 exhaust system, the 296-C-006 ventilation system and the portable exhauster have been designated SC by the BIO and the BIO, Addendum 1.

With a few exceptions, the majority of the components comprising the tank 241-C-105 and 241-C-106 ventilation system were designed, fabricated, and installed before being designated SC. Accordingly, most of the components of the ventilation system were installed as general service equipment and as such are not expected to survive a design basis accident.

The critical SC function the tank 241-C-105 and 241-C-106 ventilation system performs is to maintain tank 241-C-106 waste temperature below the local saturation temperature, thereby preventing a tank bump accident. Active ventilation, however, is not required to be continuous to maintain waste temperatures below the local saturation temperature and considerable outage time is available to restore system operation in the event of a ventilation failure.

The project strategy for ensuring the SC functions of the tank 241-C-105 and 241-C-106 ventilation system are preserved following a design basis accident is to take advantage of system redundancy and spare parts as well as the outage time available for recovery. Based on the extent of redundancy and the significant amount of outage time available, the tank 241-C-105 and 241-C-106 primary ventilation system, as designed and installed, meets all applicable functional requirements specified for SC systems and, as such, can be relied on to perform its SC functions following a design basis accident.

5.4.2 System Description

Two independent heating, ventilation, and air conditioning (HVAC) systems will be used to provide required ventilation at tanks 241-C-105 and 241-C-106. The systems to be used include the existing 296-P-16 exhaust system and the new 296-C-006 system installed by Project W-320. Both of the HVAC systems have been designated as SC systems.

The 296-P-16 exhauster provides active ventilation to tanks 241-C-105 and 241-C-106 and will continue to be operated until sluicing operations are initiated. Once sluicing operations are initiated, the 296-P-16 exhauster will be shut down and placed in a standby mode. At such time, active ventilation at tank 241-C-106 will be provided by the new 296-C-006 exhaust system. Before the 296-P-16 exhauster is shut down, tank 241-C-105 will be placed in a passive ventilation mode. While in the standby mode, the 296-P-16 ventilation system will be maintained in an operational condition and will be available for use should a need arise.

The following sections provide a general description of the 296-P-16 and the 296-C-006 exhaust systems.

5.4.2.1 296-P-16 Exhaust System. The 296-P-16 Exhaust System is installed for permanent use at tanks 241-C-105 and 241-C-106. The 296-P-16 exhaust system is continuously operated in accordance with *Tank Farm Plant Operating Procedure TO-060-050* and is occasionally shut down for short periods to perform system maintenance. System shutdown requires that tanks 241-C-105 and 241-C-106 be placed in a passive ventilation mode.

The 296-P-16 Exhaust System ventilates the tanks, thereby cooling the tank contents and controlling the concentration of flammable gases within the tank dome space. Although the primary function of the exhaust system is to ventilate tanks 241-C-105 and 241-C-106, the system also provides limited ventilation to tank 241-C-104 via the 3-in. cascade line from tank 241-C-105.

The 296-P-16 exhaust system will not be operated during sluicing operations. The primary function of the 296-P-16 exhaust system in support of sluicing operations is to cool the tank 241-C-106 waste before the initiation of sluicing to reduce the potential for a steam release event during waste retrieval. The system will also serve as a backup system to the 296-C-006 ventilation, once sluicing has been initiated. Operation of the system as a backup will require shutdown of any sluicing operations in progress.

Major components of the 296-P-16 exhaust system include the tank 241-C-105 and tank 241-C-106 air intake stations and the 296-P-16 exhauster. All components of the systems were designed and built in accordance with general service requirements. The major system components are discussed as follows.

5.4.2.1.1 Tank 241-C-105 and Tank 241-C-106 Air Intake Stations. The ventilation system draws air into tanks 241-C-105 and 241-C-106 via the air intake stations and the cascade lines, and through in-leakage from various unsealed tank components connected to the tank dome. Although a significant amount of air is drawn into the tank from other sources (approximately 45% for tank 241-C-106 as presently configured), the primary air intake for tanks 241-C-105 and tank 241-C-106 is the air intake stations.

The tank 241-C-105 and 241-C-106 air intake stations are of similar design with the primary difference being the overall size and capacity of the units (the tank 241-C-106 intake station is considerably larger). Each unit includes a screened air entrance duct, prefilter, HEPA filter, control valve (damper), differential pressure gauges, and support structure. The air intake stations are connected to the tank via a 12-in.-diameter duct which connects to a flanged tank riser (the tank 241-C-105 air intake station is connected to Riser 2; the tank 241-C-106 air intake station is connected to Riser 15). Differential pressure gauges provide indication of the pressure differential across the prefilter and the HEPA filter. Filters are changed out upon indication of a high differential pressure.

Project W-320 modified the tank 241-C-106 air intake station to include an air chiller coil (CC-1361), a new control valve, and additional instrumentation. The cooling coil is installed downstream of the filter enclosure and is designed to maintain inlet airflow at a constant 40 °F temperature. A 46% glycol solution supplied from the chiller skid circulates

through the cooling coil. The cooling coil includes a condensate drain that returns condensate to tank 241-C-106 via the intake duct.

Instrumentation installed by Project W-320 at the air intake station includes temperature indicators, installed upstream and downstream of the cooling coil, and a pressure differential indicator which indicates the pressure differential across the cooling coil. All instruments associated with the air intake stations (existing and newly installed) provide local indication only. Operators monitor instrumentation associated with the air intake stations as part of operator rounds, which are performed on a regularly scheduled basis.

5.4.2.1.2 296-P-16 Exhauster Components. The 296-P-16 exhauster is a 7,000 ft^3/min exhauster installed at the C-Farm, located between tanks 241-C-105 and 241-C-106. In the present service configuration, the capacity of the exhauster is limited to approximately 3,000 to 3,500 ft^3/min. Ventilation airflow rates are maintained at approximately 2,400 ft^3/min through tank 241-C-106 and approximately 1,000 ft^3/min through tank 241-C-105, at a vacuum pressure of approximately -1.5 in. water gauge (w.g.).

The 296-P-16 exhauster includes exhauster ducting, a deentrainer, control valves, an exhauster assembly (two 50-kW heaters, a prefilter, and two HEPA filters in series), an exhaust stack, and system-monitoring instrumentation. Air is drawn from the dome space of the tanks by the exhauster via exhaust ducts installed at tank 241-C-105, Riser 11 and tank 241-C-106, Riser 2. Valves located immediately downstream of each tank riser connection control tank airflow rates and provide isolation when needed.

Downstream of the valves the duct work joins together and connects to the deentrainer. As air passes through the deentrainer, liquid droplets and large particles are separated from the airstream. Liquid accumulated by the deentrainer (during operations and flushing) is collected and drained back to tank 241-C-106. A differential pressure gauge installed on the deentrainer provides local indication of the pressure differential across the deentrainer. Flush valves and piping are included to flush the deentrainer when a high differential pressure is observed.

Upon exiting the deentrainer, air passes through an 18-in. butterfly valve and enters the exhauster assembly. The exhauster assembly includes a heater assembly, a filter assembly and an exhaust blower.

The heater assembly contains two 50-kW electrically powered heaters that reduce the relative humidity in the airstream before entering the filters. A locally mounted thermostat and control circuit control the heaters. Temperature switches are installed upstream (TS1) and downstream (TS2 and TS3) of the heater assembly. TS1 opens above 190 °F and shuts off power to heater #1. TS2 opens above 180 °F and shuts down heater #2. TS3 opens below 140 °F and shuts off power to the exhaust vent blower.

Downstream of the heater assembly, air passes through a prefilter and a two-stage HEPA filter. Differential pressure gauges are installed at each filter stage. Differential pressure gauges across the HEPA filters also include pressure switches. Pressure switch PS-1-EXH-A senses the differential pressure across the second HEPA filter. The switch is normally closed and

opens on a low differential pressure. When the switch opens, it shuts off power to the exhauster blower. PS-1-EXH-B senses pressure across the first filter. The switch is normally closed and opens on a high differential pressure. Upon opening, the pressure switch activates a local audible and visual alarm annunciator.

The ventilation system exhaust blower located downstream of the HEPA filters maintains the required airflow to the tanks. A 15-hp, 440-V, 3-phase electric motor powers the exhaust blower. The blower starter control includes a time-delay circuit that does not allow low temperature or low and high differential pressure switches to trip the interlocks or activate an alarm during the first 4 to 5 minutes following startup.

As with the deentrainer, the exhauster assembly includes a drain system to collect liquid generated during system operation. The exhauster drain system connects to the deentrainer drain, which drains liquid back to tank 241-C-106, Riser 2 via a seal pot. Drain lines are heat traced to provide freeze protection in the winter months.

The exhaust blower discharges air to the atmosphere via the exhaust stack. The exhaust stack includes a monitoring system with a CAM and a proportional record sampler. The CAM samples the exhaust stream and is interlocked to shut down the exhaust fan when high radiation levels are detected (Project W-320 installed the CAM interlock). The CAM also has an alarm to indicate equipment failure.

5.4.2.2 296-C-006 Ventilation System. The 296-C-006 ventilation system will be operated during all active sluicing operations. The system is designed to provide enhanced ventilation capabilities, reduce emissions, and control pressure, temperature, and humidity during sluicing activities. The system includes equipment to limit the release of hazardous aerosols and vapors, as well as a radiation monitoring system to ensure system effectiveness and maintain emissions of radionuclides as low as reasonably achievable.

The 296-C-006 ventilation system is a combination recirculation and exhaust system. The recirculation portion of the system removes heat from the tank 241-C-106 vapor space, reduces fog for improved visibility in the tank, and dehumidifies the recirculating air. The exhaust portion of the system maintains the required tank negative pressure in the tank and provides for the dilution of flammable gases generated by the tank waste, thereby maintaining gas concentrations within the tank dome space below 25% LFL.

Major components of the 296-C-006 ventilation system include the Process Building, the chiller skid, the exhaust skid, the Ventilation Exhaust Radiation Monitoring System, and the 241-C-106 seal loops. Most of the components of the 296-C-006 exhaust system were designed to be portable to facilitate use at other locations and/or decommissioning.

Except for the seal loops, all components of the 296-C-006 ventilation system were designed, fabricated, and installed as general service equipment. The seal loops were designed, fabricated, and installed as SC components.

5.4.2.2.1 Process Building. The Process Building (241-C-91) is an insulated, environmentally controlled metal building that houses the Process Building skid. The Process Building is divided into two rooms. Room 1 contains the HVAC process vessels and equipment, and generally will not be accessible during operations. Room 2 contains instrumentation panel IE-1361, and will be routinely used by operators. A shielding wall separates the two rooms.

Major components of the Process Building skid include a condenser, a moisture separator, a heating coil, a recirculation fan, a HEME, a high-efficiency metal filter (HEMF), a portable exhauster connection, a seal pot, and a gamma detector. Compressed air and raw water supply systems are provided to the process building to support operation of the ventilation system, such as back washing the HEME and flushing the HEMF.

Gases from the 241-C-106 headspace enter the ventilation system through a 10-in. duct located at Riser 15 at a rate of 1,040 to 1,220 ft^3/min and enter the condenser (HX-1361). The condenser cools the air, condenses moisture in the airstream, and returns the condensate to the tank. The condenser is a shell- and tube-type condenser designed to meet the requirements of ANSI/ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, *Rules for Construction of Pressure Vessels* (ASME 1995). The ventilation airstream, circulating on the shell side, is normally cooled to about 40 °F by the chilled water cooling system, which circulates a 46% propylene glycol solution on the tube side. The condenser shell side is designed for an airflow of 1,040 to 1,220 ft^3/min, an inlet temperature range of 50 to 180 °F, an outlet temperature range of 33 to 180 °F, and an operating pressure range from -5.9 to -0.3 in. w.g. The condenser tube side is designed for a coolant flow of 110 gal/min, an inlet temperature range of 31 to 90 °F, and an outlet temperature range of 36 to 90 °F. Condenser capacity is 250,000 Btu/h.

Upon passing through the condenser, part of the flow (860 ft^3/min) circulates through the moisture separator and heating coil and returns to tank 241-C-106 through an 8-in. duct located at Riser 2. The moisture separator (MS-1361) removes moisture from the airstream and returns the liquid to the tank. The moisture separator is a centrifugal mist eliminator that removes moisture droplets from the recirculation airstream by centrifugal force and gravity. Drains from the moisture separator are routed to the seal pot in the Process Building and return to tank 241-C-106.

The recirculation heating coil (HC-1361) reduces the relative humidity of recirculating air and protects the recirculation fan from erosion by liquid aerosols. The heating coil is rated at approximately 30 kW. Liquid drains from the heating coil are routed to the Process Building seal pot for return to tank 241-C-106. Heating coil HC-1361 is interlocked with recirculation fan FN-1361 and shuts off automatically when the fan shuts down.

The recirculation fan (FN-1361) is direct driven by a 7.5-hp, single-speed, electric motor and has a rated capacity of 860 ft^3/min at 19 in. w.g. pressure differential. The fan is a centrifugal type and is of 304 L stainless steel construction. Liquid that drains from the recirculation fan is routed to the Process Building seal pot for return to tank 241-C-106.

The portion of air that is not recirculated (normally 230 ft^3/min) passes through the HEME and the HEMF and is directed to the exhaust skid. The HEME (HME-1361) is a cartridge-type moisture eliminator with a monofilament fiberglass filter bed, designed for an airflow of 180 to 360 ft^3/min at a face velocity of 30 ft/min, a temperature of 40 °F, and a pressure of 14.2 psia. The removal efficiency rating of the HEME is 99.5% for particles that are 0.5 μm and larger, which removes any moisture carryover from the condenser. The filter housing is constructed of 304 L stainless steel and is designed to meet the requirements of ANSI/ASME Section VIII, Division 1 (ASME 1995). The HEME has a provision for periodic back washing with filtered raw water to increase its efficiency. Retained particulate material is returned to tank 241-C-106 via an encased drain line connected to the sluicer dropleg. Back washing of the HEME may be initiated either manually by the operator or automatically by a timer. The HEME has a bypass that allows for continued operation of the ventilation system during the back-washing process and also includes a jacket filled with shielding shot to reduce the dose should radioactive material become trapped in the assembly.

Once air passes through the HEME it enters the HEMF. The HEMF (HMF-1361) has several sintered metal fiber-type filters arranged cylindrically within a vessel. The HEMF is designed for an airflow of 180 to 360 ft^3/min at a temperature of 40 °F and a pressure of 13.9 psia. The HEMF will act as a prefilter for the HEPA filter (in the exhaust stream) and will remove at least 99.97% of the particles sized 0.3 μm and greater. The filter housing is constructed of 304 L stainless steel and designed to meet the requirements of ANSI/ASME Section VIII, Division 1 (ASME 1995). The HEMF has provisions for back flushing using filtered raw water. Back flushing is followed by a compressed air blow down and drying of filter media. Back flushing of the HEMF is manually initiated by the operator, as required, at a predetermined radiation level as sensed by a local detector. The filtered water used for back flushing, and any particulate material removed, is returned to tank 241-C-106 via a dedicated encased drain line through the 4-in. riser ("R-4"). The HEMF has a bypass that allows for continued operation of the ventilation system during the back-flushing process. The HEMF also has a jacket filled with shielding shot to provide for radiation shielding.

A seal pot is installed on the Process Building drain line. The seal pot serves as a common collection point and seal for the condenser and other ventilation system equipment drains while preventing tank 241-C-106 from venting into the Process Building. The overflow from the seal pot, which includes the HEME back wash waste water, is returned to tank 241-C-106 via a dedicated encased drain line connected to the sluicer dropleg.

A gamma radiation monitor is installed in room 2 of the Process Building. This monitor will alarm locally and in Trailer MO-211 to indicate solids are collecting on the HEME or HEMF and flushing is needed.

An 8-in. duct is provided at the Process Building, between the moisture separator and heating coil. The duct was installed to permit the connection of a portable exhauster for ventilation of tank 241-C-106, if necessary, during ventilation system outages.

5.4.2.2.2 Chiller Skid. The chiller skid is a glycol and water chiller system that serves two functions: (1) provide cooling fluid to the process building condenser, and (2) provide cooling fluid to the tank 241-C-106 air inlet cooling coil. These two services are mutually exclusive. Before the start of sluicing, the chiller skid will be used to cool tank contents. During sluicing, the chiller skid will cool the HVAC recirculation line.

The chiller skid is located outside the fenced area of the 241-C-106 Tank Farm. The chiller skid contains an air-cooled chiller and a chilled water cooling system. The chilled water cooling system consists of a makeup storage tank, an air separator, circulation pumps, an expansion tank, and instruments for monitoring the closed-loop cooling system. The circulating fluid (chilled water) is a 46% propylene glycol solution mixed with water, and is circulated between the chiller and the recirculation system condenser. Chilled water may also be provided to the intake air cooling coil (CC-1361).

An air-cooled chiller (R-1361) removes heat gained by the chilled water system from the recirculation ventilation system condenser. The chiller is a complete factory-assembled package, rated at 40 tons, with reciprocating compressors, condenser, refrigerant circuits, cooler, and controls. The chiller reduces the temperature of the chilled water returning from the recirculation condenser by about 5 °F. The chiller also will be used, as required, to reduce the temperature of the chilled water returning from the intake air cooling coil (CC-1361).

The makeup storage tank (TK-1361) provides the ability to add glycol to the chiller skid. The tank is pressurized by compressed air so that glycol can be added while the chilled water circulation pumps operate.

An air separator (TK-1363) removes air from the chilled water circulation system. Air is automatically expelled from the air separator through a float-type air vent.

Two 110 gal/min centrifugal pumps circulate chilled water through the condenser and the air-cooled chiller. Pump P-1364 is designated as the primary pump and Pump P-1365 is the standby pump. Following a failure of the primary pump, the standby pump will start. Each pump has normally open isolation valves that allow pump maintenance while minimizing any effect on system operations.

An expansion tank (TK-1362) provides space for expansion and contraction of chilled water system fluid as the fluid temperature varies. A 3-in. circulation piping routes the chilled water to and from the Process Building and the air intake chiller. The buried and insulated piping is Schedule 40 carbon steel with welded fittings.

5.4.2.2.3 Exhaust Skid. Air is exhausted from tank 241-C-106 at a rate of up to 360 ft^3/min by the exhaust skid. Air in-leakage, to make up for the exhausted volume, will flow into 241-C-106 from two pathways: (1) between pits and pit cover blocks, into pits, and then through pit drains into tank 241-C-106; and (2) through the existing 3-in. cascade line connecting tank 241-C-105 to tank 241-C-106.

The exhaust skid is similar to many exhausters used throughout the Hanford Site. The skid includes a heating coil, two HEPA filters, and an exhaust fan. This skid also includes an exhaust stack and exhaust-monitoring instruments. The exhaust ventilation system controls the pressure and flowrate of the tank 241-C-106 vapor space.

A single-stage electric heating coil (HC-1362), located upstream of the HEPA filter train, heats the saturated air and prevents condensation on the HEPA filters. The heating coil capacity is about 3 kW. During normal operations, the heating coil raises a 40 °F airstream temperature to approximately 80 °F and maintains a 34% relative humidity. Heating coil HC-1362 is interlocked with exhaust fan FN-1362 and shuts off the heater automatically when the fan shuts down.

The HEPA filters are the bag-in/bag-out type designed for a particulate removal mass efficiency basis of 99.97% of particles sized 0.3 μm and greater. This is achieved by using two HEPA filters (HEP-1361 and HEP-1362) in series. Each filtration stage has provisions for in-place aerosol testing while in use. The HEPA filters are changed out when the pressure differential across the filter exceeds allowable limits, the radiation measurement on the filter housing is about 100 mrem/h or when the filter has failed the aerosol test.

The exhaust fan (FN-1362) is direct driven by a variable frequency, drive-controlled, 7.5-hp electric motor with a flow capacity of 360 ft^3/min at 40 in. w.g. The fan is a centrifugal type with 304 L stainless steel construction. Fan speed is modulated as required to control the vapor space pressure in tank 241-C-106. A high-pressure differential across either of the HEPA filters, detection of high radiation by the stack CAM, or a high vacuum pressure detected at tank 241-C-106 shuts down the fan. Shut down of the fan automatically shuts off heating coil HC-1362 as well as the stack-monitoring system vacuum pumps.

The exhaust fan discharges to the 296-C-006 exhaust stack. The 6-in.-diameter exhaust stack extends to a height of about 16 ft above the exhaust skid's concrete pad. The exhaust stack provides the point of discharge for the tank ventilation system. The primary exhaust airstream is sampled for radioactive particulate and monitored for radioactivity before discharge via the stack. The exhausted airstream is also monitored for flow.

Monitoring instrumentation includes isokinetic sample probes, a CAM (CAM E-085), and a record sampler (E-083) (Drawing H-2-818561). The monitoring system detects and mitigates a radioactive aerosol leak, resulting from an unfiltered release of the exhaust gases to the environment, by initiating a shutdown of the exhaust system fan (FN-1362).

5.4.2.2.4 241-C-106 Seal Loops. Two seal loops that meet SC requirements are installed at tank 241-C-106. The seal loops protect the tank from excessive vacuum should an ice storm seal off all in-leakage into the tank while the exhaust fan continues to operate. The exhaust fan can achieve a maximum pressure of -40 in. w.g., which could damage the tank structure. Redundant 6-in.-diameter seal loops pointed downward to protect them from icing over are provided to mitigate a tank under pressure condition.

The seal loops are filled with silicone fluid that has a low freezing point and are installed in the existing hatch cover plate above the 24-in. Riser 15. Each seal loop has a local level gauge for periodic verification of the fill level. The seal loops provide passive over pressure and under pressure protection and are designed to clear with a differential pressure of 5.8 in. w.g. between the tank vapor space pressure and external atmospheric pressure.

5.4.3 System Safety Functions

The BIO and the BIO, Addendum 1 credit the active ventilation at tanks 241-C-105 and 241-C-106 with performing SC functions in the prevention of two accidents: the flammable gas deflagration accident and the tank bump accident. There are no SS functions identified for the tank 241-C-105 and 241-C-106 ventilation system.

The tank 241-C-105 and 241-C-106 active ventilation system SC functions are applicable during waste storage, pre-sluicing, active sluicing, and post-sluicing periods. Although the 296-C-006 and the 296-P-16 ventilation system will not be operated at the same time, each system is relied on to fulfill the tank 241-C-106 SC function for active tank ventilation when the system is in operation.

The following discussion addresses the tank 241-C-105 and 241-C-106 active ventilation system SC functions and system outage times. The SC functions and outage times are applicable to the 296-P-16 and the 296-C-006 ventilation systems; therefore, safety functions and outage times as described are not independently addressed for each system.

5.4.3.1 Tank 241-C-105 and 241-C-106 Ventilation System. The tank 241-C-105 and 241-C-106 active ventilation system performs two distinct SC functions. The primary SC function is to maintain tank 241-C-106 waste temperatures below the local saturation temperature, thereby preventing the tank bump accident described in the BIO, Addendum 1, Section 3.4.2.11. The secondary SC function of the system is to maintain the flammable gas concentration within tank 241-C-105 and tank 241-C-106 dome spaces, due to steady-state gas release, to below 25% LFL. Minimizing the flammable gas concentration within the tank dome spaces reduces the time at risk and the potential for a flammable gas deflagration as described in the BIO, Section 5.3.2.14 and the BIO, Addendum 1, Section 3.4.2.11.

Although the 296-P-16 HVAC system, when in operation, provides active ventilation to tank 241-C-105 and tank 241-C-106, the temperature control SC function is applicable only to tank 241-C-106. Tank 241-C-105 is not classified as a high heat watch list tank and does not require active ventilation to maintain tank waste temperatures within established temperature limits (Bragg 1995).

Additionally, the active ventilation SC function is applicable to tank 241-C-105 only during periods of operation of the 296-P-16 exhaust system. When the 296-C-006 ventilation system is operational, tank 241-C-105 will be placed in a passive ventilation mode. When in the passive ventilation

mode, the tank 241-C-105 passive breather filter assembly (see Section 5.6) provides the SC function for prevention of the flammable gas deflagration.

5.4.4 Allowable Outage Time

The tank 241-C-105 and 241-C-106 ventilation system is credited with performing an SC function in the prevention of the flammable gas deflagration accident and the tank bump accident. The following discussion evaluates the available outage time associated with each SC function.

5.4.4.1 Flammable Gas Deflagration. Unlimited outage time is available for the tank 241-C-105 and 241-C-106 ventilation system when considering the SC function of the system in preventing the flammable gas deflagration. Although work activities are restricted and additional monitoring is required when the ventilation system is not operating, passive breathing has been determined to be sufficient to maintain flammable gas concentrations within the 241-C-105 and 241-C-106 tank dome space at levels lower than the worst-case passively ventilated tank (Stauffer 1997).

The SC function of an active ventilation system associated with prevention of a flammable gas deflagration is to maintain flammable gas concentrations within the tank dome space due to steady-state gas generation to below 25% LFL. Steady-state gas generation rates depend on several parameters including waste volume, decay heat load, waste temperature, organic complexant chemical concentrations, and nitrate/nitrite concentration. Accordingly, the time required for the flammable gas concentrations to reach 25% LFL in the tank dome space following loss of active ventilation varies from tank to tank.

When the 296-P-16 ventilation system is in operation, tank 241-C-105 and tank 241-C-106 are actively ventilated. However, during sluicing operations the 296-P-16 exhauster will be shut down. Upon shutdown of the 296-P-16 exhauster, tank 241-C-105 will be placed in the passive ventilation mode and the 296-C-006 ventilation system will be started to reestablish active ventilation to tank 241-C-106. Although tank 241-C-105 is considered to be passively ventilated when the 296-C-006 ventilation system is operating, continued ventilation may be provided at a minimal extent to tank 241-C-105 via the cascade line (unknown if cascade line is open or plugged) between the two tanks.

Tank Waste Remediation System Technical Safety Requirements (Noorani 1997a), LCO 3.2.3 allows tank 241-C-105 to be placed in a passive ventilation mode when the 296-P-16 exhauster is shut down and the 296-C-006 system is in operation. When tank 241-C-105 is placed in the passive ventilation mode, the passive breather filter assembly is credited with performing the SC function of maintaining flammable gas concentrations within the tank dome space within acceptable levels.

Section B3.2.3 in HNF-SD-WM-TSR-006 (Noorani 1997a) estimates the minimum time to reach 25% LFL for any passively ventilated tank to be 24 days. The time to reach 25% LFL at tank 241-C-105 following a loss of active ventilation is estimated to be 35 days, assuming atmospheric breathing only through unfiltered pathways. Because the gas generation rate for tank 241-C-105 when

passively ventilated is within the range normally encountered for passively ventilated tanks, the tank is bounded by the flammable gas deflagration accident analysis. Therefore, if tank 241-C-105 is configured in the passive ventilation mode (i.e. atmospheric breathing thru a passive breathing assembly) following a ventilation system failure, the tank could remain in this configuration for a period of unlimited duration and no additional controls would be necessary.

Similar logic can be applied to tank 241-C-106 in determining the outage time for the ventilation system associated with the flammable gas safety function. The BIO, Addendum 1, Section 3.4.2.8, concludes if active ventilation were lost at tank 241-C-106, the head space of the tank would reach 25% LFL in 117 days using the best estimate hydrogen generation rate and 113 days using the upper-bound generation rate. This estimate considers the pre-sluicing conditions and waste inventory present at tank 241-C-106 and is representative of worst-case conditions. The 113-day outage time also bounds sluicing operations performed by Project W-320 because removal of waste will reduce the steady-state generation of flammable gas at tank 241-C-106, resulting in a net increase in the outage time available.

If active ventilation is lost at tank 241-C-106, the tank could be configured in the passive ventilation mode. Atmospheric breathing would occur through the air intake station, which performs a similar function to a passive breather filter assembly. Two redundant seal loop assemblies designed to relieve at +/-5.8 in. w.g. provide over-pressure protection for the tank.

The estimated time to reach 25% LFL at tank 241-C-106 following a loss of ventilation, as with tank 241-C-105, is considerably longer than the estimated minimum time for the worst-case passively ventilated tank (24 days for tank 241-A-101). It can therefore be concluded that following a loss of active ventilation at tank 241-C-106, steady-state flammable gas generation will remain within the range normally encountered for passively ventilated tanks and as such is bounded by the flammable gas accident analysis. Although loss of active ventilation is required to be restored immediately and waste-disturbing activities are not allowed when the tank is not actively ventilated, the ventilation system outage time is governed by the temperature control SC function and is not restricted by the flammable gas safety function.

5.4.4.2 Tank Bump - Temperature Control Function. Tank 241-C-106 is classified as a high heat watch list tank and has a total heat load estimated at 132,424 BTUs/hr (38.8 kW). Currently, forced ventilation and water additions to promote thermal conductivity and evaporative cooling are used to maintain tank 241-C-106 waste temperatures within the established limits.

Tank Waste Remediation System Technical Safety Requirements (Noorani 1997a), LCO 3.3.1, establishes a maximum waste temperature of 205 °F for single-shell tanks. This temperature limit applies to tank 241-C-106 and is based on a waste saturation temperature of 220 °F adjusted by 10 °F to account for instrument uncertainties and 5 °F to allow time to detect and respond to a temperature increase before the waste reaches the temperature at which a tank bump can occur.

tank 241-C-106 waste temperatures below the local saturation
nimum airflow of 500 ft^3/min is required to be continuously
e tank (Ogden 1998). This airflow rate assumes the tank is
once-through cooling mode and requires water additions to be

roughout the year waste temperatures in single-shell tanks
t 10 °F, with the highest waste temperatures occurring in
t waste temperatures occurring in April. This holds true for
hich has a seasonally adjusted high waste temperature of
ive ventilation is supplied by the 296-P-16 exhauster and
ditions are made.

reach the 205 °F temperature limit at tank 241-C-106
of active ventilation is addressed in HNF-SD-WM-TSR-006,
oorani 1997a). With an assumed beginning temperature of
e to reach 205 °F following a loss of active ventilation is
a minimum of 126 days. Therefore, the available outage time
of active ventilation at tank 241-C-106 is established at
outage time is bounding for the SC cooling function provided
tilation system and is extremely conservative because active
een off in the past for periods exceeding 6 months and waste
ained within the 205 °F limit while cooling water additions

sign Evaluation

er safety systems, the tank 241-C-105 and 241-C-106
em has been evaluated to identify the individual system
perform SC functions during normal and off-normal conditions.
omponents of the system relied on to preserve the system SC
ntified in the Appendix.

430.1A identifies criteria to be considered in the design of
d systems to ensure the system or component can perform its
y function. These criteria include quality assurance, single-
n and redundancy, environmental considerations, maintenance,

1-C-105 and 241-C-106 ventilation system, as modified by
an be shown to meet all applicable SC criteria established by
A. Each SC criterion as applicable to the subject ventilation
dually addressed in the following discussions.

Assurance. Project W-320 performed work on the
nd 241-C-106 ventilation system in accordance with applicable
e requirements. The work performed by Project W-320 included
ion, and installation of the entire 296-C-006 ventilation
as the design and installation of the 296-P-16 CAM interlock.

6 exhaust system is an existing system that has been installed
for decades. Little information is available on the quality
ements followed in the design, fabrication, and installation

icult to postulate a common-mode failure which could result in
/ installed ventilation systems damaged to the extent that
could be restored to an operable condition within the 126 days
available. However, should such an event occur, the Portable
can be installed as required to restore active ventilation.

ance. The 296-P-016 and 296-C-006 exhausters were designed to
ired maintenance activities with minimal impact to system
l parts of the system requiring maintenance are easily
dby pumps are available which can be placed on line while the
serviced, and HEPA filters and HEMFs include bypass lines
components to be periodically flushed without shutting down
nponents expected to become contaminated as a function of
elded to minimize exposure to personnel performing maintenance
strumentation is also strategically located throughout the
le indication of component status and to alert operations
e need for equipment service.

g. The 241-C-105 and 241-C-106 ventilation system includes
periodic testing of monitoring, surveillance, and alarm
mentation is calibrated at a frequency based on the function
serves. System functional testing is performed periodically to
stem operation and response as required to maintain the system
lter trains also have ports to facilitate periodic in-place
er media.

ity

eliability study (Braun et al. 1998b) was performed on
-006, and the portable exhauster. The study determined the
each system separately and then combinations of the three
udy also reviewed the increase in reliability that could be
rading" the components to SC. Table 5-3 summarizes the
study.

lity of the 241-C-106 ventilation safety function is
proved when redundant ventilation systems are available as
line system. The difference in reliability between a single
tion and a redundant system configuration is the reduced
-cause vulnerabilities for the latter case. Where single
es can disable an individual ventilation system, multiple

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Table 5-3. Tank 241-C-106 Primary Ventilation Reliabilities.

System combinations and design bases			Calculated system reliability
296-P-16	296-C-006	Portable exhauster	
General service	--	--	94.8%
Safety class	--	--	95.2%
--	General service	--	93.3%
--	Safety class	--	93.8%
--	--	Safety significant	95.3%
--	--	Safety class	95.4%
General service	General service	--	99.2%
Safety class	Safety class	--	99.3%
General service	General service	Safety significant	99.7%
Safety class	Safety class	Safety significant	99.8%
Safety class	Safety class	Safety class	99.8%

component failures are usually required to disable the combined systems. For these ventilation systems, the common mode of failure is from natural phenomena (high winds, and seismic events) and loss of the offsite electrical power.

Analysis showed that the age of system components for the 296-P-016 system does not have a significant impact on reliability due to the long recovery time allowed by the low flammable gas generation rate and rate of temperature increase in tank 241-C-106. With such a long recovery time, a failed component can either be repaired or replaced. The contribution of component failures due to seismic or high wind events to total ventilation system reliability is small. Accordingly, the significance of qualifying certain components to SC will provide minimal improvement in the reliability of any of the ventilation systems or configurations. The most dramatic increase in reliability of the ventilation systems occurs when either the 269-P-16 exhauster or the 269-C-006 ventilation system is providing ventilation to tank 241-C-106 and the other is in a standby mode.

5.5 STACK CAM AND CAM INTERLOCK TO TANK 241-C-106 PRIMARY EXHAUST FAN (SAFETY CLASS)

The following discussion evaluates the suitability of the Project W-320 WRSS Stack CAM and CAM interlock to the tank 241-C-106 exhaust fan system to perform the safety function(s) specified for the system by the BIO and the BIO, Addendum 1.

5.5.1 Strategy Summary

The safety function of the stack CAM interlock to the exhaust fan is to ensure the fan will be shut down if HEPA exhaust filters break through.

A new primary ventilation system, 296-C-006, was installed on tank 241-C-106 by Project W-320 to support the WRSS. The ventilation exhaust stack has a stack-monitoring system, which includes a CAM and CAM interlock. The stack CAM and CAM interlock are credited as a control in a "Spray leak from structure" accident, classifying them as an SC system. This system is also credited as an SS control for HEPA filter failure and unfiltered release accident scenarios. Its purpose in each case is to alarm and deenergize the exhaust fan upon detecting a predetermined high level of radiation in the exhaust stream (indicative of an unfiltered stack release).

The stack CAM and CAM interlock were designed and procured as general service (SC-3) system in accordance with the original project criteria. Later the stack CAM and CAM interlock were redesignated as SS and subsequently redesignated SC. The equipment is expected to fail during a SC seismic event. However, the Seismic Shutdown System (Section 5.11) ensures that sluicing operations and waste transfers are shut down in the event of a significant seismic event, eliminating the possibility of a credible spray leak accident. Because of its fail-safe operating features, and procedural controls to ensure verification of operability, it is concluded the system can be depended to provide the SC safety functions necessary to support operation of the WRSS.

The stack CAM on the existing tank 241-C-106 primary ventilation system, 296-P-16, was recently modified by Project W-320 to support operation of the WRSS. This modification consisted of adding a CAM interlock to shut down the fan on high stack radiation, and brings the system into compliance with SC requirements of the BIO.

5.5.2 System Description

The CAM is located on the primary exhaust stack of the 296-C-006 exhauster for tank 241-C-106. It is part of a stack radiation monitoring system which also includes a stack flow indicator and record samplers for particulate and iodine effluents. System components associated with the CAM include two redundant vacuum sample pumps, an isokinetic sample probe, a sample flow measurement and control system, a sample return line to the stack, and various instrumentation and alarms. Plant operating procedures for the tank 241-C-106 exhauster cover routine operation of the stack-monitoring system. The stack radiation monitoring system is described in the BIO,

Addendum 1, Section 2.6.2 and vendor literature, and is depicted on Drawing H-2-818561.

The CAM is a beta-gamma monitor that continuously monitors the ventilation exhaust stream for the presence of radionuclides, which would indicate a failed exhaust filtration system (e.g., a breached filter). Its radiation detection elements require a small, continuous sample stream from the stack to detect beta-gamma activity in the stack emissions while the ventilation system is operating.

Upon detection of a predetermined high level of radiation in the exhaust stream, the CAM activates the associated interlock to shut down the exhaust fan. In this manner, the CAM interlock is able to limit an unfiltered radioactive release due to a HEPA filter failure (regardless of the cause of failure). The CAM also provides visual and audible alarms, as well as relay contacts, for high stack radiation and loss of CAM function. The CAM has a high radiation alarm bypass, which disables the remote alarm function and enables an operator to bring the CAM off line for brief periods for testing or calibration purposes without having to contend with nuisance alarms.

An online vacuum pump, which draws the sample stream necessary for the CAM and record samplers to function, provides the motive force for the stack-monitoring system. There is also a backup vacuum pump on standby that is started automatically if the online pump fails. The vacuum pumps are interlocked to the exhaust fan motor and do not operate unless the exhauster is running. Because the CAM samples a potentially flammable atmosphere, the vacuum pumps on the tank 241-C-106 stack-monitoring system were recently upgraded to meet the applicable Ignition Control Set #2 requirements of the BIO and TSRs.

The sample stream is drawn from the stack through a sample probe, which traverses the stack and is designed and positioned to comply with the requirements in ANSI N13.1, *Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities* (ANSI 1969). For accurate monitoring, the sample stream must be extracted at the same velocity as the exhaust airstream in the stack. The flow control system works in conjunction with the sample probe to ensure this, monitoring the mass flow rate of the sample stream and using it as an input signal (along with a stack flow reference signal) to modulate a sample flow control valve. The flow control system thus continuously regulates the sample stream to maintain the required isokinetic sampling conditions.

The flow control system is in a main control and alarm module, through which the various other instrument signals are also processed. The module provides alarms for loss of stack flow, loss of sample flow, non-isokinetic sample flow, and system failure. By this means, the operator is not only notified if there is a stack high-radiation condition, but is kept continuously informed of the status of the exhauster and the stack-monitoring system to ensure they are operable.

The purpose of the record samplers is to monitor and quantify emissions over time, to meet environmental licensing requirements. They operate independently of the CAM to sample the exhaust stream, and basically consist of collection filters which are changed out periodically, analyzed, and recorded with a sample probe and flow control system similar to the CAM.

The stack-monitoring system was designed to natural phenomena loads which satisfy current Performance Category 2, SS load criteria in accordance with HNF-PRO-97, *Engineering Design and Evaluation*. The Seismic Shutdown System (Section 5.11) ensures that sluicing and waste transfers are shut down if ground accelerations exceed the SS seismic design criterion; therefore, the stack-monitoring system will not be required to function during a severe earthquake.

The new tank 241-C-106 ventilation system also has high filter differential pressure interlocks on both stages of HEPA filtration that provide a means of shutting down the exhaust fan when there is a potential filter failure condition (i.e., a loaded filter), generally before a failure occurs. However, there is no shutdown function for low filter differential pressure, which would correlate with an actual filter breach.

The older, existing exhauster on tank 241-C-106, 296-P-16, which will be used as a backup for the new system during operation of the WRSS, was upgraded by Project W-320 with the addition of a CAM interlock to the exhaust fan to bring the system into compliance with the SC requirements of the BIO. The stack-monitoring system on this existing exhauster is of a design typified by primary stack-monitoring systems in other tank farms, as described in the BIO, Section B2.7.2.

5.5.3 System Safety Functions

The subject stack CAM and CAM interlock system is credited with limiting an unfiltered radiological release following a "Spray Leak from Structure" accident scenario during operation of the WRSS (BIO, Section 5.3.2.20; BIO, Addendum 1, Section 3.4.2.16). This classifies the CAM and CAM interlock on the new tank 241-C-106 exhauster as an SC system. The associated safety function is to shut down the ventilation system to terminate an unfiltered release (i.e., to prevent aerosol dispersal through the stack) if a HEPA filter is breached. The CAM interlock is the subject of a TSR control (Noorani 1997a, LCO 3.1.4) which requires it to be operable at all times while the ventilation system is operating. The CAM interlock is also credited as an SS control in a HEPA filter failure (BIO, Addendum 1, Section 3.4.2.2) or an "unfiltered release" accident scenario (BIO, Addendum 1, Section 3.4.2.3) during operation of the WRSS.

The CAM interlock cannot prevent a spray leak, an unfiltered release, or a high pressure or high temperature event from occurring, but instead mitigates the potential consequences by detecting such an event and then terminating further discharges through the ventilation stack.

The record sampler does not have an identified safety function, nor is it a required control in accordance with the BIO or TSRs. However, the sampling portion of the record sampler can be used on an emergency basis, in conjunction with a Geiger-Mueller counter, as an alternate means of stack monitoring if the CAM is inoperable. The record sampler is thus referred to in the recovery actions for LCO 3.1.4.

On a component level, anything necessary to support the CAM function is classified as SC. This includes the monitor itself as well as the beta-gamma radiation detection elements, high radiation and failure alarms and alarm relays, the fan shutdown interlock, the stack flow rate instrument, the sample flow control valve, sample flow rate and temperature instruments, vacuum pump controls, the main control and alarm module, and the high radiation alarm bypass. The vacuum pumps are classified as SC. The record samplers and components that support it are general service.

Because the new tank 241-C-106 ventilation system is designed for use during sluicing operations, during which significant aerosols are generated, it has special features that minimize misting, aerosol formation, and moisture entrainment in the ventilation stream during sluicing, and minimize the possibility of resulting damage to the filter train. The spray leak accident and the SC designation also apply to the primary ventilation CAM interlocks on tank 241-AY-102 (702-AZ system) and the older, existing exhauster on tank 241-C-106 (which will be operated before sluicing). These existing systems have been evaluated and classified in HNF-SD-WM-SEL-040, *TWRS Safety Equipment List* (Jensen 1998).

5.5.4 Allowable Outage Time

There is no allowable outage time for the stack CAM interlock system. It must be operating as long as the ventilation system is operating, based on a TSR requirement (Noorani 1997a, LCO 3.1.4). The CAMs and interlocks must be calibrated and verified as operable before the start of WRSS operations. As discussed previously, the CAM is designed with a fail-safe mechanism by which any system failure or loss of function activates an alarm or notifies and operator. If at any time the CAM is determined to be inoperable, ongoing sluicing and waste transfer operations must stop until the CAM interlock is restored. Ventilation is not typically shut down upon loss of the CAM. An alternate monitoring method must be used to detect a radiological release while CAM operability is restored. Before operation of the WRSS the 296-P-16 exhauster will provide tank ventilation. The new tank C-106 exhauster (296-C-006) will not be operating; therefore, the CAM will not be required and will not operate while the 296-P-16 exhauster is in operation.

5.5.5 System Design Evaluation

5.5.5.1 Quality Assurance. The stack-monitoring system was procured, designed, and fabricated offsite. In accordance with the procurement documentation, the system meets the requirements of ANSI N13.1 (ANSI 1969), ANSI N42.18, *Specification and Performance of On-Site Instrumentation for Continuously Monitoring Radioactivity in Effluents* (ANSI 1980), and applicable federal regulations for emissions-monitoring equipment. Vendor submittals were required and received for quality assurance purposes, including an approved quality assurance program, welding and inspection qualifications, analytical calculations, a certificate of flow instrument accuracy, and a certificate of conformance (i.e., of the overall system to the procurement specification). The system also will be tested onsite, to verify its design, after installation is completed.

5.5.5.2 Single-Failure Criteria and Redundancy. The stack-monitoring system was designed with two redundant vacuum pumps for reliability. If the online pump fails to provide sample flow, this condition is detected by the system and the standby pump is automatically energized. The same set of vacuum pumps operates the CAM as well as the record samplers. There is no other redundancy in the system. In case of a system failure or malfunction, the operator is notified by one of the various loss-of-function indicators transmitted from the control module or the CAM itself. Upon notification of a problem, maintenance can be initiated. In cases where CAM interlock operability is affected, recovery actions specified in LCO 3.1.4 ensure the system is restored as quickly as possible.

A single failure of any component in the system would not result in an offsite release or other accident. A release would require a failure (or multiple failure) resulting in a filter breach, a failure of the CAM interlock to shut down the exhaust fan, and a failure of the system to alarm and notify an operator to initiate a manual shutdown. Operating and self-monitoring features of the CAM and interlock, as well as administrative and procedural controls to verify the system is operable, minimize the possibility of such a sequence of multiple failures.

5.5.5.3 Equipment Environmental Considerations. The stack-monitoring system was procured and designed to be compatible with a full range of anticipated environmental conditions. The procurement specification defines extremes of ambient temperature, weather, and other environmental conditions, as well as characteristics of the exhaust airstream. To ensure reliable operation, the system electronics, control valves, and vacuum pumps are housed in a temperature-controlled cabinet rated for outdoor exposure. Environmental qualification of major components was verified as part of the procurement process, relying on testing, analysis, or other methods as appropriate.

5.5.5.4 Maintenance. The stack-monitoring system was designed for maintainability. As much as practical, all parts of the system are accessible and can be maintained, cleaned, tested, or calibrated using standard tools and test equipment. Where necessary, the vendor has supplied special tools as required for maintenance. The system is designed for a useful life of 2 years, in accordance with project criteria, and is designed to be capable of continuous operation for at least 12 months without failure or loss of calibration. The stack-monitoring system was supplied by the vendor with a complete set of installation, operation, and maintenance instructions.

5.5.5.5 Testing. The stack-monitoring system will undergo an acceptance test after it is installed. Before shipping from the vendor, the system was tested to certify its accuracy in accordance with applicable sections of 40 CFR 52, "Approval and Promulgation of Implementation Plans". System components are accessible for routine functional testing and calibration.

5.6 PRIMARY VENTILATION SYSTEM FOR 241-C-105 BREATHER FILTER (SAFETY CLASS)

The following discussion evaluates the suitability of the Project W-320 WRSS 241-C-105 breather filter to perform the safety function(s) specified for the system by the BIO.

5.6.1 Strategy Summary

The safety function of the 241-C-105 breather filter is to provide means to passively ventilate tank 241-C-105 when the 296-C-006 ventilation system is in operation. The breather filter ensures that steady-state release of flammable gas does not accumulate to flammable concentrations in the tank dome.

Single-shell tank passive breather filter assemblies have been designated by the BIO as SC systems. The critical SC function that passive breather filters perform is to dilute and ventilate flammable gases generated by the tank, thereby helping to prevent the flammable gas deflagration accident.

The 241-C-105 passive breather filter assembly is a new system installed by Project W-320 in support of sluicing operations. The design of the 241-C-105 passive breather filter assembly is for the most part identical to other SC passive breather filter assemblies installed throughout the tank farms.

The project SC strategy for the 241-C-105 passive breather filter assembly is to establish that the assembly meets applicable SC requirements taking into consideration the amount of outage time available and the existing periodic TSR surveillances required. While this strategy is adequate to demonstrate compliance with most SC requirements, not all SC requirements can be shown to be met for this breather filter assembly.

Given the available outage time and the current TSR surveillances specified, the 241-C-105 passive breather filter assembly cannot be shown to meet the single-failure criteria specified for SC systems by DOE Order 6430.1A. The design of the tank 241-C-105 passive breather filter assembly is, however, consistent with that of other safety class breather filter assemblies installed throughout the tank farms. This design has performed reliably throughout many years of service at the tank farms and is considered adequate to fulfill the class function specified for the system.

5.6.2 System Description

The 241-C-105 passive breather filter assembly is a new SC system installed by Project W-320 in support of sluicing operations. The passive breather filter assembly provides a means to ventilate tank 241-C-105 when active ventilation provided by the 296-P-16 exhauster is stopped and the new 241-C-106 ventilation system (296-C-006 ventilation system) is placed in operation.

The 296-P-16 exhauster actively ventilates tanks 241-C-105 and 241-C-106. Tank 241-C-105 will continue to be actively ventilated by the 296-P-016 exhauster until sluicing operations are initiated. Just before sluicing operations are started, the 296-P-16 exhauster will be shut down, tank 241-C-105 placed in the passive ventilation mode, and the new 296-C-006 ventilation system brought on line.

When the 296-C-006 ventilation system is operating, it is anticipated that tank 241-C-105 will be actively ventilated, to a minimal extent, via the 3-in. cascade between tank 241-C-106 and tank 241-C-105. However, because the 3-in. cascade line cannot be verified to be unobstructed, active ventilation at tank 241-C-105 is not assumed during operation of the 296-C-006 ventilation system. Therefore, it is necessary to configure tank 241-C-105 in a passive ventilation mode when the 296-P-16 exhauster is shut down and the 296-C-006 ventilation is in operation.

The 241-C-105 passive breather filter assembly is a standard tank farms design and includes a 4-in. butterfly valve, a housing containing a HEPA filter, an outlet screen, and a small seal loop which acts a pressure relief should the filter become plugged or blocked. The passive breather filter assembly bolts onto the existing 241-C-105 air inlet assembly flange connection located at Riser 2. The assembly is supported above the air inlet by the flange connection and by a reinforced tubular support assembly, which attaches to the filter housing via a saddle plate.

The passive breather filter assembly is designed to allow 125-ft^3/min airflow at a differential pressure of 4 in. w.g. The seal loop is filled with silicone oil and is designed to clear at a differential pressure of 4 in. w.g. A sight glass is located on the seal loop to provide operators with indication of oil fill level. Aerosol test ports are also provided on the assembly to facilitate periodic testing of the HEPA filter.

The passive breather filter ventilates the tank based on changes in atmospheric conditions (i.e., barometric pressure and temperature). Air is exchanged between the tank vapor space and the outside atmosphere through the HEPA filter at an maximum airflow rate of 7 ft^3/min.

5.6.3 System Safety Functions

The 241-C-105 passive breather filter safety function is applicable only during periods when active ventilation is not provided to tank 241-C-105 by the 296-P-16 exhauster. Although tank 241-C-105 may be actively ventilated to a minimal extent when the 296-C-006 ventilation system is operational, the passive breather filter is credited with performing the SC function associated with preventing a flammable gas deflagration.

The specific SC function that the 241-C-105 passive breather filter performs and the available outage time for the system are further discussed in the following.

5.6.3.1 241-C-105 Passive Breather Filter Assembly. The SC function of the 241-C-105 passive breather filter assembly is to provide sufficient ventilation into the headspace of tank 241-C-105 when the tank is configured

in the passive ventilation mode to maintain flammable gas concentrations below 25% LFL, thereby preventing the flammable gas deflagration accident identified in the BIO, Section 5.3.2.14. This SC function is applicable only when the 296-P-16 exhauster is shut down and tank 241-C-105 is not actively ventilated. When the tank is actively ventilated, the SC function is performed by the 296-P-16 exhauster.

5.6.4 Allowable Outage Time

A minimum of 35 days of outage time has been determined to be available to repair the 241-C-105 passive breather filter assembly and resume passive ventilation following a component failure. The 241-C-105 passive breather filter, as previously noted, performs an SC function only when the tank is configured in the passive ventilation mode (i.e., the 296-P-16 exhauster is shut down). Therefore, unlimited outage time is available if the 296-P-16 exhauster is operational.

When tank 241-C-105 is configured in the passive ventilation mode, the passive breather filter assembly performs an SC function in maintaining flammable gas concentrations below 25% LFL. The breather filter assembly provides a filtered pathway for airflow (estimated at 7 ft^3/min) through the tank due to differences in temperature and atmospheric conditions.

Calculation Note HNF-SD-WM-CN-116 (Stauffer 1997) estimates the time to reach 25% and 100% LFL for all single-shell tanks assuming a loss of normal ventilation. Both passively ventilated and actively ventilated single-shell tanks are evaluated. Tank 241-C-105 is presently an actively ventilated tank; therefore, HNF-SD-WM-CN-116 does not evaluate the time to reach 25% LFL following a loss of passive ventilation.

The estimated time to reach 25% LFL following a loss of active ventilation at tank 241-C-105 is calculated to be 35 days. The 35-day period is based on a complete loss of active/passive ventilation and assumes barometric breathing through unfiltered pathways continues at a flow rate of 0.30 ft^3/min.

The time to reach 25% LFL at tank 241-C-105 following a loss of active ventilation (35 days) is based on the hydrogen concentration measured during active ventilation (872 ft^3/min). The hydrogen concentration during periods of passive ventilation (7 ft^3/min) is, however, not measured and is presently not available.

For passively ventilated single-shell tanks that do not have measured hydrogen concentrations available, HNF-SD-WM-CN-116 assumes an average hydrogen concentration of 0.0135%. If the average hydrogen concentration rate is used for tank 241-C-105 to calculate the time to reach 25% LFL following a loss of passive ventilation, it is estimated that the tank headspace would never reach 25% LFL. Barometric breathing alone at 0.30 ft^3/min would be adequate to maintain flammable gas concentrations within 25% LFL.

However, because the average hydrogen concentration rate is an assumed value, the calculated time to reach 25% LFL following a loss of active ventilation (35 days) is established as the available outage time following a

loss of passive ventilation. This outage time is considered very conservative because no air exchange through the passive breather filter assembly, the 241-C-105 air intake station, or the 241-C-105 and 241-C-106 cascade line is assumed and calculations assuming average hydrogen concentrations for single-shell tanks indicate that it is not possible to achieve a hydrogen concentration of greater than 25% LFL.

5.6.5 System Design Evaluation

The 241-C-105 passive breather filter assembly has been evaluated to identify the individual system components that perform SC functions during normal and off-normal conditions. The individual components relied on to preserve the SC function are identified in the Appendix.

DOE Order 6430.1A identifies criteria to be considered in the design of SC components and systems to ensure the system or component can perform its identified safety function. These criteria include quality assurance, single-failure criterion and redundancy, environmental considerations, maintenance, and testing. Each SC criterion, as applicable to the subject SC system, is individually addressed in the following discussions.

5.6.5.1 Quality Assurance. All work associated with the design, fabrication, and installation of the breather filter assembly was performed in accordance with enhanced quality assurance requirements appropriate for SC systems. All work was designated as SQ requiring approval by Safety and Quality Assurance representatives. Critical characteristics were identified for all SC components as appropriate and commercial grade item dedications were performed where applicable. Fabrication and installation procedures included verifications and testing to ensure specified materials were used in the fabrication and identified critical characteristics were properly achieved. All design, fabrication, and construction activities were also overviewed by Quality Assurance, Quality Control, and the authorized inspector to ensure that the level of quality specified was obtained.

5.6.5.2 Single-Failure Criteria and Redundancy. The SC components of the 241-C-105 passive breather filter assembly are identified in the Appendix. These components are identified as the critical components in maintaining the SC function established for the assembly because failure of either of the components has the potential to impact the SC function of the assembly.

DOE Order 6430.1A requires that the design of SC components be such that a single failure does not result in the loss of capability of an SC component to accomplish its required SC function. Redundancy and diversity are also required to be considered, as appropriate, to ensure a common-mode failure does not result in the loss of the safety function provided by the component or system.

Failure modes that have the potential to impact passive ventilation include failure of the butterfly valve in the closed position, plugging of the HEPA filter, and blockage of the air duct due to the presence of foreign material. Adequate surveillances are in place to ensure each failure mode does not result in a loss of the system safety function with the exception of plugging or blockage of the HEPA filter.

HNF-SD-WM-TSR-006 requires periodic inspection and testing of selected passive breather filter components. LCO 3.2.3, Surveillance SR 3.2.3.1 (Noorani 1997a) requires that single-shell tank passive breather filter isolation valves be inspected and verified open with no blank installed on a 10-day frequency. Administrative Control AC 5.18.2.c also requires an aerosol test be performed on HEPA filters every 12 months.

The current testing specified by HNF-SD-WM-TSR-006 applies to all passively ventilated single-shell tanks and has been considered adequate surveillance to maintain passive ventilation for existing passively ventilated tanks. While the frequency of surveillance can be shown to be adequate for the breather filter isolation valve, the same does not hold true for the HEPA filter aerosol testing. Because of the 1-year frequency of aerosol testing, it is possible that a HEPA filter could become plugged due to foreign material and remain undetected in this condition for a period exceeding the 35 days of outage time available. Thus, the current TSR surveillance applicable to the breather filter can not be considered adequate to ensure the 241-C-105 passive breather filter is maintained in a condition that ensures passive ventilation at the rate necessary to prevent flammable gas from accumulating above 25% LFL.

Because no redundancy is provided by the passive breather filter assembly and existing TSR surveillance cannot be shown to be adequate to ensure that the breather filter assembly can perform its required SC function, it cannot be established that the breather filter assembly fulfills requirements specified for SC systems by DOE Order 6430.1A. However, the design of the tank 241-C-105 passive breather filter assembly is consistent with that of other safety class breather filter assemblies installed throughout the tank farms. This design has performed reliably throughout many years of service at the tank farms and is considered adequate to fulfill the class function specified for the system.

5.6.5.3 Equipment Environmental Considerations. All equipment and components associated with the 241-C-105 passive breather filter assembly were designed, fabricated, and installed specifically considering the single-shell tank operating environment. The design is based on the standard breather filter design, which has been used successfully throughout the tank farms for years to passively ventilate single-shell tanks.

The assembly is of all welded construction and is supported by a robust support assembly fabricated of 2-in. Schedule 40 carbon steel pipe. All other metallic components of the passive breather filter assembly are constructed of stainless steel, which represents an upgrade to normal breather filter assemblies installed throughout the tank farms. The isolation valve design also incorporates a one-piece stem and disk that minimizes potential for the separation of the components during service.

The breather filter assembly was designed considering general service load conditions. Safety class loads were not considered appropriate because structural failure of the assembly does not result in a loss of the safety function of the assembly. Should the breather filter structure fail for any reason, the SC function of the system would not be impacted because air would continue to exchange between the tank and the atmosphere.

Except for the HEPA filter, all components of the breather filter assembly can be relied on to perform their credited SC functions under all postulated environmental conditions. The HEPA filter, as previously noted, has the potential to become plugged due to environmental conditions and remain in this condition for a period exceeding the available outage time.

5.6.5.4 Maintenance. The 241-C-105 passive breather filter assembly was designed to accommodate required maintenance activities with minimal impact to system operations. The design is consistent with other single-shell tank passive breather filter assemblies and requires very little maintenance. A sight glass is incorporated into the design to provide indication of the seal loop oil level and aerosol test ports are provided on both sides of the filter to accommodate periodic in-place HEPA filter testing. The isolation valve also includes a disk position indicator to verify the valve is properly positioned. Additionally, the HEPA filter housing is designed to accommodate quick and easy changeout of the HEPA filter, when required.

5.6.5.5 Testing. The 241-C-105 and 241-C-106 ventilation system includes provisions for periodic testing and monitoring of the assembly as required to comply with required TSR surveillances. The HEPA filter housing also has ports to facilitate periodic in-place testing of filter media, and the isolation valve has a valve position indicator to indicate valve disk position.

System functional testing is required to be performed periodically to verify proper system operation and response as required to maintain the system SC function. Specified testing includes periodic verification of valve position and HEPA filter aerosol testing. This testing is easily accomplished due to the design of the system.

5.7 PORTABLE EXHAUST SYSTEM (SAFETY CLASS)

The following discussion evaluates the suitability of the Project W-320 WRSS Portable Exhaust System to act as a backup to the 241-AY-102 annulus exhauster, 241-AY-102 Primary Ventilation System, and the 241-C-106 Primary Tank Ventilation System to perform the safety function(s) specified for the systems by the BIO and the BIO, Addendum 1.

5.7.1 Strategy Summary

The Portable Exhaust System will be used to provide an alternate, redundant means of primary or annulus ventilation should the permanent ventilation system(s) fail for any reason. The portable system will be used only on an emergency basis if the permanent system(s) becomes inoperable and cannot be restored within a specified, allowable outage duration. This will ensure that the SC temperature control and gas dilution functions of the failed ventilation system are preserved following a design basis accident. The portable systems are intended for temporary use only, until the permanent system is restored to operation and can operate for the duration of sluicing. The portable systems will provide the safety functions necessary to support operation of the WRSS.

5.7.2 System Description

The project design basis (HNF-SD-W320-DB-001) for portable exhauster applications states that the exhauster shall perform the following activities.

- Draw moist warm air from the tank vapor space (or annulus) at a rate of 1,000 stdft^3/min while maintaining confinement of the ventilated space. Note: The AY-102 portable exhauster may have to be modified to provide 1200 CFM, the modification will be reflected in the F&R document referenced below.
- Provide nuclear quality HEPA filtration.
- Exhaust the filtered airstream through a stack and provide for stack sampling.
- Safely collect any condensate from the airstream, and safely contain it or return it to the tank.
- Meet the ignition source control requirements of AC5.10 (Noorani 1998) for ex-tank intrusion locations (IC Set #2); the inside of the ductwork and exhauster shall be considered an IC-Set #2 atmosphere.
- Comply with applicable requirements of ASME N509, N510 and B31.3

Two self-contained, skid-mounted, transportable exhausters meeting these requirements were recently procured to support saltwell pumping of single-shell tanks. Project W-320 and the Director of TWRS Operations signed a Memorandum of Agreement agreeing the two portable exhauster are available to support the sluicing of Tank 241-C-106 and storage of waste in Tank 241-AY-102 (Internal Memo 8C620-98-003). The portable exhausters are fully tested systems, capable of providing the required annulus or primary system airflow needed to provide gas dilution in the ventilated space and maintain tank waste temperatures within limits. The portable exhausters were specifically designed to ventilate underground radioactive waste storage tanks and are compliant with applicable requirements in DOE Order 6430.1A. The portable exhausters are not presently in use, and will be available for use as emergency backup exhausters while the WRSS is in operation. The exhausters are described in detail in Procurement Specification WHC-S-0490, *Specifications for a Portable Exhauster System for Waste Tank Ventilation* (WHC 1997) and the Functions and Requirements document WHC-SD-WM-DB-0035.

The two exhausters have two-stage HEPA filtration and are designed to meet applicable Site requirements and industry standards for nuclear ventilation, including ASME AG-1, *Code on Nuclear Air and Gas Treatment*, ANSI/ASME 1994a), ASME N509, *Nuclear Power Plant Air-Cleaning Units and Components* (ANSI/ASME 1989a) and N510-1989, *Nuclear Air-Cleaning Systems* (ANSI/ASME 1989b). The exhausters are also intrinsically safe for use with a flammable or explosive atmosphere, in accordance with the requirements of National Fire Protection Association (NFPA) Class I, Division 1, Group B, and meet the most stringent ignition control requirements of AC 5.10 (Noorani 1997a) for use in any Hanford Site waste tank. The exhausters have variable-speed fan drives that can operate over an exhaust flow range of 400 to 1,000 stdft^3/min at up to 9.5 in. w.g. They are reliable systems, adapted to

a variety of operating modes and qualified for operation in an outdoor environment.

In addition, the design of the portable exhausters includes features that minimize the possibility of a filter failure or diminished filter efficiency, including the following:

- A heater to prevent moisture condensation and its secondary effects, such as frost formation and corrosion.
- Two-stage, redundant HEPA filtration, with filters aerosol-tested in accordance with ASME N510-1989 before startup
- Features which preclude a flammable gas explosion, eliminating one mechanism for filter failure.

A Portable Exhaust System must be capable of being installed, tied-in, and operated on an emergency basis at any of these locations within a reasonably short time (i.e., within an allowable recovery time, based on the safety analyses). This capability will be relied on as a form of redundancy in case of a loss of operability of any of the three ventilation systems. Mechanical installation designs for the portable exhausters at tanks 241-C-106 and 241-AY-102 are shown on Drawings H-2-818506 and H-2-818507, respectively. Procedures for storage, installation, startup, and operation of the system have also been prepared and are available to support emergency use of the equipment should the need arise.

Above-grade ductwork, condensate return piping, power cords, and an air intake filter have been provided in addition to the portable exhauster. A portable electrical generator has also been identified and is available to provide emergency system power to the Annulus Ventilation System if it is required. Except for the generator, all components of the Portable Exhaust System are maintained in storage at an onsite facility that protects the components from environmental hazards. The system is maintained in an operable condition and subjected to periodic maintenance and surveillance. The exhauster is stored in the 400 Area in a hardened building to protect it from seismic activities, tornadoes, or other damage.

The portable exhausters are not equipped with stack CAMs or CAM interlocks by design, due to the temporary nature of their use. These systems rely on both low and high differential pressure interlocks on the HEPA filters, which shut the fan down to limit a potential unfiltered radioactive release in the event one of the filters is either breached or loaded beyond a preset level. This strategy provides a level of protection similar to the CAM, which is adequate considering the temporary nature of these backup systems and the unlikelihood that they will be used at all.

The intention to operate these systems without a CAM system has been deemed acceptable by Environmental [Mayer 1997] and the Authorization Basis organization [APPROVAL PENDING Authorization Basis Log #98-031]. The justification is based upon state regulatory requirements which exempt the planning for any new construction or significant modification of an emission unit from addressing accidental releases if the probability of occurrence of

an accident during the expected life of the emission unit is less than 0.01. Current indications are that the probability of occurrence of an accident which would require emergency use of the backup portable exhauster for project W-320 is on the order of 0.001. This is based upon section 5.3.2.23 (Natural Phenomena) of HNF-SD-WM-BIO-001 Rev 0-D (Tank Waste Remediation System Basis for Interim Operation).

Several Portable electrical generators are maintained onsite and have been made available for Project W-320 use by the equipment custodian. Since several 150-kW trailer-mounted diesel electrical generators are available for emergency use should the need arise, the portable generator is not identified as a critical system component. Additionally, diesel generators are readily available for lease through numerous offsite sources and can be delivered to the Site well within the available recovery time.

5.7.3 System Safety Functions

The Portable Exhaust System must provide the same safety functions of the system it is replacing as a backup. These functions consist of: (1) providing sufficient waste cooling to prevent a tank bump accident by drawing warm air from the tank to maintain the waste temperature below the saturation point, and (2) preventing the flammable gas concentration in the ventilated space (primary tank vapor space or annulus) from exceeding 25% LFL by a process of continuous fresh air dilution, and (3) maintaining the ventilated space at a partial vacuum relative to atmosphere. For all three applications, the Portable Exhaust System design nominal flow rate is sufficient to support these functions, based on the current engineering evaluation of the WRSS. The suitability of the portable exhausters for SC applications is evaluated in HNF-SD-WM-TI-808, *Safety Class Evaluation of Saltwell Portable Exhausters* (Kriskovich 1997).

5.7.4 Allowable Outage Time

The allowable outage time for the Portable Exhaust System, for repairs or maintenance, is specific to the application. Refer to related discussions in the appropriate sections for the tank 241-AY-102 and 241-C-106 Primary and tank 241-AY-102 Annulus Ventilation Systems. Project W-320 has developed the necessary design media, procedures, and other documentation required to use this equipment to support operation of the WRSS. The time to deploy the exhauster is estimated to be 7 days.

5.7.5 System Design Evaluation

5.7.5.1 Quality Assurance. The Portable Exhaust System was procured and designed to meet SS requirements in accordance with the original saltwell retrieval project criteria. Procurement of safety-related equipment was in accordance with appropriate quality assurance requirements, including test and inspection documentation, supplier qualifications, certified data on materials used, and certification of compliance with project specifications. The same procurement requirements apply in large part to SC equipment. Any future

maintenance, parts replacements, or modifications will be performed in accordance with the appropriate quality assurance requirements.

5.7.5.2 **Single-Failure Criteria and Redundancy.** The Portable Exhaust System is, by definition, a redundant system. It is intended for temporary use only, until the failed permanent system is restored to operation. In the unlikely event that a portable exhauster fails and cannot be repaired within an acceptable time, and the permanent system is still out of service, it can be replaced with another portable exhauster of similar design. In addition to the two 1,000 ft^3/min units, three 500 ft^3/min units of similar physical size, weight, and design features are available and will provide sufficient flow for two of the three applications (primary ventilation for tanks 241-AY-102 and 241-C-106).

5.7.5.3 **Equipment Environmental Considerations.** The portable exhausters were designed for reliable operation in an outdoor location, given Hanford site weather and environmental conditions. Parts subject to deterioration in these conditions are suitably protected. The internal components exposed to the tank airstream are selected for material compatibility with tank waste and vapors, as well as non-sparking or intrinsically safe properties for use in a potentially flammable atmosphere. Most of the materials exposed to the ventilation stream are stainless steel alloys. The portable exhausters use design features, construction methods, materials, filter media, and other technology similar to the permanent systems they may replace, and are pressure tested to verify confinement integrity before use to verify no damage has been done to the filter train during transport or installation.

5.7.5.4 **Maintenance.** The portable exhausters were designed for ease of maintainability, taking field conditions into account. The system provides a local readout for operators of critical system parameters (e.g., flow, pressure). The equipment is arranged on an open skid, with critical instruments, valves, test ports, filters, and other components accessible for inspection or replacement. The exhausters were delivered with a complete set of vendor data, and this has been augmented by Site-developed procedures to ensure these portable systems are properly stored and maintained in an operable condition. The Portable Exhauster vendor information file is VI 50024.

5.7.5.5 **Testing.** The portable exhausters were designed to enable testing of system functions. Instrumentation and controls are accessible for routine testing and calibration, which will be part of regularly scheduled maintenance of the exhausters. The filter train is designed for in-place testing of HEPA filters in compliance with ASME N510-1989. The confinement barrier (filter and fan housings and isolation valves) will be leak-tested before startup and operation. Operability testing will also be performed before startup to verify proper function of critical monitoring systems and interlocks.

5.8 TRANSFER LINE PIPE-IN-PIPE SYSTEM (SAFETY CLASS)

The following discussion evaluates the suitability of the Project W-320 WRSS Transfer Line Pipe-In-Pipe System to perform the safety function(s) specified for the system by the BIO, Addendum 1.

5.8.1 Strategy Summary

The safety function of the Transfer Line Pipe-in-Pipe System is to ensure a leak in the primary waste transfer system piping will be directed to a waste transfer-associated structure, where the leak will be detected, subsequently resulting in operator shutdown of the transfer operation.

The Transfer Line Pipe-in-Pipe System consists of two encased waste transfer lines of all-welded, steel construction, connecting tanks 241-AY-102 and 241-C-106. It supports waste retrieval from tank 241-C-106 and transfer of the retrieved waste to tank 241-AY-102. The encasement was originally designed and constructed to meet SC 3 and later reclassified to SS. The primary pipe was originally designated SC 2 and later changed to SS. The BIO and the BIO, Addendum 1 reclassified the encasement to SC and the primary to general service.

The Transfer Line Pipe-in-Pipe System can be expected to fail during a design basis seismic event of SC severity, and the strategy for mitigating the consequences of a potential pipeline failure takes this into account. The Seismic Shutdown System (Section 5.11), interlocked with the transfer pumps, is designed to detect ground movement of the appropriate magnitude and deenergize the pumps. This will stop any in-progress transfers and limit the amount of material at risk (i.e., for being released) to whatever is contained in the encased pipelines. The inventory of waste in the pipeline is bounded by the safety analyses. After such an event, the piping can be assessed for damage and to determine whether it can continue to be used, before operation of the WRSS resumes. In addition, the transfer system has leak detection capability (Section 5.9) in the encasement lines and pits. This ensures safe shutdown or restricted operation of the WRSS in the event of a loss of primary containment.

Given the design of the system and its limited or intermittent use, the system is expected to meet its safety function for the duration of WRSS-operations.

5.8.2 System Description

The Transfer Line Pipe-in-Pipe System consists of two double-contained waste transfer lines connecting tanks 241-AY-102 and 241-C-106, over a distance of 0.3 miles. The waste Transfer Line Pipe-in-Pipe System is described in the BIO, Addendum 1 (Sections 2.3.4, 2.4.1.7, and 2.4.1.8); it is depicted on P&ID Drawings H-2-818559 and H-2-818560; piping plans H-2-818426, H-2-818427, and H-2-818434; and in the BIO, Addendum 1, Figures 2-1 and 2-2.

One line delivers the sluicing medium (tank 241-AY-102 supernatant) from sluice pit 241-AY-02E to sluice pit 241-C-06C, where it supplies the sluicer in tank 241-C-106. The other line transfers slurry, retrieved by sluicing, from pump pit 241-C-06A to pump (distributor) pit 241-AY-02A on tank 241-AY-102. Both lines consist of a primary (inner) pipeline surrounded by an encasement pipe. The inner pipe carries the waste liquid (slurry or supernatant), while the outer encasement line provides secondary containment and leak detection functions in the event of a primary pipe leak.

Both primary (inner) pipelines, as well as their encasement (outer) lines, are constructed of welded Schedule 40 pipe material, and meet the design, fabrication, installation, and testing requirements of ANSI/ASME B31.3-1993 for normal service fluid over the anticipated range of pressures and temperatures. The primary pipelines are constructed of stainless steel for corrosion resistance and more effective flushing and decontamination. Their encasement lines are constructed of carbon steel, epoxy-coated and cathodically protected for service in contact with soil. The lines are buried or have a bermed covering for shielding to minimize radiological exposure of the onsite worker.

The primary (inner) pipe in either case is designed for a nominal flow rate of 350 gal/min at an operating pressure of 200 lb/in^2 and operating temperatures from 40 to 180 °F. Thermal stresses and expansion are accommodated by bends in the pipelines. Both the primary and encasement lines were flushed and pressure tested to 480 lb/in^2 during construction. The design flow rate is in the turbulent range to minimize settling of solids, and the lines are designed (sloped) to self-drain by gravity following a waste transfer. Both transfer lines are provided with a capability for flushing the primary pipeline to unplug a blocked line or to minimize potential accumulations of settled solids following waste transfer and gravity drainage of the line. Section 5.12 discusses the transfer line flushing system with reference to service water back-flow preventers.

The encasement lines have leak detectors at their low points, and the connecting waste transfer system pits have leak detectors as well. Any leakage from a primary pipe will be detected, resulting in appropriate shutdowns and operator notifications, and will drain, via the respective encasement line and pit, to tank 241-C-106. Section 5.9 evaluates and describes the transfer and encasement line leak detection systems in greater detail.

In accordance with the original project criteria, the encasement system was designed to SC 3 seismic loads, as well as thermal stresses due to the high-heat service liquid. Both the inner pipe and encasement designs satisfy current Performance Category 2, SS load criteria in accordance with HNF-PRO-97, *Engineering Design and Evaluation*. A Seismic Shutdown System (see Section 5.11) deenergizes the transfer system pumps in the event of a significant earthquake, stopping any ongoing transfer through the lines to help mitigate or prevent a release of liquid waste. The Seismic Shutdown System is described in the BIO, Addendum 1, Section 2.3.7, and in Section 5.11 of this document and depicted on drawings H-2-818559 and H-2-818560.

Administrative controls ensure that, before each use of the transfer system, the transfer lines and valves have been inspected and are configured

properly, excavation and vehicle restrictions are in place, and leak detection systems are functionally tested. If a leak detection system is discovered to be inoperable or alarming, any ongoing sluicing and waste transfer operations are stopped immediately and the affected transfer line is drained and flushed as appropriate, unless an alternate monitoring device is available. If a seismic event occurs of sufficient magnitude to potentially damage the piping, the Seismic Shutdown System automatically ensures that ongoing waste transfers are stopped and the facility is placed in a safe condition.

5.8.3 System Safety Functions

The Transfer Line Pipe-in-Pipe System, specifically the encasement piping, is credited in a subsurface or surface leak resulting in a pool as well as a spray leak from structure accident (BIO, Addendum 1, Sections 3.4.2.14, 3.4.2.15, and 3.4.2.16). These accident scenarios classify the interfarm piping system as SC. The safety function of the encasement system is to ensure that a leak from the primary waste transfer pipeline will be detected and safely channeled to a transfer pit, and that operations personnel are notified of the leak so that a safe shutdown of the transfer can be initiated.

5.8.4 Allowable Outage Time

There is no allowable outage time. The Transfer Line Pipe-in-Pipe System and its associated leak detection and seismic shutdown systems must be operable at all times during sluicing and waste transfer activities. Procedures require either a total shutdown or restricted operation of the WRSS in the event of a leak or other malfunction that affects a transfer line. Following a waste transfer, the lines can be flushed, drained, and left inactive for an indefinite period of time.

5.8.5 System Design Evaluation

5.8.5.1 Quality Assurance. The quality of the pipe materials and welds on the Transfer Line Pipe-in-Pipe System was verified, first by inspection then by pressure testing, and documented as part of the construction process. Primary and encasement pipe materials were procured from suppliers qualified in accordance with applicable requirements of ASME NQA-1-1994 (ANSI/ASME 1994). Welding was performed using qualified personnel and procedures in accordance with ASME B31.3-1993. Weld inspections consisted of visual examination in addition to radiographic testing of the primary pipeline welds. No special quality assurance requirements will apply to the Transfer Line Pipe-in-Pipe System after it is put into operation.

5.8.5.2 Single-Failure Criteria and Redundancy. The outer encasement line provides containment if the primary (inner) pipe leaks. The primary and encasement piping are of welded construction and are unlikely to fail under normal operation. The leak detection system ensures that the transfer is shut down in event of a primary pipe leak. In addition, the lines are only subjected to intermittent uses of short duration, or a total of 10 to 20 days per year. Other than a severe seismic event or an excavation accident, there

is no credible scenario that would cause a failure of both the primary and encasement lines, resulting in a radioactive release. Procedural (TSR) controls and engineered features minimize the likelihood or the consequences of such catastrophic events. The Seismic Shutdown System (Section 5.11) is also designed with redundant components to ensure reliability.

5.8.5.3 Equipment Environmental Considerations. The transfer lines are located outdoors and were designed to maintain structural integrity in such an environment. The primary pipe is of stainless steel to minimize internal corrosion and facilitate eventual decontamination after sluicing retrieval is completed. The encasement is coated and cathodically protected for contact with the soil.

5.8.5.4 Maintenance. The Transfer Line Pipe-in-Pipe System consists of passive components (piping, supports) that do not require any form of special monitoring or routine maintenance, other than flushing after waste transfers. A WRSS-specific operating procedure addresses transfer line flushing. The flushing system is also discussed in Section 5.12 with reference to service water back-flow preventers. Initial inspections and pressure tests were performed at the time of construction, and pre-operational checks before each use as required in the operating procedures will help ensure the integrity of the system throughout its operating life. The transfer lines are not likely to require repairs or replacement in the course of their limited operating life. During actual operation, the seismic shutdown and leak detection systems minimize the consequences of a system failure; operation and maintenance of these related systems are discussed in the appropriate sections.

5.8.5.5 Testing. The Transfer Line Pipe-in-Pipe System will be operationally tested before being turned over to operations, and will be turned over with a complete set of verified test and calibration procedures to support regular testing and maintenance. These test procedures apply primarily to the leak detection and seismic shutdown systems, which help ensure safe operation of the transfer lines. The encasement lines have test ports which enable verification of their integrity as needed.

5.9 TRANSFER LINE LEAK DETECTION SYSTEM (SAFETY CLASS)

The following discussion evaluates the suitability of the Project W-320 WRSS Transfer Line Leak Detection System to perform the safety function(s) specified for the system by the BIO, Addendum 1. The WRSS Transfer Line Leak Detection System includes the pit leak detectors located at tank 241-AY-102 and the pit and encasement leak detectors located at tank 241-C-106.

5.9.1 Strategy Summary

The safety function of the Transfer Line Leak Detection System is to provide warning of waste accumulation in the pits or in the encasement. The operator would then terminate the waste transfer.

The Transfer Line Leak Detection System has been designated by the BIO and the BIO, Addendum 1 as both an SC and an SS system. The primary safety

function the Leak Detection System performs is to detect leaks in transfer-associated structures (pits and pipe encasement) such that actions may be taken to shut down the waste transfer pumps, thereby limiting the volume of liquid unintentionally transferred into the associated structures.

The Transfer Line Leak Detection System is a new system recently installed as part of Project W-320 and includes leak detectors installed at tanks 241-C-106 and 241-AY-102. The system has been designed to comply with the requirements specified by the BIO and the BIO, Addendum 1 as well as applicable requirements for systems performing SC functions.

The SC strategy for the Transfer Line Leak Detection System is to provide a leak detection system that is consistent with the new SC leak detector design used by TWRS at the tank farms. The new design can be shown to meet all requirements for the leak detection systems specified by the BIO and the BIO, Addendum 1 (intrinsically safe, supervised monitoring circuit, and compliant with the national electric code) and can be shown to meet all applicable SC requirements for the system to reliably perform its credited SC function.

5.9.2 System Description

The Transfer Line Leak Detection System includes individual leak detection systems installed at the tank 241-C-106 and 241-AY-102 transfer pits, which are connected to the slurry and supernate waste transfer lines. In addition to the pit leak detectors, encasement leak detectors are installed at the tank 241-C-106 transfer pits.

The pit leak detectors and the encasement leak detectors comprise the Transfer Line Leak Detection System. Pit leak detectors are installed at tank 241-C-106, in the 241-C-06A pump pit and the 241-C-06C sluice pit, and at tank 241-AY-102, in the 241-AY-02A pump pit and the 241-AY-02E sluice pit. Encasement leak detectors are installed at the tank 241-C-106, 241-C-06A pump pit and the 241-C-06C sluice pit only. Encasement leak detectors are not installed at tank 241-AY-102 because tank 241-AY-102 is at an elevation approximately 34 ft higher than tank 241-C-106 and the WRSS slurry and supernate transfer line encasements are designed to drain to tank 241-C-106.

With the exception of the tank 241-AY-102, pit 241-AY-02A leak detector, all leak detector assemblies are new assemblies which were designed, fabricated, and installed by Project W-320. The tank 241-AY-102, pit 241-AY-02A leak detector is an existing leak detector assembly that was recently upgraded by TWRS Operations to meet BIO and SC requirements. Although this leak detector is considered part of the Leak Detection System, TWRS operations performed the leak detector upgrades because pit 241-AY-02A is connected to the master pump shutdown circuit and is routinely used by operations for transfer of waste within the AY-Farm Complex. All other pits connected to the WRSS transfer lines were not part of an existing active waste transfer route; therefore, the leak detector design and installation was provided as part of Project W-320.

Each individual leak detector assembly consists of a conductivity probe, circuit electronics assembly, and local and remote panell alarms. All leak

detection assemblies, including the 241-AY-02A pit leak detector assembly, are essentially identical, with minor differences in the encasement and pit leak detector electrode design and location. The 241-AY-02A pit leak detector is also unique in that it is the only leak detector assembly connected to the master pump shutdown circuit.

The encasement and pit conductivity probes incorporate B&W Controls' electrode assemblies. Each electrode assembly includes two electrodes. Two conductors are terminated on each of the electrodes.

Pit electrodes are mounted on stainless steel support assemblies positioned in the low point on the pit floor. The electrode support assemblies support the electrodes in a vertical position and provide a means to adjust the height of the electrode in relation to the pit floor. The electrode assemblies are adjusted to alarm when 1 in. of liquid is accumulated on the pit floor. Conductors terminated on the electrodes are routed through penetrations in the pit and connect to relays in the electronics assembly located next to the pit walls.

Encasement electrodes are mounted next to the tank pit wall on the top of leak detection risers. The leak detection risers are constructed of 2-in. vertical pipe, which is connected to a horizontal pipe located below and connected to the 6-in. transfer line encasement. The leak detection risers are designed to collect any liquid that originates from the encasement. The electrodes extend into the leak detection riser to a point approximately 1 in. from the bottom of the pipe. Conductors terminate at the top of the leak detector electrode assembly and are routed through conduits to the associated pit leak detector electronics assemblies.

Each leak detector electronic assembly includes three relays (LD1, LD2, and LD3), a power transformer, and a strobe light assembly. The relays and transformer are mounted inside a National Electrical Manufacturers' Association (NEMA) 4 enclosure, which is supported by unistrut posts bolted to a concrete pad, located next to the respective pit wall. The strobe light assembly is mounted on the top of the NEMA 4 enclosure.

The operation of the system is based on electrical conductivity between the two electrodes created by the presence of liquid. When the electrodes contact liquid with a resistance of 10k ohm or less, LD1 activates causing the normally open contacts to close and the normally closed contacts to open. The normally closed contacts generate remote alarms and the normally open contacts activate the local strobe light.

Relays LD2 and LD3 are used to provide a monitoring circuit that supervises the wiring from the leak detector electrode wiring to relay LD1. Relay LD3 monitors the DC voltage applied to the electrodes by Relay LD1. When the voltage is greater than 2.5 V, LD3 is energized which in turn energizes LD2. If one of the electrode wires is open or if LD1 voltage drops below 2.5 V, LD3 deenergizes causing LD2 to switch, which generates both local and remote alarms. Remote alarms are also generated on a loss of power to relays LD2 and LD3. When the leak detector is in the alarm condition, the local strobe light is activated. The strobe remains in the alarm condition and requires an operation action to reset the alarm following the evacuation of the detected liquid.

In addition to the local alarms, remote leak detector alarms are located in the MO-211 control room for the C-Farm pit and encasement leak detectors and the 241-AY-51 electrical equipment skid for the AY-Farm pit leak detectors. The C-Farm pit and encasement leak detectors also alarm at the Tank Monitoring and Control System (TMACS).

The remote alarms at C-Farm and AY-Farm are included on the WRSS annunciator panels. The annunciators provide a 24-V dc current loop through normally closed contacts on relays LD1 and LD2. Individual windows on the annunciator panels alarm if either the LD1 or LD2 contacts open. The remote annunciators provide operators with an alarm location at the pump shutdown location, thereby eliminating the need to continuously staff the local alarm location. The control room will be continuously manned during 241-C-106 active sluicing operations.

5.9.3 System Safety Functions

The BIO and the BIO, Addendum 1 credit the Transfer Line Leak Detection System with performing SC functions in the prevention of the "Subsurface Leak Resulting in Pool" (BIO Accident 5.3.2.18 and the BIO, Addendum 1, Accident 3.4.2.14) and the "Surface Leak Resulting in Pool" (BIO, Addendum 1 Accident 3.4.2.15) accidents. The Transfer Line Leak Detection System is also credited with performing an SS function in the prevention of the "Subsurface Leak Remaining Subsurface" accident (BIO Accident 5.3.2.7 and the BIO, Addendum 1, Accident 3.2.13).

The specific SC function the Transfer Line Leak Detection System performs and the available outage time for the system are discussed further in the following sections. The safety function the leak detectors perform is the same for both the SC and SS functions; therefore, no distinction is made between the two functions.

5.9.3.1 Transfer Line Leak Detection System. The safety function the Transfer Line Leak Detection System performs is to detect leakage into structures physically connected to active waste transfer pumps and create an alarm such that an associated operator action may be taken to shut down the waste transfer pump to minimize the amount of material released. Technical Safety Requirement, Surveillance 3.1.3 requires transfer line leak detectors be operable any time administrative locks are removed from the transfer pumps. For the leak detectors to be considered operable, the alarm location and the pump shutdown location are required to be continuously staffed.

5.9.4 Allowable Outage Time

The leak detectors perform a safety function and are required to be operable at all times when administrative locks are removed from pumps physically connected to structures connected to the waste transfer route. Therefore, when the administrative locks are removed from the associated transfer pumps, no outage time is available. However, when administrative locks on connected transfer pumps are in place, the leak detection system may be inoperable for periods of unlimited duration.

5.9.5 System Design Evaluation

Tank Waste Remediation System Operations has evaluated the suitability of the new intrinsically safe leak detector design which forms the basis for the design used by Project W-320. The results of the analysis are documented in HNF-SD-WM-ER-736, *Intrinsically Safe Leak Detector Circuit Design Description* (Scaief 1998). HNF-SD-WM-ER-736 concludes that the leak detector design meets requirements for functional operation as well as the requirements for SC SSCs.

The Transfer line Leak Detection System also has been independently evaluated by Project W-320 to identify individual components of the system which perform SC functions. The specific components relied on to preserve the safety function of the system are identified in the Appendix. The classifications are consistent with the TWRS component classification as described in the TWRS SEL and HNF-SD-WM-RD-057 (Smith-Fewell 1997) with the exception of designation of the remote annunciator alarm circuit as SC. The remote annunciator circuit and relays LD2 and LD3 have been designated as SC to eliminate the need to continuously staff the local alarm location.

DOE Order 6430.1A identifies criteria to be considered in the design of SC components and systems to ensure the system or component can perform its identified safety function. These criteria include quality assurance, single-failure criterion and redundancy, environmental considerations, maintenance, and testing. Each SC criterion as applicable to the subject SC system is individually addressed in the following discussions.

5.9.5.1 Quality Assurance. All work associated with the design, fabrication, and installation of the individual transfer line leak detector assemblies provided by Project W-320 was performed in accordance with enhanced quality assurance requirements appropriate for SC systems. All work was designated as SQ requiring approval by Safety and Quality Assurance representatives.

Critical characteristics were identified for all SC components as appropriate and commercial grade item dedications were performed for all components identified as SC. Fabrication and installation procedures included numerous verifications during the fabrication and installation process to ensure specified materials and components were used in the fabrication and identified critical characteristics were properly achieved. All design, fabrication, and construction activities were also overviewed by Quality Assurance, Quality Control, and the authorized inspector to ensure that the level of quality specified was obtained.

Considerable testing was also specified for the assemblies and performed during the fabrication and installation process. This testing included functional tests performed on the individual assemblies in the shop following fabrication, as well as a final comprehensive tests performed following installation in the field to verify the system operated as designed and fail-safe features worked properly. All testing was witnessed and verified either by a Fluor Daniel Northwest, Inc., field quality control representative or the authorized inspector.

5.9.5.2 Single-Failure Criteria and Redundancy. The SC components of the Transfer Line Leak Detection System, as identified in the Appendix, include the leak detector electrodes; the transformer; relays LD1, LD2, and LD3; the strobe light; and the remote annunciator. These components are identified as the critical components in maintaining the SC function established for the assembly because failure of any of the components has the potential to impact the SC function of the assembly.

DOE Order 6430.1A requires that the design of SC components be such that a single failure does not result in the loss of capability of an SC component to accomplish its required SC function. Redundancy and diversity are also required to be considered, as appropriate, to ensure a common-mode failure does not result in the loss of the safety function provided by the component or system.

The leak detector electrode is wired with four conductors with two conductors terminated on each of the two electrodes. The circuit is intrinsically safe and continuously supervised. If the circuit voltage drops below 2.5 V or if the circuit is interrupted for any reason (e.g., severed wire, poor termination, etc.), the leak detector alarms at local and remote locations.

The leak detection alarms are also redundant, which provides for further fail-safe operation of the system. The annunciator is powered from a separate power source than the local electronics assembly and provides a 24 V dc current loop through normally closed contacts on relays LD1 and LD2. The annunciator is designed to alarm if power is lost at the local circuit electronics assembly or if the annunciator circuit is interrupted for any reason.

5.9.5.3 Equipment Environmental Considerations. All equipment and components comprising the Transfer Line Leak Detection System were designed considering the tank farms' harsh operating environment and SC service conditions. The components interfacing with the tank are designed in accordance with intrinsically safe requirements and are suitable for use in Ignition Source Control Set 1 (Noorani 1997a) environments which represent the highest flammable gas category established for waste storage tanks at the Hanford Site. The electrode assemblies are constructed of stainless steel and conform to the standard electrode assembly design successfully and reliably used for leak detection throughout the Hanford Site for decades.

The leak detector electronics enclosure, support assembly, concrete pad, and conductor raceways are all designed, fabricated, and installed in accordance with general service requirements. General service is considered appropriate for these components because a failure of any of the components for any reason (seismic event, high wind, lightning, etc.) will result in an alarm due to the fail-safe design of the interfacing SC components.

5.9.5.4 Maintenance. The Transfer Line Leak Detection System was designed to facilitate periodic maintenance. With the exception of the pit electrodes, all components of the system are easily accessible and located in areas of low radiation. The encasement electrodes can also be easily replaced should a failure occur. The pit electrodes, however, due to their location within the pits, require removal of the cover blocks for replacement. Although the pit

electrodes are not easily replaceable, their passive design has proven to be very reliable at the tank farms.

5.9.5.5 Testing. Each leak detector assembly is extensively tested as part the fabrication and installation process. The testing performed is very comprehensive and verifies all fail-safe features of the complete system.

The Transfer Line Leak Detection System has also been designed to accommodate periodic testing of the system. Individual leak detector assemblies include a test switch which simulates an open conductor on the supervised circuitry in addition to simulating the presence of liquid with a conductance of 10k Ohm. Remote annunciator panels also include a test button, which can be used to periodically verify the annunciator windows are functioning properly.

5.10 PIT COVER BLOCKS SYSTEM (SAFETY CLASS AND SAFETY SIGNIFICANT)

The following discussion evaluates the suitability of the Project W-320 WRSS Pit Cover Blocks System to perform the safety function(s) specified for the system by the BIO and the BIO, Addendum 1.

5.10.1 Strategy Summary

The safety function of the pit cover blocks is to mitigate the effects of a spray release (i.e., knock down the spray) from the pressurized transfer line and limit the release of aerosols to the atmosphere.

The transfer system pit cover blocks are steel-reinforced, structural concrete blocks used to cover various pits that access waste transfer lines, pumps, and other WRSS equipment to support waste transfers between tanks 241-AY-102 and 241-C-106. The cover blocks are required to be in place at all times during waste transfers. The blocks are constructed to meet the requirements of their designation of SC, and have a low likelihood of failure during use. Recovery from a cover block failure would be to shut down any ongoing waste transfer, place the facility in a safe configuration, and repair or replace the failed cover block.

5.10.2 System Description

The Pit Cover Blocks System consists of heavy concrete blocks positioned over transfer system pits, associated with tanks 241-AY-102 and 241-C-106, to provide shielding and a barrier to liquid spray. The covered pits are as follows.

- Sluice pit 241-AY-02A, accessing D-0621 distributor in tank 241-AY-102. Only one cover block was replaced by Project W-320: the sluice pit. Replacement cover block was designed and fabricated to SC requirements.

- Sluice pit 241-AY-02E, accessing P-0621 sluice pump in tank 241-AY-102
- Pump pit 241-C-06A, accessing P-1361 slurry pump in tank 241-C-106
- Sluice pit 241-C-06C, accessing S-1361 sluicer in tank 241-C-106.

Other pits are not connected to or associated with active transfer lines; the covers on such pits are not considered part of the transfer pit cover block system and do not have the same safety function.

The blocks are designed to be structurally sound and fully cover the pits so as to preclude an undiverted liquid spray to the atmosphere. The blocks function by creating a tortuous leak path for spray leaks, and are not required to provide a pressure boundary or an air-tight seal. In fact, a small amount of in leakage between cover blocks is required to provide a path for fresh air ventilation inside the pits. Therefore, small cracks, spalling, or other forms of minor damage typically do not affect the function of the cover blocks. Whenever pits are opened, procedures require the cover blocks and pit interior to be examined for signs of structural damage or degradation. The exterior of the pits and covers are also subject to visual inspection before operation of the WRSS.

The pit cover blocks must be verified as being installed and in place before the start of and during any waste transfer, and the blocks may not be lifted or removed without appropriate reviews and other controls. Some of the cover blocks are penetrated with access ports. These openings are provided with shield plugs or covers, which must be in place during transfers and are subject to the same controls as the cover blocks themselves. The AY pits have floor drains which channel any accumulated liquids from the pit into the waste tank below. These floor drains may be plugged to maintain confinement if the cover blocks are removed, but are normally left open whenever the pit is covered. The tank 241-C-106 floor drains are plugged.

The designs for the cover blocks, including modifications to provide new access ports for WRSS equipment, are shown on Drawings H-2-818448, H-2-818450, and H-2-818454. Project W-320 structural calculations for the blocks, based on SC natural phenomena loads, are referenced on Drawing H-2-818423.

5.10.3 System Safety Functions

Pit cover blocks are SC and are credited in a "Spray Leak from Structure" accident (BIO, Addendum 1, Section 3.4.2.16). This accident classifies the cover blocks as SC. The pit cover blocks are also SS and are credited in a "Surface Leak Causing a Pool" (BIO, Addendum 1, Section 3.4.2.15). The safety function of the cover blocks is to mitigate the effects of a spray release from pressurized transfer lines in the associated pits, and limit the release of radioactive or hazardous aerosols to the atmosphere. The pit cover blocks are also SC and SS according to the BIO, Sections 5.3.2.20 and 5.3.2.18.

5.10.4 Allowable Outage Time

An allowable outage time is zero, or does not exist. The blocks must be in place (i.e., "operable") at all times during sluicing. Administrative controls ensure that the cover blocks are reinstalled if they have been removed, and if the cover blocks are not verified to be in place, waste transfers cannot take place. In the unlikely event that an accident or natural event results in a catastrophic failure of a cover block during an active transfer, similar controls require that the transfer be stopped immediately and the facility placed in a safe condition.

5.10.5 System Design Evaluation

5.10.5.1 Quality Assurance. The SC classification of the pit cover blocks, along with the construction specifications for the blocks, painting, and lifting bail load test requirements, are specified on the design drawings (e.g., H-2-818448). The appropriate inspections and verifications were applied to the original fabrication, and will apply again if any of the cover blocks ever need to be repaired or replaced.

5.10.5.2 Single-Failure Criteria and Redundancy. The pit cover blocks are not redundant components. If damaged, they must be replaced. The cover blocks are simple structures that, once installed and in use, are unlikely to fail. A single failure of a cover block during a waste transfer could potentially result in a radioactive release, but may be considered an incredible event due to the simplicity of its design and function, controls in place to verify that pits are covered before and during transfers, and periodic visual inspections of the pits and cover blocks.

5.10.5.3 Equipment Environmental Considerations. The pit cover blocks are located outdoors (in a tank farm) and were designed to maintain structural integrity in this environment. The cover blocks are simple slabs of reinforced concrete, equipped with lifting bails or lugs for safe removal and handling, and painted for protection from weathering. Pit cover blocks of similar design and materials have been in service onsite for many years and are proven to operate reliably under similar environmental conditions.

5.10.5.4 Maintenance and Testing. The pit cover blocks do not require any form of regularly scheduled maintenance or testing, other than occasional visual inspections to verify their structural integrity as described previously. Effects of weathering and minor damage from handling the blocks may require corrective action such as repair, painting, or replacement of some cover blocks.

5.11 SEISMIC SHUTDOWN SYSTEM (SAFETY CLASS)

The following discussion evaluates the suitability of the Project W-320 WRSS Seismic Shutdown System to perform the safety function(s) specified for the system by the BIO, Addendum 1.

5.11.1 Strategy Summary

The safety function of the Seismic Shutdown System is to interrupt the electrical power to the transfer pumps if a seismic event is detected by the sensors.

The Seismic Shutdown System is interlocked with the WRSS transfer pumps, and is designed to detect ground movement of the appropriate magnitude and deenergize the pumps. The triggering event or setpoint is a measured ground acceleration equivalent to an SS design event. The system will stop in-progress transfers and limit the amount of material at risk (i.e., for being released) to whatever is contained in the Transfer Line Pipe-in-Pipe System (see Section 5.8). The inventory of waste in the pipeline is bounded by the safety analyses.

The Seismic Shutdown System is classified as SC, and it functions to reduce the volume of a spill from a transfer line that could be ruptured during an SC design basis earthquake. It was designed and procured to meet SC and electrical "Class 1E" requirements, including natural phenomena loads, in accordance with the original project criteria. Its safety function enables the Transfer Line Pipe-in-Pipe System and other SC systems (e.g., the stack CAM interlock) to be designed to SS natural phenomena loads. Given the redundancy and other design features of the system, initial qualification testing, routine calibration, and the limited or intermittent operation and service life of the WRSS, the Seismic Shutdown System is expected to meet its safety function for the duration of WRSS operations.

5.11.2 System Description

The Seismic Shutdown System consists of two instrument enclosures at tank 241-C-106, and two more at tank 241-AY-102. These are identified as 241-C-51A, 241-C-51B, 241-AY-51A, and 241-AY-51B, respectively. Each enclosure houses and protects a seismic shutdown switch or "trigger," and is climate controlled to ensure reliable operation of its contents. The trigger consists of a seismic detection unit, or triaxial accelerometer, with an internal relay and other associated control components. The trigger operates in conjunction with a Class 1E magnetic contactor assembly, housed in the same enclosure. The Seismic Shutdown System is described in the BIO, Addendum 1, Section 2.3.7; it is depicted on Drawings H-2-818559 and H-2-818560.

Either of the two triggers at tank 241-C-106 is independently capable of automatically shutting down the submersible slurry pump and the booster pump in tank 241-C-106 upon detecting a measured ground acceleration vertically (0.08 *g*) or along either of two horizontal (0.12 *g*) axis. Similarly, either of the two triggers at tank 241-AY-102 is independently capable of automatically shutting down the submersible sluice (supernatant) and booster pumps in tank 241-AY-102 upon detecting the same magnitude event. Both sets of triggers are wired to local operator stations as well as the interlocks that provide the safety function. The trigger operates by opening the control circuit of the associated contactor upon detecting a triggering seismic event. The contactor remains open during and after the seismic event, interrupting power to the affected transfer pumps until it is manually reset.

Each enclosure also has three separate temperature instruments. One of these monitors the enclosure temperature, and notifies an operator of an out-of-range (extreme high- or low-temperature) condition. A second instrument is a temperature controller that operates in conjunction with the enclosure heating and cooling unit to enable climate control to maintain the enclosure within the ideal range for reliable system operation. Neither of these two instruments has an identified safety function.

The third temperature instrument is an electrical "Class 1E" qualified, high-temperature switch interlocked to the same contactor assembly as the associated seismic trigger. By this means, a high temperature in a seismic shutdown system instrument enclosure will also cause the contactor to open, shutting down the corresponding WRSS transfer pumps. The high-temperature switches are integral with the associated magnetic contactor assemblies. A local loss of AC power to a contactor will also cause the contactor to open (i.e., to fail safe). The seismic trigger is supplied by a backup battery power supply which will maintain it in an operable state for 16 hours.

If a seismic event occurs of sufficient magnitude to potentially damage the Transfer Line Pipe-in-Pipe System, or if any of the instrument enclosures overheat to the point where its instrumentation may not operate reliably, the Seismic Shutdown System automatically ensures that ongoing waste transfers are stopped and the facility is placed in a safe condition.

5.11.3 System Safety Functions

The Seismic Shutdown System is necessary for the safe operation of the Transfer Line Pipe-in-Pipe System, which is credited in the Authorization Basis with limiting a subsurface or surface leak resulting in a pool as well as a "Spray Leak from Structure Accident" (BIO, Addendum 1, Sections 3.4.2.14, 3.4.2.15, and 3.4.2.16). These accident scenarios classify the Transfer Line Pipe-in-Pipe System as SC; however, this system is expected to fail in an SC design basis earthquake. Therefore, the safety functions of the Seismic Shutdown System are to detect a seismic event of sufficient magnitude to damage the primary waste transfer pipeline, shut down ongoing sluicing and waste transfer operations, and notify an operator of the event so that the situation can be assessed and any additional measures be initiated if necessary to ensure a safe shutdown of the facility. There are no TSR controls associated with the Seismic Shutdown System.

On a component level, those items necessary to support the safety function of the Seismic Shutdown System are classified as SC. These items consist of the seismic triggers and the associated magnetic contactor assemblies (including the enclosure high-temperature switches).

5.11.4 Allowable Outage Time

There is no allowable outage time. The Seismic Shutdown System must be operable at all times during sluicing and waste transfer activities. Because the magnetic contactor fails open when deenergized, the WRSS transfer pumps cannot operate unless all four enclosures in the Seismic Shutdown System are

fully operable. Operating procedures require that system operability be verified before the start of sluicing.

5.11.5 System Design Evaluation

5.11.5.1 Quality Assurance. The Seismic Shutdown System was procured from a qualified supplier in accordance with applicable quality assurance requirements of ASME NQA-1-1994 (ANSI/ASME 1994). Structural welding was performed using qualified personnel and procedures in accordance with AWS D1.1, *Structural Welding Code--Steel* (AWS 1996). The finished system was seismically qualified by testing. Performance and acceptance testing were also performed to verify the system's design functions and operability. Normal quality assurance verification will be followed during system maintenance, testing and procurement of spare replacement parts.

5.11.5.2 Single-Failure Criteria and Redundancy. The Seismic Shutdown System is redundant by design, consisting of two identical, independent shutdown systems at both tanks in the WRSS. Because of this redundancy, and the fail-safe nature of their design, there is no single failure of a component which could result in a loss of system safety function.

5.11.5.3 Equipment Environmental Considerations. The Seismic Shutdown System is located in climate-controlled enclosures that were designed to maintain structural integrity in an outdoor environment and protect the system's function and reliability. Anticipated extremes of ambient temperature and other Site conditions were specified for procurement, and vendor submittals were reviewed against these requirements.

5.11.5.4 Maintenance. The Seismic Shutdown System was supplied with a complete set of operating and maintenance procedures. Based on the vendor's qualification testing of the system, no major parts replacement is required to maintain the equipment qualification. Consumable electrical components, such as lights, fuses, relays, and contactors are subject to occasional failure and should be stocked in accordance with the vendor-submitted spare parts list. Preventive maintenance is recommended on an annual basis, including visual inspection of panels, cleaning, and repair or replacement of deteriorated parts or insulation.

5.11.5.5 Testing. The Seismic Shutdown System was supplied by the vendor with calibration and troubleshooting procedures. The seismic triggers were supplied with a certificate of calibration traceable to the National Bureau of Standards. The assembled systems were also subjected to seismic qualification testing. For the duration of WRSS operations, calibration and testing of the seismic trigger should be performed every 6 months, and can be achieved by means of a vendor-supplied "field calibrator." All three axes of the switch are tested to verify their setpoints. Though usually not necessary, minor adjustments can be made at this time if needed. The setpoint of the enclosure high temperature switch is verified annually.

5.12 BACK-FLOW PREVENTERS (SAFETY SIGNIFICANT)

The following discussion evaluates the suitability of the Project W-320 WRSS back-flow preventers to perform the safety function(s) specified for the system by the BIO, Addendum 1.

5.12.1 Strategy Summary

The safety function of the back-flow preventer devices is to prevent back flow of waste into the service water system (e.g., tank trucks).

The waste transfer line flushing system back-flow preventers are mechanically simple jumper assemblies. They are used intermittently to support WRSS operations. The back-flow preventers were designed, procured, and fabricated to meet all the requirements of their designation of SS. The flushing system is disconnected and taken out of service between uses. Therefore, a back-flow preventer can be repaired or replaced without disrupting operations, if needed.

5.12.2 System Description

The WRSS features a capability to routinely flush the slurry and sluice transfer lines between tanks 241-AY-102 and 241-C-106. This process removes solids that may have settled out in the lines during transfers or gravity drainage of the lines. The settled solids restrict the flow of subsequent transfers, are a source of personnel radiological exposure, and may generate a flammable gas mixture. Transfer line flushing minimizes the risk of these hazards and is considered good operating practice in general. The flushing system will be installed at the tank 241-AY-102 end of the two lines, in pits 241-AY-02A and 241-AY-02E, and will consist of jumpers or lines that connect the transfer line temporarily to a pressurized flush water supply.

Back-flow preventers will be required because the flushing system will rely on a service water supply system or tank truck, and these sources of water as well as the connecting hoses or jumpers need to be protected from contamination. The back-flow preventers are located on the flushing lines in such a manner as to minimize the potential spread of contamination outside the pit boundaries, transfer lines, or waste tanks; minimize water traps or collection points; and drain freely into the connecting jumpers after flushing is completed.

A flushing jumper design which incorporates the required back-flow preventer feature, for use on tank 241-AY-102, is shown on Drawing H-2-818510. The back-flow preventers are engineered by Project W-320, with positive features to prevent back flow, including double redundant, ball check valves, and test ports used to verify valve integrity before use. The jumper assembly, including the check valves, is hydrostatically tested for service as part of fabrication.

Back-flow preventers are not certified back-flow assemblies, such as approved by the State for use on potable water supplies, and they are not required to meet the same standards for testing as approved devices, although

their design does enable functional testing between uses if needed. The flushing system will not provide a potential cross connection to a potable water supply; all known service water supplies to the tank farms (both raw and sanitary water) are already provided with approved back-flow devices that must be tested regularly as part of an established program under the cognizance of the Site water purveyor.

5.12.3 System Safety Functions

The safety function of the back-flow preventers is to prevent general contamination of service water supply systems or tank trucks. They are credited in the BIO (Addendum 1, Section 3.4.2.15) as safety SSCs and defense-in-depth controls for a surface leak resulting in a pool, such as an overflow of a pit, for which they are classified as SS.

5.12.4 Allowable Outage Time

There is no allowable outage time for the back-flow preventers while they are in use. The devices must be in place and functional at all times during transfer line flushing or when the water supply is connected to a pit or flushing line. Flushing must take place within a month after each waste transfer. However, at other times the devices are not in use and can be disconnected for inspection, testing, or repairs without impacting operations. Therefore, a maximum allowable outage time, for the purpose of maintenance or testing only, would be about 1 month provided flushing of transfer lines is not planned during the same period. The existence of spare flush jumpers and back-flow preventers would further alleviate any outage restrictions.

5.12.5 System Design Evaluation

5.12.5.1 Quality Assurance. The transfer line flush system, including the double check valves, was procured and designed to meet SS criteria. Procurement was in accordance with appropriate quality assurance requirements, including test and inspection documentation. The check valves were commercial grade items dedicated as SS in accordance with HNF-IP-0842, Vol. IV, Section 3.11, "Replacement Item Evaluation, Commercial Grade Item Dedication and Upgrade" (Gibson 1997). Any future maintenance, parts replacements, or modifications will be performed in accordance with the appropriate quality assurance requirements.

5.12.5.2 Single-Failure Criteria and Redundancy. The back-flow preventer design features double check valves to provide redundancy while they are in use. Before use, if needed, each check valve can be independently tested for function and integrity. A system failure or loss of safety function would require a simultaneous failure of both check valves, which is unlikely. Stocking spare parts would not improve operating redundancy, but might simplify maintenance between uses.

5.12.5.3 Equipment Environmental Considerations. The check valves and associated components of the flushing jumpers were procured as SS components, and selected for the anticipated service conditions. Wetted parts include stainless steel alloys.

5.12.5.4 Maintenance. Maintenance needs for the back-flow preventers are minimal, mostly limited to replacement of worn or damaged check valves or valve parts. Valve integrity can be verified by testing between uses. The balance of the flush jumper assemblies are of welded and screwed stainless pipe materials that do not require any maintenance. The jumpers and the valves themselves are not likely to be contaminated, but the potential is there due to their location and use, and appropriate precautions apply when handling them. The jumpers are designed to be remotely connected and disconnected.

5.12.5.5 Testing. Testing needs are limited to possible functional testing of the check valves, which can be performed while the devices are out of service. An initial hydrotest on the jumper and individual check valves was performed at the time of fabrication.

5.13 241-AY-102 AND 241-C-106 PRIMARY TANK LEVEL DETECTION SYSTEMS (SAFETY SIGNIFICANT)

The following discussion evaluates the suitability of the Project W-320 WRSS Primary Tank Level Detection Systems to perform the safety function(s) specified for the system by the BIO and the BIO, Addendum 1.

5.13.1 Strategy Summary

The safety function of the Primary Tank Level Detection Systems is to provide measurements used in the performance of material balance calculations between transfer batches. The calculations are used to detect discrepancies during the transfers to detect leaks or misroutes.

The Primary Tank Level Detection Systems use existing technology to support TSR compliance, process control, and periodic material balance calculations on waste transfers during operation of the WRSS. They are credited in the BIO, Addendum 1 with the SS function of detecting and helping to mitigate subsurface or surface leaks from either of the two tanks or the associated interfarm transfer lines. The level gauges and certain other system components were previously designated throughout TWRS as SS equipment, were procured as such, and meet all the requirements of the WRSS.

While the level detection systems are considered generally reliable, failure or malfunction of the system is detectable during operation. Tank levels are monitored with TMACS. A loss of the signal causes the tank displayed on the TMACS screen to turn white. The white color indicates a failed instrument. Waste transfers and sluicing operations must be suspended in the event of a loss of level gauge or level detection system until operability is restored. However, this does not pose an immediate threat to operating safety, and there is no requirement for redundancy. Given the availability of spare parts in stock and work control documents prepared in

advance, these systems can typically be restored in less than 48 hours, even if a complete level gauge replacement is required. Based on operating experience throughout TWRS with these systems, it is concluded that they can be relied on to perform their safety function.

5.13.2 System Description

Tanks 241-AY-102 and 241-C-106 are each equipped with a liquid level detection system, which will play an important role in sluicing by supporting process control and periodic material balance calculations during transfers between the two tanks. Each level detection system consists of a liquid level gauge installed in a tank riser, a level-indicating transmitter, a tank level alarm (at the TMACS), a remote liquid level signal at the MO-211 operator station, and associated electrical components. The heart of either system is an Enraf-Nonius Series 854 (ENRAF) liquid-level gauge. This device is described in detail in the BIO, Section B2.4.11.2.1, and HNF-SD-WM-ATP-077, *Enraf Series 854 Advanced Technology Gauge (ATG) Acceptance Test Procedure* (Huber 1998).

The ENRAF instrument provides precise indication of waste level by detecting variations in the weight of a plummet, or displacer, due to buoyancy. The displacer is hung by a thin wire from the instrument and suspended in the waste or at the waste surface. A level change causes a change in the weight of the displacer (i.e., a change in the wire tension) which is detected by a force transducer in the gauge. The wire is fed from a servo-driven measuring drum inside the gauge, by which means the displacer position is automatically and continuously adjusted to maintain a preset sensing level. These instruments are certified for use in flammable atmospheres potentially found in Hanford Site waste tanks.

The gauge displays the level locally in decimal inches, as well as transmitting the level data to MO-211, the TMACS, or other remote data acquisition or processing system. Each time a reading is taken, either manually (locally) or automatically (remotely), the status of the instrument is also displayed. This status check either indicates normal operation or notifies the operator that there is a malfunction. In the latter case, it does not necessarily identify the specific cause, which may be a loss of signal, loss of power, or out-of-range condition. Limited diagnostics are available on the instrument display or from a remote control console, but further field investigation may be needed to determine the cause. At any rate, the system can prompt notify an operator of a loss of power or other problem with the instrument.

Tank 241-AY-102 also has a second, modified ENRAF instrument, referred to as the "densitometer." Unlike the case of the liquid level gauge, in which the displacer operates at the waste surface, the displacer on the densitometer is of a different design and operates submerged in the waste. This instrument will primarily serve a process control function, being used to measure sludge depth and the density of the fluid portion of the waste in tank 241-AY-102. In combination with grab samples or temperature data, the densitometer will be used to monitor the rate of slurry solids loading, sludge transfer, sludge settling, and sludge uniformity during the sluicing retrieval process.

During normal operation, ENRAF liquid-level gauges are read and checked for operability as part of the operators' daily rounds. Many of the ENRAF gauges, including those on tanks 241-AY-102 and 241-C-106, are normally connected to the TMACS. The TMACS reads the gauges once per minute and at the same time checks their status to ensure they are operational and are reading correctly. During sluicing, the ENRAF in tank 241-C-106 will be out of service (i.e., the displacer is raised above the waste to avoid damage). When the tank 241-C-106 ENRAF gauge is out of service during sluicing, a signal will inform the TMACS operator that the device was taken off line deliberately and that the gauge is not out of service for some other reason (malfunction, etc.). Both the liquid level gauge and the densitometer in tank 241-AY-102 will be operational during the sluicing process.

5.13.3 System Safety Functions

Primary tank level detection in tanks 241-AY-102 and 241-C-106 is credited with detecting and helping to mitigate subsurface or surface leaks from either of the two tanks or the associated interfarm transfer lines during waste retrieval from tank 241-C-106 and concurrent transfer to tank 241-AY-102 (BIO, Addendum 1, Sections 3.4.2.13, 3.4.2.14, and 3.4.2.15). These accidents classify the systems as SS. The safety function of the level detection systems is to support periodic material balance calculations during waste transfers, and to provide indication of tank waste level to help detect leaks or misroutes, thereby preventing or minimizing a significant facility worker hazard. This support function is not used during actual sluicing, but is performed after each sluicing batch of up to 12 hours duration, and at least once every 24 hours while WRSS operations are in progress.

Primary tank level detection is also credited as an SS control in association with a postulated tank bump accident in the main portion of the BIO, Section 5.3.2.22, though not in the BIO, Addendum 1 or the safety assessment for the WRSS.

On a component level, the ENRAF liquid level instrument is classified as SS; the remaining system components are general service. The densitometer, or second ENRAF instrument in tank 241-AY-102, is used primarily for process control and is classified as general service.

There are no TSR controls directly associated with these systems. However, waste level readings support material balance calculations during waste transfers as required by AC 5.12, "Transfer Controls;" this function is specified in AC 5.12.2.d. During normal, non-WRSS operations, the ENRAF gauges support daily monitoring of tank waste levels as required by AC 5.21, "Service Water Intrusion Monitoring." Regular testing and calibration of liquid level detection systems are managed in accordance with AC 5.19, "Process Instrumentation." The ENRAF gauges meet the most stringent ignition control requirements of AC 5.10, "Ignition Controls," qualifying them for use inside any Hanford Site waste tank.

All waste tanks must be monitored for potential leaks, and to verify primary tank integrity, in accordance with environmental regulations. This is a requirement of TSR 3.2.6. (Noorani 1997a). In many of the single-shell waste tanks, liquid level detection systems represent the primary means and

the best available technology for leak (and intrusion) detection. In the case of tank 241-C-106, however, evaporation losses and regular water additions are part of normal operation, and these must be tracked and factored in on a periodic basis. During sluicing, this means of leak detection will not be practical and the periodic material balance calculations in between sluicing batches will become the primary means of leak detection, backed up by surveys of an existing system of dry wells. In the case of double-shell tanks, including tank 241-AY-102, the annulus ventilation system (not the level detection system) provides the primary means of leak detection and can be operated continuously during sluicing.

5.13.4 Allowable Outage Time

An allowable outage time is not relevant in this case. The tank liquid level detection systems are not required to be continuously operable during actual sluicing and waste transfer, but must be read at least once every 24 hours during both WRSS and normal, non-WRSS operations. In either case, a malfunction or loss of instrument function will be detected within 24 hours (whenever the next level reading is attempted) and maintenance or other corrective action will be initiated as a result. If an ENRAF liquid level gauge is out of service, sluicing operations cannot continue and must be shut down until the device in question is back in service, due to the TSR requirements of AC 5.12. This does not represent an unsafe condition because the facility would revert to a normal operating mode governed by existing procedures and recovery actions.

5.13.5 System Design Evaluation

5.13.5.1 Quality Assurance. The liquid level gauges and densitometer were procured as SS equipment. The gauges are certified by the manufacturer, and were acceptance tested onsite before installation in the field. Acceptance testing is witnessed and verified by quality assurance personnel. Any maintenance, parts replacements, or modifications are performed in accordance with the appropriate quality assurance requirements.

5.13.5.2 Single-Failure Criteria and Redundancy. The ENRAF liquid level gauge in tank 241-AY-102 is backed up by a manual tape as an alternate means of measurement, but this is not credited in the BIO, Addendum 1. In tank 241-C-106, there is no alternate means of level measurement if the ENRAF gauge is lost. Therefore, both ENRAF liquid level detection systems and the densitometer are not redundant for practical purposes. However, a single failure of a level detection system or any component thereof does not result in a loss of safety function because the system will simply not be operated until the problem is corrected. DOE Order 6430.1A redundancy requirements do not apply to SS systems.

5.13.5.3 Equipment Environmental Considerations. The ENRAF and associated components were procured as safety-related equipment. Environmental qualification was verified as part of the procurement process; both the outdoor (tank farm) environment and the internal tank atmosphere and waste properties were considered. Procurement criteria for the ENRAF gauges included all applicable NFPA requirements for flammable or explosive

locations. Level detection systems of the same design have been in service onsite for several years and are proven to operate reliably in the tank farm environment.

5.13.5.4 Maintenance. The ENRAF liquid level gauges are supported by plant operating, calibration, and maintenance procedures. Regular calibration and preventive maintenance are performed on each ENRAF every 6 months. A failed ENRAF gauge can be replaced within 48 hours or less, provided the hardware is available onsite and the work package is prepared in advance. If work planning is not prepared in advance, or spare parts are not in stock, repairs or replacement of an ENRAF gauge may require up to a week or longer to complete, resulting in potential TSR or procedural violations. It is recommended to have such preparations in place before sluicing commences to minimize potential downtime. More likely, the system can be restored with a simple repair, part replacement, or calibration which is accomplished using existing procedures that do not require extensive planning or a special work package.

5.13.5.5 Testing. The ENRAF liquid level gauges are not tested, other than an acceptance test performed at initial installation and regular calibrations as part of normal maintenance. Each time the ENRAF gauge is read its operating status is also indicated, providing a form of periodic self-test whereby any significant malfunction or loss of calibration is detected.

5.14 TEMPERATURE MONITOR SYSTEM FOR TANK 241-AY-102 (SAFETY SIGNIFICANT)

The following discussion evaluates the suitability of the Project W-320 WRSS Temperature Monitor System to perform the safety function(s) specified for the system by the BIO and the BIO, Addendum 1.

5.14.1 Strategy Summary

The safety function of the tank temperature monitoring system is to measure tank temperature. The temperature measurement will be used to detect high temperatures in the tank waste this aids in preventing a tank bump accident.

The temperature monitoring system in tank 241-AY-102 primary tank utilizes existing thermocouples as well as a multi-functional instrument tree (MIT) of an existing tank farms design, newly installed by Project W-320, to support TSR compliance, process control, and periodic material balance calculations on waste transfers during operation of the WRSS. The system is credited in the BIO, Addendum 1 with the SS function of monitoring tank waste temperature and helping to prevent a tank bump or steam release. The system must be operated continuously during normal WRSS operations. The existing thermocouples are designated as SS equipment. The new MIT is of an existing design that meets SS requirements and was procured as SS to support process control during operation of the WRSS. Both existing and new portions of the system provide the temperature monitoring safety function.

Based on the design features of the system, past operating experience throughout TWRS with similar technology, and recent upgrades to the existing thermocouples, it is concluded that the system can be relied on to perform its safety function and support operation of the WRSS.

5.14.2 System Description

The temperature monitoring system in tank 241-AY-102 will play an important role in sluicing by supporting process control and periodic material balance calculations during transfers between the two tanks, and will also provide a safety function by supporting a TSR control. The system consists of a combination of existing tank thermocouples and a newly installed MIT. The existing thermocouples are listed in the BIO, Addendum 1 (Table 2-2) and are considered to provide the safety function.

Some of the 79 existing thermocouples are located in the tank walls, dome, and underneath the tank bottom, and were installed as part of the original tank equipment. Others are located on instrument trees, extending down from risers and submerged in the tank waste. The latter sensors are the most critical to the system safety function since they monitor the sludge and supernatant temperatures directly. Many of the thermocouples are over 20 years old, and over a third of them were known to be out of service as recently as 1996. These have been tested, and in many cases either repaired or replaced as needed, by Project W-320. The thermocouples are not connected to control station alarms, but transmit a signal to the TMACS and the data acquisition system in the WRSS control station in MO-211, and are available as process indicators during operation of the WRSS. Readings can also be obtained manually from any of the individual thermocouples by means of field mounted panel monitors or hand held instruments.

The existing thermocouples will provide useful process information in addition to their safety function, but are distributed too sparsely in the tank to provide detailed information about the vertical distribution of temperatures in the tank. Information at this level of detail is not necessary to the system safety function but is needed to understand the physical layering of the retrieved waste and its heat load, including the locations of convective and nonconnective layers. This in turn will support computer modeling that can predict steady state temperatures in the tank, and will enable more efficient WRSS operations. It can also provide needed information about sludge settling and the fluffing factor of the waste. For these reasons the MIT was installed to obtain more accurate data on vertical temperature gradients in the waste.

The MIT, installed in Riser 5A of tank 241-AY-102, is of an existing standard design that has been used in other waste tanks. It will provide a detailed vertical temperature profile through the waste in tank 241-AY-102 by accurately measuring temperatures at 22 different elevations. It consists of three parts.

- An in-tank instrument probe assembly extending from the tank riser flange down to within a few inches of the tank bottom, containing the temperature sensing elements and access conduits

- An adapter flange to seal the top end of the probe assembly to the tank riser and provide mechanical support
- An external "instrument head" or junction box providing interface connections between the probe and a control room, data acquisition system, or other external monitoring equipment.

The temperature sensing elements of the probe supply signals to the existing TMACS as well as a local WRSS control station. A hollow shaft through the center of the MIT probe accommodates a validation probe that can be used to verify readings from the 22 stationary temperature elements, or measuring temperatures at intermediate increments. The MIT can also sense vapor space pressure and obtain vapor samples (hence its name) but these features will not be used for the WRSS.

The MIT is designed to SC 2 or SS requirements and has been evaluated for anticipated normal and accident structural loads, temperatures, and other conditions during WRSS operations, as well as applicable generic SC 2 (SS) loads. The MIT meets the most stringent ignition control requirements of the BIO and TSRs. The MIT is described in detail in WHC-SD-WM-RD-014, *Requirements for Design of a Multifunctional Instrument Tree for Waste Tank Surveillance* (Powers 1992) and in the BIO, Addendum 1, Section 2.4.1.12.

5.14.3 System Safety Functions

Temperature monitoring in tank 241-AY-102 is credited with detecting high temperatures in the waste and helping to prevent a tank bump accident, during or following waste transfers from tank 241-C-106 to tank 241-AY-102 (BIO, Section 5.3.2.22; BIO, Addendum 1, Section 3.4.2.11). There are no TSR controls directly associated with the temperature monitoring system. However, TSR temperature controls set an operating limit (Noorani 1997a, LCO 3.3.2) on the waste in tank AY-102 of at least 25 °F below the local saturation (boiling) temperature. The temperature monitoring system supports compliance, and is cited in the basis for this TSR control (there is also a higher Safety Limit for waste temperature, which is protected by the same LCO).

This accident classifies double-shell tank and Aging Waste Facility waste temperature monitoring systems in general as SS, which applies to the existing thermocouples and thermocouple trees, as well as the new MIT. Temperature monitoring, using the existing thermocouples, also provides data about radial temperature distribution in the tank. This is needed to evaluate effectiveness and the uniformity of cooling provided by the annulus ventilation system, as it relates to LCOs 3.3.2 and 3.3.3 (Noorani 1997a). Regular testing and calibration of temperature monitoring systems is managed in accordance with AC 5.19, *Process Instrumentation*. The MIT meets the most stringent ignition control requirements of AC 5.10, *Ignition Controls*.

5.14.4 Allowable Outage Time

An allowable outage time is not relevant in this case. The temperature monitoring system, both the existing thermocouples and the MIT, will be continuously operated during sluicing and waste transfer to support process

control as well as safe operation. Because of redundancy, individual elements of the system can be lost with little impact. However, if a substantial portion of the temperature monitoring equipment is out of service, the safety function may be lost, adequate process control is not possible, and WRSS operations cannot continue and will need to be suspended until the problem is corrected.

5.14.5 System Design Evaluation

5.14.5.1 Quality Assurance. Testing, repairs, replacement, and field verification activities related to the existing thermocouples were supported by quality assurance requirements appropriate to the SC designation of SS. The MIT was procured, installed, and tested to SS requirements.

5.14.5.2 Single-Failure Criteria and Redundancy. The temperature monitoring system has considerable inherent redundancy, consisting of a large number of individual sensing elements and multiple alternate means of obtaining data from them. Similar technology has been used in the same facility and other tank farms for many years, and has proven reliable. A loss or malfunction of an individual sensing element is noted on the daily operator rounds, and maintenance can be initiated including repairs or replacement of the element without disrupting the rest of the system. The thermocouples do not require an external power source to obtain a signal, and hence any reliance on the TMACS, a data acquisition system, or other external equipment is not necessary. A single failure of a thermocouple or any other component of the system does not result in a loss of safety function.

5.14.5.3 Equipment Environmental Considerations. The MIT and associated components were procured as safety related equipment. Environmental qualification was verified as part of the procurement process; both the outdoor (tank farm) environment and the internal tank atmosphere and waste properties were considered. The instrument probe is designed for a minimum operational life span of 15 years in the corrosive environment of the tank waste. Procurement criteria for the MIT included all applicable NFPA requirements for Class I, Division 1, Group B (hydrogen) flammable or explosive locations. Multi-functional instrument trees of the same design have been in service onsite for several years and are proven to operate reliably in similar waste tank environments.

The existing thermocouples have operated for up to 20 years or longer in the tank environment, and most of them continue to function. As noted, those that have gone out of service, or show signs of deterioration due to corrosion or other environmental factors, have been repaired or replaced. The replacement thermocouples were of the same proven technology, meeting or exceeding the original specifications, and are expected to function beyond the minimum WRSS design life of 2 years.

5.14.5.4 Maintenance. The temperature monitoring system is supported by operator rounds and plant operating procedures. Thermocouples are read daily by operators as well as being in communication with the Data Acquisition System and TMACS. The operational status of each individual sensing element being read, including any malfunction thereof (as evidenced by a failure to read or a clearly out-of-range reading), is noted on the daily operator rounds

so that repairs or other maintenance can be initiated. Maintenance consists mainly of replacing failed elements or repairing their external interface connections. Thermocouples can also be functionally tested before or following maintenance.

5.14.5.5 Testing. Functional testing is performed on all thermocouples critical to safety on an annual basis per an approved TWRS generic test procedure. The same procedure is used to test thermocouples that have been repaired or replaced. The thermocouples can be functionally tested to verify they are within the required accuracy of ±5 °F without being removed or disrupting system operation.

6.0 CONCLUSION

This engineering evaluation examined each of the SC and SS systems to determine if they can perform their intended safety function described in the BIO and the BIO, Addendum 1. The evaluation assessed each system to the SC design requirements in 6430.1A to determine if the systems met the criteria for SC systems. The evaluation also examined each system on a component level and assigned a safety designator to each component. The safety designator is directly related to the importance of the component in aiding the system to perform the intended safety function.

To meet the SC requirements of 6430.1A some of the systems were modified to provide redundancy and increased reliability. The ventilation systems are examples of the addition of a back up system to provide the required redundancy specified in 6430.1A and increased system reliability.

The evaluation considered recovery time, the capability to restore the component or system function following a failure. Recovery time was not sufficient rationale to designate a component as general service because this would imply the component did not have a safety function; however, recovery time did play an important role in determining the design requirements. In many cases the outage time or recovery time provides sufficient time to repair a failed component or install a replacement part or entire system. Using the recovery time, the evaluation acknowledges the system may fail during a design basis accident however sufficient recovery time exists to allow the system to be repaired and the system safety function reestablished to prevent an onsite or off site release.

This evaluation examined each W-320 system and concludes each SC and SS system can perform the required safety function. The evaluation also provides the basis for the addition of the W-320 equipment to the TWRS SEL.

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Drawing H-2-818448, *Structural 241-C-06A Pump Pit Mod Plan Section and Details*.

Drawing H-2-818450, *Structural 241-C-06C Sluice Pit Mod Cover Blk Plan Sections and Details*.

Drawing H-2-818454, *Structural 241-C-06C Sluice Pit Mod Cover Blk Sections and Details*.

Drawing H-2-818506, *HVAC Alternate Emergency Ventilation Configuration*.

Drawing H-2-818507, *HVAC Alternate Emergency Ventilation Configuration*.

Drawing H-2-818510, *Piping Jumper Flushing Supply Head*.

Drawing H-2-818559, *Project W-320 P&ID TK 241-C-106*.

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APPENDIX

SSC	Accident(s)	Safety Functions	Functional Requirements	Performance Criteria	Planned Modifications Involving This SSC
Annulus Ventilation System (Tank 241-AY-102)	Tank Bump BIO Add. 1 Section 3.4.2.11	Waste Cooling (SC)	Maintain waste temperatures below local steam saturation temperatures (Ref TSR 3.3.3)	Provide sufficient air flow to maintain waste temperature below the temperature limits in TSR 3.3.2. Critical Characteristics: Must maintain a minimum floor channel flow of 1000 CFM for sufficient heat removal, subject to additional in-process thermal analysis during WRSS operation. *NOTE: Differs from the BIO Addendum 1, Sec. 4.3.1.4, which states a requirement for up to 2500 CFM of chilled air through the annulus system.*	1. Annulus Blocking Upgrade 2. High Vacuum Upgrade 3. Portable Exhauster 4. Portable Generator
	Surface Leak Resulting in Pool BIO Section 5.3.2.18 BIO, Add. 1 section 3.4.2.15	Primary tank leak detection (SC)	Detect leak of tank waste into the annulus (Ref TSR 3.2.6)	Pass functional test per TSR 3.2.6.	

THE ITEMS BELOW ARE THE UNIQUE COMPONENTS THAT MAKE UP THIS SSC					
COMPONENT IDENTIFICATION	COMPONENT FUNCTION	COMPONENT FAILURE MODE	COMPONENT FAILURE EFFECTS ON SSC SAFETY FUNCTION	COMPONENT SAFETY CLASSIFICATION JUSTIFICATION	COMPONENT SAFETY CLASS
Inlet Station Prefilters (K2-1-1, K2-2-1); H2-64462, Sht. 1, Rev. 7	Remove large particles from air stream to reduce loading on HEPA filters.	Filter breach	Breach of prefilter will increase particulate loading on the HEPA filters. The particulate loading is gradual, blocking of the HEPA filter would be detected by low vacuum pressure switch. Although this would not be considered a component failure, blockage of filter would cause loss of annulus air flow.	Potential effects of component failure: Breach of prefilter could cause an increased rate of loading on the downstream HEPA filters. Blockage of a filter is not a failure of the filter itself (which is performing its function), but a failure to monitor and replace the filter as required. Critical functional requirements: None - The only safety requirement on the system is to provide adequate airflow for waste cooling and leak detection when the system is operating. No failure of the filter component itself will disable the system safety function. Component failure detection: Blockage of prefilter with fan running would trip high vacuum pressure switch PS-K2-1-2 activating vent system failure alarm XA-102-AY and CASS alarm 1167. Quality assurance criteria: Since failure of the filter component does not affect the safety function of the system, design and procurement of this component to general service requirements is adequate.	GS
Differential Pressure Indicators (K2-PI-1-1, K2-PI-1-2); H2-64462, Sht. 1, Rev. 7	Indicate differential pressure across prefilter to provide indication of filter loading.	Failure to detect filter loading. Erroneous indication of high DP.	Failure of differential pressure indication results in loss of one indication of filter blockage. The high vacuum pressure switch provides safety system for detection of filter blockage.	Potential effects of component failure: Possible reduction of annulus air flow if filter loading becomes high. Critical functional requirements: None - Failure of differential pressure indication will not reduce annulus ventilation flowrate. Component failure detection: Periodic surveillance and testing. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS

Manual Butterfly Valve (MK6302); H2-64462, Sht. 1, Rev. 7	Control annulus pressure. Isolate inlet filter from tank annulus to allow filter change out.	Valve failure in closed position	Mechanical failure of valve to closed position will cut off annulus air flow and disable the safety functions of the annulus ventilation system.	Potential effects of component failure: Prolonged loss of annulus air flow would cause gradual heatup of sludge layer in tank possibly leading to a steam bump. Loss of annulus airflow would also disable the CAM. Failure of the CAM to function could cause primary tank leak to be unrecognized leading to flammable gas buildup and possible deflagration. Critical functional requirements: The only safety requirement on the inlet butterfly valve is to permit adequate airflow for waste cooling and leak detection when the system is operating. Component failure detection: Valve closure with fan running would trip high vacuum pressure switch PS-K2-1-2 activating vent system failure alarm XA-102-AY and CASS alarm 1167. Quality assurance criteria: Since failure of the component safety function would be immediately detected and worst-case waste heat-up and tank leak scenarios permit ample time to repair the component, the safety function can be preserved by recovery time alone. *	SC
Continuous Air Monitor (CAM-102-AY); H2-64462, Sht. 1, Rev. 7	Monitors for radiation in the tank annulus exhaust stream when annulus ventilation system is operating.	Fails to detect radiation above setpoint	Failure to detect radiation above setpoint will cause failure of alarm signal	Potential effects of component failure: Failure of alarm signal could cause primary tank leak to be unrecognized leading to flammable gas buildup and possible deflagration. Component failure, by itself, does not initiate an accident. Backup leak detection is provided by conductivity probes. TSRs require only one of the two leak detection systems to be operational. Critical functional requirements: The continuous air monitor (CAM) must be able to detect monitored air radioactivity above the setpoint and to activate the high radiation alarm. Component failure detection: Component could fail without detection of failure other than by routine surveillance or calibration activities. Quality assurance criteria: Safety function could be preserved by periodic testing since ample recovery time is available in the worst-case waste heat-up and tank leak scenarios to permit ample time to repair the component. *	SC

High Radiation Alarm (RA-102-AY); H2-64462, Sht. 1, Rev. 7	Alarms on radiation reading above CAM setpoint	Failure to alarm on high radiation. Erroneous Alarm.	Radiation reading above setpoint not recognized.	Potential effects of component failure: Failure of alarm signal could cause primary tank leak to be unrecognized leading to flammable gas buildup and possible deflagration. Component failure, by itself, does not initiate an accident. Backup leak detection is provided by conductivity probes. Critical functional requirements: The high radiation alarm must be able to respond a high radiation alarm signal from the CAM. Component failure detection: Component could fail without detection of failure other than by routine surveillance or calibration activities. Quality assurance criteria: Safety function preserved by periodic testing since ample recovery time is available in the worst-case waste heat-up and tank leak scenarios to permit ample time to repair the component. Not required to be in service if conductivity probes are in service. *	SC
CAM Vacuum Pump H2-64462, Sht. 1, Rev. 7	Draws sample from tank annulus air stream through CAM	Fails to function	Sample air movement through CAM prevented.	Potential effects of component failure: Failure of the CAM vacuum pump would disable the ability of the CAM to monitor for high radiation in the annulus air. Disabling the alarm function could cause primary tank leak to be unrecognized leading to flammable gas buildup and possible deflagration. Component failure, by itself, does not initiate an accident. Critical functional requirements: Pump must maintain sufficient air flow through the CAM to respond to a high radiation level in the annulus air stream. Component failure detection: Low flow condition in CAM is indicated by Combined Failure Alarm UXA-102-AY. Quality assurance criteria: Since failure of the component safety function would be immediately detected and worst-case waste heat-up and tank leak scenarios permit ample time to repair the component, the safety function can be preserved by recovery time alone. *	SC

Combined Failure Alarm With Associated Flow Switch and Circuitry (UXA-102-AY); H2-64462, Sht. 1, Rev. 7	Detects low sample air flow in CAM	Failure to detect and alarm low flow condition	Possible undetected loss of CAM function	Potential effects of component failure: Failure of combined failure alarm could cause primary tank leak to be unrecognized leading to flammable gas buildup and possible deflagration. Component failure, by itself, does not initiate an accident. Critical functional requirements: The combined failure alarm system must be able to detect and respond to a low sample flow condition in the CAM. Component failure detection: Component could fail without detection of failure other than by routine surveillance or calibration activities. Quality assurance criteria: Safety function could be preserved by periodic testing since ample recovery time is available in the worst-case waste heat-up and tank leak scenarios to permit ample time to repair the component. *	SC
Heater and Associated Controller and Sensors (K2-4-1); H2-64462, Sht. 1, Rev. 7	Maintain exhaust air stream above dew point to prevent condensation in exhaust system and possible wetting of HEPA filters. To be operated as necessary. Since the annulus is dry, the heater is presently inactive.	Failure to function as designed (fail on, off or intermittent)	Failure of the heater will not effect the safety function of the annulus ventilation system. The main function of the heater is to extend the life of the exhaust HEPA filters by preventing moisture buildup on the filter media.	Potential effects of component failure: Heater failure could shorten the life of the exhaust HEPA filters. Critical functional requirements: None - Heater failure (either on or off) will not decrease annulus air flow. Component failure detection: Periodic surveillance and testing. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS

Manual Butterfly Valve (MK6501); H2-64462, Sht. 1, Rev. 7	Control annulus air flow rate. Isolate exhaust HEPA filters and fan from tank annulus to allow filter change out.	Valve failure in closed position	Mechanical failure of valve to closed position will cut off annulus air flow and disable the safety functions of the annulus ventilation system.	Potential effects of component failure: Prolonged loss of annulus air flow would cause gradual heatup of sludge layer in tank possibly leading to a steam bump. Loss of annulus airflow would also disable the CAM. Failure of the CAM to function could cause primary tank leak to be unrecognized leading to flammable gas buildup and possible deflagration. Critical functional requirements: The only safety requirement on the outlet butterfly valve is to permit adequate airflow for waste cooling and leak detection when the system is operating. Component failure detection: Valve closure with fan running would trip high vacuum pressure switch PS-K2-1-3 activating vent system failure alarm XA-102-AY and CASS alarm 1167. Quality assurance criteria: Since failure of the component safety function would be immediately detected and worst-case waste heat-up and tank leak scenarios permit ample time to repair the component, the safety function can be preserved by recovery time alone. *	SC
First Stage Exhaust HEPA Filter (K2-5-1); H2-64462, Sht. 1, Rev. 7	Prevent any radioactive particulates in the exhaust air stream from reaching the environment.	Filter breach	Failure of exhaust HEPA filter will not affect the safety function of the system. Although this would not be considered a component failure, blockage of exhaust HEPA filter would cause loss of air flow and disable the safety functions of the annulus ventilation system.	Potential effects of component failure: HEPA filter breach could cause a localized release of contamination. Blockage of a filter is not a failure of the filter itself (which is performing its function), but a failure to monitor and replace the filter as required. Critical functional requirements: None - The only safety requirement on the system is to provide adequate airflow for waste cooling and leak detection when the system is operating. No failure of the filter component itself will disable the system safety function. Component failure detection: Blockage of an exhaust HEPA filter with fan running would trip low vacuum pressure switch PS-K2-1-3 activating alarm XA-102-AY and CASS alarm 1167. Quality assurance criteria: Since failure of the filter component does not affect the safety function of the system, design and procurement of this component to general service requirements is adequate.	GS

Differential Pressure Indicator (K2-PI-1-3) H2-64462, Sht. 1, Rev. 7	Indicate differential pressure across 1st stage HEPA filter.	Erroneous indication	Failure of differential pressure indication will not affect safety function of system.	Potential effects of component failure: Possible reduction of annulus air flow if filter loading becomes high. Critical functional requirements: None - Failure of differential pressure indication will not reduce annulus ventilation flowrate. Component failure detection: Periodic surveillance and testing. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
Second Stage Exhaust HEPA Filter (K2-5-2); H2-64462, Sht. 1, Rev. 7	Prevent any radioactive particulates in the exhaust air stream from reaching the environment.	Filter breach	Failure of exhaust HEPA filter will not affect the safety function of the system. Although this would not be considered a component failure, blockage of exhaust HEPA filter would cause loss of air flow and disable the safety functions of the annulus ventilation system	Potential effects of component failure: HEPA filter breach could cause a localized release of contamination. Blockage of a filter is not a failure of the filter itself (which is performing its function), but a failure to monitor and replace the filter as required. Critical functional requirements: None - The only safety requirement on the system is to provide adequate airflow for waste cooling and leak detection when the system is operating. No failure of the filter component itself will disable the system safety function. Component failure detection: Blockage of an exhaust HEPA filter with fan running would trip low vacuum pressure switch PS-K2-1-3 activating alarm XA-102-AY and CASS alarm 1167. Quality assurance criteria: Since failure of the filter component does not affect the safety function of the system, design and procurement of this component to general service requirements is adequate.	GS
Differential Pressure Indicator (K2-PI-1-4); H2-64462, Sht. 1, Rev. 7	Indicate differential pressure across 2nd stage HEPA filter.	Erroneous indication	Failure of differential pressure indication will not affect safety function of system.	Potential effects of component failure: Possible reduction of annulus air flow if filter loading becomes high. Critical functional requirements: None - Failure of differential pressure indication will not reduce annulus ventilation flowrate. Component failure detection: Periodic surveillance and testing. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS

Exhaust Fan and Associated Controls (K2-3-2); H2-64462, Sht. 1, Rev. 7	Provide air flow through the AY-102 tank annulus.	Failure to provide required airflow	Failure of fan to provide air flow will disable the safety functions of the annulus ventilation system.	Potential effects of component failure: Prolonged loss of annulus air flow would cause gradual heatup of sludge layer in tank possibly leading to a steam bump. Loss of annulus airflow would also disable the CAM. Failure of the CAM to function could cause primary tank leak to be unrecognized leading to flammable gas buildup and possible deflagration. Critical functional requirements: The only safety requirement on the exhaust fan is to provide adequate airflow for waste cooling and leak detection when the system is operating. Component failure detection: Failure of the exhaust fan to provide required airflow would trip low vacuum pressure switch PS-K2-1-3 activating alarm XA-102-AY and CASS alarm 1167. Quality assurance criteria: Since failure of the component safety function would be immediately detected and worst-case waste heat-up and tank leak scenarios permit ample time to repair the component, or if necessary, to install the backup portable exhauster, the safety function can be preserved by recovery time alone. *	SC
Annulus Exit Line High and Low Vacuum Pressure Switches with Associated Interlock Relay and Alarms (PS-K2-1-2, PS-K2-1-3 XA-102-AY); H2-64462, Sht. 1, Rev. 7	Pressure switch opens if pressure goes above -0.1" WG (PS-K2-1-3) or falls below -5" WG (PS-K21-2) at the annulus exit.	Fail open	Extraneous alarms No loss of safety function	Potential effects of component failure: Loss of either the high or low vacuum alarm function could lead to an undetected loss of system safety function in the event of a blocked filter or other blockage in system. Critical functional requirements: Detect pressure above -0.1" WG or below -5" WG at exhaust stream exit from tank annulus and activate alarm XA-102-AY and CASS alarm 1167. Component failure detection: Component could fail without detection of failure other than by routine surveillance or calibration activities. Quality assurance criteria: Safety function could be preserved by periodic testing since ample recovery time is available in the worst-case waste heat-up and tank leak scenarios to permit ample time to repair or replace the failed component. *	SC
		Fail closed (either switch)	Loss of alarm function to detect filter blockage or other blockage in system.		

MASSTRON II Annulus Flow Rate Instrument and Associated Flow Temperature Instrument, Relays and Indicators. New MASSTRON II Will Replace FIT-0622. (FE-0622, FY-0622, FI-0622, TE-0620, TIT-0620, TY-0620, TI-0620) H2-818560, Sht. 1, Rev. 3	Provide Annulus flowrate indication	Erroneous indication (high, low, or intermediate)	Loss of true indication of annulus flowrate.	Potential effects of component failure: Possible nonrecognition of decrease of annulus flowrate to less than the required 1000 CFM: Critical functional requirements: Provide indication of annulus flowrate. Component failure detection: Component could fail without detection of failure other than by routine surveillance and calibration activities. Quality assurance criteria: Safety function can be preserved by periodic calibration since ample recovery time is available in the worst-case waste heat-up scenario to permit time to repair or replace component. *	SC
Annulus Flow Blocking Upgrade Including Associated Duct Work and Fittings	Diverts all of the annulus air flow to the tank floor air slots. Provides additional cooling of tank sludge through the tank bottom.	Structural failure of annulus block upgrade which reduces floor slot air flow.	Loss of part of air flow to floor slots. Will not effect ability of CAM to detect leakage into the annulus.	Potential effects of component failure: Modification involves installation of duct work (pipe) including flanges and blanks to redirect annulus air flow to the floor slots. Loss of part of the air flow to the floor slots may cause a gradual increase in sludge temperature. Note that there will no longer be connections to the four annulus supply lines. Critical functional requirements: Direct sufficient airflow to the floor cooling channels to prevent excessive temperatures in sludge near bottom of tank. Component failure detection: Component could fail without detection of failure other than by routine surveillance or calibration activities. Quality assurance criteria: Below grade duct work complies with all applicable requirements for safety class components and will withstand the evaluation basis earthquake. The ducting modifications and blanks which redirect air flow to the floor slots are easily accessible and can readily be repaired in case of failure.	SC

High Vacuum Upgrade - Fan Test inlet valve assembly on riser 19B	BIO: Waste Storage None BIO Add. 1: WRSS Operations Provide increased air flow to the tank floor to enhance waste cooling preventing sludge or supernate from reaching local saturation temperature.	Bearing or drive belt failure will prevent fan from operating.	Failure will stop annulus air flow and possibly allow hydrogen buildup over a period of time. Loss of air flow will allow a gradual tank temperature increase.	Modification: Installation of a new fan sheave to produce a higher speed resulting in a higher negative pressure in the annulus. The modification does not affect or otherwise impact the existing BIO safety class function of the fan. Potential effects of component failure: Prolonged loss of annulus air flow would cause gradual heatup of sludge layer in tank possibly leading to a steam bump. Loss of annulus airflow would also disable the CAM. Failure of the CAM to function could cause primary tank leak to be unrecognized leading to flammable gas buildup and possible deflagration. Critical functional requirements: The only safety requirement on the exhaust fan is to provide adequate airflow for waste cooling and leak detection when the system is operating. This modification (replacement of sheave and drive belt) will produce a higher fan speed to provide additional cooling to the tank bottom. Component failure detection: Failure of the exhaust fan would trip low vacuum pressure switch PS-K2-1-3 activating alarm XA-102-AY and CASS alarm 1167. Quality assurance criteria: Since failure of the component safety function would be immediately detected and worst-case waste heat-up and tank leak scenarios permit ample time to replace the sheave and/or drive belt, or if necessary, to install the backup portable exhauster, the safety function can be preserved by recovery time alone. *	SC

SSC	Accident(s)	Safety Functions	Functional Requirements	Performance Criteria	Planned Modifications Involving This SSC
Primary Tank Ventilation (Tank 241-AY-102)	**BIO Add. 1: SC -** Flammable Gas Deflagration, Section 3.4.2.8; Tank Bump, Section 3.4.2.11	1. Maintain flammable gas concentration below 25% of LFL	Maintain ventilation flow rate / vapor space vacuum per operating procedures	Verify operability prior to WRSS operations **Critical Characteristics:** Must maintain a partial vacuum in primary tank of 0.25 to 6.0 in. w.g. (RD-057). Must maintain a minimum 3 CFM of flow, sufficient to maintain flammable gas concentration below 25% LFL (CN-114). Must be intrinsically safe for operation in an ex-tank intrusive location, or must be located downstream of a duct mixing point (DB-001). *NOTE: Differs from BIO Addendum 1, Sec. 4.3.2.4, which states a requirement for 11.6 CFM; this is based on a previous revision of the same reference.*	Humidity Instrumentation Installation
		2. Waste cooling	Maintain ventilation flow rate / vapor space vacuum per operating procedures	Verify operability prior to WRSS operations **Critical Characteristics:** For sufficient heat removal, must maintain a minimum of 100 CFM of exhaust flow, in combination with recirculation cooling and a recirculation flow of 400 CFM, or 500 CFM of exhaust flow in once-through (non-recirculating) mode, subject to additional in-process thermal analysis during WRSS operation [based on Addendum 1 system description and ER-004].	

THE ITEMS BELOW ARE THE UNIQUE COMPONENTS THAT MAKE UP THIS SSC					
COMPONENT IDENTIFICATION	COMPONENT FUNCTION	COMPONENT FAILURE MODE	COMPONENT FAILURE EFFECTS ON SSC SAFETY FUNCTION	COMPONENT SAFETY CLASSIFICATION JUSTIFICATION	COMPONENT SAFETY CLASS
Ductwork Connection Associated With Humidity Instrumentation Installation	Humidity instrumentation supports tank energy & material balance calculations	Structural damage allowing air in-leakage. Failure to function	Air in-leakage to the ducting associated with a potential humidity instrument housing failure would be expected to be too small to affect the safety function of maintaining flammable gas concentrations below the LFL. Air in-leakage to the ducting associated with a potential humidity instrument housing failure would be expected to be small compared to the total duct flow and, therefore , would not significantly affect the cooling safety function. Failure to function would have no effect on system safety function.	Potential effects of component failure: Failure of duct connection or instrument housing associated with the humidity instrument could produce a small amount of in-leakage into ventilation system. Failure to function would result in loss of one channel of operational input to tank thermal and material balance analyses. Critical functional requirements: None - The humidity instrumentation provides no safety function. It also does not impact the ventilation duct's safety function other than potentially structurally failing and providing an in leakage pathway. Component failure detection: Component could fail without detection of failure other than by routine surveillance or calibration activities. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS

SSC	Accident(s)	Safety Functions	Functional Requirements	Performance Criteria	Planned Modifications Involving This SSC
Primary Tank Ventilation System 296-P-16 (Tank 241-C-106)	BIO: SC - Flammable Gas Deflagration, Section 5.3.2.14 BIO Add. 1: SC - Flammable Gas Deflagration, Section 3.4.2.8; Tank Bump, Section 3.4.2.11 SS - Unfiltered Release, Section 3.4.2.3	1. Maintain flammable gas concentration below 25% of LFL	Act as backup to new ventilation system C-006 Maintain ventilation flow rate / vapor space vacuum per operating procedures Shut down ventilation in the event of contamination release from tank exhaust	Verify operability prior to WRSS operations. Critical Characteristics: Must maintain a partial vacuum in the primary tank relative to atmosphere (RD-057). Must maintain a minimum 1 CFM of flow, sufficient to maintain flammable gas concentration below 25% LFL (CN-114). Must be intrinsically safe for operation in a dome intrusive location, or must be located downstream of a duct mixing point (DB-001). *NOTE: This differs from the BIO Addendum 1, Sec. 4.3.2.4, which states a requirement for 4.9 CFM; this is based on a previous revision of the same reference.*	None. Safety functions and performance criteria have not been changed for W-320.
		2. Waste cooling	Act as backup to new ventilation system C-006 Maintain ventilation flow rate / vapor space vacuum per operating procedures Shut down ventilation in the event of contamination release from tank exhaust	Verify operability prior to WRSS operations Critical Characteristics: For sufficient heat removal prior to sluicing, system must maintain 2400 CFM of once-through ventilation. [Based on ER-588 and Addendum 1 system description].	

THE ITEMS BELOW ARE THE UNIQUE COMPONENTS THAT MAKE UP THIS SSC					
COMPONENT IDENTIFICATION	COMPONENT FUNCTION	COMPONENT FAILURE MODE	COMPONENT FAILURE EFFECTS ON SSC SAFETY FUNCTION	COMPONENT SAFETY CLASSIFICATION JUSTIFICATION	COMPONENT SAFETY CLASS
Bird Screen-Inlet Filter H2-95451; H2-818468	Prevents birds or animals from entering HEPA filter inlet structure	Corrosion failure of screen	Failure allows birds to enter structure and build nests, partially blocking air inlet. Since tank also receives inleakage through pit cover blocks and cascaded ventilation from 241-C-105, there should be adequate airflow to prevent buildup of flammable gas.	Potential effects of component failure: Possible reduction in airflow through intake system. Critical functional requirements: None - Even complete blockage would have no significant effect on safety function of the tank ventilation system. Component failure detection: Periodic surveillance. The bird screen is a passive component not prone to failure. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
Inlet Filter Housing H2-95451; H2-818468	Contains and directs airflow through prefilter and HEPA filter	Housing breach causing air in-leakage and possible bypassing of prefilter or HEPA filter	Failure of filter housing would not cause a reduction in airflow but could cause a reduction in useful lifetimes of filters.	Potential effects of component failure: Possible increase in airflow. Possible decrease in one or both filter differential pressures. Possible increase in rate of filter loading or degradation. Critical functional requirements: None. Component failure detection: Periodic surveillance. The filter housing is a passive component not prone to failure. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS

Inlet Pre-filter H2-95451; H2-818468	Protect HEPA filter from large particle loading	Filter breach	Failure of the inlet pre-filter will not effect the safety function of the tank ventilation system. Although this would not be considered a component failure, blockage of the inlet pre-filter would cause a loss of flow through the inlet system. Since tank also receives inleakage through pit cover blocks and cascaded ventilation from 241-C-105, there would still be adequate airflow to prevent buildup of flammable gas.	Potential effects of component failure: Breach of prefilter could cause an increased rate of loading on the downstream HEPA filters. Blockage of a filter is not a failure of the filter itself (which is performing its function), but a failure to monitor and replace the filter as required. Critical functional requirements: None. Component failure detection: Periodic reading of filter differential pressure instruments. Quality assurance criteria: Design and procurement of this component to general service requirements is adequate.	GS

Inlet HEPA filter H2-95451; H2-818468	Removes particulate material from air entering or leaving the tank.	Filter breach	Failure of the inlet HEPA filter will not effect the safety function of the tank ventilation system. Although this would not be considered a component failure, blockage of the inlet HEPA filter would cause a loss of flow through the inlet system. Since tank also receives inleakage through pit cover blocks and cascaded ventilation from 241-C-105, there would still be adequate airflow to prevent buildup of flammable gas.	Potential effects of component failure: HEPA filter breach could cause a localized release of contamination. Blockage of a filter is not a failure of the filter itself (which is performing its function), but a failure to monitor and replace the filter as required. Critical functional requirements: None. Component failure detection: Periodic reading of filter differential pressure instruments. Quality assurance criteria: Design and procurement of this component to general service requirements is adequate.	GS
Inlet Filter Differential Pressure Gages With Associated Instrument Lines H2-95451; H2-818468	Measure differential pressure across inlet pre-filter and HEPA filter.	Erroneous indication due to gage failure or plugged or leaking instrument line	Erroneous reading could mask high differential pressure due to filter buildup or low differential pressure due to filter breach.	Potential effects of component failure: Possible reduction or loss of flow through inlet system in the event of heavy filter buildup or blockage. An undetected filter breach would not affect safety function. Critical functional requirements: None - Even complete blockage would have no significant effect on safety function of the tank ventilation system. Component failure detection: A severe reduction in flow through inlet system would cause a decrease in tank C-106 headspace pressure which could be detected at pressure indicator PI-13611. A failed differential pressure gage would be detected during periodic testing and calibration activities. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS

Inlet Air Chiller Heat Exchanger (CC-1361) With Associated Differential Pressure Indicator (PDI-13614) H2-818561, Sht. 1, Rev. 2	Cool inlet air during tank cool-down operations between sluicing campaigns.	Failure to function	Failure of inlet heat exchanger would have no effect on the safety functions of the ventilation system.	Potential effects of component failure: Delay in tank C-106 cooldown in preparation for sluicing. Critical functional requirements: None - The only purpose of the inlet heat exchanger is to provide additional cooling to reach lower tank temperatures prior to a sluicing campaign. Component failure detection: Periodic surveillance. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
Manually Operated Inlet Control Damper (HV-136140) H2-95451; H2-818468; H2-818561, Sht. 1, Rev. 2	Controls pressure in tank by controlling inlet air flow (Normally closed during sluicing operations)	Fail open	Failure of the inlet damper to the open position would cause a decrease in headspace vacuum. Safety function of the ventilation system would not be affected.	Potential effects of component failure: Blockage of air flow through intake system. Critical functional requirements: None - Even complete blockage would have no significant effect on safety function of the tank ventilation system. Component failure detection: Periodic reading of filter differential pressure instruments. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
		Fail closed	Failure of the inlet damper to the closed position would cause a loss of flow through the inlet system.		

Isolation Valve (16" Manually Operated Butterfly Valve V-1) H2-93797, Sht. 2, Rev. 1; H2-93799, Sht. 4, Rev. 1	Isolate 296-C-006 exhaust system from tank C-106 during operation of 296-P-16 system	Valve failure in closed position	Mechanical failure of valve to closed position during 296-P-16 system operation will cut off tank C-106 airflow and disable the safety functions of the system. Inability to open valve while 296-P-16 system is in standby will disable its ability to act a backup for the 296-C-006 (recirculating) system.	Potential effects of component failure: Prolonged loss or reduction of tank C-106 airflow could cause a gradual heatup of the sludge layer and a possible buildup of flammable gas. It is expected, however, that only a small airflow would be required to maintain flammable gas below the required limit. Critical functional requirements: The only safety requirement on valve V-1 is to permit adequate airflow for waste cooling and prevention of flammable gas buildup when the system is operating. Component failure detection: Valve closure with fan running would trip the low HEPA filter differential pressure interlock, which would shut down the fan and trip local and remote alarms. Quality assurance criteria: Since failure of the component safety function would be immediately detected and worst-case heat-up and flammable gas buildup scenarios permit ample time to repair the component, the safety function can be preserved by recovery time alone. *	SC
		Valve failure in open position	Mechanical failure of valve in open position during 296-P-16 system operation would have no effect on the safety functions of the system. Failure of the valve to the open position while 296-C-006 system is in standby could result in back-flow through the 296-P-16 system.		

Deentrainer H2-93797, Sht. 2, Rev. 1	Removes mist from airstream	Failure to function	Failure to remove mist (e.g. due to heavy solids loading) could cause premature loading of HEPA filter leading to reduced air flow. Deentrainers are passive components not prone to failure.	Potential effects of component failure: Prolonged reduction of tank C-106 airflow could cause a gradual heatup of the sludge layer. Critical functional requirements: None - The heaters downstream of the deentrainer and upstream of the HEPA filters normally prevent any moisture buildup on the filters and any solids buildup would be detected by required periodic monitoring. Component failure detection: Periodic surveillance of the differential pressure gage on the deentrainer. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS

Isolation Valve (18" Manually Operated Butterfly Valve V-3) H2-93797, Sht. 2, Rev. 1; H2-93799, Sht. 1, Rev. 1	Isolate 296-P-16 exhaust system downstream from deentrainer and tank C-106 to permit changout of HEPA filters	Valve failure in closed position	Mechanical failure of valve to closed position during 296-P-16 system operation will cut off tank C-106 airflow and disable the safety functions of the system. Inability to open valve while 296-P-16 system is in standby (e.g. after HEPA filter changout) will disable its ability to act a backup for the 296-C-006 (recirculating) system.	Potential effects of component failure: Prolonged loss or reduction of tank C-106 airflow could cause a gradual heatup of the sludge layer and a possible buildup of flammable gas. It is expected, however, that only a small airflow would be required to maintain flammable gas below the required limit. Critical functional requirements: The only safety requirement on valve V-3 is to permit adequate airflow for waste cooling and prevention of flammable gas buildup when the system is operating. Component failure detection: Valve closure with fan running would trip the low HEPA filter differential pressure interlock, which would shut down the fan and trip local and remote alarms. Quality assurance criteria: Since failure of the component safety function would be immediately detected and worst-case heat-up and flammable gas buildup scenarios permit ample time to repair the component, the safety function can be preserved by recovery time alone. *	SC
		Valve failure in open position	Mechanical failure of valve in open position during 296-P-16 system operation would have no effect on the safety functions of the system. Failure of the valve to the open position while 296-P-16 system is in standby would have no effect on the operating system.		

Heaters and Associated Controllers and Sensors H2-35769, Sht. 2, Rev. 11	Maintain exhaust air stream above dew point to prevent condensation in exhaust system and possible wetting of HEPA filters.	Failure to function as designed (fail on, off or intermittent)	Failure of heaters to maintain minimum air stream temperature would shut down fan Heater housing high temperature cut-off would protect system in the event heaters failed on	Potential effects of component failure: Wetting of HEPA filters, system shut down. Heater failure (off) or interlock failure could trip off exhaust fan. Critical functional requirements: None - The only function of the heaters is to extend the life of the exhaust HEPA filters by preventing moisture buildup on the filter media. Component failure detection: Airstream temperature below minimum se point will trip interlock and shut down fan. Loss of fan power and low HEPA differential pressure will then trip local and remote alarms. Quality assurance criteria: Since these non-safety function components can be readily repaired or bypassed in the available recovery time, design and construction of these components to general service requirements is adequate. *	GS
Exhaust HEPA Filters (two stages) H2-35769, Sht. 1, Rev. 11	Prevent any radioactive particulates in the airstream from reaching the environment	Filter breach	Failure of the exhaust HEPA filter will not affect the safety function of the system HEPA filter breach would require a shut down to replace filter. Although this would not be considered a component failure, blockage of exhaust HEPA filter would cause loss of air flow and disable the safety functions of the system	Potential effects of component failure: HEPA filter breach could cause a localized release of contamination which would be limited by the (safety class) stack CAM fan shutdown interlock. Blockage of a filter is not a failure of the filter itself (which is performing its function), but a failure to monitor and replace the filter as required. Critical functional requirements: None - The only safety requirement on the system is to provide adequate airflow for waste cooling and prevention of flammable gas buildup when the system is operating. No failure of the filter component itself will disable the system safety function. Component failure detection: Blockage of exhaust HEPA filter with fan running would trip the high HEPA filter differential pressure remote alarm. In addition, the loss of system flow would trip the combined failure alarm (FA-ASI) and cause a loss of tank vacuum which would trip loss of tank vacuum alarms (PAL-1361A and PAL-1361B) and the evacuation horn (PAL-1361C) at the tank process building. Breach of both HEPA filters could result in a CAM high radiation alarm and exhaust fan shutdown. Quality assurance criteria: Since failure of the filter component does not affect the safety function of the system, design and procurement of this component to general service requirements is adequate.	GS

HEPA Filter Differential Pressure Switches (PS-1-A, PS-1-B) H2-35769, Sht. 2, Rev. 11	Operate interlocks and alarms associated with HEPA filter differential pressure	Failure to function as designed	Malfunction of differential pressure switches could cause spurious fan shutdown (with loss of fan power remote alarm) or spurious alarms.	Potential effects of component failure: Possible spurious fan shutdown. Critical functional requirements: None. Component failure detection: Loss of fan power will trip remote alarm. Quality assurance criteria: Since these non-safety function components can be readily repaired or bypassed in the available recovery time, design and construction of these components to general service requirements is adequate.	GS
Interlock Shutdown Bypass Timer H2-35769, Sht. 2, Rev. 11	Bypass low airstream temperature and low HEPA filter differential pressure fan shutdown interlocks for 4 to 5 minutes after fan start	Fail open	Failure of bypass to open position would disable ability to start system	Potential effects of component failure: Possible inability to start system. Critical functional requirements: None. Component failure detection: Inability to start fan. Quality assurance criteria: Since this non-safety function component can be readily repaired or bypassed in the available recovery time, design and construction of this component to general service requirements is adequate.	GS
		Fail closed (bypass position)	Failure of bypass to closed position would disable low airstream temperature and low differential pressure fan shutdown interlocks. Exhaust flowrate would not be affected.		

Local HEPA Filter Low Differential Pressure Alarms (horn and light) H2-35769, Sht. 2, Rev. 11	Provide local alarms if HEPA filter differential pressure falls below the setpoint	Fail on	Spurious alarm - Exhaust flowrate would not be affected	Potential effects of component failure: Loss of one of one channel of detection of a low airflow condition in the exhaust system. Critical functional requirements: None - Redundant SC detector and alarms are available to detect loss of flow. Component failure detection: Component could fail without detection of failure other than by routine surveillance or calibration activities. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
		Loss of function (inability to alarm)	Ability of this component to detect low air flow condition would be disabled. Low airflow condition would also be detected by the stack flow detector on the CAM system through the associated combined failure alarm.		
Exhaust Fan With Associated Controls and Alarms H2-35769, Sht. 1, Rev. 11	Provide required exhaust flow rate through the exhaust system	Failure to function	Fan failure would cut off tank exhaust flow and disable the safety functions of the ventilation system.	Potential effects of component failure: Prolonged loss of tank C-106 airflow could cause a gradual heatup of the sludge layer, possibly leaking to a steam bump, and a possible buildup of flammable gas. Critical functional requirements: The only safety requirement on the exhaust fan is to provide adequate airflow for waste cooling and prevention of flammable gas buildup when the system is operating. Component failure detection: Loss of stack flow would trip remote alarm. Quality assurance criteria: Since failure of the component safety function would be immediately detected and worst-case heat-up and flammable gas buildup scenarios permit ample time to repair the component, the safety function can be preserved by recovery time alone. *	SC

Continuous Air Monitor (CAM-1) H2-95267, Sht. 2, Rev. 7	Monitors for beta/gamma radiation in exhaust stack when ventilation system is operating	Fail to detect radiation above setpoint	Failure to detect radiation above setpoint will cause failure of alarm signals.	Potential effects of component failure: Failure of alarm signal could cause HEPA filter failure to be unrecognized. Spurious alarm would cause fan shut down. Component failure, by itself, does not initiate an accident. Critical functional requirements: CAM must be able to detect stack air radioactivity above the setpoint and to activate the local and remote high radiation alarms. CAM must be operating whenever the ventilation system is operating. Component failure detection: Component could fail without detection of failure other than by routine surveillance and calibration activities. Spurious alarm would cause fan shut down. Quality assurance criteria: Safety function can be preserved by periodic testing since ample recovery time is available in the worst-case waste heat-up and flammable gas accumulation scenarios to permit repair or replacement of component. *	SC
		Spurious alarms	Spurious alarm would cause fan shut down.		
High Radiation Alarms and Fan Shutdown Interlock (RA-ASI, ASI-1-1) H2-95267, Sht. 2, Rev. 7; Sht. 3, Rev. 3	Alarms on radiation reading above CAM setpoint	Failure to alarm on high radiation	Stack radiation level above setpoint not recognized	Potential effects of component failure: Failure of alarm signal could cause HEPA filter failure to be unrecognized. Component failure, by itself, does not initiate an accident. Spurious alarm would cause fan shut down. Critical functional requirements: High radiation alarms must be able to respond to a high radiation alarm signal from the CAM. CAM must be operating whenever the ventilation system is operating. High radiation level must trip fan shutdown interlock. Component failure detection: Component could fail without detection of failure other than by routine surveillance and calibration activities. Spurious alarm would cause fan shut down. Quality assurance criteria: Safety function can be preserved by periodic testing since ample recovery time is available in the worst-case waste heat-up and flammable gas accumulation scenarios to permit repair or replacement of component. *	SC
		Spurious alarm	Spurious alarm would cause fan shut down		

CAM Vacuum Pump H2-95267, Sht. 2, Rev. 7	Draws sample from exhaust stack air stream through CAM	Failure to function	No sample air movement through CAM	Potential effects of component failure: Failure of the CAM vacuum pump would disable the ability of the CAM to monitor for radiation in the exhaust stack air stream. Disabling the alarm function could cause a HEPA filter failure to be unrecognized. Component failure, by itself, does not initiate an accident. Critical functional requirements: Pump must maintain sufficient air flow through the CAM to respond to a high radiation level in the stack air stream. CAM must be operating whenever the ventilation system is operating. Component failure detection: Low flow condition in CAM is indicated by Combined failure alarm FA-ASI and local alarm FA-ASI-2. Quality assurance criteria: Since failure of the component safety function would be immediately detected and the worst-case waste heat-up and flammable gas buildup scenarios permit ample time to repair or replace the component, the safety function can be preserved by recovery time alone. *	SC
Record Sampler H2-95267, Sht. 2, Rev. 7	Obtains record sample of exhaust stack air stream on filter	Fails to function (blockage or filter breach)	Malfunction of record sample could result in failure to obtain a record sample, and could cause low flow alarm and combined failure alarm	Potential effects of component failure: Loss of record sample. Critical functional requirements: None - No safety function. Component failure detection: Low flow condition in record sampler is indicated by Combined failure alarm FA-ASI and local alarm FA-ASI-1. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
Record Sampler Vacuum Pump H2-95267, Sht. 2, Rev. 7	Draws sample from exhaust stack air stream through record sampler Power controlled by stack flow switch FS-1	Failure to function	No sample air movement through record sampler	Potential effects of component failure: Loss of record sample. Critical functional requirements: None - No safety function. Component failure detection: Low flow condition in record sampler is indicated by Combined failure alarm FA-ASI and local alarm FA-ASI-1. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS

Stack Flow Switch (FS-1) H2-95267, Sht. 2, Rev. 7	Switches on the record sampler vacuum pump when flow through the exhaust stack is detected	Fail open	Failure of the stack flow detector switch in the open position will disable the record sampler	Potential effects of component failure: Failure of the stack flow detector switch in the closed position will disable the ability to detect loss of exhaust flow for any reason other than loss of fan power. Critical functional requirements: Stop record sampler sample flow on loss of exhaust stack flow. CAM and record sampler must be operating whenever the ventilation system is operating. Component failure detection: Component could fail without detection of failure other than by routine surveillance and calibration activities. Quality assurance criteria: Safety function can be preserved by periodic testing since ample recovery time is available in the worst-case waste heat-up and flammable gas accumulation scenarios to permit repair or replacement of component. *	SC
		Fail closed	Failure of the stack flow detector switch in the closed position will disable the ability to detect loss of stack flow		
Combined Failure Alarm (FA-ASI) With Associated Flow Switches (FAS-RS-1, FAS-CAM-2) and Circuitry H2-95265, Sht. 2, Rev. 7; Sht. 3, Rev. 3	Detects low sample flow in CAM or record sampler	Failure to detect and alarm low flow condition	Possible undetected loss of CAM function Possible undetected loss of exhaust system flow	Potential effects of component failure: Failure of combined failure alarm could cause HEPA filter failure or loss of exhaust flow to be unrecognized. Component failure, by itself, does not initiate an accident. Critical functional requirements: The combined failure alarm system must be able to detect and respond to a low sample flow condition in either the CAM or record sampler. CAM and record sampler must be operating whenever the ventilation system is operating. Component failure detection: Component could fail without detection of failure other than by routine surveillance and calibration activities. Quality assurance criteria: Safety function can be preserved by periodic testing since ample recovery time is available in the worst-case waste heat-up and flammable gas accumulation scenarios to permit repair or replacement of component. *	SC

Ductwork and HEPA Filter Housing H2-93797, Sht. 2, Rev. 1; H2-35769 Shts. 1 and 2, Rev. 11	Contain and direct air through ventilation system Provide boundary between tank air/aerosol mix and environment	Seal failure at joint or structural damage to system.	Air leakage into ventilation system No effect on system safety function	Potential effects of component failure: The pressure in the operating ventilation system will be less than atmospheric. The amount of air inleakage for a minor leak would be far less than the flow rate through the system and would not have a significant effect on the system safety function. Major damage could produce a loss or reduction of air flow possibly leading to a gradual heatup of the sludge layer or flammable gas buildup. Critical functional requirements: The only safety requirement on the ductwork is to permit adequate airflow for waste cooling and prevention of flammable gas buildup when the system is operating. Component failure detection: A major failure would be detected by a loss of tank vacuum. Quality assurance criteria: Since failure of the component safety function would be immediately detected and worst-case heat-up and flammable gas buildup scenarios permit ample time to repair or replace the component, the safety function can be preserved by recovery time alone. *	SC
		Major break due to vehicle collision or missile.	Loss or reduction of tank flow.		

SSC	Accident(s)	Safety Functions	Functional Requirements	Performance Criteria	Planned Modifications Involving This SSC
SYSTEM: 296-C-006 Primary Tank Ventilation System (241-C-106)	BIO Add. 1: SC - Flammable Gas Deflagration, Section 3.4.2.8; Tank Bump, Section 3.4.2.11 SS - Unfiltered Release, Section 3.4.2.3	1. Maintain flammable gas concentration below 25% of LFL	Act as backup to ventilation system P-16 when P-16 is operating Maintain ventilation flow rate / vapor space vacuum per operating procedures Shut down ventilation in the event of contamination release from tank exhaust	Verify operability prior to WRSS operations. The exhaust flow rate from the exhauster portion of the 296-C-006 system is sufficient to prevent hydrogen buildup in tank C-106. Critical Characteristics: Must maintain a partial vacuum in the primary tank relative to atmosphere (RD-057). Must maintain a minimum 4.9 CFM of flow, sufficient to maintain flammable gas concentration below 25% LFL (BIO Addendum 1, Sec. 4.3.2.4). Must be intrinsically safe for operation in an ex-tank intrusive location, or must be located downstream of a duct mixing point (DB-001). NOTE: The BIO figures (4.9 cfm) are based on CN-114, a later revision of CN-114, states 1.0 CFM is sufficient to maintain flammable gas concentrations below 25% LFL.	High Vacuum Upgrade
		2. Waste cooling	Act as backup to ventilation system P-16 when P-16 is operating Maintain ventilation flow rate / vapor space vacuum per operating procedures Shut down ventilation in the event of contamination release from tank exhaust	Verify operability prior to WRSS operations. The 296-C-006 system with recirculation is to be operated during sluicing operations, primarily to remove moisture from the dome space in order to maintain visibility for direction of the sluicing nozzle. Sludge temperature buildup will not be a consideration during the short times involved in actual sluicing operations. If the 296-C-006 system becomes disabled, sluicing operations will be secured and ventilation switched to the 296-P-16 system. Critical Characteristics: For sufficient heat removal: • During sluicing, until 4 ft. of waste is retrieved, system must maintain either a minimum exhaust flow rate of 200 CFM, in combination with recirculation cooling and a recirculation flow of 860 CFM, or a minimum exhaust flow of 500 CFM in once-through (non-recirculating) mode, subject to additional in-process thermal analysis during WRSS operation. • After 4 ft of waste has been removed from Tank C-106, 50 CFM of once-through ventilation is sufficient for heat removal. [Based on ER-588, Ogden 1998, and Addendum 1 system description].	

THE ITEMS BELOW ARE THE UNIQUE COMPONENTS THAT MAKE UP THIS SSC					
COMPONENT IDENTIFICATION	COMPONENT FUNCTION	COMPONENT FAILURE MODE	COMPONENT FAILURE EFFECTS ON SSC SAFETY FUNCTION	COMPONENT SAFETY CLASSIFICATION JUSTIFICATION	COMPONENT SAFETY CLASS
Chill Water Condenser (heat exchanger) For Removing Moisture From Air Stream With Associated Drain To Seal Pot (HX-1361, HV-136118) H2-818468, Rev. 0; H2-818561, Sht. 3, Rev. 2	Removes moisture from air stream	Failure to function due to loss of chill water supply	Failure of the condenser would have no effect on prevention of flammable gas buildup. Heat removal via the exhaust fan would not be affected. Safety function of ventilation system would not be affected.	Potential effects of component failure: Possible slow heatup of tank due to loss of condenser cooling and heat addition by 30 kW heater in recirculation loop. This is not considered a problem during the short times involved in actual sluicing operations. Critical functional requirements: None - Primary function of the condenser is to maintain head space visibility. Component failure detection: Comparison of upstream and downstream airflow temperatures provided by temperature instruments TISH-13620 and TISH-13621. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
Temperature Instruments Upstream And Downstream Of Condenser Along With Associated High Temperature Trips And Alarms (TE-13620, TISH-13620, TAH-13620, TE-13621, TISH-13621, TAH-13621, XA-1368) H2-818561, Sht. 3, Rev. 2	Provide operational information on air temperatures upstream and downstream of the condenser Provide warning of high temperature in tank headspace	Erroneous indication, spurious or disabled alarms	Erroneous indication could permit undetected malfunction of condenser. Safety function of ventilation system would not be affected. Defense in depth function of monitoring tank headspace temperature would be disabled	Potential effects of component failure: Possible undetected loss or out-of-range function of condenser. Possible loss of one means to detect high temperature condition in tank void space. Critical functional requirements: None - Provide defense in depth for in-tank temperature measuring systems. Component failure detection: Periodic testing and calibration. Failure of upstream and downstream temperature indications to show expected temperature differential across condenser. Quality assurance criteria: Since these non-safety function components can be readily repaired or bypassed in the available recovery time, design and construction of these components to general service requirements is adequate.	GS

Condenser Inlet And Outlet Valves (HV-136142, HV-13639) H2-818561, Sht. 3, Rev. 2	Provide ability to isolate condenser for maintenance	Fail open	Either or both valves failing to the open position would have no effect on the safety function of the ventilation system.	Potential effects of component failure: Prolonged loss of tank C-106 airflow could cause a gradual heatup of the sludge layer and a possible buildup of flammable gas. Critical functional requirements: The only safety requirement on valves HV-136142 and HV-13639 is to permit adequate airflow for waste cooling and prevention of flammable gas buildup when the system is operating. Component failure detection: Closure of either valve with the recirculation or exhaust fan running would trip the high condenser differential pressure local and remote alarms. Quality assurance criteria: Since failure of the component safety function would be immediately detected and worst-case heat-up and flammable gas buildup scenarios permit ample time to repair the component, the safety function can be preserved by recovery time alone. *	SC
		Fail closed	Either valve failing to the closed position would cut off both recirculating and exhaust flow from the tank.		
Condenser Inlet Pressure Instrument (PT-13611, PI-13611) H2-818561, Sht. 3, Rev. 2	Provides indication of condenser inlet pressure	Erroneous indication	Failure of condenser inlet pressure indication would cause loss of operational information. Safety function of ventilation system would not be affected.	Potential effects of component failure: Loss of one local indication of tank headspace pressure. Critical functional requirements: None - Failure would not affect safety functions of ventilation system. Component failure detection: Periodic surveillance and testing. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
Condenser Differential Pressure Instrument With Associated High Differential Pressure Alarms (PDT-13611, PDISH-13611, PDAH-13611, XA-1368) H2-818561, Sht. 3, Rev. 2	Provides indication of differential pressure across condenser High differential pressure condition trips local and remote alarms	Erroneous indication Spurious alarms Failure to alarm	Spurious indication or loss of alarm function could cause a condenser low flow condition due to closure of inlet or outlet valve or blockage of condenser to go unrecognized	Potential effects of component failure: Possible undetected low flow condition through condenser. Critical functional requirements: None - Failure would not affect safety functions of ventilation system. Component failure detection: Periodic surveillance and testing. Quality assurance criteria: Since these non-safety function components can be readily repaired or bypassed in the available recovery time, design and construction of these components to general service requirements is adequate.	GS

Moisture Separator With Associated Drain To Seal Pot (MS-1361, HV-136121) H2-818561, Sht. 3, Rev. 2	Removes any mist carry-over from condenser	Failure to function The inertial moisture separator is a passive system not normally subject to failure.	Failure of moisture separator (for example, by plugging of drain line) could cause carry-over of moisture into heater. Effects on recirculation fan would be reduced or eliminated by the action of the heater (HC-1361). No effect on safety functions of ventilation system.	Potential effects of component failure: Possible moisture damage (corrosion or pitting) to heater and recirculation fan. Critical functional requirements: None - The only function of the moisture separator is to extend the life of the heater and exhaust fan by reducing the rate of corrosion and wear due to entrained moisture. Component failure detection: Periodic surveillance. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS

Heating Coil (HC-1361) With Associated Controls, Indications and Alarms (TE-13610A/B, TISH-13622, HS-13622, YL-13622, TY-13622A, TIC-13622A, HS-13627, TIC-13622, TSH-13622, TE-13622A, TE-13622, TAH-13622) H2-818561, Sht. 3, Rev. 2	Heats recirculated air to eliminate moisture in recirculation fan	Fail on	Failure to the on condition with air flow would result in loss of temperature control of the recirculation flow. Failure to turn off on loss of air flow (by interlock with recirculation fan) could result in high local temperatures in heater enclosure if local high temperature interlock fails also (double failure). Safety function of the ventilation system would not be affected.	Potential effects of component failure: Possible moisture damage (corrosion or pitting) to recirculation fan. Critical functional requirements: None - The only function of the heater is to extend the life of the exhaust fan by reducing the rate of corrosion and wear due to entrained moisture. Component failure detection: A high temperature condition in the heater or heater exhaust air would be indicated by local alarm TAH-13622 and remote combined system trouble alarm XA-1368. Failure of heater to function would be detected by periodic surveillance and testing. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
		Fail off	Failure to the off condition could cause moisture to enter recirculation fan. Safety function of the ventilation system would not be affected.		

Recirculation Fan And Drain (FN-1361, HV-136134) With Associated Controls, interlocks And Alarms (motor starter, interlock 15, HS-13635A, YL-13635A, HS-13635B, YL-13635B, IT-13635, IISH-13635, IAH-13635) H2-818561, Sht. 3, Rev. 2	Provide recirculating flow of tank void space air through condenser to remove moisture (fog and mist) during sluicing operations	Fail to function due to seized bearing, loss of power, controller malfunction, or other cause	Failure of recirculating fan during sluicing operations could allow fog and mist buildup in head space leading to impaired visibility and inability to continue sluicing operations. Would not affect safety functions of ventilation system.	Potential effects of component failure: Loss of visibility in the tank head space. Inability to continue sluicing operations. The recirculating loop heater (HC-1361) is interlocked to fan controller to shut down on loss of fan power. Critical functional requirements: None - The only function of the recirculation system is to maintain visibility in the tank head space during sluicing operations so that the in-tank camera can be used to direct the sluice stream. Component failure detection: Loss of fan power would trip remote common system shutdown alarms XA-1362A and XA-1362B. High motor current condition would trip local alarm IAH-13635 and remote combined trouble alarm XA-1368. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
Recirculation System Return Damper (HV-13643) H2-818561, Sht. 3, Rev. 2	Provide ability to isolate 296-C-06 system from tank for maintenance, or when system 296-P-16 is operating	Fail open	Normally open during system 296-C-006 operation. Failure to open position while system 296-P-16 is operating could result in a reverse flow condition through 296-C-006 exhaust system leading to some reduction of the tank exhaust flow.	Potential effects of component failure: Possible reduction in tank exhaust flow if system 296-P-16 is operating and valve fails open (or is inadvertently opened). Loss of recirculation flow if valve fails closed during system 296-C-006 operation. Critical functional requirements: None - No significant effect on ventilation safety functions in either failure mode. Component failure detection: Periodic surveillance. Possible high current trip on recirculation fan. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
		Fail closed	Failure to the closed position would cut off recirculation flow back into tank. System 296-C-006 exhaust flow would not be affected. Safety functions of ventilation system not affected.		

Chill Water System With Associated Controls And Alarms And Valving Required To Switch Function Between Recirculation And Intake Systems H2-818561, Sht. 2, Rev. 2	Provides chill water to condenser in recirculation system during sluicing operations, Provides chill water to air inlet heat exchanger during tank cool-down periods.	Failure to function	Failure of the chill water system would disable the function of the condenser or heat exchanger. Safety functions of ventilation system not affected.	Potential effects of component failure: Failure of condenser function during sluicing operations could cause loss of visibility in the tank dome space and inability to continue sluicing operations. Failure of intake station heat exchanger would delay tank cool-down operations. Critical functional requirements: None - The only function of the recirculation system is to maintain visibility in the tank head space during sluicing operations so that the in-tank camera can be used to direct the sluice stream. The only function of the intake heat exchanger is to provide additional cooling during pre-sluicing tank cool-down operations. Component failure detection: Failure of chill water system would be indicated by local and remote alarms. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
Seal Pot With Associated Level Sensors And Alarms H2-818561, Sht. 3, Rev. 2	Prevent escape of vapor or aerosols from the ventilation system through the condensate drain lines. Prevent inleakage of air into the ventilation system through the drain lines.	Release of liquid, vapor or aerosols due to leakage or excessive pressure in drain line. Drain lines will normally be at less than atmospheric pressure. Seal pot overflows to a drain to tank C-106	Failure of the seal pot could cause local contamination. Safety functions of ventilation system not affected.	Potential effects of component failure: Local contamination around the seal pot. Critical functional requirements: None - Failure would not effect safety function of ventilation system. Component failure detection: Periodic surveillance. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS

High Efficiency Mist Eliminator, HEME, (HME-1361) With Associated Drains, Differential Pressure Detector And Alarm (HV-136119, HV-136135, PDT-13612, PDISH-13612, PDAH-13612) H2-818561, Sht. 4, Rev. 2	Removes moisture carryover in exhaust air stream after passage through condenser	Failure to function The HEME is a passive system not prone to failure.	Internal failure or blockage could cause carry-over of moisture or reduced air flow. Any severe blockage would build up over a period of time, and the HEME could be bypassed by opening HV-13644. Safety function of the ventilation system would not be affected.	Potential effects of component failure: Possible carry-over of moisture and wetting of HEPA filters. This effect would be reduced by the intervening high efficiency metal filter (HEMF) and the exhaust stream heater. Critical functional requirements: None - Failure would not effect safety function of ventilation system. Component failure detection: Loss of exhaust flow would be indicated by a stack flow alarm at the CAM and MO-211 (Safety Class). Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
HEME Isolation Valves (HV-13649, HV-13646) H2-818561, Sht. 4, Rev. 2	Isolate HEME from ventilation system for maintenance	Fail to closed position Valves are normally open during ventilation system operation.	Failure of either isolation valve to the closed position would block flow through the exhaust system. Since the HEME is not essential to the safety function of the ventilation system, the isolation valves could be bypassed by opening HV-13644.	Potential effects of component failure: Blockage of flow through the exhaust system. Critical functional requirements: Allow sufficient flow through the exhaust system for adequate tank cooling and prevention of flammable gas buildup. Component failure detection: Loss of exhaust flow would be indicated by a stack flow alarm at the CAM and MO-211 (Safety Class). Quality assurance criteria: Since failure of the component safety function would be immediately detected and worst-case heat-up and flammable gas buildup scenarios permit ample time to repair the component or bypass the HEME, the safety function can be preserved by recovery time alone. *	SC

High Efficiency Metal Filter, HEMF (HMF-1361) With Associated Drains, Differential Pressure Detector And Alarm (HV-13638, PDT-13613, PDISH-13613, PDAH-13613) H2-818561, Sht. 4, Rev. 2	Acts as a prefilter to extend the HEPA filter service life	Filter breach	Breach of the HEMF would not affect the safety function of the ventilation system.	Potential effects of component failure: Possible carryover of material to HEPA filters or reduction in flow due to excessive loading. Critical functional requirements: None -- The only function of the HEMF is to extend the service life of the HEPA filters. Component failure detection: Loss of exhaust flow would be indicated by a stack flow alarm at the CAM and MO-211 (Safety Class). Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
		Filter blockage	Blockage would build up over a period of time and filter could be bypassed by opening HV-13645. Safety function of the ventilation system would not be affected.		
HEMF Isolation Valves (HV-13647, HV-13648) H2-818561, Sht. 4, Rev. 2	Isolate HEME from ventilation system for maintenance	Fail to closed position Valves are normally open during ventilation system operation.	Failure of either isolation valve to the closed position would block flow through the exhaust system. Since the HEMF is not essential to the safety function of the ventilation system, the isolation valves could be bypassed by opening HV-13645.	Potential effects of component failure: Blockage of flow through the exhaust system. Critical functional requirements: Allow sufficient flow through the exhaust system for adequate tank cooling and prevention of flammable gas buildup. Component failure detection: Loss of exhaust flow would be indicated by a loss of stack flow alarm at the CAM and MO-211. Quality assurance criteria: Since failure of the component safety function would be immediately detected and worst-case heat-up and flammable gas buildup scenarios permit ample time to repair the component or bypass the HEMF, the safety function can be preserved by recovery time alone. *	SC

Exhaust System Isolation Valve (HV-13654) H2-818561, Sht. 6, Rev. 2	Isolate exhaust heater and HEPA filters from upstream portion of exhaust for maintenance and filter change-out	Fail to closed position Valve is normally open during system operation.	Mechanical failure of valve to closed position during exhaust system operation will cut off tank C-106 airflow and disable the safety functions of the system.	Potential effects of component failure: Prolonged loss or reduction of tank C-106 airflow could cause a gradual heatup of the sludge layer and a possible buildup of flammable gas. Critical functional requirements: The only safety requirement on valve HV-13654 is to permit adequate airflow for waste cooling and prevention of flammable gas buildup when the system is operating. Component failure detection: Valve closure with fan running would trip the loss of stack flow alarm FLL-13627 on the CAM and remote system trouble alarms RXA-1365A and RXA-1365B. Quality assurance criteria: Since failure of the component safety function would be immediately detected and worst-case heat-up and flammable gas buildup scenarios permit ample time to repair the component, the safety function can be preserved by recovery time alone. *	SC
Heater Inlet Temperature Instrument With High Temperature Alarm (TE-13626, TIT-13626, TSH-13626, TLH-13626) H2-818561, Sht. 6, Rev. 2	Indicate high air temperature at heater inlet	Fail to function	Failure of the temperature detector or alarm would have no effect on safety function of ventilation system.	Potential effects of component failure: Possible higher than normal air temperature at HEPA filter inlet. Critical functional requirements: None - Failure would not effect ventilation flow rate. Component failure detection: Periodic surveillance and testing. High temperature at HEPA filter outlet would be indicated by alarm TLH-13635 and common exhaust skid trouble alarm XA-13640. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS

Exhaust System Heater (HC-1362) With Controller (TY-13629, YL-13629A, YL-13629B, HS-13630, TE-13629, TIT-13629, TIC-13629, TISH-13629, TE-13634A/B/C) And Fan Interlock (I-4) H2-818561, Sht. 6, Rev. 2	Maintain exhaust air stream above dew point to prevent condensation in exhaust system and possible wetting of HEPA filters.	Failure to function as designed (fail on, off or intermittent)	Failure of the heater will not effect the safety functions of the ventilation system. Heater power (2 kW) is not sufficient to cause damage if heater controller fails in the on condition. Heater housing high temperature cut-off would protect system in the event heater fails on during no flow condition.	Potential effects of component failure: Wetting of HEPA filters. Critical functional requirements: None - The main function of the heaters is to extend the life of the exhaust HEPA filters by preventing moisture buildup on the filter media. Heater failure (either on or off) will not decrease the exhaust airflow. Component failure detection: Periodic surveillance and testing. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
Exhaust HEPA Filters (two stages, HEP-1361 and HEP-1362) H2-818561, Sht. 6, Rev. 2	Prevent any radioactive particulates in the airstream from reaching the environment	Filter breach	Failure of the exhaust HEPA filter will not affect the safety function of the system. HEPA filter breach would require a shut down to replace filter. Although this would not be considered a component failure, blockage of exhaust HEPA filter would cause loss of air flow and disable the safety functions of the system.	Potential effects of component failure: HEPA filter breach could cause a localized release of contamination which would be limited by the (safety class) stack CAM fan shutdown interlock. Blockage of a filter is not a failure of the filter itself (which is performing its function), but a failure to monitor and replace the filter as required. Critical functional requirements: None - The only safety requirement on the system is to provide adequate airflow for waste cooling and prevention of flammable gas buildup when the system is operating. No failure of the filter component itself will disable the system safety function. Component failure detection: Blockage of exhaust HEPA filter with fan running would trip one of the high HEPA filter high differential pressure alarms (PDLH-13618 or PDLH-13619), the overall high differential pressure alarm PDLH-13620 and the exhauster skid trouble alarm XA-13640. In addition, loss of system flow would trip the loss of stack flow and common fault alarms (FLL-13627, RXA-1365A, RXA-13658), loss of tank vacuum alarms (PAL-1361A and PAL-1361B), and the evacuation horn (PAL-1361C) at the tank process building. Breach of both HEPA filters could result in a CAM high radiation alarm and exhaust fan shut down. Quality assurance criteria: Since failure of the filter component does not affect the safety function of the system, design and procurement of this component to general service requirements is adequate.	GS

HEPA Filter Differential Pressure Switches (PDISH-13618, PDISH-13619, PDISH-13620) With Associated Timer Relay And Alarms (PDLH-13618, PDLH-13619, KY-13620, PDLH-13620) H2-818561, Sht. 6, Rev. 2	Operate interlocks and alarms associated with HEPA filter differential pressure	Failure to function as designed	Malfunction of differential pressure switches could cause spurious alarms and exhaust fan shut down. Failure to alarm on HEPA high differential pressure could result in reduced exhaust flow.	Potential effects of component failure: Possible spurious fan shutdown. Possible reduced exhaust flow. Critical functional requirements: None - The only requirement is to shut down fan on detection of high differential pressure. Component failure detection: Loss of fan power would trip remote exhauster skid trouble alarm XA-13640. Loss of flow (from blocked filter) would trip the loss of stack flow alarm FLL-13627 on the CAM and remote system trouble alarms RXA-1365A and RXA-1365B. Quality assurance criteria: Since these non-safety function components can be readily repaired or bypassed in the available recovery time, design and construction of these components to general service requirements is adequate.	GS
HEPA Filter Outlet Damper (HV-13655) H2-818561, Sht. 6, Rev. 2	Isolate fan from upstream portion of exhaust system for maintenance	Fail to closed position Valve is normally open during system operation.	Mechanical failure of valve to closed position during exhaust system operation would cut off exhaust airflow and disable the safety functions of the system.	Potential effects of component failure: Prolonged loss or reduction of tank C-106 airflow could cause a gradual heatup of the sludge layer and a possible buildup of flammable gas. Critical functional requirements: The only safety requirement on valve HV-13655 is to permit adequate airflow for waste cooling and prevention of flammable gas buildup when the system is operating. Component failure detection: Valve closure with fan running would trip the loss of stack flow alarm FLL-13627 on the CAM and remote system trouble alarms RXA-1365A and RXA-1365B. Quality assurance criteria: Since failure of the component safety function would be immediately detected and worst-case heat-up and flammable gas buildup scenarios permit ample time to repair the component, the safety function can be preserved by recovery time alone. *	SC
HEPA Filter Outlet Temperature Instrument With High Temperature Alarm (TE-13635, TIT-13635, TSH-13635, TLH-13635) H2-818561, Sht. 6, Rev. 2	Indicate high air temperature at HEPA filter outlet	Fail to function	Failure of the temperature detector or alarm would have no effect on safety function of ventilation system.	Potential effects of component failure: Possible higher than normal air temperature at HEPA filter outlet. Critical functional requirements: None - Failure would not effect ventilation flow rate. Component failure detection: Periodic surveillance and testing. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS

Exhaust Fan (FN-1362) With Variable Speed Drive (VSD), VSD Keypad, And Contactor (HS-3639A, HS-3639B, HS-3639C, HS-3639D, 3640A, HS-3640B) H2-818561, Sht. 6, Rev. 2	Provide required exhaust flow rate through the exhaust system Fan is interlocked to (1) High HEPA differential pressure (2) High radiation alarm from CAM (3) excessive vacuum in C-106 headspace	Failure to function	Fan failure would cut off tank exhaust flow and disable the safety functions of the ventilation system.	Potential effects of component failure: Prolonged loss or reduction of tank C-106 airflow could cause a gradual heatup of the sludge layer and a possible buildup of flammable gas. Critical functional requirements: The only safety requirement on the exhaust fan is to provide adequate airflow for waste cooling and prevention of flammable gas buildup when the system is operating. Component failure detection: Loss of fan power would trip exhauster skid remote trouble alarm XA-13640. Mechanical failure of exhaust fan would trip the loss of stack flow alarm FLL-13627 on the CAM and remote system trouble alarms RXA-1365A and RXA-1365B. Quality assurance criteria: Since failure of the component safety function would be immediately detected and worst-case heat-up and flammable gas buildup scenarios permit ample time to repair the component, the safety function can be preserved by recovery time alone. *	SC
Exhaust Fan Emergency Stop Switch (HS-13640) H2-818561, Sht. 6, Rev. 2	Provides backup means to stop fan	Fail to function	Failure of emergency stop switch would not affect the ventilation system safety functions.	Potential effects of component failure: Continued fan operation after failure of normal stop controls at MO-211 and VSD keypad. Critical functional requirements: None - Failure of this component would not affect ventilation flow rate. Component failure detection: Failure to function would be apparent to local operator. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
XA-13640 Exhauster Skid HVAC System Trouble CP-01 H-2-818561, Rev. 2	Indicates system trouble in MO-211	Fails to indicate system trouble in the event of high filter differential pressure or fan failure.	Failure of exhaust skid trouble light could prevent immediate response to high filter differential pressure or exhaust fan shutdown due to failure of fan controller or trip of interlock I-3 (high filter differential pressure, high radiation in stack, or excessive vacuum in tank).	Potential effects of component failure: Delayed response to loss of exhaust flow due to high filter differential pressure or trip of fan interlock. Critical functional requirements: Indicate exhaust skid trouble to operator in manned control room (defense in depth). Component failure detection: Periodic surveillance of systems and other indications (depending on nature of trouble) in MO-211 control room. Quality assurance criteria: Since tank heat-up and flammable gas buildup would occur very slowly, safety classification can be preserved by periodic testing and calibration. *	SS

Interlock 3 H2-818561, Sht. 6, Rev. 2	Shutdown exhaust fan FN-1362 on high pressure differential across HEPA filters HEP-1361 and 1362, high radiation released from exhaust stack, and tank C-106 high vacuum	Failure to function	Failure of interlock to shut down exhaust fan could result in potential radiological release to the environment	Potential effects of component failure: Prolonged loss of tank C-106 airflow could cause a gradual heatup of the sludge layer and a possible buildup of flammable gas. Critical functional requirements: The only safety requirement on the I-3 interlock is to maintain operation of the exhaust fan so as to provide adequate airflow for waste cooling and prevention of flammable gas buildup when the system is operating normally. Component failure detection: Fan shut down would trip exhauster skid remote trouble alarm XA-13640 and trip the loss of stack flow alarm FLL-13627 on the CAM and remote system trouble alarms RXA-1365A and RXA-1365B. Quality assurance criteria: Since failure of the component safety function would be immediately detected and worst-case heat-up and flammable gas buildup scenarios permit ample time to repair the component, the safety function can be preserved by recovery time alone. *	SC
		Spurious trip	Spurious I-3 trip would shut down exhaust fan.		
Exhaust Fan Controls And Status Indication In MO-211 (HS-13640C, YL-13640C, HS-13640D, YL-13640D) H2-818561, Sht. 6, Rev. 2	Provide exhaust fan control at control room MO-211	Failure to function so as to cause unintended fan shut down with no indication of shutdown in control room	Failure could cut off exhaust airflow and disable the safety functions of the system. Failure would be easily recoverable since system could be operated from VSD keypad at electrical equipment skid 241-C-51.	Potential effects of component failure: Prolonged loss of tank C-106 airflow could cause a gradual heatup of the sludge layer and a possible buildup of flammable gas. Critical functional requirements: The only safety requirement on the MO-211 exhaust fan controls and indication is to maintain operation of the exhaust fan so as to provide adequate airflow for waste cooling and prevention of flammable gas buildup when the system is operating. Component failure detection: Fan shut down would trip exhauster skid remote trouble alarm XA-13640 and trip the loss of stack flow alarm FLL-13627 on the CAM and remote system trouble alarms RXA-1365A and RXA-1365B. Quality assurance criteria: Since failure of the component safety function would be immediately detected and worst-case heat-up and flammable gas buildup scenarios permit ample time to repair the component, the safety function can be preserved by recovery time alone. *	SC

Status Indicator Lights On VSD Keypad (YL-13639A, YL-13639B, YL-13639C, YL-13639D, YL-13639E, YL-13639F) H2-818561, Sht. 6, Rev. 2	Indicate status of exhaust fan motor controller at the local station on electrical equipment skid 241-C-51.	Failure to indicate condition (on or off)	Failure of indicator lights will have no effect on ventilation system safety functions.	Potential effects of component failure: Lack of, or erroneous, local indication of system status. Critical functional requirements: None - Provide local indication of status with no effect on system operation. Component failure detection: Periodic surveillance and testing of VSD motor controller. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
Ductwork and HEPA Filter Housing H2-818559, Sht. 2, Rev. 1; H2-818561 Shts. 3, 4, 6, and 7, Rev. 2	Contain and direct air through ventilation system Provide boundary between tank air/aerosol mix and environment	Seal failure at joint or structural damage to system.	Air leakage into ventilation system No effect on system safety function	Potential effects of component failure: The pressure in the operating ventilation system will be less than atmospheric. The amount of air inleakage for a minor leak would be far less than the flow rate through the system and would not have a significant effect on the system safety function. Major damage could produce a loss or reduction of air flow possibly leading to a gradual heatup of the sludge layer or flammable gas buildup. Critical functional requirements: The only safety requirement on the ductwork is to permit adequate airflow for waste cooling and prevention of flammable gas buildup when the system is operating. Component failure detection: A major failure would be detected by a loss of tank vacuum. Quality assurance criteria: Since failure of the component safety function would be immediately detected and worst-case heat-up and flammable gas buildup scenarios permit ample time to repair or replace the component, the safety function can be preserved by recovery time alone. *	SC
		Major break due to vehicle collision or missile.	Loss or reduction of tank flow.		
Seal Loop Assemblies H2-818470, Sht. 1, Rev. 1; H2-818559, Sht. 5, Rev. 1	Provide pressure/vacuum relief	No liquid in loop due to leakage or blowout due to pressure differential	No effect on safety function	Potential effects of component failure: Leakage or blowout of seal liquid could result in local contamination. Critical functional requirements: None - No credible failure mode would disable safety function as a differential pressure relief path. Component failure detection: Component could fail without detection of failure other than by routine surveillance activities. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS

SSC	Accident(s)	Safety Functions	Functional Requirements	Performance Criteria	Planned Modifications Involving This SSC
Stack CAM and Interlock To Exhaust Fan On 296-C-006 Primary Tank Ventilation System (Tank C-106)	BIO: SC - Spray Leak in Structure or Overground Waste Transfer Line, Section 5.3.2.20 BIO Add. 1: SS - HEPA Filter Failure, Section 3.4.2.2; Unfiltered Release, Section 3.4.2.3	Shut down the ventilation system to prevent an unfiltered release for more than a specified time.	Continuously monitor exhaust air while the ventilation system is in operation. Measure the radiation level in the exhaust stream and shut down the ventilation system when a predetermined level is reached. The CAMs shall also activate an alarm and shut down the exhaust system in the event of CAM failure.	CAMs shall be inspected and tested in accordance with existing Hanford Site procedures. NOTE: The accident which produces safety class consequences during sluicing operations, analyzed in Section 3.4.2.16 of the BIO Addendum 1, is applicable only to tank 241-AY-102, ie., it is not applicable to tank 241-C-106. NOTE: A failure of the CAM system or fan shutdown interlock does not, in itself, initiate an accident. For Spray Leak (SC), Critical Characteristics: Must operate continuously while ventilation is running, detect stack radiation in excess of 10,000 cpm, and activate an alarm and an interlock to shut down exhaust fan upon detecting excess radiation (RD-057). For HEPA Filter Failure and Unfiltered Release (SS), Critical Characteristics: Must operate continuously while ventilation is running, maintaining isokinetic sampling conditions. Must measure stack radiation, detect stack radiation in excess of a preset level of no more than 10,000 cpm, and activate an interlock to shut down exhaust fan within 10 minutes of detecting excess radiation. Must activate an alarm or an exhaust fan interlock (or both) upon CAM failure (RD-057).	Vacuum Pump Replacement to Meet FG Requirements

THE ITEMS BELOW ARE THE UNIQUE COMPONENTS THAT MAKE UP THIS SSC					
COMPONENT IDENTIFICATION	COMPONENT FUNCTION	COMPONENT FAILURE MODE	COMPONENT FAILURE EFFECTS ON SSC SAFETY FUNCTION	COMPONENT SAFETY CLASSIFICATION JUSTIFICATION	COMPONENT SAFETY CLASS
Radiation Detector (RE-1363) H2-818561, Sht. 7, Rev. 2	Detect beta/gamma radiation in sample airstream when ventilation system is operating	Fail high	Spurious local and remote high radiation alarms and shutdown of primary tank ventilation fan	Potential effects of component failure: Failure low or intermediate could cause a HEPA filter failure and radiation release to go unrecognized. Failure high would cause spurious alarms and shut down the exhaust fan. Critical functional requirements: Must be able to detect and measure radiation in the stack air. Must be able to transmit signal to the beta/gamma monitor (RI-1363). Component failure detection: Component could fail without detection other than by routine surveillance and calibration activities. Failure high would cause exhaust fan shutdown with attendant alarms. Quality assurance criteria: Safety function can be preserved by periodic testing since ample recovery time is available in the worst-case waste heat-up and flammable gas accumulation scenarios to permit repair or replacement of component or switch-over to backup ventilation system. *	SC
		Fail low or intermediate	Possible undetected loss of function		

Beta/Gamma Monitor (RI-1363) H2-818561, Sht. 7, Rev. 2	Monitor radiation level signal from detector and activate alarms and primary fan shutdown as required	Fail high	Spurious local and remote high radiation alarms and shutdown of primary tank ventilation fan	Potential effects of component failure: Failure low or intermediate could cause a HEPA filter failure and radiation release to go unrecognized. Failure high would cause spurious alarms and shut down the exhaust fan disabling the safety function of the ventilation system. Critical functional requirements: Must be able to monitor radiation in the stack air. Must be able to trip (deenergize) alarm relay and trip exhaust fan interlock if radiation level goes above setpoint. Component failure detection: Component could fail without detection other than by routine surveillance and calibration activities. Failure to deenergized state would cause exhaust fan shutdown with attendant alarms. Quality assurance criteria: Safety function can be preserved by periodic testing since ample recovery time is available in the worst-case waste heat-up and flammable gas accumulation scenarios to permit repair or replacement of component or switch-over to backup ventilation system. *	SC
		Fail to function	Undetected loss of function		
High Radiation Monitor Alarm Relay (RSH-1363) H2-818561, Sht. 7, Rev. 2	activate local and remote high radiation alarms and operate interlock to shut down primary fan	Fail open (N.O. - held closed during normal operation)	Spurious local and remote high radiation alarms and shutdown of primary tank ventilation fan	Potential effects of component failure: Failure closed could cause a HEPA filter failure and radiation release to go unrecognized. Failure open would cause spurious alarms and shut down the exhaust fan disabling the safety function of the ventilation system. Critical functional requirements: Must be able to open contacts on loss of signal. Must be able to trip alarms and exhaust fan interlock if radiation level goes above setpoint. Component failure detection: Component could fail without detection other than by routine surveillance and testing activities. Failure to open contact position would cause exhaust fan shutdown with attendant alarms. Quality assurance criteria: Safety function can be preserved by periodic testing since ample recovery time is available in the worst-case waste heat-up and flammable gas accumulation scenarios to permit repair or replacement of component or switch-over to backup ventilation system. *	SC
		Fail closed	Undetected loss of function		

CAM High Radiation Primary Exhaust Fan Shutdown Interlock (I-3) H2-818561, Sht. 7, Rev. 2; (KY-13631A) H2-818675, Sht. 4, Rev. 1	Shut down primary exhaust fan on CAM high radiation alarm	Fail open (N.O. - held closed during normal operation)	Spurious shutdown of primary tank ventilation fan	Potential effects of component failure: Failure closed could cause additional radiation release from a failed HEPA filter after a CAM high radiation alarm. Failure open would shut down the exhaust fan disabling the safety function of the exhaust system. High radiation alarms would still be functional. However system functional requirements could still be violated due to delay in manually shutting down exhaust fan. Critical functional requirements: Must be able to open contacts on loss of signal. Must be able to shut down exhaust fan if radiation level goes above setpoint and CAM alarm relay opens. Component failure detection: Component could fail without detection other than by routine surveillance and testing activities. Failure to open contact position would cause exhaust fan shutdown with attendant alarms. Quality assurance criteria: Safety function can be preserved by periodic testing since ample recovery time is available in the worst-case waste heat-up and flammable gas accumulation scenarios to permit repair or replacement of component or switch-over to backup ventilation system. *	SC
		Fail closed	Undetected loss of function		
Local and Remote High Radiation Alarms (RLH-1363A RLH-1363B UA-1365A HS-13649B RAH-1363A RAH-1363B); H2-818561, Sht. 7, Rev. 2	Indicates high radiation level condition	Fail to function	loss of one or more local or remote high stack radiation alarms	Potential effects of component failure: Possible partial loss of indication of high stack radiation level condition. Critical functional requirements: None - System safety function is fulfilled by fan shutdown interlock which is not affected. Component failure detection: Component could fail without detection other than by routine surveillance and testing activities. Spurious alarms would have no effect on system. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS

Radiation Detector Failure Alarm Relay (RXS-1363) H2-818561, Sht. 7, Rev. 2	Activates radiation detector failure alarm	Fail open (N.O. - held closed during normal operation)	Spurious radiation detector failure alarm	Potential effects of component failure: Spurious alarm. Possible undetected loss of CAM system safety function. Critical functional requirements: Acts as a defense in depth supporting safety significant radiation detector by alarming on any of the anticipated failure modes of radiation detector. Component failure detection: Component could fail without detection other than by routine surveillance and testing activities. Spurious alarms would have no effect on system. Quality assurance criteria: Safety function can be preserved by periodic testing and calibration. *	SC
		Fail closed	Loss of function		
Radiation Monitor Failure Alarm (RXL-1363) H2-818561, Sht. 7, Rev. 2	Indicates radiation detector failure	Fail to function	Loss of local alarm	Potential effects of component failure: Spurious alarm. Loss of one channel of indication of radiation detector failure. Critical functional requirements: Act as a defense in depth supporting safety class radiation detector by alarming on any of the anticipated failure modes of radiation detector. Alarm condition would also be indicated by CAM system trouble alarm at MO-211 (RXA-1365A). Component failure detection: Component could fail without detection other than by routine surveillance and testing activities. Spurious alarms would have no effect on system. Quality assurance criteria: Safety function can be preserved by periodic testing and calibration. *	SC
High Radiation Alarm Bypass (HS-13644 KY-13631) H2-818561, Sht. 7, Rev. 2	Bypasses alarm functions during calibration of radiation monitor Pushing button HS-13644 energizes timing relay KY-13631 bypassing any alarm conditions that may occur during calibration.	Failure to reset after 1 hour or spurious alarm bypass	Loss of alarm and fan interlock functions	Potential effects of component failure: Loss of CAM high radiation alarm and fan interlock functions. Critical functional requirements: Acts as a defense in depth for required operator action to return the bypass switch (HS-13644) to normal operating mode after calibration activities are complete. Timing relay resets to its initial state (alarm functions enabled) after 1 hour. Component failure detection: Component could fail without detection other than by routine surveillance and testing activities. Quality assurance criteria: Safety function can be preserved by periodic testing and calibration. *	SC

MASSTRON II Radiation Monitor Sample Flow Rate Instrument Including Lo-Flo Venturi Element (FE-1366 FT-1366 FY-1366 PT-1366); H2-818561, Sht. 7, Rev. 2	Provides mass flow signal used to regulate radiation monitor sample flow rate and to trip local and remote low flow alarms	Fail high	Possible loss of flow in radiation monitor sample line and loss of ability to detect low flow condition	Potential effects of component failure: Failure of this component could cause an undetected loss of the CAM system safety function (exhaust fan shutdown on high radiation level). Critical functional requirements: Maintain sufficient radiation monitor sample flow rate to allow the radiation detector to respond to a high radiation condition. Component failure detection: Component could fail without detection other than by routine surveillance and calibration activities. Quality assurance criteria: Safety function can be preserved by periodic testing and calibration. *	SC
		Fail low	Spurious low flow alarms and increased sample flow rate		
Temperature Element With Associated Transmitter and Indicator (TE-13624 TT-13624 TI-13624); H2-818561, Sht. 7, Rev. 2	Provides radiation monitor sample gas temperature compensation for mass flow rate calculation	Fail to function (high, low or intermediate)	Erroneous temperature compensation - possible minor effect on sample flow rate	Potential effects of component failure: Possible minor effect on CAM system calibration. No significant effect on safety function (exhaust fan shutdown on high radiation level). Critical functional requirements: None - Provides minor correction to radiation monitor sample flowrate in response to air temperature. Component failure detection: Component could fail without detection other than by routine surveillance and calibration activities. Deviation of sample line temperature by more than 10% from set point will activate local and remote system trouble alarms. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
Radiation Monitor Mass Flow Indicator and Totalizer (FI-1366 FQI-1366); H2-818561, Sht. 7, Rev. 2	Provide local indication of mass flow rate and total mass flow	Fail to operate	Failure to provide valid indication	Potential effects of component failure: Failure of this component would have no effect on system function. Critical functional requirements: None. Component failure detection: Component could fail without detection other than by routine surveillance and calibration activities. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS

Radiation Detector Sample High/Low Flow Rate Alarm (FLL-1366) H2-818561, Sht. 7, Rev. 2	Provide local alarm for radiation detector non-isokinetic flow (high or low flow rate)	Fail to operate	Failure to provide local alarm for radiation detector out of specification flow rate condition	Potential effects of component failure: Loss of local indication of high/low sample flow rate condition in radiation detector. This alarm is backed up by combined system trouble alarm at MO-211 control room (RXA-1365A) and TMAX alarm (RXA-1365B). Critical functional requirements: None - This alarm would aid in trouble shooting system in the event of a combined trouble alarm. Component failure detection: Component could fail without detection other than by routine surveillance and calibration activities. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
Record Sample Filters (E-083, E-084) H2-818561, Sht. 7, Rev. 2	Provide record samples of stack effluent particulates and iodine	Fail (rupture or plug)	Abnormal flow rate through record sample filter Part of record sample flow stream could bypass record sample filter	Potential effects of component failure: Invalid record sample. Critical functional requirements: None - Record sample has no system safety function. Component failure detection: Component could fail without detection other than by routine surveillance and calibration activities. Blockage of filter would trip local loss of record sample flow alarm (FLL-1365) and combined system trouble alarm (RXA-1365A) at MO-211 control room. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS

MASSTRON II Record Sample Flow Rate Instrument Including Lo-Flo Venturi Element With Associated Temperature Instruments and Alarms (FE-1365 FT-1365 FY-1365 PT-1365 TE-13623 TT-13623 TI-13623 FI-1365 FQI-1365 FLL-1365); H2-818561, Sht. 7, Rev. 2	Provides mass flow signal used to regulate record sample flow rate and to trip local and remote low flow alarms Provide local indication of mass flow rate and integrated mass flow	Fail to operate (high, low or intermediate)	possible abnormal flow rate through record sample filter Loss of alarm functions	Potential effects of component failure: Invalid record sample. Critical functional requirements: None - Record sample has no system safety function. Component failure detection: Components could fail without detection other than by routine surveillance and calibration activities. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
MASSTRON II Stack Flow Rate Instrument Including Lo-Flo Venturi Element With Associated Temperature Instruments and Alarms (FE-13627 FT-13627 FY-13627 PT-13627 TE-13627 TT-13627 TI-13627A FI-13627A FQI-13627 FLL-13627); H2-818561, Sht. 7, Rev. 2	Provides stack mass flow signal used to regulate radiation monitor and record sample flow rates and to trip low stack flow alarm Provide local indication of stack mass flow rate and integrated mass flow	Fail to operate (high, low or intermediate)	Possible improper control of radiation detector and record sample flow rates leading to low flow condition	Potential effects of component failure: Possible abnormal flow rate through radiation detector leading to invalid reading. Possible undetected loss of CAM system safety function. Loss of low stack flow rate alarms. Critical functional requirements: Regulate radiation detector mass flow rate within design parameters relative to stack flow rate. Provide loss of stack flow rate alarm function as a defense in depth supporting ventilation exhaust system. Component failure detection: Component could fail without detection other than by routine surveillance and calibration activities. Quality assurance criteria: Safety function can be preserved by periodic testing and calibration. *	SC

Main Control Module (CM-1) With Associated Combined Failure Alarms (XL-1365, UA-1365B, RXA-1365A) H2-818561, Sht. 7, Rev. 2	Control mass flow rates through record sample filters and radiation detector Provide high/low flow alarms for record sample and radiation detector sample lines, and for stack flow provide outputs to remote combined fault alarm circuit	Fail to function	Possible loss of radiation detector sample flow and loss of all low flow alarm functions	Potential effects of component failure: Possible loss of control of radiation detector sample flow rate and loss of system trouble alarm functions including the remote combined trouble alarm at MO-211 (RXA-1365A). Critical functional requirements: Function as designed to maintain proper flow rates and alarm functions. Component failure detection: Component could fail without detection other than by routine surveillance and calibration activities. Quality assurance criteria: Safety function can be preserved by periodic testing and calibration. *	SC
Radiation Detector Mass Flow Rate Control Valve (FCV-1366) H2-818561, Sht. 7, Rev. 2	Regulates radiation detector mass flow rate in response to signal from main control module (CM-1)	Fail to operate (open, closed or intermediate)	Loss of control of radiation sample flow rate	Potential effects of component failure: Improper sample flow rate through radiation detector. Possible loss of radiation detector sample flow. Critical functional requirements: Respond to signal from main control module to maintain proper flow rate through radiation detector. Component failure detection: Component could fail without detection other than by routine surveillance and calibration activities. Radiation detector mass flow rate instrument remains functional and would trip local alarm (FLL-1366) and combined system trouble alarms at the MO-211 control room (RXA-1365A) and at TMAX (RXA-1365B) on low flow condition. Quality assurance criteria: Safety function can be preserved by periodic testing and calibration. *	SC
Record Sample Mass Flow Rate Control Valve (FCV-1365) H2-818561, Sht. 7, Rev. 2	Regulates record sample mass flow rate in response to signal from main control module (CM-1)	Fail to operate (open, closed or intermediate)	Loss of control of record sample flow rate Possible loss of record sample filter flow	Potential effects of component failure: Invalid record sample. Critical functional requirements: None - Record sample has no system safety function. Component failure detection: Components could fail without detection other than by routine surveillance and calibration activities. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS

VELTROL II Sample Manifold Vacuum Controller (PT-13621 PIC-13621) H2-818561, Sht. 7, Rev. 2	Provides control signal to valve PCV-13621 to maintain manifold vacuum at preset level	Fail to function	Loss of control of vacuum in sample manifold	Potential effects of component failure: Possible loss of vacuum in sample manifold leading to low flow condition in radiation detector sample line. Critical functional requirements: Maintain vacuum in sample manifold at preset level. Component failure detection: Radiation detector mass flow rate instrument remains functional and would trip local alarm (FLL-1366) and combined system trouble alarms at the MO-211 control room (RXA-1365A) and at TMAX (RXA-1365B) on low flow condition. Quality assurance criteria: Safety function can be preserved by periodic testing and calibration. *	SC
Motor-Actuated Control Valve (PCV-13621) H2-818561, Sht. 7, Rev. 2	Responds to control signal from VELTROL II controller to modulate filtered air flow into manifold to maintain manifold vacuum at preset value	Fail to function	Loss of control of vacuum in sample manifold	Potential effects of component failure: Possible loss of vacuum in sample manifold leading to low flow condition in radiation detector sample line. Critical functional requirements: Maintain vacuum in sample manifold at preset level in response to signals from the VELTROL II controller. Component failure detection: Radiation detector mass flow rate instrument remains functional and would trip local alarm (FLL-1366) and combined system trouble alarms at the MO-211 control room (RXA-1365A) and at TMAX (RXA-1365B) on low flow condition. Quality assurance criteria: Safety function can be preserved by periodic testing and calibration. *	SC
Pressure/ Vacuum Indicator (PI-13641) H2-818561, Sht. 7, Rev. 2	Provides local indication of manifold vacuum/pressure at inlet to vacuum pumps	Fail to function (high or Low)	Loss of indication	Potential effects of component failure: Loss of local indication of sample manifold vacuum. No effect on CAM system safety function. Critical functional requirements: None. Component failure detection: Component could fail without detection other than by routine surveillance and calibration activities. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS

Motor-Actuated Selector Valves (UCV-1367 UCV-1368) H2-818561, Sht. 7, Rev. 2	Select air flow to primary or standby vacuum pump as directed by pump control module	Fail to operate or spurious operation	Loss of radiation detector sample flow	Potential effects of component failure: Possible loss of radiation detector sample flow and loss of CAM system safety function. Critical functional requirements: Maintain proper line-up as directed by pump control module. Component failure detection: Radiation detector mass flow rate instrument remains functional and would trip local alarm (FLL-1366) and combined system trouble alarms at the MO-211 control room (RXA-1365A) and at TMAX (RXA-1365B) on low flow condition. Quality assurance criteria: Safety function can be preserved by periodic testing and calibration. *	SC
Pressure Switches (PSH-13641 PSH-13642) H2-818561, Sht. 7, Rev. 2	Sense vacuum pump failure and triggers pump switch by pump control module	Fail closed	Triggers switch to standby pump	Potential effects of component failure: Possible loss of radiation detector sample flow and loss of CAM system safety function. Critical functional requirements: Sense vacuum pump failure and send proper signal to pump control module. Component failure detection: Radiation detector mass flow rate instrument remains functional and would trip local alarm (FLL-1366) and combined system trouble alarms at the MO-211 control room (RXA-1365A) and at TMAX (RXA-1365B) on low flow condition. Quality assurance criteria: Safety function can be preserved by periodic testing and calibration. *	SC
		Fail open	Unable to detect pump failure		

Vacuum Pumps (P-1366 P-1367) H2-818561, Sht. 7, Rev. 2	Provide flow through radiation detector and record sample vacuum manifolds	Fail to operate	Transfer to standby pump (either pump can be selected as primary with the other in standby) Airflows restored after pump transfer - system safety function not affected.	Potential effects of component failure: Pump control module (safety class) would switch to standby pump and re-align motor-actuated selector valves (safety class) to restore flow. CAM system safety function would not be affected. Critical functional requirements: Provide required vacuum for air flow through CAM instruments. Start on demand. Component failure detection: Pump failure would be indicated by local alarm (YL-13644B or YL-13645B depending on which pump failed) and by combined system trouble alarms at the MO-211 control room (RXA-1365A) and at TMAX (RXA-1365B). Quality assurance criteria: Since the system would automatically transfer to the standby pump in the event of a failure, and since the transfer would be immediately detected, the safety function can be preserved by periodic maintenance and testing. *	SC
Vacuum Relief Valves (PSV-1364 PSV-1365) H2-818561, Sht. 7, Rev. 2	Provide protection to vacuum pumps in case of airflow starvation	Fail closed	Possible damage to vacuum pump if low flow condition occurs	Potential effects of component failure: Failure (open) of relief valve on operating pump would have the same effect as loss of pump. Pump control module would switch to standby pump and re-align motor-actuated selector valves to restore flow. CAM system safety function would not be affected. Critical functional requirements: None - System would recover automatically. The only purpose of the vacuum relief valves is to protect the pumps from excessive inlet vacuum. Component failure detection: Loss of vacuum would be indicated by local alarm (YL-13644B or YL-13645B depending on which relief valve failed) and by combined system trouble alarms at the MO-211 control room (RXA-1365A) and at TMAX (RXA-1365B). Quality assurance criteria: Design and construction of these components to general service requirements is adequate.	GS
		Fail open	Possible loss of vacuum upstream of operating vacuum pump		

Pump Control Module CM-2 (I-7) H2-818561, Sht. 7, Rev. 2	Provides automatic control of vacuum pumps Switches pumps in case of pump failure and actuates pump failure alarms and system trouble alarms through control module C-1	Fail to function	Possible loss of ability to automatically shift to standby pump Possible loss of alarm functions	Potential effects of component failure: Possible loss of sample flow through radiation detector if the operating vacuum pump fails or if the operating vacuum relief valve fails open. Possible loss of pump failure alarms. Possible Loss of CAM system safety function. Critical functional requirements: Switch pumps in case of loss of vacuum on upstream side of operating pump. Provide pump failure alarms. Component failure detection: Component could fail without detection other than by routine testing and calibration activities. Radiation detector mass flow rate instrument remains functional and would trip local alarm (FLL-1366) and combined system trouble alarms at the MO-211 control room (RXA-1365A) and at TMAX (RXA-1365B) on low flow condition. Quality assurance criteria: Safety function can be preserved by periodic testing and calibration. *	SC

Fan Status Interlock (I-4) H2-818561, Sht. 7, Rev. 2	Turns off vacuum pumps if primary ventilation fan is turned off or loses power	Fail open	Loss of radiation detector sample flow	Potential effects of component failure: Failure (open) of the interlock so as to produce a spurious shutdown of the CAM system would disable the safety function of the CAM system while the exhaust system is operating. Critical functional requirements: None - Turns off CAM vacuum pumps when exhaust system is not operating. Component failure detection: Radiation detector mass flow rate instrument remains functional and would trip local alarm (FLL-1366) and combined system trouble alarms at the MO-211 control room (RXA-1365A) and at TMAX (RXA-1365B) on low flow condition. Quality assurance criteria: Since this non-safety function component can be readily repaired or bypassed in the available recovery time, design and construction of this component to general service requirements is adequate.	GS
		Fail closed	Stack monitor system runs with no stack flow		

APPENDIX A: FAILURE MODES AND EFFECTS ANALYSIS (FMEA)

SSC	Accident(s)	Safety Functions	Functional Requirements	Performance Criteria	Planned Modifications Involving This SSC
Primary Ventilation System (Tank C-105)	BIO: SC - Flammable Gas Deflagrations, Section 5.3.2.14	BIO: Maintain flammable gas concentrations in tank dome spaces, due to steady state releases, below 25% of the LFL	BIO: Assure that steady state release of flammable gas does not accumulate in flammable concentrations in vapor spaces of TWRS facilities and structures	System operability verified prior to sluicing and periodically thereafter. Critical Characteristics: Must provide a filtered flow path of sufficient capacity to maintain vapor space pressure in equilibrium with the atmosphere (RD-057).	Passive Ventilation System (Breather Filter System)
THE ITEMS BELOW ARE THE UNIQUE COMPONENTS THAT MAKE UP THIS SSC					
COMPONENT IDENTIFICATION	COMPONENT FUNCTION	COMPONENT FAILURE MODE	COMPONENT FAILURE EFFECTS ON SSC SAFETY FUNCTION	COMPONENT SAFETY CLASSIFICATION JUSTIFICATION	COMPONENT SAFETY CLASS
Bird Screen H2-818519, Sht. 1, ECN W-320-691	Prevents birds or animals from entering atmospheric opening of breather structure	Corrosion failure of screen The inlet screen is a passive component not prone to failure.	Failure could allow birds to enter 4" dia. inlet duct and build nests, partially or completely blocking air inlet.	Potential effects of component failure: Prolonged loss of airflow through tank breather system could cause a gradual buildup of flammable gas. Critical functional requirements: Allow sufficient airflow to maintain flammable gas concentration in tank headspace within allowable limit. Component failure detection: Component could fail without detection of failure other than by routine surveillance activities. Quality assurance criteria: Safety classification can be maintained by periodic surveillance.	SC

HEPA Filter H2-818519, Sht. 1, ECN W-320-691	Removes particulate material from air entering or leaving the tank.	Filter breach	Failure of the HEPA filter would not affect the safety function of the breather system	Potential effects of component failure: HEPA filter breach could cause a localized release of contamination. Blockage of a filter is not a failure of the filter itself (which is performing its function), but a failure to monitor and replace the filter as required. Critical functional requirements: None. Component failure detection: Component could fail without detection of failure other than by routine testing and surveillance activities. Quality assurance criteria: Since this non-safety function component can be readily replaced in the available recovery time, design and construction of this component to general service requirements is adequate.	GS
Isolation Valve (4" manually operated butterfly valve) H2-818519, Sht. 1, ECN W-320-691	Isolate tank C-105 from breather system during filter changout	Valve failure in closed position	Mechanical failure of valve to closed position would cut off air flow and disable the safety function of the system.	Potential effects of component failure: Prolonged loss of airflow through tank breather system could cause a gradual buildup of flammable gas. Critical functional requirements: Allow sufficient airflow to maintain flammable gas concentration in tank headspace within allowable limit. Component failure detection: Component could fail without detection of failure other than by routine testing and surveillance activities. Quality assurance criteria: Safety classification can be maintained by periodic testing and surveillance. *	SC
		Valve failure in open position	Mechanical failure of valve to open position would have no effect on the safety function of the system.		
HEPA Filter Housing and Ductwork (including support structure) H2-818519, Sht. 1, ECN W-320-691	Contain and direct air through tank breather system Provide boundary between tank air/aerosol mix and the environment	Seal failure at joint or structural damage	Failure of the filter housing or ductwork could cause leakage into or out of the breather system. Failure in such a way as to cause a complete blockage is not considered credible No effect on the system safety function	Potential effects of component failure: The tank breather system will be at or very close to atmospheric pressure. Any leakage would be very small possibly producing some local contamination. Critical functional requirements: None - Leakage into or out of the HEPA filter housing or ductwork would have no effect on the system safety function. Component failure detection: Component could fail without detection of failure other than by routine testing and surveillance activities. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS

Seal Loop Assembly H2-818519, Sht. 1, ECN W-320-691	Provide pressure relief if HEPA is plugged	No oil in loop due to leakage or blowout due to pressure differential	No effect on safety function	Potential effects of component failure: leakage or blowout of seal oil could result in minor local contamination. Critical functional requirements: None - No credible failure mode would disable safety function as a pressure relief path. Component failure detection: Component could fail without detection of failure other than by routine testing and surveillance activities. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS

SSC	Accident(s)	Safety Functions	Functional Requirements	Performance Criteria	Planned Modifications Involving This SSC
Portable Exhauster as backup for tank 241-C-106 primary ventilation	BIO Add. 1: SC - Flammable Gas Deflagration, Section 3.4.2.8; Tank Bump, Section 3.4.2.11	Maintain flammable gas concentration below 25% of LFL (SC) Waste cooling (SC)	Act as backup for redundant safety class ventilation systems 296-P-16 and 296-C-006 to be installed in the event of unrecoverable failure of, or unrecoverable loss of power to, both primary systems Maintain ventilation flow rate / vapor space vacuum per operating procedures	Maintain sufficient exhaust flow rate to provide waste cooling and to prevent hydrogen buildup in tank C-106. Verify availability and operability prior to WRSS operations. Operability will be maintained by periodic functional tests. Portable exhausters will not normally be installed at tank C-106, but will be stored at a secure indoor location. Critical Characteristics: Must maintain a minimum flow rate of 500 CFM, must maintain ventilated space at a partial vacuum relative to atmosphere, and must be safe for operation in an ex-tank intrusive location (DB-001) per TSR administrative control AC-5.10.	None

SSC	Accident(s)	Safety Functions	Functional Requirements	Performance Criteria	Planned Modifications Involving This SSC
Portable Exhauster as backup for tank 241-AY-102 primary ventilation	BIO Add. I: SC - Flammable Gas Deflagration, Section 3.4.2.8; Tank Bump, Section 3.4.2.11	Maintain flammable gas concentration below 25% of LFL (SC) Waste cooling (SC)	Act as backup for safety class primary ventilation system to be installed in the event of unrecoverable failure of, or unrecoverable loss of power to primary system Maintain ventilation flow rate / vapor space vacuum per operating procedures	Maintain sufficient exhaust flow rate to provide waste cooling and to prevent hydrogen buildup in tank AY-102. Verify availability and operability prior to WRSS operations. Operability will be maintained by periodic functional tests. Portable exhausters will not normally be installed at tank AY-102, but will be stored at a secure indoor location. Critical Characteristics: Must maintain a minimum flow rate of 500 CFM, must maintain ventilated space at a partial vacuum relative to atmosphere, and must be safe for operation in an ex-tank intrusive location (DB-001) per TSR administrative control AC-5.10.	None

SSC	Accident(s)	Safety Functions	Functional Requirements	Performance Criteria	Planned Modifications Involving This SSC
Portable Exhauster as backup for tank 241-AY-102 annulus ventilation system	Tank Bump BIO Add. 1 Section 3.4.2.11	Waste Cooling (SC)	Act as backup for safety class annulus ventilation system to be installed in the event of unrecoverable failure of, or unrecoverable loss of power to annulus ventilation system. Maintain ventilation flow rate / annulus vacuum per operating procedures.	Maintain sufficient exhaust flow rate for waste cooling. Verify availability and operability prior to WRSS operations. Operability will be maintained by periodic functional tests. Portable exhausters will not normally be installed at tank AY-102, but will be stored at a secure indoor location. Critical Characteristics: Must maintain a minimum flow rate of 1000 CFM, must maintain ventilated space at a partial vacuum relative to atmosphere, and must be safe for operation in an ex-tank intrusive location (DB-001). NOTE: Portable exhauster will be installed on riser 19B bypassing annulus exhaust CAM. This channel of tank leak detection will therefore be lost. The other leak detection channel (conductivity probes in tank annulus) must be operational at all times while the annulus exhaust CAM is not operating.	None

THE ITEMS BELOW ARE THE UNIQUE COMPONENTS THAT MAKE UP THIS SSC					
COMPONENT IDENTIFICATION	COMPONENT FUNCTION	COMPONENT FAILURE MODE	COMPONENT FAILURE EFFECTS ON SSC SAFETY FUNCTION	COMPONENT SAFETY CLASSIFICATION JUSTIFICATION	COMPONENT SAFETY CLASS
Inlet isolation Valve (12" Manually Operated Butterfly Valve V-135) H14-102610, Sht. 1, Rev. 0; H14-102577, Sht. 1, Rev. 0	Isolate portable exhaust system from tank or annulus during filter changeout or other system maintenance	Valve failure in closed position	Mechanical failure of valve to closed position during portable exhauster operation will cut off airflow and disable system function. Inability to open valve after installation will disable its ability to act a backup for the primary or annulus ventilation system.	Potential effects of component failure: Prolonged loss or reduction of airflow could cause a gradual heatup of the sludge layer and a possible buildup of flammable gas. Critical functional requirements: The only safety requirement on valve V-135 is to permit adequate airflow for waste cooling, prevention of flammable gas buildup and leak detection (if applicable) while the system is installed and operating. Component failure detection: Valve closure with fan running would trip the low flow alarm (FAL-184) after 10 s, and trip the fan shutdown interlock after 20 s. Quality assurance criteria: Safety classification of component can be preserved by periodic functional testing of portable exhauster system while in storage. *	SC
		Valve failure in open position	Mechanical failure of valve in open position during system operation would have no effect on system function. Failure of the valve to the open position after the exhauster has been operated in its backup function, and removed from the tank, could result in localized contamination.		

Demister H14-102610, Sht. 1, Rev. 0; H14-102577, Sht. 1, Rev. 0	Removes mist from airstream	Failure to function	Failure to remove mist (e.g. due to heavy solids loading) could cause premature loading of prefilter and HEPA filter leading to reduced air flow. Demisters are passive components not prone to failure. Demister is equipped with washdown system to reduce solids loading as necessary.	Potential effects of component failure: Prolonged reduction of airflow could cause a gradual heatup of the sludge layer. Critical functional requirements: None - The only function of the demister is to extend the useful life of the filters. Component failure detection: Periodic monitoring would detect solids buildup on demister. High differential pressure across the demister and heater would trip alarm PDAH-170. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
Demister washdown system (PRV-001, V-301, BFP-001, V-302) H14-102610, Sht. 1, Rev. 0	Provide capability to washdown demister in case of excessive solids buildup	Failure to function due to obstruction or valve failure	Inability to washdown demister could lead to excessive radiation field around portable exhauster.	Potential effects of component failure: Excessive solids loading on the demister could lead to excessive radiation around the portable exhauster and possibly a reduction in exhaust flow rate. Air inleakage would not have a significant effect on system function since any credible leakage rate would be far less than the exhauster flow rate. The system is readily repairable and solids buildup on the demister would take place slowly over a considerable period of time. Critical functional requirements: None. Component failure detection: Component failure would be detected during periodic maintenance activities to reduce solids loading on demister. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
		Breach in system	A breach (leak or valve failure) could allow air leakage into exhauster plenum.		

Heater coil and glycol recirculating heater system with associated heater controls (V-201, P-001, V-202, HTR-001, V-204, V-205, TK-001, LG-201, V-203, TS-206, CON-206, YYC-MDL9) H14-102610, Sht. 1, Rev. 0	Maintain exhaust air stream above dew point to prevent condensation in exhaust system and possible wetting of HEPA filters.	Failure to function as designed (fail on, off or intermittent) Glycol leak leading to loss of flow in heater system	Failure of heater system could result in failure to maintain air stream temperature within design limits. Heater coil housing and glycol heater high temperature interlocks would protect system in the event heater failed on. HEPA filter inlet air above 200°F would trip interlock and shut down glycol heater.	Potential effects of component failure: Heater system failure could cause wetting of HEPA filters. Critical functional requirements: None - The only function of the heater is to extend the life of the exhaust HEPA filters by preventing moisture buildup on the filter media. Component failure detection: Heater system could fail without detection other than routine surveillance and testing activities. HEPA filter inlet air temperature below 40°F would trip alarm TAL-179. Glycol expansion tank level below 50% would trip alarm LAL-205 and interlock shutting down glycol heater and pump. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
Prefilter (FLT-001) H14-102610, Sht. 1, Rev. 0	Protect HEPA filter from large particle loading	Filter breach	Failure of the pre-filter will not affect the safety function of the exhauster system. Although this would not be considered a component failure, blockage of pre-filter would cause loss of air flow and disable the safety functions of the system	Potential effects of component failure: Breach of pre-filter could cause an increased rate of loading on the downstream HEPA filters. Blockage of a filter is not a failure of the filter itself (which is performing its function), but a failure to monitor and replace the filter as required. Critical functional requirements: None - The only safety requirement on the system is to provide adequate airflow for waste cooling, prevention of flammable gas buildup and leak detection (if applicable) when the system is operating. No failure of the filter component itself will disable the system safety function. Component failure detection: Prefilter differential pressure greater than 1.0" WG would trip alarm PDAH-178. Stack flow rate less than 470 CFM would trip fan interlock and shut down exhaust fan. Quality assurance criteria: Since failure of the filter component does not affect the safety function of the system, design and procurement of this component to general service requirements is adequate.	GS

Exhaust HEPA Filters (two stages: FLT-002 and FLT-003) H14-102610, Sht. 1, Rev. 0	Prevent any radioactive particulates in the airstream from reaching the environment	Filter breach	Failure of the exhaust HEPA filter will not affect the safety function of the system. HEPA filter breach would require a shut down to replace filter. Although this would not be considered a component failure, blockage of exhaust HEPA filter would cause loss of air flow and disable the safety functions of the system	Potential effects of component-failure: HEPA filter breach could cause a localized release of contamination. Blockage of a filter is not a failure of the filter itself (which is performing its function), but a failure to monitor and replace the filter as required. Critical functional requirements: None - The only safety requirement on the system is to provide adequate airflow for waste cooling, prevention of flammable gas buildup and leak detection (if applicable) when the system is operating. No failure of the filter component itself will disable the system safety function. Component failure detection: Differential pressure greater than 4.5" WG across 1st stage HEPA filter would trip alarm PDAH-180. Differential pressure exceeding 5.4" WG across the 1st stage or across both stages would trip the fan interlock and shut down the exhaust fan. Stack flow rate less than 470 CFM would trip fan interlock and shut down exhaust fan. In addition, loss of system flow would trip the loss of tank vacuum alarms (PAL-1361A and PAL-1361B), and the evacuation horn (PAL-1361C) at the tank process building. Breach of either HEPA filter would trip the (safety class) fan shutdown interlock on low differential pressure and activate alarm. Quality assurance criteria: Since failure of the filter component does not affect the safety function of the system, design and procurement of this component to general service requirements is adequate.	GS

APPENDIX A: FAILURE-MODES AND EFFECTS ANALYSIS (FMEA)

Filter outlet isolation Valve (8" Manually Operated Butterfly Valve V-136) H14-102610, Sht. 1, Rev. 0; H14-102577, Sht. 1, Rev. 0	Isolate filters from environment during filter changeout or other system maintenance	Valve failure in closed position	Mechanical failure of valve to closed position during portable exhauster operation will cut off airflow and disable system function. Inability to open valve after installation will disable its ability to act a backup for the primary tank or annulus ventilation system.	Potential effects of component failure: Prolonged loss or reduction of airflow could cause a gradual heatup of the sludge layer and a possible buildup of flammable gas. It is expected, however, that only a small airflow would be required to maintain flammable gas below the required limit. Critical functional requirements: The only safety requirement on valve V-136 is to permit adequate airflow for waste cooling, prevention of flammable gas buildup and leak detection (if applicable) while the system is installed and operating. Component failure detection: Valve closure with fan running would trip the low flow alarm (FAL-184) after 10 s, and trip the fan shutdown interlock after 20 s. Quality assurance criteria: Safety classification of component can be preserved by periodic functional testing of portable exhauster system while in storage. *	SC
		Valve failure in open position	Mechanical failure of valve in open position during system operation would have no effect on system function.		
Exhaust Fan With Variable Frequency Drive and Associated Controls (including fan shutdown interlock) (EF-001, M-001, YYC-MDL7, VFD-001, HS-103, PB-101, PB-102) H14-102610, Sht. 1, Rev. 0	Provide required exhaust flow rate through the portable exhaust system	Failure to function Spurious fan shutdown due to interlock malfunction	Fan failure or spurious shutdown would cut off tank exhaust flow and disable the safety functions of the portable ventilation system.	Potential effects of component failure: Prolonged loss of airflow could cause a gradual heatup of the sludge layer and a possible buildup of flammable gas. Critical functional requirements: The only safety requirement on the exhaust fan is to provide adequate airflow for waste cooling, prevention of flammable gas buildup and leak detection (if applicable) when the system is operating. Component failure detection: Low system air flow would be indicated by multiple alarms including FAL-184, PDAL-180, PDAL-181 and PDAL-182. Quality assurance criteria: Since failure of the component safety function would be immediately detected and worst-case heat-up and flammable gas buildup scenarios permit ample time to repair the component, the safety function can be preserved by recovery time alone. *	SC

Ductwork including plenums, filter housings, transition pieces, and fan inlet expansion joint H14-102610, Sht. 1, Rev. 0; H14-102577, Sht. 1, Rev. 0	Contain and direct air through exhaust system Provide boundary between tank air/aerosol mix and environment	Seal failure at joint or structural damage to system	Air inleakage into exhaust system No effect on system safety function	Potential effects of component failure: The pressure in the operating exhauster system will be less than atmospheric. The amount of air inleakage for a minor leak would be far less than the flow rate through the system and would not have a significant effect on the system safety function. Major damage could produce a loss or reduction of air flow possibly leading to a gradual heatup of the sludge layer or flammable gas buildup. Critical functional requirements: The only safety requirement on the ductwork is to permit adequate airflow for waste cooling and prevention of flammable gas buildup when the system is operating. Component failure detection: A major failure would be detected by a loss of tank vacuum. Quality assurance criteria: Since failure of the component safety function would be immediately detected and worst-case heat-up and flammable gas buildup scenarios permit ample time to repair or replace the component, the safety function can be preserved by recovery time alone. *	SC
		Major break due to vehicle collision or missile.	Loss or reduction for tank flow.		
Programmable logic controller YYC-MDL1 with associated sensors and relays (PDT-177, V-137, V-138, V-139, PDT-178, V-140, V-141, V-142, FT-184, FI-184, V-153, V-154, V-155, V-156, V-157, FSL-184) H14-102610, Sht. 1, Rev. 0	Monitor demister and prefilter differential pressures and stack flow rate Operate fan shutdown interlock (High tank vacuum, high or low stack flow rate)	Failure to shut down fan when required	Failure to shut down exhaust fan will not disable system safety functions.	Potential effects of component failure: Prolonged loss of tank C-106 airflow could cause a gradual heatup of the sludge layer and a possible buildup of flammable gas. Critical functional requirements: Permit operation of exhaust fan while monitored functions are within their allowed ranges. Component failure detection: Low system air flow would be indicated by multiple alarms including FAL-184, PDAL-180, PDAL-181 and PDAL-182. Quality assurance criteria: Since failure of the component safety function would be immediately detected and worst-case heat-up and flammable gas buildup scenarios permit ample time to repair the component, the safety function can be preserved by recovery time alone. *	SC
		Spurious trip of fan shutdown interlock	Spurious shutdown of exhaust fan will cut off exhaust flow and disable the system safety functions.		

Stack low flow alarm (FAL-184)	Alarms if stack flow falls below 470 CFM Provides primary indication of low stack flow.	Failure to function	Failure of stack low flow alarm function would disable the primary means of detecting loss of exhaust flow and disabling of system safety functions.	Potential effects of component failure: Possible undetected loss of exhaust system flow. Note that loss of alarm function does not, in itself, cause a loss of system safety function. Critical functional requirements: Indicate low exhaust system flow rate. Component failure detection: Component could fail without detection other than routine testing and calibration. Quality assurance criteria: Component safety classification can be preserved by periodic testing and calibration. *	SC
Noncritical indicators and alarms associated with YYC-MDL1 (PDI-177, PDI-178, FAH-184, PDAH-170, PDAH-178) H14-102610, Sht. 1, Rev. 0	Provide indication and alarms associated with demister and prefilter differential pressure and stack flow.	Failure to function or erroneous indication/alarm	Failure of any of these components would not effect safety function of system.	Potential effects of component failure: Possible loss of indication or alarm functions. Critical functional requirements: None - Failure would not affect system safety functions. Component failure detection: Components could fail without detection other than routine testing and calibration. Quality assurance criteria: Design and construction of these components to general service requirements is adequate.	GS
Programmable logic controller YYC-MDL2 with associated sensors and relays (PDT-180, V-143, V-144, V-145, PDT-181, V-146, V-147, V-148, PDT-182, V-149, V-150, V-151). H14-102610, Sht. 1, Rev. 0	Monitor HEPA filter differential pressures Operate fan shutdown interlock (high plenum vacuum, high or low combined HEPA filter differential pressure, high or low differential pressure across HEPA filter #1 or #2)	Failure to shut down fan when required	Failure to shut down exhaust fan will not disable system safety functions.	Potential effects of component failure: Prolonged loss of tank C-106 airflow could cause a gradual heatup of the sludge layer and a possible buildup of flammable gas. Critical functional requirements: Permit operation of exhaust fan while monitored functions are within their allowed ranges. Component failure detection: Low system air flow would be indicated by multiple alarms including FAL-184, PDAL-180, PDAL-181 and PDAL-182. Quality assurance criteria: Since failure of the component safety function would be immediately detected and worst-case heat-up and flammable gas buildup scenarios permit ample time to repair the component, the safety function can be preserved by recovery time alone. *	SC
		Spurious trip of fan shutdown interlock	Spurious shutdown of exhaust fan will cut off exhaust flow and disable the system safety functions.		

Noncritical indicators and alarms associated with YYC-MDL2 (PDI-180, PDI-181, PDI-182, PDAH-173, PDAHH-181, PDAL-181, PDAHH-182, PDAL-182, PDAHH-180, PDAL-180, PDAH-180, PDAH-182) H14-102610, Sht. 1, Rev. 0	Provide indication and alarms associated with HEPA filter differential pressures.	Failure to function or erroneous indication/alarm	Failure of any of these components would not effect safety function of system.	Potential effects of component failure: Possible loss of indication or alarm functions. Critical functional requirements: None - Failure would not affect system safety functions. Component failure detection: Components could fail without detection other than routine testing and calibration. Quality assurance criteria: Design and construction of these components to general service requirements is adequate.	GS
Programmable logic controller YYC-MDL3 with associated sensors and relays (LT-185, LT-205), H14-102610, Sht. 1, Rev. 0	Monitor liquid levels in seal pot and heater system glycol expansion tank. Operate fan shutdown interlock on high or low seal pot level. Start seal pot drain pump in auto mode on high seal pot level (70%). Operate interlock to shut down glycol heater and recirculation pump on low glycol expansion tank level.	Failure to shut down fan when required	Failure to shut down exhaust fan will not disable system safety functions.	Potential effects of component failure: Prolonged loss of tank C-106 airflow could cause a gradual heatup of the sludge layer and a possible buildup of flammable gas. Critical functional requirements: Permit operation of exhaust fan while monitored function is within its allowed range. Component failure detection: Low system air flow would be indicated by multiple alarms including FAL-184, PDAL-180, PDAL-181 and PDAL-182. Quality assurance criteria: Since failure of the component safety function would be immediately detected and worst-case heat-up and flammable gas buildup scenarios permit ample time to repair the component, the safety function can be preserved by recovery time alone. *	SC
		Spurious trip of fan shutdown interlock	Spurious shutdown of exhaust fan will cut off exhaust flow and disable the system safety functions.		

APPENDIX A: FAILURE MODES AND EFFECTS ANALYSIS (FMEA)

Noncritical indicators and alarms associated with YYC-MDL3 (LI-205, LI-185, LAL-205, LAL-185, LAH-185) H14-102610, Sht. 1, Rev. 0	Provide indication and alarms associated with glycol expansion tank and seal pot liquid levels.	Failure to function or erroneous indication/alarm	Failure of any of these components would not effect safety function of system.	Potential effects of component failure: Possible loss of indication or alarm functions. Critical functional requirements: None - Failure would not affect system safety functions. Component failure detection: Components could fail without detection other than routine testing and calibration. Quality assurance criteria: Design and construction of these components to general service requirements is adequate.	GS
Programmable logic controller YYC-MDL8 with associated controls (HS-101, HS-102), H14-102610, Sht. 1, Rev. 0	Control seal pot drain pump and glycol recirculation pump.	Failure to operate either or both pumps when required	Failure of the glycol recirculation pump to operate when required would not affect the system safety functions. Failure of the seal pot pump to operate when required could disable system safety functions.	Potential effects of component failure: Failure of the glycol recirculation pump would cause glycol heater shut down due to high temperature in heater tank with no effect on system safety functions. Failure of the seal pot drain pump could cause activation of fan shutdown interlock due to high seal pot level. Prolonged loss of tank C-106 airflow could cause a gradual heatup of the sludge layer and a possible buildup of flammable gas. Critical functional requirements: Operate seal pot drain pump so as to maintain seal pot level within allowed range (30% to 80%). Component failure detection: Seal pot level outside allowed range would be indicated by alarms LAL-185 and LAH-185. Low system air flow would be indicated by multiple alarms including FAL-184, PDAL-180, PDAL-181 and PDAL-182. Quality assurance criteria: Since failure of the component safety function would be immediately detected and worst-case heat-up and flammable gas buildup scenarios permit ample time to repair the component, the safety function can be preserved by recovery time alone. *	SC

Programmable logic controller YYC-MDL11 with associated sensors, indications and alarms, (TE-176, TE-179, TE-183, TI-176, TI-179, TI-183, TAH-179, TAL-179), H14-102610, Sht. 1, Rev. 0	Monitor exhaust air stream temperatures between demister and heater (1st plenum), at the inlet to HEPA filter #1, and at exhaust of HEPA filter #2 (stack). Operate interlock to shut down glycol heater on high temperature (200°F) at HEPA filter #1 inlet.	Failure to function (erroneous indication, spurious alarms) Spurious shutdown of glycol heater	Failure of any of these components would not effect safety function of system.	Potential effects of component failure: Possible loss of indication or alarm functions. Possible loss of heater function. Critical functional requirements: None - Failure would not affect system safety functions. Component failure detection: Components could fail without detection o her than routine testing and calibration. Quality assurance criteria: Design and construction of these components to general service requirements is adequate.	GS
Intrinsically Safe Instrument Barriers, (EB177, EB178, EB184, EB180, EB182, EB181, EB170, EB173, EB171, EB172, EB174, EB175) F14-100868 Sht. 7, Rev. 5	Prevent ignition of any flammable gas by differential pressure, flow, and plenum pressure instruments	Failure to function Open Circuit	Loss of intrinsic barrier Loss of instrument function	Potential effects of component failure: Loss of intrinsic barrier could lead to flammable gas deflagration. Loss of instrument function could disable safety function of system. Critical functional requirements: Prevent flammable gas ignition. Maintain instrument functions. Component failure detection: Component could fail without detection other than routine testing and calibration. Quality assurance criteria: Safety classification of component can be preserved by periodic functional testing of portable exhauster system while in storage. *	SC
Portable Exhauster Frame Including Main I-Beams 96159-W01 Sht. 1, Rev. 3	Support System components and maintain alignment of duct components during system transport	Structural failure during transport or DBE	Possible electrical or instrument malfunction. Possible damage to ductwork components due to misalignment.	Potential effects of component failure: Structural failure of portable exhauster frame could disable safety function as a backup for installed primary systems. Critical functional requirements: Maintain operability and alignment of system under transport and DBE stresses. Component failure detection: Structural failure would be evident to operators. Quality assurance criteria: Structure was designed to standards for SS SSCs and will be re-analyzed to verify that it will withstand the DBE.	SC

Main Electrical Power Connectors, Main Circuit Breakers, Transformer F14-100868 Sht. 1, Rev. 4	Provide connection to external 480V power. Route power to system components.	Open Circuit. Grounded Conductor.	System Disabled.	Potential effects of component failure: Malfunction of main power component would render system inoperable. Critical functional requirements: Receive 480V power from external source and distribute power to system components. Component failure detection: Failure would be evident to operators. Loss of exhaust flow would produce loss of tank or annulus vacuum. Quality assurance criteria: Safety classification of components can be preserved by periodic functional testing of portable exhauster system while in storage. *	SC
Exhaust Stack 96675-0V1 Sht. 1, Rev. 5; 96675-A02 Sht. 1, Rev. 0	Channel exhaust air from fan to elevated exhaust point. Support stack flow rate instrument.	Structural failure	Structural failure of stack could disable stack flow rate instrument.	Potential effects of component failure: Safety Class stack low flow alarm (FAL-184) could be disabled. Critical functional requirements: Support stack flow rate instrument. Component failure detection: Component could fail without detection other than routine surveillance and testing. Failure of the stack flow rate instrument would be nearly certain to trip the low flow alarm. Quality assurance criteria: Safety classification of components can be preserved by periodic functional testing of portable exhauster system while in storage.	SC
Portable Generator	BIO Add. 1: WRSS Operations Provide temporary power to the portable annulus exhauster pending repair / restart of the permanent annulus ventilation system. Portable generator can also be used to provide temporary power to primary tank or annulus ventilation systems.	Generator failure will prevent the generator from providing power to the portable exhauster.	Failure of power to the portable exhauster while in use as backup system will cause loss of annulus air flow.	Potential effects of component failure: Prolonged loss of annulus air flow could cause gradual heatup of sludge layer in tank possibly leading to a steam bump. Critical functional requirements: The only safety requirement on the portable generator is to provide backup power to the portable exhauster (or primary tank or annulus ventilation systems as needed). Component failure detection: Failure of the portable generator would be immediately apparent to operator. Quality assurance criteria: Since failure of the component safety function would be immediately detected and worst-case waste heat-up and tank leak scenarios permit ample time to replace the component, the safety function can be preserved by recovery time alone. In the event of a serious failure, the portable generator could be replaced by another portable generator.	SC

SSC	Accident(s)	Safety Functions	Functional Requirements	Performance Criteria	Planned Modifications Involving This SSC
Transfer Line (pipe-in-pipe) System	BIO Add. 1: SC-Subsurface Leak Resulting in a Pool , Section 3.4.2.14; Surface Leak Resulting in a Pool, Section 3.4.2.15; Spray Leak from Structure, Section 3.4.2.16	Ensures leak in primary transfer piping is directed to a waste transfer-associated structure.	Route the waste from the leaking primary pipe to the pit.	Shall be verified operable prior to WRSS operations Critical Characteristics: Encasement must provide containment and an unobstructed flow path to route waste leaking from primary pipe to transfer pit, where the leak can be detected and contained (ref. RD-057). Encasement must be capable of withstanding a test pressure of 480 PSIG, and must be designed for periodic pressure testing.	This system was designed and constructed for the WRSS project.
	BIO Add. 1: SS - Subsurface Leak Staying Subsurface, Section 3.4.2.13	Same as above.	Same as above.	Same as above.	

THE ITEMS BELOW ARE THE UNIQUE COMPONENTS THAT MAKE UP THIS SSC					
COMPONENT IDENTIFICATION	COMPONENT FUNCTION	COMPONENT FAILURE MODE	COMPONENT FAILURE EFFECTS ON SSC SAFETY FUNCTION	COMPONENT SAFETY CLASSIFICATION JUSTIFICATION	COMPONENT SAFETY CLASS
4-Inch Sluice Transfer Line (SN-200-M9) H2-818559, Shts. 2 and 4, Rev. 1	Contain sluice liquid pumped from tank AY-102 to tank C-106	Leakage from line. This is a passive component not prone to failure.	Leakage from primary sluice transfer line would not affect system safety function.	Potential effects of component failure: Failure of sluice transfer line could result in leakage into the 6-inch outer encasement which would route the leakage into sluice pit 241-C-06C through valve HV-13611 (Safety Class). If enough leakage accumulated in the pit to reach the pit drain, the excess would flow into tank C-106. Critical functional requirements: None - this component has no safety function. Component failure detection: Leakage into the outer encasement would activate the encasement leak detector (LDE-1364) tripping alarms LDA-1364 in process building room 2 and LDA-1364A in the MO-211 control room. If leakage is sufficient to produce a 1-inch accumulation in the pit, the pit leak detector (LDE-1368) would also alarm in the process control building and the MO-211 control room. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
4-Inch Slurry Transfer Line (SL-100-M9) H2-818559, Shts. 2 and 4, Rev. 1	Contain slurry pumped from tank C-106 to tank AY-102	Leakage from line This is a passive component not prone to failure.	Leakage from primary slurry transfer line would not affect system safety function.	Potential effects of component failure: Failure of slurry transfer line could result in leakage into the 6-inch outer encasement which would route the leakage into pump pit 241-C-06A through valve HV-13612 (Safety Class). If enough leakage accumulated in the pit to reach the pit drain, the excess would flow into tank C-106. Critical functional requirements: None - this component has no safety function. Component failure detection: Leakage into the outer encasement would activate the encasement leak detector (LDE-1363) tripping alarms LDA-1363 in process building room 2 and LDA-1363A in the MO-211 control room. If leakage is sufficient to produce a 1-inch accumulation in the pit, the pit leak detector (LDE-1366) would also alarm in the process control building and the MO-211 control room. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS

6-Inch Encasement Lines for sluice liquid and slurry transfer lines (ENC-M26a) H2-818559, Shts. 2 and 4, Rev. 1	Contain any leakage from primary sluice or slurry lines and drain to sluice or pump pit, respectively	Breach of encasement line which could permit leakage from a failed primary line to escape into environment. The encasement is not normally pressurized, but is designed to withstand the same pressure as the primary transfer lines.	Failure of an encasement line would disable the safety function of the component. Failure of an encasement line would not, by itself, cause a release.	Potential effects of component failure: Possible release of sluice liquid or slurry into the ground or formation of a pool. Note that the encasement would not be pressurized as a result of a primary line leak. Failure of an encasement line does not, by itself, cause a release. Critical functional requirements: Contain any leakage from the primary sluice or slurry transfer lines and direct it to a pit connected to tank C-106. Component failure detection: Component failure would be detected by surveillance and radiation surveys along transfer line route after detection of a primary transfer line failure. Quality assurance criteria: Safety classification can be maintained by required periodic surveillance and testing, and by required controls on excavation activities near the transfer line.	SC

SSC	Accident(s)	Safety Functions	Functional Requirements	Performance Criteria	Planned Modifications Involving This SSC
Transfer Leak Detector System - Transfer Line Encasements	BIO Add. 1: SC - Subsurface leak resulting in a pool Section 3.4.2.14 Surface leak resulting in a pool Section 3.4.2.15 BIO Add. 1: SS - Subsurface leak staying subsurface, Section 3.4.2.13	Detect leaks in transfer line encasements.	Shall be capable of detecting waste in the transfer line encasement.	Shall be verified operable prior to WRSS operations. Critical Characteristics: Must detect a 1-inch deep accumulation of liquid in the transfer line encasement drain, and must provide an alarm to notify operators when such an accumulation is detected.	Leak Detector Upgrades to FG Requirements

THE ITEMS BELOW ARE THE UNIQUE COMPONENTS THAT MAKE UP THIS SSC					
COMPONENT IDENTIFICATION	COMPONENT FUNCTION	COMPONENT FAILURE MODE.	COMPONENT FAILURE EFFECTS ON SSC SAFETY FUNCTION	COMPONENT SAFETY CLASSIFICATION JUSTIFICATION	COMPONENT SAFETY CLASS
Transfer Line Encasement Leak Detector Elements At Tank C-106 LDE-1363 (pump pit 241-C-06A); LDE-1364 (sluice pit 241-C-06C); H2-818559, Shts. 2-4, Rev. 1	Detect water in transfer line encasements	Short circuit	Spurious alarm	Potential effects of component failure: Failure to activate alarm on leakage of waste into transfer line encasement. Critical functional requirements: The encasement leak detector systems act as a defense in depth which are judged to substantially reduce the risk of releases due a break in a transfer line (sluice line or slurry line) and the surrounding encasement. Component failure detection: The elements are connected via a four wire arrangement to the electronics box. The design utilizes two wires per probe between the sensing element and the electronics. The two wire/probe configuration is part of a "monitoring" circuit that continuously monitors the wiring between the probe and the electronics. If the wires between the probe and the electronics are severed , the "monitoring" circuit will sense the break and provide a local and remote (Operator Station) alarm. The arrangement described above is "Fail Safe" and has been used successfully throughout the Tank Farms for several years. Quality assurance criteria: Prior to placing the probes in service, the probes will be tested to ensure they activate the Leak Detector electronics when immersed in liquid. In addition, procedures will be in place to (1) periodically test the encasement leak detector systems, (2) test operability of leak detector systems prior to the start of a sluicing operation, and (3) provide surveillance of leak detector systems during sluicing operations. CGIs were dedicated for use in this Safety Class system per CGI-DST-AY-5. *	SC
		Open circuit Failure to detect water	Possible undetected loss of safety function		

Intrinsically Safe Leak Detector Module (LD1) H-2-818702, Sht. 2, Rev. 1; H-2-818704, Sht. 2, Rev. 1	Open normally closed-contacts to actuate alarms when tripped by leak detector element	Fail open	Spurious alarms	Potential effects of component failure: Possible undetected leak into encasement. Critical functional requirements: Actuate alarms when water is detected in encasement. Component failure detection: Procedures will be in place to (1) periodically test the leak detector systems, (2) test operability of leak detector systems prior to the start of a sluicing operation, and (3) provide surveillance of leak detector systems during sluicing operations. Quality assurance criteria: CGI were dedicated for use in this Safety Class assembly per CGI-DST-AY-1 and CGI-DST-AY-4. *	SC
		Fail closed	Loss of ability to detect water in encasement Loss of safety function		
MTL 2313A Trip Amplifier (LD3) H-2-818702, Sht. 2, Rev. 1; H-2-818704, Sht. 2, Rev. 1	Monitor continuity in leak detector leads and leak detector circuit in LD1 Activate local strobe if continuity lost	Fail with LD3 output energized	Loss of ability to detect loss of continuity in leak detector circuit	Potential effects of component failure: Possible undetected loss of leak detector safety function. Critical functional requirements: Detect loss of continuity in leak detector circuit. Component failure detection: Periodic testing and calibration. Quality assurance criteria: Safety classification can be maintained by required periodic testing and calibration. *	SC
		Fail with LD3 output de-energized	Spurious alarms		
Test/Operate/Fail (T/O/F) Switch and Associated Test Circuit H-2-818702, Sht. 2, Rev. 1; H-2-818704, Sht. 2, Rev. 1	Provide ability to verify operation of LD1 and LD3	Fail to "Test" position	Trips LD1 on test load Spurious alarms	Potential effects of component failure: Leak detector will be disabled by spurious alarms until failure is corrected. No effect on safety function since no transfers can take place while leak detector is inoperative. Critical functional requirements: None - no failure mode of this component initiates an accident or effects the safety function of the leak detector. Component failure detection: Spurious alarms. Quality assurance criteria: Design and construction of these components to general service requirements is adequate.	GS
		Fail to "Fail" position	Trips LD3 by opening continuity test circuit Spurious alarms		

Alarm Relay (LD2) H-2-818702, Sht. 2, Rev. 1; H-2-818704, Sht. 2, Rev. 1	Activate local and remote alarms on loss of power from LD3	Contacts fail in energized position	Loss of alarm functions associated with loss of continuity in leak detector circuit	Potential effects of component failure: Possible loss of leak detector safety function. Critical functional requirements: Activate alarm on loss of continuity in leak detector circuit. Component failure detection: Periodic testing and calibration. Quality assurance criteria: Safety classification can be maintained by required periodic testing and calibration. *	SC
		Contacts fail in de-energized position	Spurious alarms		
120/12 V Transformer H-2-818702, Sht. 2, Rev. 1; H-2-818704, Sht. 2, Rev. 1	Provide power to local strobe light on alarm condition or loss of continuity in leak detector circuit	Fail to function	Loss of ability to energize local strobe light on alarm condition	Potential effects of component failure: Failure of local alarm if leak to encasement occurs leading to possible overflow into pit with associated pit leak detector alarm. Critical functional requirements: Provide 12 V power to local strobe light on alarm condition. Component failure detection: Procedures will be in place to (1) periodically test the leak detector systems, (2) test operability of leak detector systems prior to the start of a sluicing operation, and (3) provide surveillance of leak detector systems during sluicing operations. Quality assurance criteria: CGI were dedicated for use in this Safety Class assembly per CGI-DST-AY-2 and CGI-DST-AY-4. *	SC
Local Alarm Strobe Light H-2-818702, Sht. 2, Rev. 1; H-2-818704, Sht. 2, Rev. 1	Provide local alarm on detection of water in encasement or loss of continuity in leak detector circuit	Fail to function	Loss of local alarm (strobe light)	Potential effects of component failure: Failure of local alarm if leak to encasement occurs leading to possible overflow into pit with associated pit leak detector alarm. Critical functional requirements: Alert local operators of leak to encasement so that the transfer can be stopped. Component failure detection: Procedures will be in place to (1) periodically test the leak detector systems, (2) test operability of leak detector systems prior to the start of a sluicing operation, and (3) provide surveillance of leak detector systems during sluicing operations. Quality assurance criteria: CGI were dedicated for use in this Safety Class assembly per CGI-DST-AY-3 and CGI-DST-AY-4. *	SC

Remote Alarms At MO-211 At The C Tank Farm LDA-1363A (Pump pit 241-C-06A); LDA-1364A (Sluice pit 241-C-06C); H2-818559, Shts. 2-4, Rev. 1	Alarm on detection of liquid in encasement	Fail to operate	Loss of remote alarm at manned location	Potential effects of component failure: Failure of local alarm if leak to encasement occurs leading to possible overflow into pit with associated pit leak detector alarm. Critical functional requirements: The safety function is to alarm when leak is detected so that operators can stop the transfer pumps. Component failure detection: A failure in an alarm which could disable the alarm function may not be detectible. Loss of power (signal) from the alarm relay, however, will normally activate the alarm. Quality assurance criteria: Testing following installation will verify the alarm actuates on loss of signal. Procedures will be in place to (1) periodically test the leak detector systems, including remote alarms, (2) test operability of leak detector systems prior to the start of a sluicing operation, and (3) provide surveillance of leak detector systems during sluicing operations. *	SC
Leak Detector Field Cabinet and Support Structure	Support leak detector electronics enclosure and associated cabling	Structural failure	Possible loss of power to instrument and/or loss of signal from instrument	Potential effects of component failure: Loss of leak detector signal leading to spurious alarm. Critical functional requirements: None. Component failure detection: In the unlikely event of support failure which caused the detector to become inoperable because of a loss of power, the failure would be detected by the remote alarms. Quality assurance criteria: Design and construction of the Leak Detector structural components to general service requirements is adequate for the accident initiating events listed in the BIO and the BIO addendum #1.	GS

Encasement Drain Valves HV-13611 (sluice pit 241-C-06C); HV-13612 (pump pit 241-C-06A); H2-818559, Shts. 2 & 4, Rev. 1; H2-818558, Sht. 3, Rev. 1	Drain liquid from encasements through jumper so as to provide adequate level at encasement leak detector to activate alarm	Fail to test position	Drain from encasement shut off No effect on safety function of encasement leak detector	Potential effects of component failure: Possible undetected loss of function of encasement leak detector if drain valve fails to, or is left in, the drain position. In such a case, the liquid would drain directly to the pit and after a sufficient accumulation, would set off the pit leak detector. Fail to test position would disable the ability of the pit leak detector to function as a backup to the encasement leak detector. Critical functional requirements: Provide a flow path from the encasement into the pit which would (in the event of a leak into the encasement) produce a sufficient liquid depth at the leak detector for the detector to function and activate the associated alarms. Component failure detection: Periodic surveillance and testing. Quality assurance criteria: Safety function will be maintained by inspection and testing prior to installation, a check of valve position prior to a sluicing operation and periodically during sluicing operations. *	SC
		Fail to drain position	May disable encasement leak detector Possible undetected loss of safety function of encasement leak detector		

SSC	Accident(s)	Safety Functions	Functional Requirements	Performance Criteria	Planned Modifications Involving This SSC
Transfer Leak Detector System - Pits	BIO Add. 1: SC - Subsurface Leak Resulting in a Pool, Section 3.4.2.14; Subsurface Leak Resulting in a Pool, Section 3.4.2.15	Detect leaks in transfer associated structures. SC	Shall be capable of detecting a specified depth of waste in the pit.	Shall be verified operable prior to WRSS operations. **Critical Characteristics:** Must detect a 2-inch (maximum) accumulation of liquid in the bottom of the leak detection pit, and provide an alarm to notify operators when such an accumulation is detected (Ref. RD-057).	Leak Detector Upgrades to FG Requirements
	BIO Add. 1: SS-Subsurface Leak Staying Subsurface, Section 3.4.2.13	Same as above. SS	Same as above.	Same as above.	

THE ITEMS BELOW ARE THE UNIQUE COMPONENTS THAT MAKE UP THIS SSC					
COMPONENT IDENTIFICATION	COMPONENT FUNCTION	COMPONENT FAILURE MODE	COMPONENT FAILURE EFFECTS ON SSC SAFETY FUNCTION	COMPONENT SAFETY CLASSIFICATION JUSTIFICATION	COMPONENT SAFETY CLASS
Leak Detector Elements Tank C-106 LDE-1366 (Pump pit 241-C-06A); LDE-1368 (Sluice pit 211-C-06C); H2-818559, Shts. 2-4, Rev. 1 Tank AY-102 LDE-102-22A (Pump pit 241-AY-02A); LDE-102-32 (Sluice pit 241-AY-02E); H2-818560, Shts. 1-3, Rev. 2	Detect water on floor of pit	Short circuit	Spurious alarms	Potential effects of component failure: Failure to activate alarm if pit flooding occurs leading to possible overflow of pit with associated releases. Critical functional requirements: The safety function is to detect a (minimum) 1-inch deep pool of liquid in the bottom of the pit and to trip the Intrinsically Safe Leak Detector Module (LD1) when such a condition is detected. Component failure detection: The elements are connected via a four wire arrangement to the electronics box. The design utilizes two wires per probe between the sensing element and the electronics. The two wire/probe configuration is part of a "monitoring" circuit that continuously monitors the wiring between the probe and the electronics. If the wires between the probe and the electronics are severed , the "monitoring" circuit will sense the break and provide a local and remote (Operator Station) alarm. Procedures will be in place to (1) periodically test the leak detector systems, (2) test operability of leak detector systems prior to the start of a sluicing operation, and (3) provide surveillance of leak detector systems during sluicing operations. Quality assurance criteria: Prior to placing the probes in the pit, the probes will tested to ensure they activate the Leak Detector electronics when immersed in liquid to the height designated in the BIO and BIO addendum #1. CGIs were dedicated for use in this Safety Class system per CGI-DST-AY-5. *	SC
		Open circuit Failure to detect water	Possible undetected loss of safety function		
Intrinsically Safe Leak Detector Module (LD1) H-2-818702, Sht. 2, Rev. 1; H-2-818704, Sht. 2, Rev. 1	Open normally closed-contacts to actuate alarms when tripped by leak detector element	Fail open	Spurious alarms	Potential effects of component failure: Possible undetected flooding of pit. Critical functional requirements: Actuate alarms when water is detected in pit. Component failure detection: Procedures will be in place to (1) periodically test the leak detector systems, (2) test operability of leak detector systems prior to the start of a sluicing operation, and (3) provide surveillance of leak detector systems during sluicing operations. Quality assurance criteria: CGI were dedicated for use in this Safety Class assembly per CGI-DST-AY-1 and CGI-DST-AY-4. *	SC
		Fail closed	Loss of ability to detect water in pit Loss of safety function		

APPENDIX A: FAILURE MODES AND EFFECTS ANALYSIS (FMEA)

MTL 2313A Trip Amplifier (LD3) H-2-818702, Sht. 2, Rev. 1; H-2-818704, Sht. 2, Rev. 1	Monitor continuity in leak detector leads and leak detector circuit in LD1 Activate local strobe if continuity lost	Fail with LD3 output energized	Loss of ability to detect loss of continuity in leak detector circuit	Potential effects of component failure: Possible undetected loss of leak detector safety function. Critical functional requirements: Detect loss of continuity in leak detector circuit. Component failure detection: Periodic testing and calibration. Quality assurance criteria: Safety classification can be maintained by required periodic testing and calibration. *	SC
		Fail with LD3 output de-energized	Spurious alarms		
Test/Operate/Fail (T/O/F) Switch and Associated Test Circuit H-2-818702, Sht. 2, Rev. 1; H-2-818704, Sht. 2, Rev. 1	Provide ability to verify operation of LD1 and LD3	Fail to "Test" position	Trips LD1 on test load Spurious alarms	Potential effects of component failure: Leak detector will be disabled by spurious alarms until failure is corrected. No effect on safety function since no transfers can take place while leak detector is inoperative. Critical functional requirements: None - No failure mode of this component initiates an accident or effects the safety function of the leak detector. Component failure detection: Spurious alarms. Quality assurance criteria: Design and construction of these components to general service requirements is adequate.	GS
		Fail to "Fail" position	Trips LD3 by opening continuity test circuit Spurious alarms		
Alarm Relay (LD2) H-2-818702, Sht. 2, Rev. 1 H-2-818704, Sht. 2, Rev. 1	Activate local and remote alarms on loss of power from LD3	Contacts fail in energized position	Loss of alarm functions associated with loss of continuity in leak detector circuit	Potential effects of component failure: Possible undetected loss of leak detector safety function. Critical functional requirements: Activate alarm on loss of continuity in leak detector circuit. Component failure detection: Periodic testing and calibration. Quality assurance criteria: Safety classification can be maintained by required periodic testing and calibration. *	SC
		Contacts fail in de-energized position	Spurious alarms		

120/12 V Transformer H-2-818702, Sht. 2, Rev. 1; H-2-818704, Sht. 2, Rev. 1	Provide power to local strobe light on alarm condition or loss of continuity in leak detector circuit	Fail to function	Loss of ability to energize local strobe light on alarm condition	Potential effects of component failure: Failure of local alarm if pit flooding occurs leading to possible overflow of pit with associated releases. Critical functional requirements: Provide 12 V power to local strobe light on alarm condition Component failure detection: Procedures will be in place to (1) periodically test the leak detector systems, (2) test operability of leak detector systems prior to the start of a sluicing operation, and (3) provide surveillance of leak detector systems during sluicing operations. Quality assurance criteria: CGI were dedicated for use in this Safety Class assembly per CGI-DST-AY-2 and CGI-DST-AY-4. *	SC
Local Alarm Strobe Light H-2-818702, Sht. 2, Rev. 1; H-2-818704, Sht. 2, Rev. 1	Provide local alarm on detection of water in pit or loss of continuity in leak detector circuit	Fail to function	Loss of local alarm (strobe light)	Potential effects of component failure: Failure of local alarm if pit flooding occurs leading to possible overflow of pit with associated releases. Critical functional requirements: Alert local operators of pit flooding so that the transfer can be stopped. Component failure detection: Procedures will be in place to (1) periodically test the leak detector systems, (2) test operability of leak detector systems prior to the start of a sluicing operation, and (3) provide surveillance of leak detector systems during sluicing operations. Quality assurance criteria: CGI were dedicated for use in this Safety Class assembly per CGI-DST-AY-3 and CGI-DST-AY-4. *	SC

Remote Alarms at MO-211 and the 241-AY-51 Elect. Equipment Skid Tank C-106 LDA-1366A (Pump pit 241-C-06A); LDA-1368A (Sluice pit 241-C-06C); H2-818559, Shts. 2-4, Rev. 1 Tank AY-102 LDA-102-22A (Pump pit 241-AY-02A); LDA-102-32 (Sluice pit 241-AY-02E); H2-818560, Shts. 1-3, Rev. 2	Alarm on detection of liquid in pit	Fail to operate	Loss of remote alarm at manned location. Local alarm would still function.	Potential effects of component failure: Failure to alarm if pit flooding occurs leading to possible flooding of pit with associated releases. Critical functional requirements: The safety function is to alarm when leak or system failure is detected so that operators can stop the transfer pumps. Component failure detection: A failure in an alarm which could disable the alarm function may not be detectible except by periodic testing. Loss of power (signal) from the alarm relay, however, will normally activate the alarm. Quality assurance criteria: Testing following installation will verify the alarm actuates on loss of signal. Procedures will be in place to (1) periodically test the leak detector systems, including remote alarms, (2) test operability of leak detector systems prior to the start of a sluicing operation, and (3) provide surveillance of leak detector systems during sluicing operations. *	SC
Leak Detector Field Cabinet and Support Structure	Support leak detector electronics enclosure and associated cabling	Structural failure	Possible loss of power to instrument and/or loss of signal from instrument	Potential effects of component failure: Loss of leak detector signal leading to spurious alarm. Critical functional requirements: None. Component failure detection: In the unlikely event of support failure which caused the detector to become inoperable because of a loss of power, the failure would be detected by the remote alarms. Quality assurance criteria: Design and construction of the Leak Detector structural components to general service requirements is adequate for the accident initiating events listed in the BIO and the BIO addendum #1.	GS

SSC	Accident(s)	Safety Functions	Functional Requirements	Performance Criteria	Planned Modifications Involving This SSC
Pit Cover Blocks and Shield Plugs (Transfer System Covers)	BIO: SC - Spray Leak in structure or from overground waste transfer Line, Section 5.3.2.20 BIO Add. 1: SC - Spray Release from structure, Section 3.4.2.16	1. Mitigate the effect of a spray leak within the transfer pits.	The cover assembly for a structure must confine spray leaks to the inside of the structure. Transfer system covers must eliminate direct spray leakage paths. Covers must fit their supporting structure.	Pit covers must be installed during sluicing or other waste transfer operations. Note: The accident which produces safety class consequences during sluicing operations, analyzed in Section 3.4.2.16 of the BIO Addendum 1, is applicable only to tank 241-AY-102, i.e., it is not applicable to tank 241-C-106. Note: The safety class seismic switches would shut down WRSS pumping operations in the event of a seismic event. Critical Characteristics: Cover blocks must fit their respective pits, must preclude direct spray leak paths, and must confine spray leaks to inside of pit (RD-057).	C-Farm Pit Cover Block Camera Port Plug Modification on sluice pit 241-C-06C Replace pit cover block on 241-C-06B with cover plate Camera Mount for In-Tank Imaging System at top of riser #7 associated with pump pit 241-C-06A
		2. Limit release of aerosols generated by splatter inside the pit; limit shine and skyshine dose to onsite receptor.	The cover blocks must be capable of limiting the splatter of a spray release and mitigating the release of aerosols and direct radiation.		
	BIO Add. 1: SS - Surface Leak Causing a Pool, Section 3.4.2.15	Limit release of aerosols generated by splatter inside the pit	Pit structures and covers provide a mitigative safety function to limit releases	Critical Characteristics: Cover blocks must fit their respective pits, and must confine leakage to inside of pit (RD-057).	

APPENDIX A: FAILURE MODES AND EFFECTS ANALYSIS (FMEA)

THE ITEMS BELOW ARE THE UNIQUE COMPONENTS THAT MAKE UP THIS SSC					
COMPONENT IDENTIFICATION	COMPONENT FUNCTION	COMPONENT FAILURE MODE	COMPONENT FAILURE EFFECTS ON SSC SAFETY FUNCTION	COMPONENT SAFETY CLASSIFICATION JUSTIFICATION	COMPONENT SAFETY CLASS
Cover Blocks On Pump Pit 241-AY-02E and Pump Pit 241-AY-02A including shield plugs (Tank AY-102) H2-818560, Rev. 3	Contain spray stream from a breach in the sluice line or slurry return line. Limit release of aerosols to environment Limit shine or skyshine dose to onsite receptor	Crack in cover block Note that these are passive components not prone to failure.	Large cracks or holes in a cover block could allow radioactive aerosols or sprays to be released to the environment.	Potential effects of component failure: Unmitigated spray leak in a transfer pit could result in radiological doses above onsite and offsite risk guidelines. Critical functional requirements: Confine spray leaks to the interior of the pit. Limit release of aerosols to the environment. Component failure detection: Component could fail without detection of failure other than routine surveillance. Quality assurance criteria: An administrative control will require inspection of the pits to ensure pit covers are in place and intact prior to any transfer or sluicing operation. This inspection will include verification that all shield plugs are in place.	SC
Cover Blocks On Sluice Pit 241-C-06C and Pump Pit 241-C-06A including shield plugs (Tank C-106) H2-818559, Rev. 1	Contain spray stream from a breach in the sluice line or slurry return line. Limit release of aerosols to environment Limit shine or skyshine dose to onsite receptor	Crack in cover block Note that these are passive components not prone to failure.	Large cracks or holes in a cover block could allow radioactive aerosols or sprays to be released to the environment.	Potential effects of component failure: Unmitigated spray leak in a transfer pit could result in radiological doses above onsite and offsite risk guidelines. Critical functional requirements: Confine spray leaks to the interior of the pit. Limit release of aerosols to the environment. Component failure detection: Component could fail without detection of failure other than routine surveillance. Quality assurance criteria: An administrative control will require inspection of the pits to ensure pit covers are in place and intact prior to any transfer or sluicing operation. This inspection will include verification that all shield plugs are in place.	SC

APPENDIX A: FAILURE MODES AND EFFECTS ANALYSIS (FMEA)

Pit Cover Plate For Heel Pit 241-C-06B (Tank C-106) H2-818559, Sht. 3, Rev. 1	Confine existing contamination within the pit structure Provide radiation shielding for nearby workers	Structural or seal failure Note that this is a passive component not prone to failure.	Failure of this component would have no effect on the system safety function.	Potential effects of component failure: Failure could result in minor local contamination. Critical functional requirements: None - Waste transfer through pit 06B is not possible with the current configuration. All transfer lines routed to this pit are isolated, and will remain so for the duration of sluicing operations in tank C-106. Component failure detection: Component could fail without detection of failure other than routine surveillance. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
Camera Mount For In-Tank Imaging System at top of riser #7 associated with pump pit 241-C-06A (Tank C-106) H2-818559, Sht. 3, Rev. 1	Contain radioactive aerosols released into the tank headspace during sluicing operations	Structural or seal failure Note that this is a passive component not prone to failure.	Failure of this component would have no effect on the system safety function.	Potential effects of component failure: Failure could result in minor local contamination. Critical functional requirements: None - There are no transfer lines within the camera penetration and the sluice stream is physically prevented from reaching the lower end of the camera penetration. In addition, the tank headspace pressure will be below atmospheric during sluicing operations so that any air leakage would be directed into the tank. Component failure detection: Component could fail without detection of failure other than routine surveillance. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS

SSC	Accident(s)	Safety Functions	Functional Requirements	Performance Criteria	Planned Modifications Involving This SSC
Seismic Shutdown Systems for tanks AY-102 and C-106	BIO Add. 1: SC-Subsurface Leak Resulting in a Pool, Section 3.4.2.14; Surface Leak Resulting in a Pool, Section 3.4.2.15; Spray Leak from Structure, Section 3.4.2.16 BIO Add. 1: SS - Subsurface Leak Staying Subsurface, Section 3.4.2.13	Detect seismic event and shut down sluice and slurry pumps to limit any releases from a failed transfer line	Open magnetic contactor to shut down transfer pumps at 0.12 g horizontal acceleration or 0.08 g vertical acceleration.	Shall be verified operable prior to WRSS operations Note that failure of the seismic detection system would not, in itself, initiate an accident. Critical Characteristics: Must detect ground motion along three axes and must activate an alarm and an interlock to shut down transfer pumps upon detecting a seismic ground motion in excess of 0.12 g horizontal acceleration or 0.08 g vertical acceleration.	Install four seismic switch instruments. Two redundant switches at tank AY-102 and two redundant switches at tank C-106.

THE ITEMS BELOW ARE THE UNIQUE COMPONENTS THAT MAKE UP THIS SSC

COMPONENT IDENTIFICATION	COMPONENT FUNCTION	COMPONENT FAILURE MODE	COMPONENT FAILURE EFFECTS ON SSC SAFETY FUNCTION	COMPONENT SAFETY CLASSIFICATION JUSTIFICATION	COMPONENT SAFETY CLASS
Seismic detection units (0621 and 0622) for tank AY-102 systems in enclosures 241-AY-51A and -51B, H2-818560, Sht. 4, Rev. 3	Measure triaxial acceleration and trip (de-energize) magnetic contactor when any level exceeds setpoint (0.12 g horiz. and 0.08 g vert.)	Spurious trip	A spurious trip would shut down sluice transfer pumps at tank AY-102. Safety function not affected.	Potential effects of component failure: Possible releases from breached sluice transfer line which could lead to onsite and offsite doses in excess of limits. Critical functional requirements: Trip (de-energize) magnetic contactor in the event of seismic acceleration exceeding setpoints. Component failure detection: Spurious trip would be indicated by alarm AAH-0621/0622 at operator station on electrical equipment skid 241-AY-51. Failure to function in a seismic event would be detected by, and could be overridden by operator using HS-06211A. Quality assurance criteria: The seismic shutdown system was procured and qualified as a safety class system. Safety classification can be maintained by required periodic testing and calibration. *	SC
		Failure to function in seismic event	A failure to function would disable the safety function of affected seismic detection system.		

Magnetic contactor assemblies for tank AY-102 seismic switch systems in enclosures 241-AY-51A and -51B, including high temperature switches, H2-818560, Sht. 4, Rev. 3	Shut down submersible sluice pump (P-0621) and sluice booster pump (P-0622) on trip signal from corresponding seismic detection unit. High current contacts directly cut off power to affected motor controllers.	Spurious trip or high temperature trip	A spurious trip would shut down transfer pumps at tank AY-102. Safety function not affected.	Potential effects of component failure: Possible releases from breached sluice transfer line which could lead to onsite and offsite doses in excess of limits. Failure of high temperature trip could lead to loss of safety function. Critical functional requirements: Shut down AY-102 sluice pumps in the event of seismic acceleration exceeding setpoints. Note that either of the two magnetic contactors will independently shut down the sluice transfer pumps. Component failure detection: Spurious trip would be indicated by alarm AAH-0621/0622 at operator station on electrical equipment skid 241-AY-51. Failure to function in a seismic event could be detected and overridden by operator using HS-06211A. Quality assurance criteria: The seismic shutdown system was procured and qualified as a safety class system. Safety classification can be maintained by required periodic testing and calibration. *	SC
		Failure to function on seismic trip	A failure to function would disable the safety function of affected seismic detection system.		
Seismic system trip alarm at operator station on skid 241-AY-51 (AAH-0621/0622) H2-818560, Sht. 4, Rev. 3	Provide indication of seismic trip	Spurious alarm	A spurious alarm would not affect the system safety function.	Potential effects of component failure: Loss of indication of seismic trip. Critical functional requirements: None - Component has no safety function. Component failure detection: Component could fail with no indication of failure other than routine testing and maintenance. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
		Failure to function on seismic trip	Failure to indicate trip would have no effect on system safety function		
Seismic system power failure alarm and relays for tank AY-102 (JXA-0621/0622, JXY-0621, JXY-0622) H2-818560, Sht. 4, Rev. 3	Provide alarm at operator station on loss of power to either seismic shutdown system	Spurious alarm	A spurious alarm would not affect the system safety function.	Potential effects of component failure: Loss of indication of loss of power in the event of a spurious trip due to loss of power. Critical functional requirements: None - Loss of power indication has no safety function. Component failure detection: Component could fail with no indication of failure other than routine testing and maintenance. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
		Failure to function on loss of power	Failure to function on loss of power would have no effect on safety function since the magnetic contactors would trip (de-energize) on loss of power.		

System enclosure high/low temperature alarm (TAHL-0623/0624, TSHL-0623, TE-0623, TSHL-0624, TE-0624) H2-818560, Sht. 4, Rev. 3	Activate alarm at operator station on high/low ambient temperature in either seismic switch system enclosure (241-AY-51A or 241-AY-51B)	Spurious alarm	A spurious alarm would not affect the system safety function.	Potential effects of component failure: Loss of indication of temperature outside normal range in system enclosures. Loss of indication of an actual high temperature condition could lead to a high-high temperature trip of the effected seismic switch causing automatic shutdown of the sluice pump and sluice booster pump at AY-102. Critical functional requirements: None - The only function of the enclosure temperature alarm is to provide indication which could help avoid a spurious shutdown of the sluice pumps if enclosure temperature control fails. Component failure detection: Component could fail without indication of failure other than routine testing and calibration. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
		Failure to function on high/low temperature condition	A separate safety class high temperature switch in the magnetic contactor assembly protects system against loss of function due to high temperature. Low temperature would have no immediate effect on safety function. No effect on safety function.		
Emergency trip at operator station on electrical skid 241-AY-51 (HS-06211A, YL-06211A) H2-818560, Sht. 4, Rev. 3	Provides emergency over-ride to trip seismic switches from the operator station	Spurious trip	A spurious trip would shut down sluicing pumps at AY-102. System safety function would not be affected.	Potential effects of component failure: Possible delay in shutting down sluice pumps during seismic event below seismic switch setpoints. Seismic switches would still be operable. Critical functional requirements: None - provides manual means of tripping seismic switches from operator station. Sluice pumps could be shut down manually if required. Component failure detection: Component could fail without indication of failure other than routine testing and calibration. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
		Failure to function on demand	Seismic switches would still be operative. System safety function would not be affected.		

Seismic switch enclosure heating/cooling units (AC-0621, TE-0626, TC-0626, AC-0622, TE-0627, TC-0627) H2-818560, Sht. 4, Rev. 3	Maintain seismic switch enclosure temperatures within acceptable limits	Failure to function	A separate safety class high temperature switch in the magnetic contactor assembly protects system against loss of function due to high temperature. Low temperature would have no immediate effect on safety function. No effect on safety function.	Potential effects of component failure: Possible unavailability of seismic switches and delay of sluicing operations. Critical functional requirements: None - Failure may require shutdown or delay of sluicing operations. Component failure detection: Enclosure high/low temperature condition would be indicated by alarm TAHL-0623/0624 at operator station. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
Seismic detection units (1361 and 1362) for tank C-106 systems in enclosures 241-C-51A and -51B, H2-818559, Sht. 1, Rev. 3	Measure triaxial acceleration and trip (de-energize) magnetic contactor when any level exceeds setpoint (0.12 g horiz. and 0.08 g vert.)	Spurious trip	A spurious trip would shut down slurry transfer pumps at tank C-106. Safety function not affected.	Potential effects of component failure: Possible releases from breached slurry transfer line which could lead to onsite and offsite doses in excess of limits. Critical functional requirements: Trip (de-energize) magnetic contactor in the event of seismic acceleration exceeding setpoints. Component failure detection: Spurious trip would be indicated by alarm AAH-1361A/1362A at operator station in MO-211. Failure to function in a seismic event would be detected by, and could be overridden by operator using HS-13650A. Quality assurance criteria: The seismic shutdown system was procured and qualified as a safety class system. Safety classification can be maintained by required periodic testing and calibration. *	SC
		Failure to function in seismic event	A failure to function would disable the safety function of affected seismic detection system.		

Magnetic contactor assemblies for tank C-106 seismic switch systems in enclosures 241-C-51A and -51B, including high temperature switches, H2-818559, Sht. 1, Rev. 3	Shut down submersible slurry pump (P-1361) and slurry booster pump (P-1362) on trip signal from corresponding seismic detection unit. High current contacts directly cut off power to affected motor controllers.	Spurious trip or high temperature trip	A spurious trip would shut down transfer pumps at tank C-102. Safety function not affected.	Potential effects of component failure: Possible releases from breached slurry transfer line which could lead to onsite and offsite doses in excess of limits. Failure of high temperature trip could lead to loss of safety function. Critical functional requirements: Shut down C-106 slurry pumps in the event of seismic acceleration exceeding setpoints. Note that either of the two magnetic contactors will independently shut down the slurry transfer pumps. Component failure detection: Spurious trip would be indicated by alarm AAH-1361A/1362A at operator station in MO-211. Failure to function in a seismic event could be detected and overridden by operator using HS-13650A. Quality assurance criteria: The seismic shutdown system was procured and qualified as a safety class system. Safety classification can be maintained by required periodic testing and calibration. *	SC
		Failure to function on seismic trip	A failure to function would disable the safety function of affected seismic detection system.		
Seismic system trip alarm at operator station in MO-211 (AAH-1361A/1362A) H2-818559, Sht. 1, Rev. 3	Provide indication of seismic trip	Spurious alarm	A spurious alarm would not affect the system safety function.	Potential effects of component failure: Loss of indication of seismic trip. Critical functional requirements: None - Component has no safety function. Component failure detection: Component could fail with no indication of failure other than routine testing and maintenance. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
		Failure to function on seismic trip	Failure to indicate trip would have no effect on system safety function		
Seismic system power failure alarm and relays for tank C-106 (JXA-1361/1362, JXY-1361, JXY-1362) H2-818559, Sht. 1, Rev. 3	Provide alarm at operator station on loss of power to either seismic shutdown system	Spurious alarm	A spurious alarm would not affect the system safety function.	Potential effects of component failure: Loss of indication of loss of power in the event of a spurious trip due to loss of power. Critical functional requirements: None - Loss of power indication has no safety function. Component failure detection: Component could fail with no indication of failure other than routine testing and maintenance. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
		Failure to function on loss of power	Failure to function on loss of power would have no effect on safety function since the magnetic contactors would trip (de-energize) on loss of power.		

System enclosure high/low temperature alarm (TAHL-1361/1362, TSHL-1361, TE-1361, TSHL-1362, TE-1362) H2-818559, Sht. 1, Rev. 3	Activate alarm at operator station on high/low ambient temperature in either seismic switch system enclosure (241-C-51A or 241-C-51B)	Spurious alarm	A spurious alarm would not affect the system safety function.	Potential effects of component failure: Loss of indication of temperature outside normal range in system enclosures. Loss of indication of an actual high temperature condition could lead to a high-high temperature trip of the effected seismic switch causing automatic shutdown of the slurry pump and slurry booster pump at C-106. Critical functional requirements: None - The only function of the enclosure temperature alarm is to provide indication which could help avoid a spurious shutdown of the sluice pumps if enclosure temperature control fails. Component failure detection: Component could fail without indication of failure other than routine testing and calibration. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
		Failure to function on high/low temperature condition	A separate safety class high temperature switch in the magnetic contactor assembly protects system against loss of function due to high temperature. Low temperature would have no immediate effect on safety function. No effect on safety function.		
Emergency trip at operator station in MO-211 (HS-13650A, YL-13650A) H2-818559, Sht. 1, Rev. 3	Provides emergency over-ride to trip seismic switches from the operator station	Spurious trip	A spurious trip would shut down sluicing pumps at C-106. System safety function would not be affected	Potential effects of component failure: Possible delay in shutting down slurry pumps during seismic event below seismic switch setpoints. Seismic switches would still be operable. Critical functional requirements: None - provides manual means of tripping seismic switches from operator station. Sluice pumps could be shut down manually if required. Component failure detection: Component could fail without indication of failure other than routine testing and calibration. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
		Failure to function on demand	Seismic switches would still be operative. System safety function would not be affected.		

Seismic switch enclosure heating/cooling units (AC-1361, TE-13632, TC-13632, AC-1362, TE-13633, TC-13633) H2-818559, Sht. 1, Rev. 3	Maintain seismic switch enclosure temperatures within acceptable limits	Failure to function	A separate safety class high temperature switch in the magnetic contactor assembly protects system against loss of function due to high temperature. Low temperature would have no immediate effect on safety function. No effect on safety function.	Potential effects of component failure: Possible unavailability of seismic switches and delay of sluicing operations. Critical functional requirements: None - Failure may require shutdown or delay of sluicing operations. Component failure detection: Enclosure high/low temperature condition would be indicated by alarm TAHL-1361/1362 at operator station. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS

SSC	Accident(s)	Safety Functions	Functional Requirements	Performance Criteria	Planned Modifications Involving This SSC
Backflow Preventers H2-818510 Sht. 1, Rev. 0 as modified by ECN W320-696	BIO Add. 1: SS - Surface Leak Causing a Pool Section 3.4.2.15 Spray leak from structure Section 3.4.2.16	Prevent backflow of waste into water supply	Prevent contamination of service water supply system (e.g., tanker truck)	Perform functional test to verify operability of backflow preventers. **Critical Characteristics:** Must prevent backflow of liquid from slurry or supernatant transfer lines during transfer line flushing with sanitary water. Must provide means for independent in-place testing of integrity of each check valve at 400 PSIG (DB-001).	Project W-320 will build a flushing adapter jumper which will include backflow prevention features.
THE ITEMS BELOW ARE THE UNIQUE COMPONENTS THAT MAKE UP THIS SSC					
COMPONENT IDENTIFICATION	COMPONENT FUNCTION	COMPONENT FAILURE MODE	COMPONENT FAILURE EFFECTS ON SSC SAFETY FUNCTION	COMPONENT SAFETY CLASSIFICATION JUSTIFICATION	COMPONENT SAFETY CLASS
2-Inch 316 SST Ball-Cone Check Valves (2) H2-818510 Sht. 1, Rev. 0 as modified by ECN W320-696	Prevent contamination of above grade flush hoses/piping and tank truck systems.	Failure of check valve function so as to permit leakage from transfer line into service water system	Contaminated waste could potentially leak into the above grade tank truck and/or flush piping.	Potential effects of component failure: Contamination of service water system. This could only occur if the transfer line were to be inadvertently pressurized while the flush system is lined up for operation. Note that failure of both check valves would not, by itself, cause an accident. Critical functional requirements: Prevent backflow of waste into service water system. Component failure detection: These components could fail without indication of failure other than routine testing. Quality assurance criteria: The backflow preventers were designed, procured, and fabricated to meet all requirements for safety significant components. Each check valve will be independently tested at 5 psig and 400 psig. *	SS

SSC	Accident(s)	Safety Functions	Functional Requirements	Performance Criteria	Planned Modifications Involving This SSC
Primary Tank Level Detection Systems In Tanks C-106 and AY-102	BIO: SS - Tank Bump, Section 5.3.2.22 BIO Add. 1: SS -Subsurface Leak Staying Subsurface, Section 3.4.2.13; Subsurface Leak Resulting in a Pool, Section 3.4.2.14; Surface Leak Resulting in a Pool, Section 3.4.2.15	BIO: Monitor tank waste level to support implementing tank temperature controls BIO ADD 1: Provide tank level indication to support material balance calculations between slurry transfers	BIO: Provide readout of tank level and high/low level alarm function at TMACS BIO ADD 1: Provide level readouts within a specified tolerance locally and at the MO-211 operator station	Shall be verified operable prior to WRSS operations. For Subsurface Leak and Subsurface Leak/Pool (SS), Critical Characteristics: Must provide tank waste level measurements to an accuracy of ± 0.5 inches (RD-057). Must provide measurements during WRSS operation, prior to transfers to or from the tanks, and following each sluicing batch. For Surface Leak/Pool (SS), Critical Characteristics: Must provide tank waste level measurements to an accuracy of ± 0.5 inches (RD-057). Must provide measurements during WRSS operation, prior to transfers to or from the tanks, and following each sluicing batch. Must also provide level measurements during normal, non-WRSS operation at 24-hour intervals to detect a service water intrusion. For Tank Bump (SS), Critical Characteristics: Must provide tank waste level measurements above 15 ft to an accuracy of ± 2 inches, and transmit data to local or remote readout, to support implementation of tank temperature controls (RD-057).	ENRAF Installation at tank AY-102. Signal Output Modifications at tank C-106: TMACS Switch & Digital Output Signal

THE ITEMS BELOW ARE THE UNIQUE COMPONENTS THAT MAKE UP THIS SSC					
COMPONENT IDENTIFICATION	COMPONENT FUNCTION	COMPONENT FAILURE MODE	COMPONENT FAILURE EFFECTS ON SSC SAFETY FUNCTION	COMPONENT SAFETY CLASSIFICATION JUSTIFICATION	COMPONENT SAFETY CLASS
ENRAF Liquid Level Instrument At Tank AY-102 (WST-LIT-602A) H2-818560, Sht. 5, Rev. 0	Provides continuous detection and local indication of tank liquid level	Fails open (no signal) or gives erroneous reading (high or low)	Level instrument failure would cause a loss of information on tank liquid level which is one of several indicators of a tank leak or service water intrusion into the tank	Potential effects of component failure: Possible tank overflow and pit overflow. Erroneous information could mask material imbalance resulting from leakage or misroutes during a sludge transfer. Any of these conditions could lead to an environmental release exceeding onsite risk criteria. Note that failure of the level instrument does not, in itself, initiate an accident. Critical functional requirements: Provide tank level information in support of periodic material balance calculations during waste transfers, and detection of misroutes or leakage. The only safety function of the level indicator is periodic monitoring to detect water inleakage from the service water system and for periodic mass balance calculations. Component failure detection: Component could fail without indication of failure other than periodic maintenance and calibration. Failure would almost certainly be detected when the instrument status is checked and a local reading taken (required at least once every 24 hours). Quality assurance criteria: The ENRAF instruments were procured as, and meet all requirements for, safety significant components. Component safety classification can be maintained by required routine checks. A failed component can be readily repaired or replaced. *	SS
Level Indicating Transmitter At Tank AY-102 (WST-LIT-602A) H2-818560, Sht. 5, Rev. 0	Provides remote indication of tank level	Fails open (no signal)	Loss of remote indication and alarms at TMACS No effect on safety function	Potential effects of component failure: Loss of remote tank level indication. Critical functional requirements: None - System safety function is fulfilled by periodic reading of local indication at the ENRAF instrument. Component failure detection: Loss of signal would trip high/low level alarm at TMACS. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS

AY-102 Tank Level Alarm At TMACS	Provides remote high/low level alarm on AY-102 tank liquid level	Fails open (no alarm function)	Loss of alarm function No effect on safety function	Potential effects of component failure: Partial loss of indication of change in tank level. Critical functional requirements: None - System safety function is fulfilled by periodic reading of local indication at the ENRAF instrument. Component failure detection: Component could fail without indication of failure other than periodic maintenance and calibration. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
		Spurious alarm	No effect on safety function		
Remote AY-102 Liquid Level Indication At Operator Stations In MO-211 and 241-AY-51 Equipment Skid, Including Related Signal Communication and Recording Components H2-818560, Sht. 5, Rev. 0	Provides tank AY-102 liquid level digital indication at the operator stations as part of the information needed to balance sluice and slurry line transfer rates during sluicing operations	Fails open (no signal)	Failure of the AY-102 liquid level indication at either of the operator stations would have no effect on the system safety function. Operators at C-106 and AY-102 are required to be in continuous communication during sluicing operations.	Potential effects of component failure: Partial loss of operational information needed to balance sluice and slurry flow rates during sluicing operations. Critical functional requirements: None - These components have no safety function. If necessary, a technician could be stationed at the local indicator at the ENRAF instrument to report levels to the operators, or alternatively, the sluicing operation could be secured. Component failure detection: Loss of indication would be apparent to operators. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
AY-102 ENRAF Level Gauge Electrical Stand	Provides physical support for electrical junction boxes, terminal boxes and conduit runs associated the nearby ENRAF level gauge	Fails open (loss of local electrical power and/or signal)	Loss of remote tank level indication and alarms No effect on safety function.	Potential effects of component failure: Structural failure of this stand may interrupt the signal or power. Critical functional requirements: None - If a slurry transfer was in progress and the problem could not be corrected by end of shift, when a mass balance calculation is required, the transfer would be halted. Component failure detection: In the event of support failure which caused the level detector to become inoperative because of loss of power or interruption of outgoing signals, The failure would be detected as a loss of remote indication at TMACS and would trip the high/low level alarm. Quality assurance criteria: Design and construction of the electrical stand structural components to general service requirements is adequate for the accident initiating events listed in the BIO and the BIO Addendum 1. The electrical stand is easily accessible and there would be ample time for repairs.	GS

ENRAF Liquid Level Instrument At Tank C-106 (WST-LIT-1306) H2-818559, Sht. 2, Rev. 1	Provides continuous detection and local indication of tank liquid level	Fails open (no signal) or gives erroneous reading (high or low)	Loss of information on tank level	Potential effects of component failure: Possible tank overflow and pit overflow. Erroneous information could mask material imbalance resulting from leakage or misroutes during a sludge transfer. Any of these conditions could lead to an environmental release exceeding onsite risk criteria. Note that failure of the level instrument does not, in itself, initiate an accident. Critical functional requirements: Provide tank level information in support of periodic material balance calculations during waste transfers, and detection of misroutes or leakage. The only safety function of the level indicator is periodic monitoring to detect water inleakage from the service water system and for periodic mass balance calculations. Component failure detection: Component could fail without indication of failure other than periodic maintenance and calibration. Failure would almost certainly be detected when the instrument status is checked and a local reading taken (required at least once every 24 hours). Quality assurance criteria: The ENRAF instruments were procured as, and meet all requirements for, safety significant components. Component safety classification can be maintained by required routine checks. A failed component can be readily repaired or replaced. *	SS
Level Indicating Transmitter At Tank C-106 (WST-LIT-1306) H2-818559, Sht. 2, Rev. 1	Provides remote indication of tank level	Fails open (no signal)	Loss of remote indication and alarms at TMACS No effect on safety function	Potential effects of component failure: Loss of remote tank level indication. Critical functional requirements: None - System safety function is fulfilled by periodic reading of local indication at the ENRAF instrument. Component failure detection: Loss of signal would trip high/low level alarm at TMACS. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
C-106 Tank Level Alarm At TMACS	Provides remote high/low level alarm on C-106 tank liquid level	Fails open (no alarm function)	Loss of alarm function No effect on safety function	Potential effects of component failure: Partial loss of indication of change in tank level. Critical functional requirements: None - System safety function is fulfilled by periodic reading of local indication at the ENRAF instrument. Component failure detection: Component could fail without indication of failure other than periodic maintenance and calibration. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
		Spurious alarm	No effect on safety function		

Remote C-106 Liquid Level Indication At Operator Station In MO-211 Including Related Signal Communication and Recording Components H2-818559, Sht. 2, Rev. 1	Provides tank C-106 liquid level digital indication at the operator's station as part of the information needed to balance sluice and slurry line transfer rates during sluicing operations.	Fails open (no signal)	Loss of remote tank C-106 liquid level indication at the operator station in MO-211 No effect on system safety function.	Potential effects of component failure: Partial loss of operational information needed to balance sluice and slurry flow rates during sluicing operations. Critical functional requirements: None - These components have no safety function. If necessary, a technician could be stationed at the local indicator at the ENRAF instrument to report levels to the operators, or alternatively, the sluicing operation could be secured. Component failure detection: Loss of indication would be apparent to operators. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS
ENRAF Densitometer System At Tank AY-102 (WST-DIT-602A) H2-818560, Sht. 5, Rev. 0	Provides tank waste density profile indications to support solids settling assessments between transfer batches.	Fails open (no signal)	No effect on safety function.	Potential effects of component failure: Loss of density information could cause a delay in the assessment of the adequacy of settling of the solids transferred to tank AY-102 potentially extending the duration of the monitoring period between sluicing batches. Critical functional requirements: None - No safety function. Component failure detection: Loss of indication (DI-602A) would be apparent to operator. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS

SSC	Accident(s)	Safety Functions	Functional Requirements	Performance Criteria	Planned Modifications Involving This SSC
241-AY Temperature Monitoring System - Multifunction Instrument Tree (MIT)	BIO: SS - Tank Bump, Section 5.3.2.22 BIO Add. 1: - Tank Bump, Section 3.4.2.11	Detect high temperatures in the tank waste as an aid in preventing a tank bump. Provide information on temperatures at various depths in the waste during and following transfers from tank C-106 to allow analysis of thermal conditions in tank AY-102.	Provide local (at tank AY-102) indication of temperatures at thermocouple locations. Transmit temperature readings to TMACS and to the WRSS control station in MO-211.	Verify operability prior to WRSS operations. Critical Characteristics: Temperature display must be accurate within ± 10°F over maximum anticipated operating range (ambient to 215°F). Must detect and display waste temperatures representative of overall tank and a full range of operating conditions, including loss of cooling (RD-057). The following minimum data points would be considered "representative": • To satisfy Authorization Basis requirements, temperature must be measured in at least one location, between 2 and 5 ft from the tank bottom, as well as one location near the top of the waste. • To support process control, tank bottom temperatures in all four quadrants, both near the perimeter of the tank and toward the center, dome space air temperature, and a vertical temperature profile must be measured. Tank bottom temperature may be measured using either the bottom thermocouple of an instrument tree or thermocouples embedded in the tank bottom insulating concrete.	Installation of an MIT instrument tree

THE ITEMS BELOW ARE THE UNIQUE COMPONENTS THAT MAKE UP THIS SSC					
COMPONENT IDENTIFICATION	COMPONENT FUNCTION	COMPONENT FAILURE MODE	COMPONENT FAILURE EFFECTS ON SSC SAFETY FUNCTION	COMPONENT SAFETY CLASSIFICATION JUSTIFICATION	COMPONENT SAFETY CLASS
241-AY-102 Temperature Monitoring System (TE-06230 through 06252, TI-06230 through 06252) H2-818560, Sht. 3, Rev. 3	Detect waste temperatures at thermocouple locations at various elevations in the waste. Provide local indication at 241-AY-801 Bldg.	Probe corrosion Break in wiring	Loss of temperature data from the MIT will not impact the general waste temperature monitoring functions in this tank.	Potential effects of component failure: Ability to perform thermal analysis of the tank waste during and after a slurry transfer could be affected. The purpose of the new MIT instrumentation is to provide process control data to support the thermal analysis conducted between sluicing batches to support the transfer of additional waste solids to tank AY-102. Loss of temperature data could delay an accurate thermal analysis and increase risk of waste temperatures reaching higher than expected values following a slurry transfer. Critical functional requirements: Provide temperature data for thermal analyses. The extensive existing temperature monitoring instrumentation in tank AY-102 meets the safety significant temperature monitoring requirements. Component failure detection: Failure of thermocouple circuits are detected as a loss of signal or out of range reading during routine temperature readings. Quality assurance criteria: The MIT was designed and procured as a safety significant system. Safety classification can be maintained by routine testing (during readings) and calibration activities. *	SS
Remote temperature indication at TMACS and MO-211 control center H2-818560, Sht. 3, Rev. 3	Provide remote indication of waste temperatures for operational purposes during and following WRSS operations.	Fail open (loss of signal)	Loss of remote indication would have no effect on safety function.	Potential effects of component failure: Loss of remote temperature indication. Tank thermocouples are not connected to any alarm functions. Critical functional requirements: None - Required periodic readings taken from local indication meets the safety significant temperature monitoring requirements. Component failure detection: Loss of indication would be apparent to operator at MO-211. Quality assurance criteria: Design and construction of this component to general service requirements is adequate.	GS

* May require spare parts. For spare parts related to safety components and systems, see HNF-2404, "Project W-320 241-C-106 Waste Retrieval Spare Parts List."

Hanford Tanks Initiative Program Review

Hanford
Tanks
Initiative

May 20, 1998

Agenda

- Opening Remarks and Background — Craig West
- EM 30/50 Administration — Craig West & Dennis Brown
- Summary Planned vs. Actual — Bill Root - Program Manager
- Impact of Technical Scope at Hanford — Al Noonan - Characterization Manager
- Impact of Technical Scope to DOE Tanks Complex-Wide — Larry McDaniel - Retrieval Manager
- Administration and Financial Management — John Bloom - Nuclear Safety Licensing
- Stakeholder Interaction — Steve Schaus - Systems Engineering
- Industry Participation — Beth Northrop - Administration and Financial
- Technical and Programmatic Reviews — Dave Nichols - Retrieval Performance, Evaluation Criteria, and Stakeholder Involvement
- Path to Program Completion

Hanford Tanks Initiative - Background

- Proposed by DOE-RL December 10, 1995
- Need confirmed by STCG February 21, 1996
- EM 30/50 support letter March 14, 1996
- Briefings to DOE-HQ: May 16, 1996; August 27, 1996; November 1, 1996
- Pre-project planning April, 1996 through September 30, 1996
- EM 30/50 HTI Review & Recommendations letter November 6, 1996
- Project funded October 1, 1996
- In-situ tank closure removed from scope at request of regulators and stakeholders

Hanford Tanks Initiative - Background

Key Criteria Established By DOE

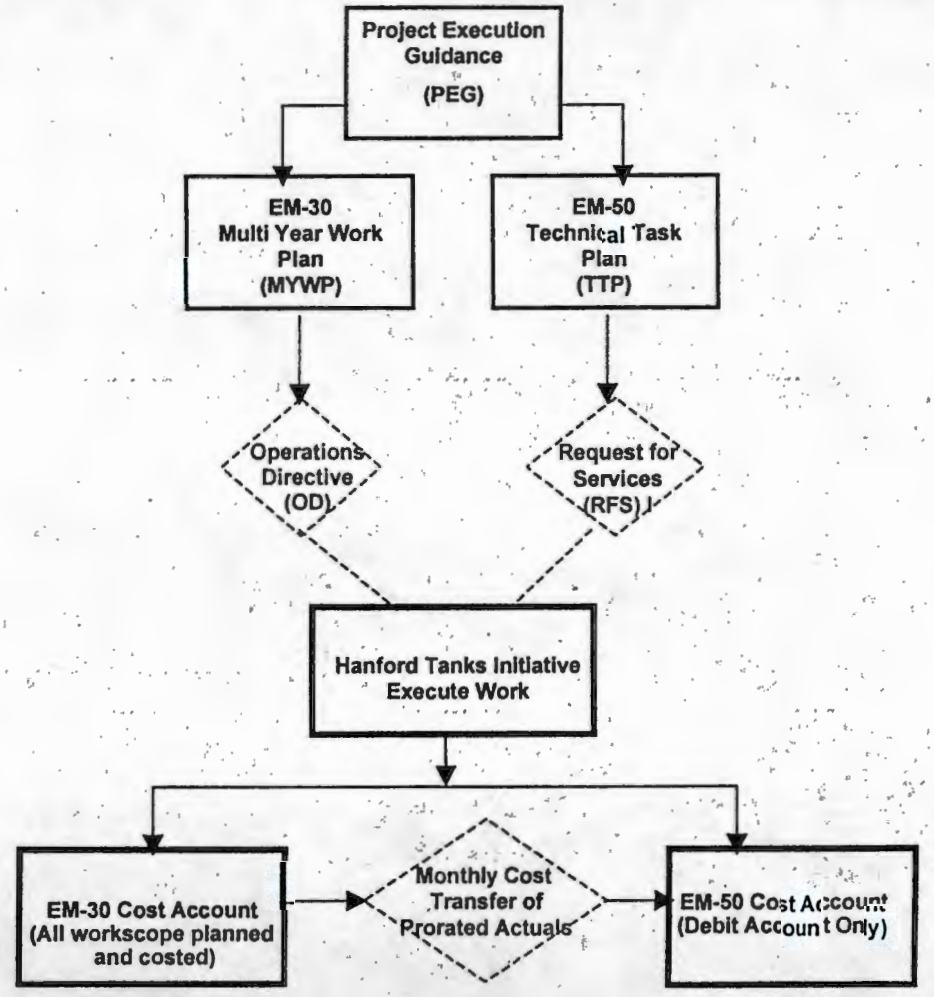
- Retrieval technology for leaking tank and hard heel
- In-situ tank closure demonstration
- Performance assessment and vadose zone modeling for residual waste
- Demonstrate characterization technologies
- Complete project by September 30, 2000
- 50% of OST funding to private industry
- Tribal Nation and stakeholder participation

Hanford Tanks Initiative - Background

- Interfacing program status at HTI inception (10/96)
  - Phase 2 Privatization
    - RFP 2003
    - Award 2004
  - W320
    - Complete Sluicing 3/3/97
  - Vadose Zone Program
    - Limited to spectral-gamma logging of Existing Boreholes
    - Modeling conducted by PNNL
  - Closure Program
    - Closure work plan developed in FY 1997 and incorporated into FY 98 MYWP

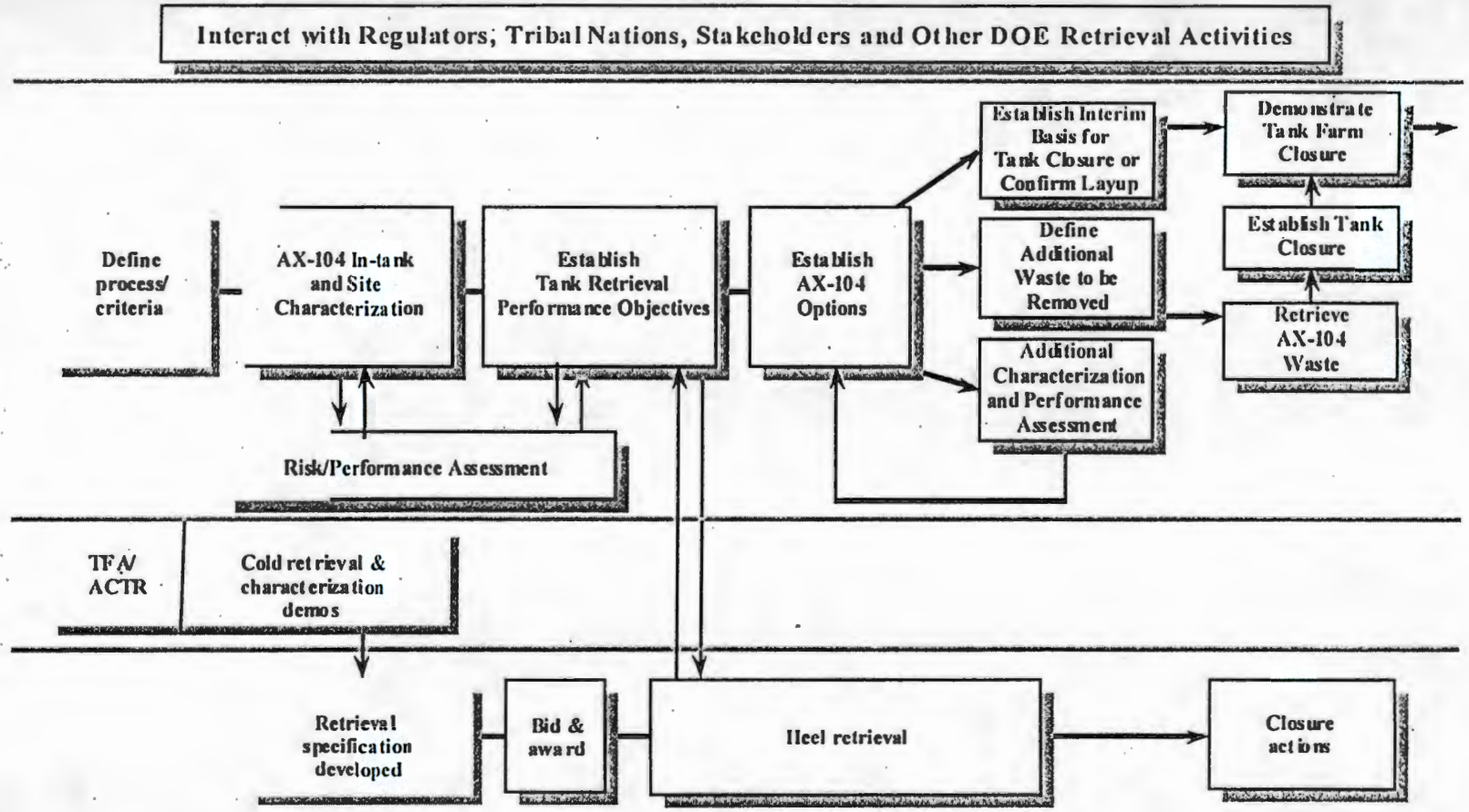
EM 30/50 ADMINISTRATION

EM 30/50 Interface Process



PROGRESS TO DATE

HANFORD TANKS INITIATIVE



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Hanford Tanks Initiative

HTI Summary

- HTI Initiated to Solve Critical Retrieval Issues and Provide a Basis for Closure Evaluation to Proceed
- Supporting and Integrated With Key TWRS Programs
- Initial Approved Plan Being Implemented-No In Tank Characterization System

HTI Summary (Cont'd)

- Intense Collaboration and Integration With Other DOE Sites, Private Industry, National Laboratories, Regulations, Stakeholders, and Tribal Nations
- Defining Approaches and Methodologies for Deploying New Technologies Within TWRS
- Challenges Remain

HTI Schedule/ Status

Cold Demonstration	Proposal November 1, 1996	Status
Initiate ACTR integrated testing	09/96	Completed
Complete RFP and specification	11/26/96	Completed
Complete ACTR integrated testing	01/01/97	Completed
Award four contracts	01/20/97	Completed
Issue GFI package	07/21/97	Completed
Complete demonstrations	08/26/97	Completed

HTI Schedule/ Status

C-106 Hard Heel Retrieval	Proposal November 1, 1996		Status
Complete project design concept	05/30//97		Completed
Complete procurement spec and issue RFP	08/08/97		Completed
Award two "cold" design/demonstration contracts	01/20/98		Completed
Complete site upgrades	11/13/98	-	08/31/00
Complete "cold testing	11/25/98	-	09/22/99
Down select & initiate retrieval (down select to be completed 1/15/99)	05/21/99	-	08/31/00
Complete C-106 retrieval	08/13/99	-	12/28/00
Ready tank for closure	02/03/99	-	05/10/01

HTI Schedule/ Status

AX-104 Residual Waste Volume/Inventory	Proposal November 1, 1996		Status
Deploy Phase I LDUA in AX-104	02/28//97		Cancelled
Complete LUDA Sampling	09/30/97	-	09/30/98
Complete in-tank characterization tools	11/30/97	-	09/30/97
Deploy tracked vehicle sampling	03/01/99		Cancelled
Completed tracked vehicle sampling	11/13/98		Cancelled
Issue in-tank characterization report	09/30/98	-	03/27/99
C-106 Post Retrieval			
Deploy LDUA	01/06/00		Proposed
Analyze retrieval samples and submit residual waste report	06/30/00		Proposed
Post retrieval volume/inventory assessment	06/30/00		Proposed

HTI Schedule/ Status

Closure Schedule	Proposal November 1, 1996		Status
Submit draft final report for SST & footing structural models & analysis results	06/30//97		Completed
Complete transport modeling & risk assessment for draft supplemental EIS for AX farm closure	06/30/97*	-	01/31/99
Publish draft supplemental EIS for AX farm closure	08/30/97*		Deleted
Obtain NRC definition of quantitative basis for classification of residual waste at DOE HLW sites as non-HLW	09/30/97**	-	09/30/98
Submit closure plan for tank 241-AX-104 to Ecology	09/30/99		Deleted
Initiate closure action for tank 241-AX-104	03/01/00		Deleted

*Based on tentative planning schedule for supplemental EIS

**Scope is strategy document for classification of waste as incidental waste

HTI Schedule/ Status

Systems Engineering Schedule	Proposal November 1, 1996		Status
Complete test implementation plans	11/08/96		Completed
Issue test implementation plans to DNFSB	01/07/97		Completed
Complete test and evaluation plans	05/01/98	--	05/31/98

HTI Schedule/Status

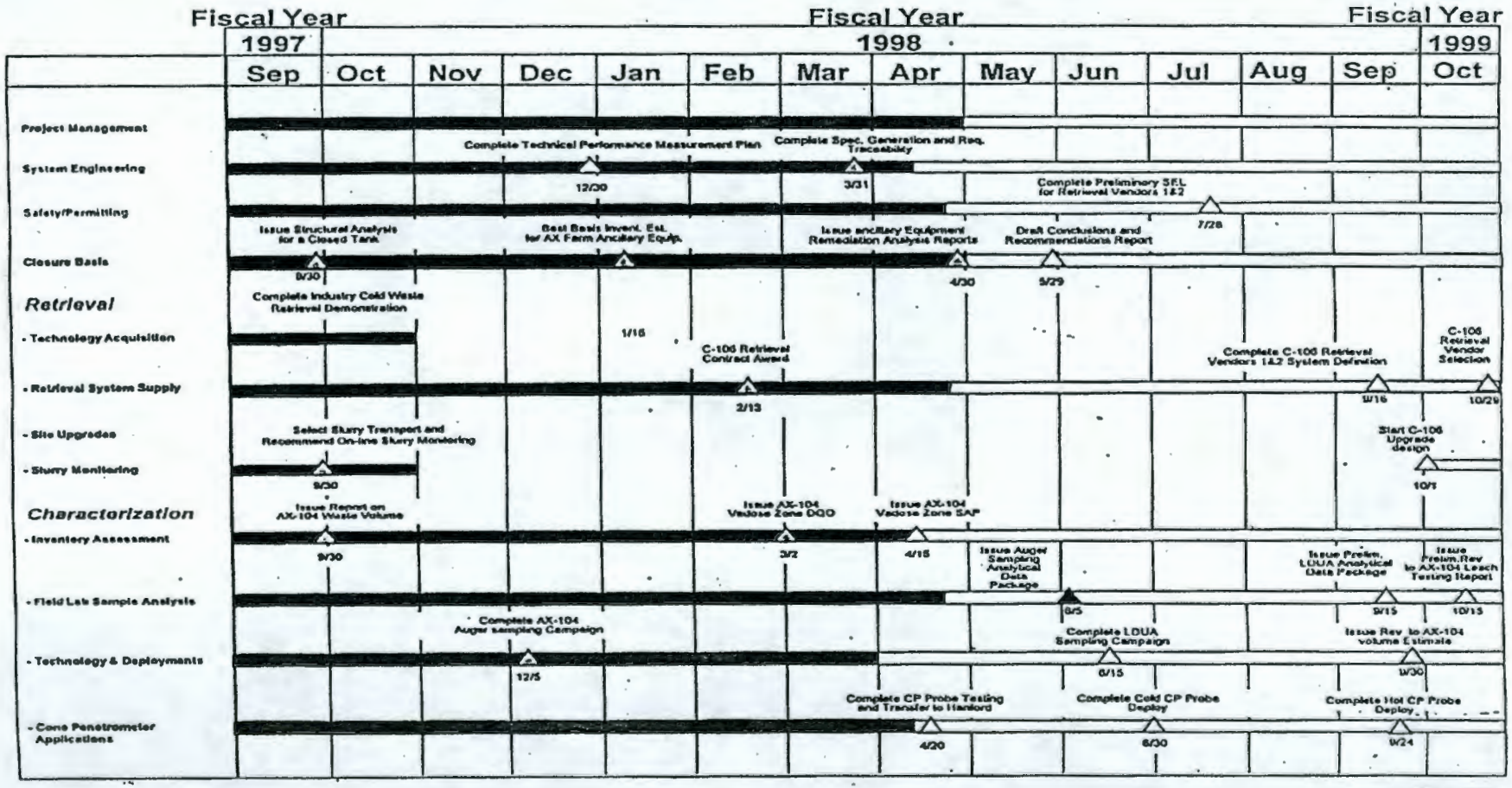
Safety/Permitting Schedule	Proposal November 1, 1996	Status
• Complete permitting plan	03/01/97	Completed
• Complete initial safety controls definition	06/30/97	Completed
• Complete initial unreviewed safety question evaluation	03/31/98	Completed
• Complete air permit plan modification	09/30/98	Completed
• Complete initial accident analysis	03/31/98	TBD*
• Final safety controls definition	03/31/99	TBD*
• Complete AX-104 closure safety analysis		Deleted

*Not required if selected retrieval vendor technology USQ is negative.

Project W-320 Baseline Changes

- As of 9/96
  - Original baseline for retrieval 10/1/96 through 3/3/97
  - Due to safety issues project schedule slipped
- As of 3/97
  - Retrieval 7/30/98 through 6/4/99
- As of 5/98
  - Retrieval 10/1/98 through 7/30/99 or 11/30/99

Hanford Tanks Initiative FY 1997/98 Summary Schedule



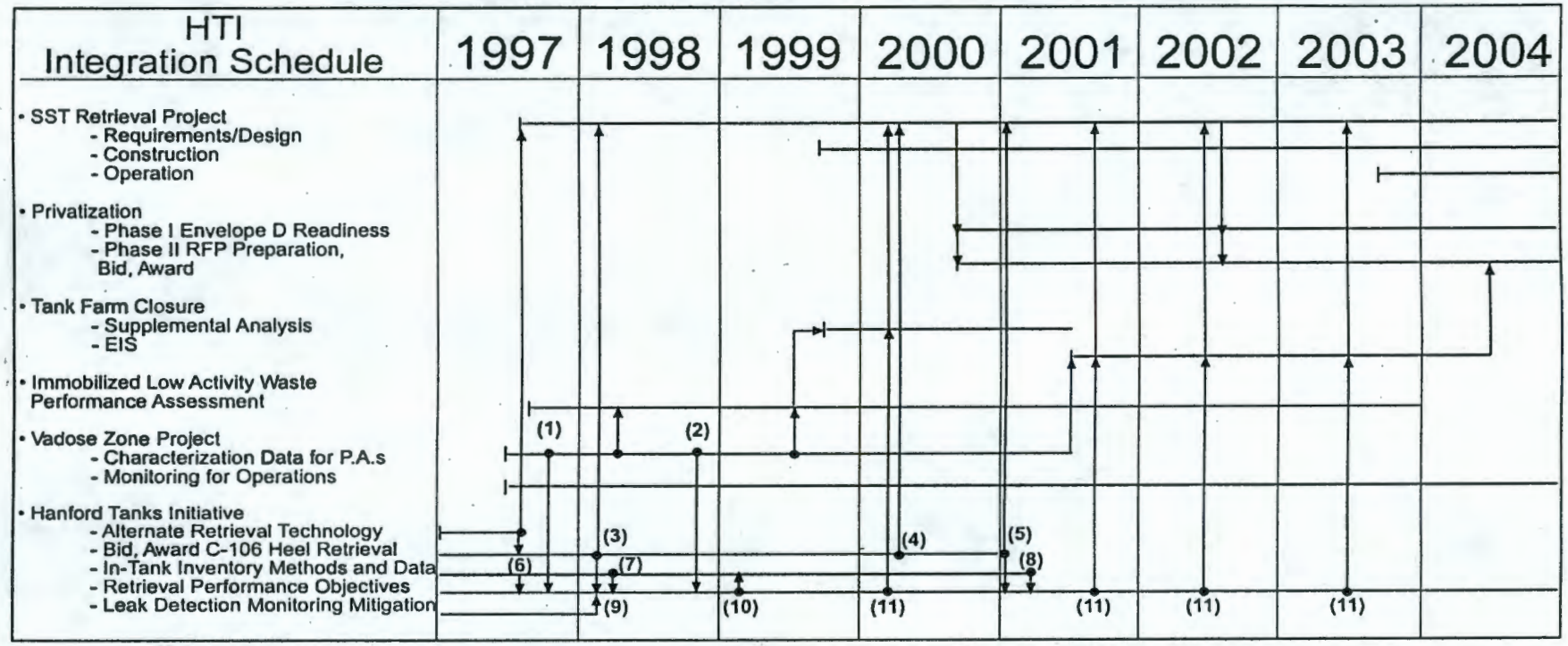
IMPACTS OF TECHNICAL SCOPE AT HANFORD

- Technical Integration
  - The technical analysis is being performed in coordination with other related 200 Area and sitewide analysis of risks to human health and the environment including
    - TWRS programs
      - HTI retrieval technology demonstration projects
      - Leakage loss and leak detection, monitoring, and mitigation programs
      - Vadose zone characterization
      - Tank waste characterization
      - Vitrified low-activity waste disposal

Hanford Tanks Initiative Products

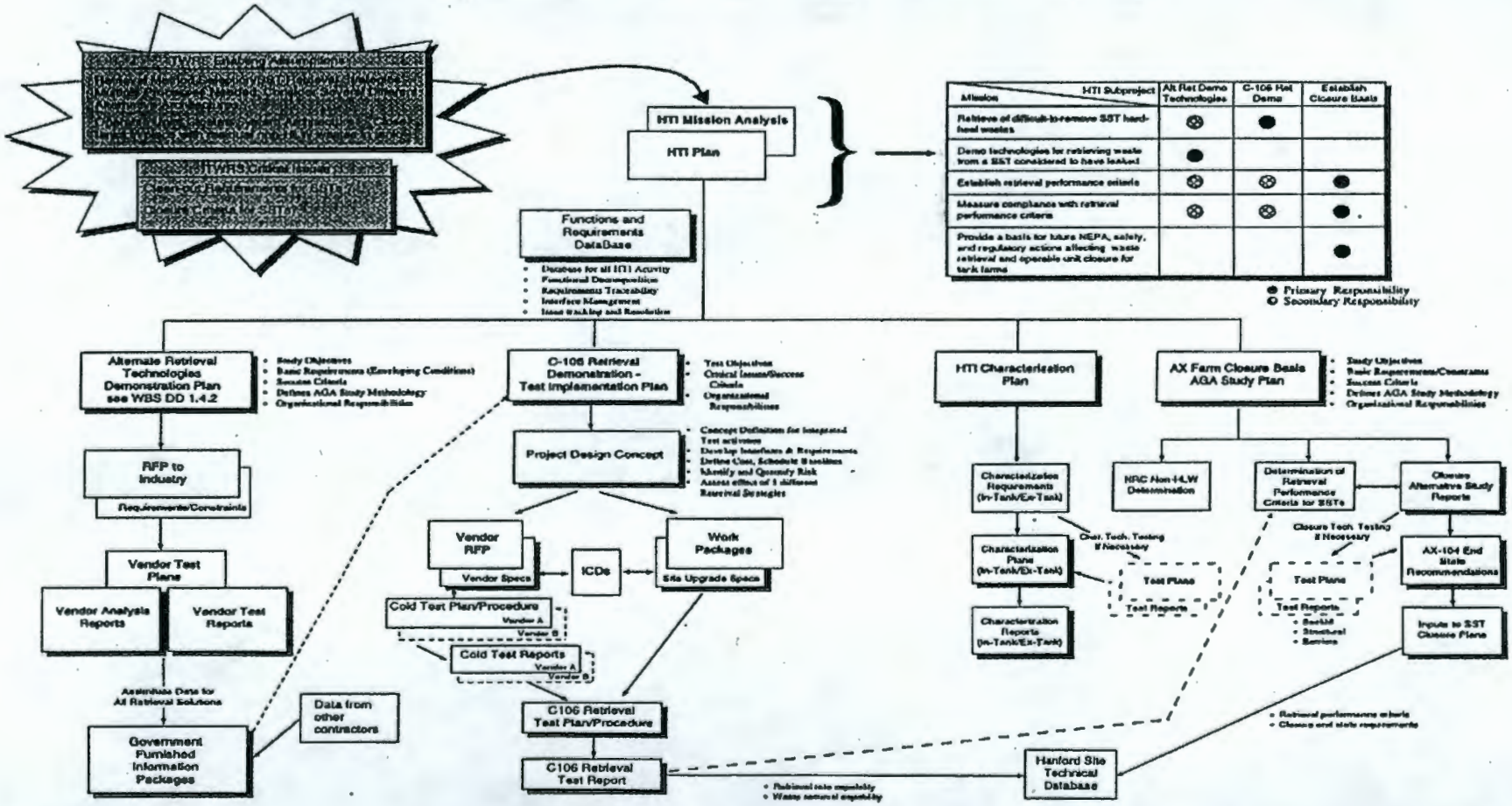
- On critical path for TPA retrieval milestones and SST retrieval program
- On critical path for closure criteria
- On critical path to support Privatization Phase 2
- On critical path for vadose zone screening tools
- On critical path for risk/transport DQO methodology
- On critical path to deploy new characterization tools by using investments to-date

HTI Integration Schedule

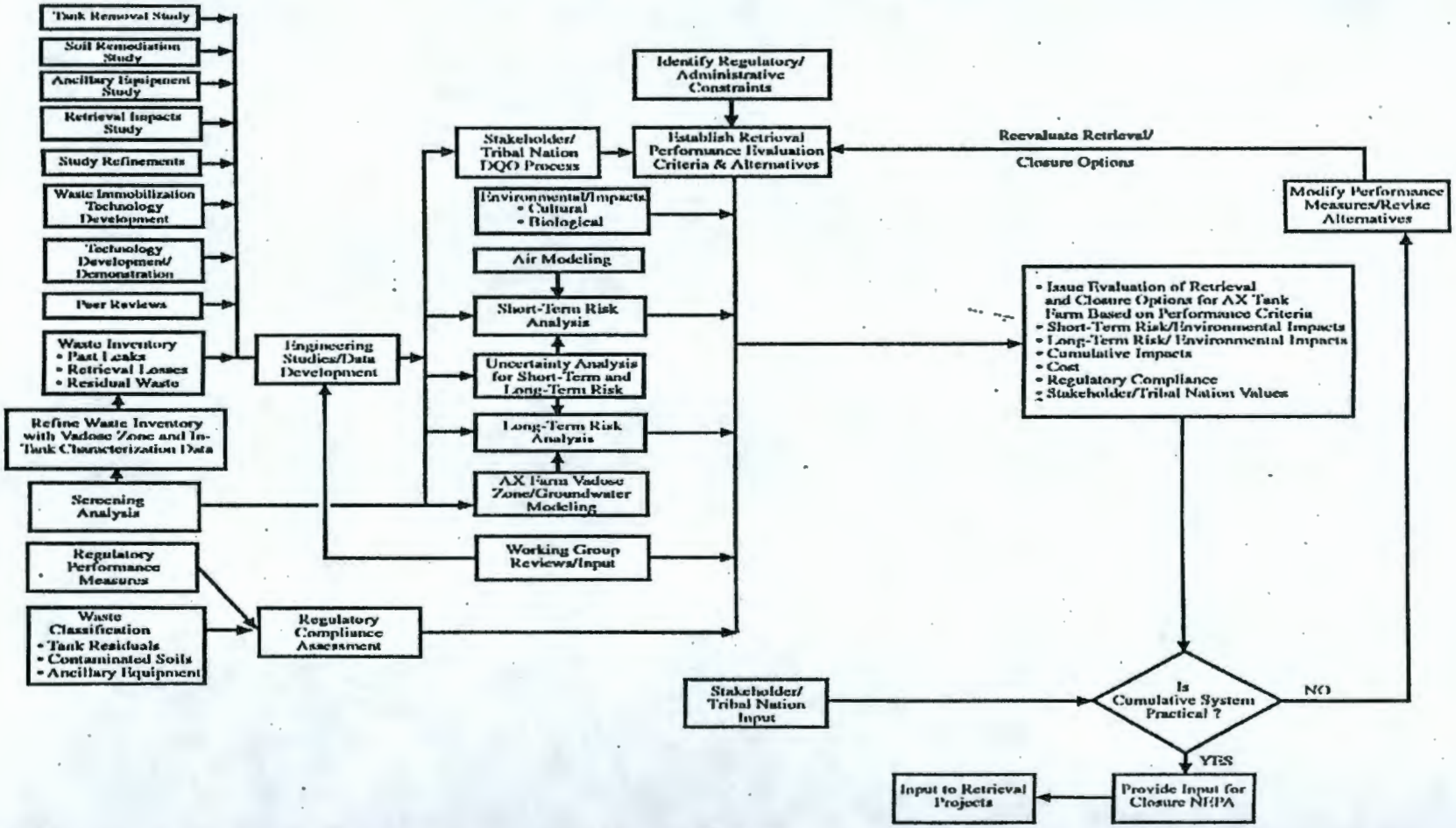


(1) SX Tank Farm Data
(2) AX Tank Farm Data
(3) Award C-106 Retrieval Contract
(4) Complete Infrastructure Construction for C-106 Heel Retrieval
(5) Complete C-106 Heel Retrieval Operation
(6) AX-104 Volume Assessment
(7) AX-104 Constituents Assessment
(8) C-106 Residual Volume Assessment
(9) Risk Assessment on Potential Leak Volume
(10) Retrieval Performance Objective First Report
(11) Annual Update

Implementation Strategy for HTI's Systems Engineering



Hanford Tanks Initiative Closure Basis Strategy



HTI Risk Management

- HTI Risk Management Approach consistent with DOE Order 430.1 (LCAM)
- HTI uses TWRS Risk Management Plan and Procedure; has issued a HTI management guide
- HTI Risk Management List, including Risk Values and Handling Actions
- Risk Handling Plans in Place For High-Risk Items
- HTI Risk List is Routinely Statused

TECHNICAL AND PROGRAMMATIC REVIEWS

HTI - Technical & Programmatic Reviews

- Technical peer reviews of closure basis engineering studies
- TFA midyear reviews (2)
- Characterization peer review (1)
- Retrieval/closure peer review (1)
- Working group review of RPEC activities (3)
- Monthly review with EM 30/50
- EM 30 Assistant Secretary of Energy review (1)

CHARACTERIZATION

Impact of Technical Scope at Hanford

- Characterization Technology: In-Tank and Vadose Zone
  - Client is TWRS retrieval performance Evaluation Criteria and TWR Vadose Zone
  - Performer is HTI and TWRS Characterization Project Operations
  - Driven by DQO Process-Defines Benefits
  - Three Technologies Demonstrated To-Date
  - Authorization Basis and Configuration Control Issues Have Delayed LDUA Deployment

AL NOONAN
Manager, Characterization

RETRIEVAL

Impact of Technical Scope at Hanford

Retrieval technology hard heel/leaking tank

- Client is TWRS retrieval performance evaluation criteria, privatization contractors, private industry
- Performer is HTI and TWRS Operations
- Driven by TPA retrieval requirements - 99% target
- Four cold demonstration completed to-date

Larry McDaniel
Manager, Retrieval

RETRIEVAL PERFOMRANCE EVALUATION CRITERIA

Impact of Technical Scope at Hanford

Retrieval Performance Evaluation Criteria

- Client is a DOE, regulator, Tribal Nation, and stakeholders
- Performer is HTI and Jacobs Engineering
- Driven by Risk/Transport analysis, regulatory requirements, and stakeholder/Tribal Nation values
- Analysis in progress - Need data
- Transport modeling complete - risk modeling complete next week

DAVE NICHOLS
Manager, Retrieval Performance Evaluation Criteria
Jacob Engineering

INTEGRATION WITH OTHER DOE SITES

IMPACT OF HTI TO DOE COMPLEX

Interactions To-Date

- Complex-wide integrated schedule of HTI retrieval, closure, and characterization development activities
- HTI technical teams to ORNL (4), SR (2), ID (1), Fernald/West Valley (1)
- Bi-Monthly HTI Hilites distributed complex-wide
- External peer reviews of HTI programs
- Government-Furnished Information for retrieval vendors

Impact of HTI Technical Scope to DOE Complex

- SR accessed contractors used by HTI for retrieval
- Private company at ORNL lead team that submitted bid & won on HTI's retrieval contract
- Fernald adopted HTI's acquisition strategy
- HTI may demonstrate cone permeameter technology demonstrated at SR
- HTI's multisensor probe will deploy the gamma sensor technology demonstrated at SR
- HTI is collaborating with ORNL on slurry monitoring (TDI)
- National Laboratories' capabilities used to support fixed-price retrieval vendors

ADMINISTRATION & FINANCIAL MANAGEMENT

HTI Process for Decision Making

- Developed HTI decision management process guide and decision logic
- Training on decision making and management was provided to HTI staff (Von Winterfieldt/Eppel)
- Documented decision completion
- Use alternatives generation and analysis (AGAs) as basis for evaluating alternatives associated with major decisions
- Change requests processed using EM 30 procedures
- Change requests requiring DOE approval on effected TTP milestones reviewed & concurred on by EM 30/50

TWRS Management Process (Initial Planning Phase)

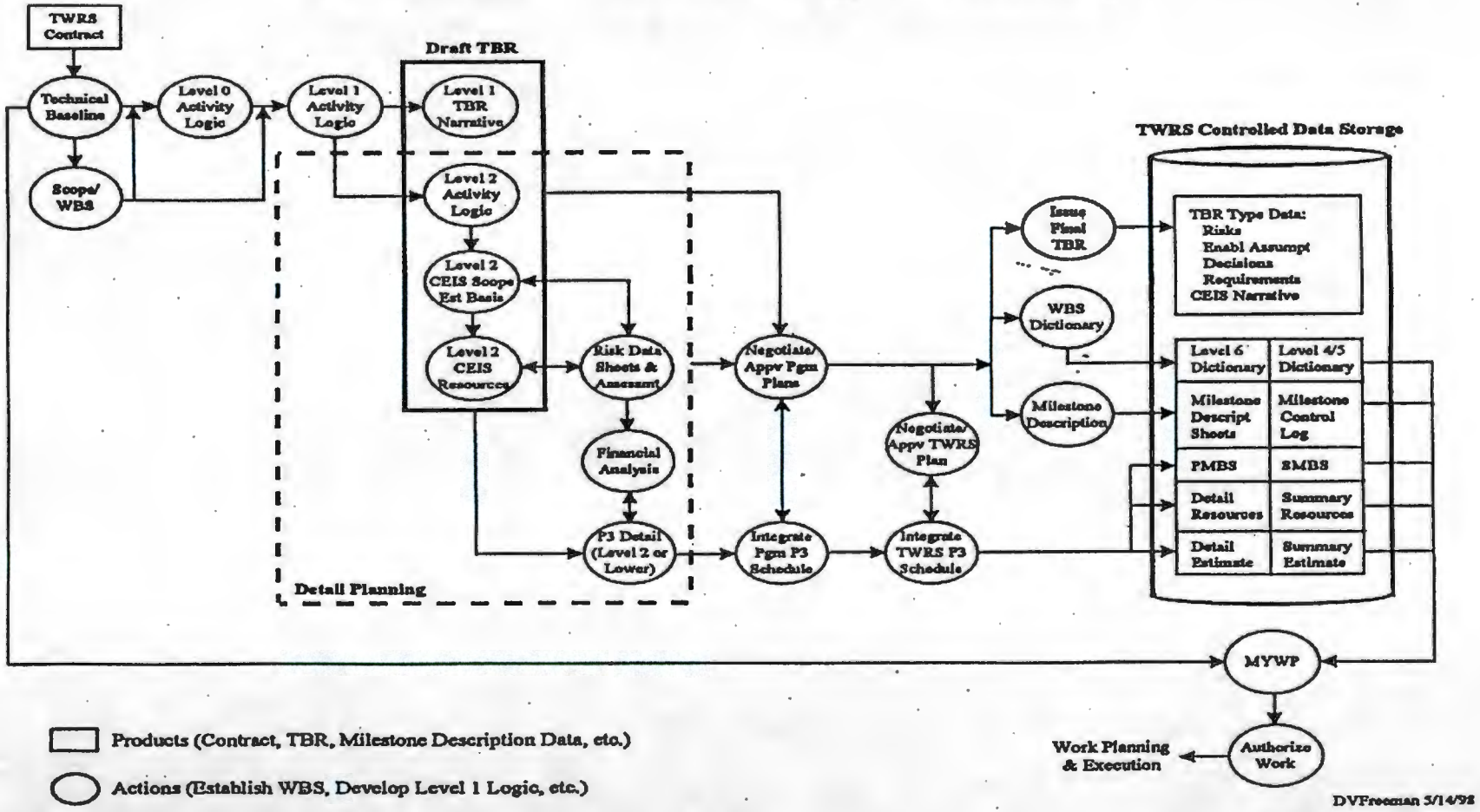
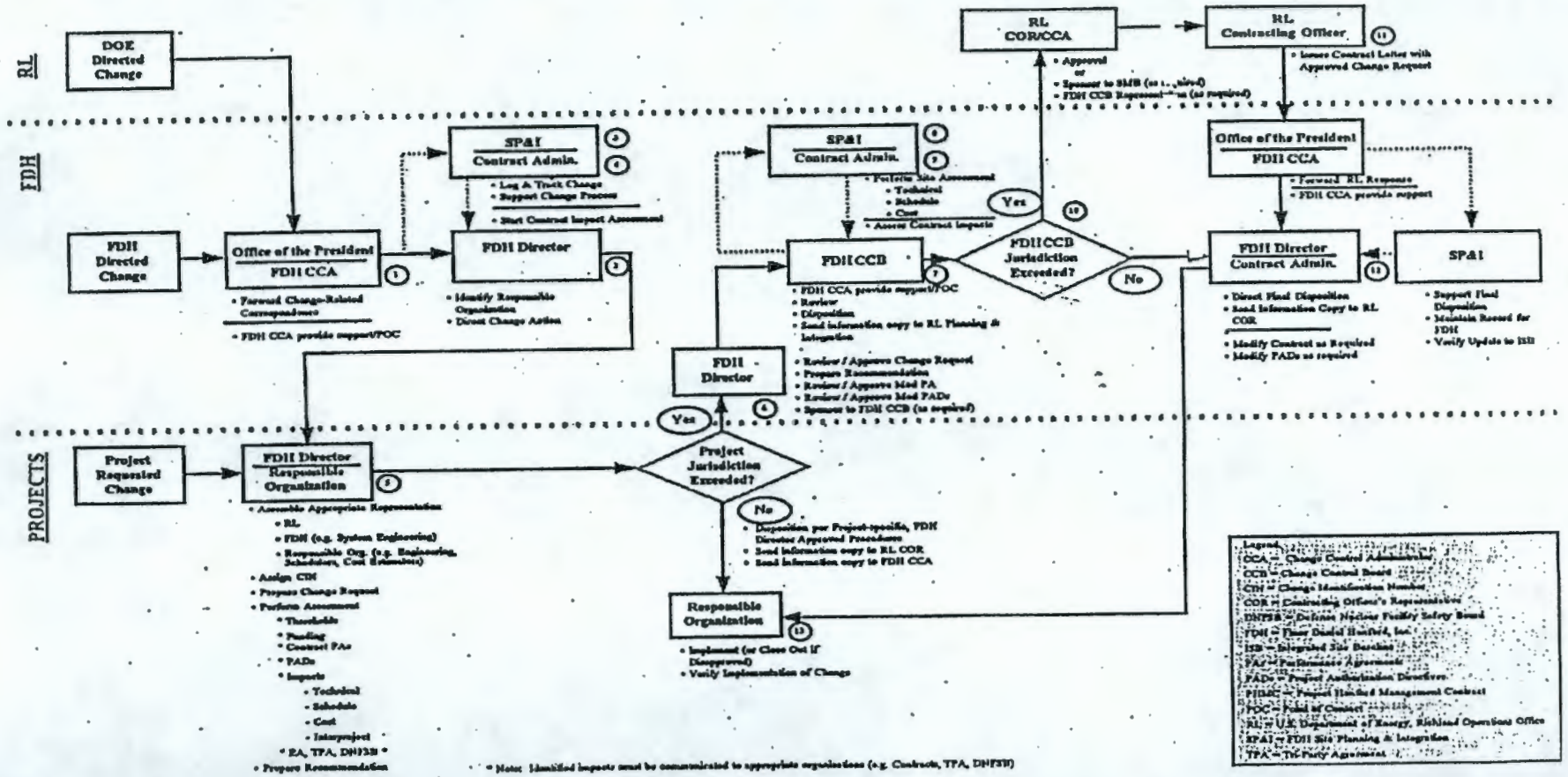
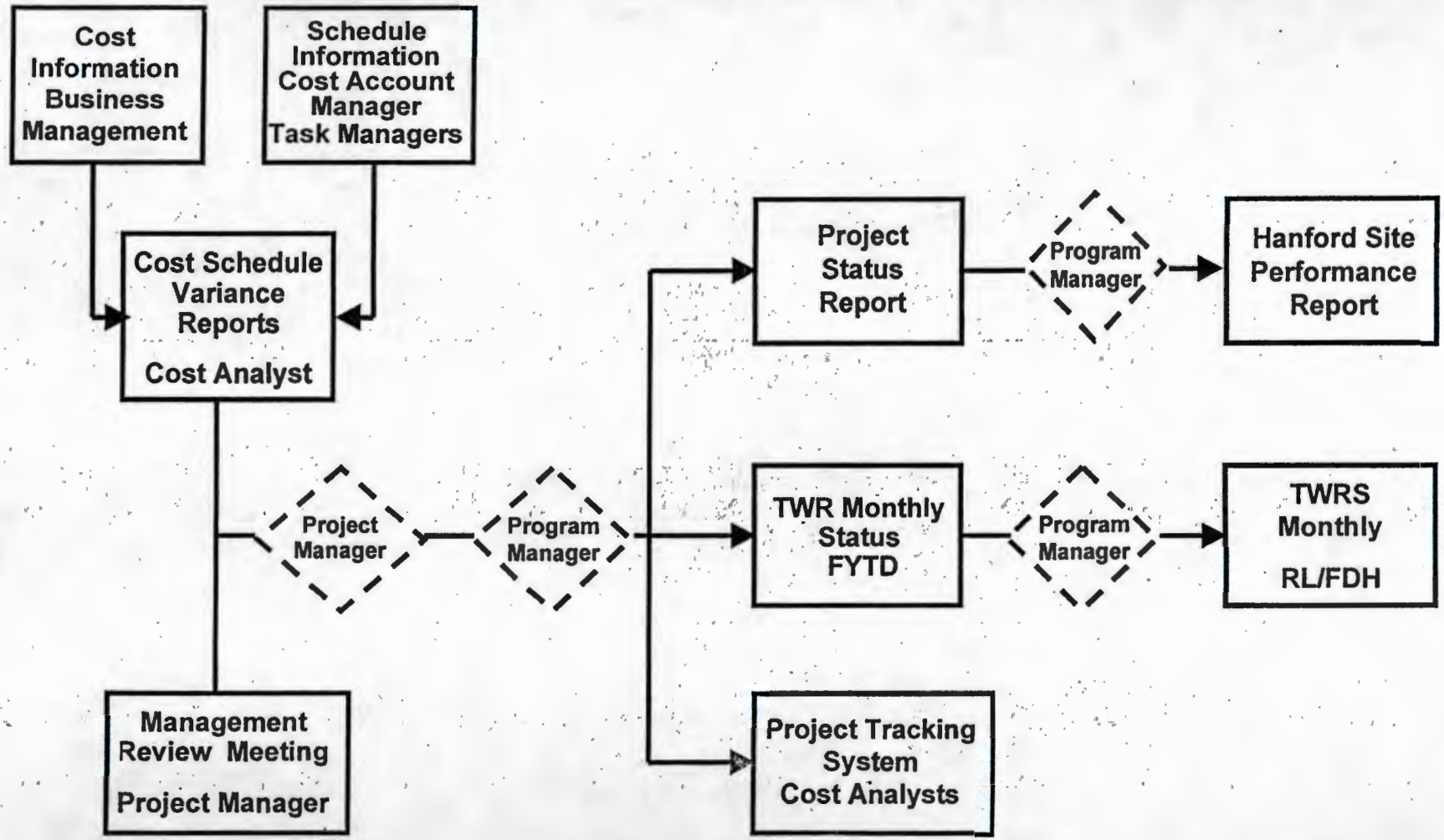


Figure 3-1 Change Control Process Flowchart



Process For Monthly Reports



STAKEHOLDER INTERACTION

Hanford Tanks Initiative Stakeholder Interaction

- Define values, issues, concerns, desired outcomes
- Consultation on criteria results, trade-offs
- Initiated at HTI workshop Spring, 1996
- Review and comment on assumptions, data sufficiency, and models

DAVE NICHOLS

STAKEHOLDER INTERACTION

INDUSTRY PARTICIPATION

Industry Participation

HANFORD TANKS INITIATIVE

	Dollars in Millions			
	FY 1997	FY 1998	FY 1999-2001	Total
Private Industry				
Jacobs Engineering Group	1.0	1.0	0.3	2.3
Parsons Infrastructure & Technology Group	0.4	0.0	0.0	0.4
Retrieval Cold Demos (ESG, Delphinus, ARD, Grey Pilgrim)	2.2	0.0	0.0	2.2
LATA Retrieval System	0.0	1.1	0.0	1.1
Foster-Wheeler Retrieval System	0.0	1.4	0.0	1.4
Retrieval Vendor for C-106	0.0	0.0	9.0	9.0
MacTec	0.1	0.2	0.6	0.9
Applied Research Associates, Inc.	0.1	0.7	0.0	0.8
TRW, Inc.	0.3	0.3	0.6	1.2
Totals	**4.1**	**4.7**	**10.5**	**19.3**
Enterprise Companies				
Fluor Daniel Northwest	1.1	0.7	9.5	11.3
COGEMA Engineering Corp.	1.5	0.8	2.0	4.3
Rust Federal Services	0.1	0.1	0.0	0.2
Lockheed Martin Services	0.1	0.1	0.1	0.3
Totals	**2.8**	**1.7**	**11.6**	**16.1**
National Laboratories				
Sandia National Laboratories	0.0	0.4	0.0	0.4
PNNL	1.2	0.8	1.8	3.8
Totals	**1.2**	**1.2**	**1.8**	**4.2**
EM-50 Total Budget	**6.8**	**7.0**	**20.0**	**33.8**
Percent of Private Industry Participation				**57.1%**

HTI Retrieval Procurement Process

- Demonstrations
  - Technical collaboration with industry
  - Two tracks - vehicle and arm
  - Issue driven
  - 13 proposals, 28 companies, 13 team bids
  - Four awards - scope completed August 1997
- C-106 Deployment
  - Focus on hard heel
  - 99% retrieval target
  - Align national laboratories with private industry
  - Define licensing strategy for private vendors
  - 8 proposals, 42 companies, 6 team bids
  - Retrieval service contracts awarded February 13, 1998
  - Two awards down selected to one vendor January 15, 1999

Larry McDaniel
Manager, Retrieval

RETRIEVAL PROCUREMENT PROCESS

KEY PRODUCTS

Hanford Tanks Initiative Products

- On critical path for TPA retrieval milestones and SST retrieval program
- On critical path for closure criteria
- On critical path to support Privatization Phase 2
- On critical path for vadose zone screening tools
- On critical path for risk/transport DQO methodology
- On critical path to deploy new characterization tools by using investments to-date

PATH TO PROGRAM COMPLETION

HTI Key 1999 Milestones

	Baseline	Status
• Select C-106 Heel Retrieval Vendor	01/15/99	
• Issue Final RPECA Conclusions and Recommendations Report for AX Tank Farm Closure alternatives	01/31/99	
• Issue AX-104 Cone Penetrometer Vadose Zone Analytical Data Package	03/05/99	- 06/30/99
• Complete Preliminary Safety Equipment List for Selected C-106 Retrieval Vendor	04/23/99	
• Complete Site Upgrades Design	06/30/99	

HTI Key 1998 Milestones

	Baseline		Status
• Complete Light-Duty Utility Arm Sampling Campaign in AX-104	06/15/98	-	09/30/98
• Complete Cone Penetrometer Probe Testing and Transfer to Hanford	04/15/98	-	07/31/98
• Complete "Hot" Cone Penetrometer Probe Deployment at AX-104	09/24/98		
• Issue Light-Duty Utility Arm Sampling Analytical Data Package	12/15/98	-	03/31/99
• Define Proposed Approach to Establish Waste Classification for AX Farm Closure	09/30/98		
• Issue Draft RPECA Conclusions & Recommendations Report	06/15/98	-	08/17/98

HTI Key 2000 Milestones

	Present Baseline	Status
• Issue C-106 Heel Characterization Data Package	03/31/00	
• Install C-106 Retrieval System	05/02/00	
• Complete C-106 Upgrades Construction	07/26/00	
• Start C-106 Heel Retrieval	08/23/00	

HTI Key 2001 Milestones

	Present Baseline	Status
• C-106 Retrieval Demonstration Complete	04/02/01	
• Issue C-106 Waste Volume Estimate Report	07/31/01	

Hanford Tanks Initiative Budget

Activity	Actuals	Budget				
	FY 1997	FY 1998*	FY 1999	FY 2000	FY 2001	Total
Project Management, Admin., & Contingency	1,220	1,056	1,109	1,312	867	5,564
System Engineering	463	445	250	256	0	1,414
Closure Basis	2,885	2,352	507	127	0	5,871
Safety/Permitting	131	324	349	160	160	1,124
Retrieval	4,141	4,179	10,807	14,727	2,481	36,335
Deployment & Technology	2,225	4,447	2,057	879	631	10,239
Totals	11,065	12,803	15,079	17,461	4,139	60,547
EM-30 Contribution	4,371	5,636	5,079	7,461	4,139	26,686
EM-50 Contribution	6,694	7,167	10,000	10,000	0	33,861

*Does not include correction of LDUA configuration management issue.

Hanford Tanks Initiative Key Issues

- W-320 Schedule
- Authorization to initiate corrective action to LDUA drawings
- Co-deployment of LDUA and Cone Penetrometer - Resource availability
- Operational Readiness Reviews - New Approach
- Continued Funding

HTI Summary

- HTI Initiated to Solve Critical Retrieval Issues and Provide a Basis for Closure Evaluation to Proceed
- Supporting and Integrated With Key TWRS Programs
- Initial Approved Plan Being Implemented - No In-Tank Characterization System

HTI Summary (Cont'd)

- Intense Collaboration and Integration With Other DOE Sites, Private Industry, National Laboratories, Regulations, Stakeholders, and Tribal Nations
- Defining Approaches and Methodologies for Deploying New Technologies Within TWRS
- Challenges Remain