INTEROFFICE MEMORANDUM

WRPS-1804673.1

Date: February 21, 2019

To: T. G. Goetz

From: M. G. Valentine

Subject: TANK SIDE CESIUM REMOVAL and ION EXCHANGE COLUMN INTERIM STORAGE PAD CONTROL SELECTION MEETINGS

Attached are the results of meetings for the Tank Side Cesium Removal (TSCR) and Cesium Ion Exchange Interim Storage Pad control selection, held October 15-17, 2018 and January 29, 2019. The meetings had the following objectives:

1. Review the record of the Process Hazards Analysis (PrHA) sessions on the 30% design and reach consensus on proposed controls derived during that analysis;
2. Review the record of the Process Hazards Analysis (PrHA) sessions on the 60% design and reach consensus on proposed controls derived during that analysis.

The controls agreed upon by the team as the minimum necessary to achieve the nuclear safety requirements, are included in Attachment 1.

MGV:PAM

Attachments

Distribution

K. E. Ard	J. E. Ashe	T. Barker
J. A. Buczek	C. A. Burke	B. G. Carpenter
B. E. Chamberlain	J. E. Corbett	J. T. Devere
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D. R. Seiner	K. E. Smith	S. Smith
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cc: WRPS Correspondence Control

Attachment 1

Summary of Control Selection Following PrHA on TSCR 30% and 60% Design

Among the several controls for each event that were proposed during the PrHA, the following were agreed upon by the team, as the minimum necessary to achieve the nuclear safety requirements:

TSCR Process Enclosure (including the airlock process enclosure cabinet and pipe chase between the airlock process enclosure cabinet and the TSCR Process Enclosure)	Passive SS SSC
IXC Outlet Connection	Passive SS SSC
Chem Joint (Including Weld between TSCR Pipe and hose-in-hose transfer line (HIHTL))	Passive SS SSC
Ion exchange columns (IXCs)	Passive SS SSC
IXC Filtered Vents	Passive SS SSC
Spent IXC Interim Storage Pad	Passive SS SSC
*TSCR Enclosure Pad	Passive SS SSC
*Vehicle Barriers (Positioned as Necessary at TSCR Process Enclosure and IXC Interim Storage Pad)	Passive SS SSC
*Restriction on forklift maximum lift height	Passive SS SSC
Pressure relief device on compressor.	Passive SS SSC
Blowdown Assurance Controls	Active SS SSC
Sweep Air Flow Indication	Active SS SSC
Traffic Control SAC	SAC
TSCR Process Enclosure Access Controls	SAC
TSCR Waste Acceptance Criteria	WAC-SAC
Hoisting Rigging Program	SMP
Emergency Response Program	SMP
Vent Inspection	SAC
Requirement to Establish Vent	SAC
Pump lockout	SAC
Requirement to connect column to storage pad using seismic restraint.	SAC

*Table entries that are only applicable to Project T1P190, Tank Farm Upgrades. All other entries are applicable to Project TD101, TSCR. While the Spent IXC Storage Pad seismic restraints will be fabricated and installed as part of Project T1P190, the design of the seismic restraints is in the scope of Project TD101.

Summary of Control Selection Meetings Following PrHA on TSCR 30% and 60% Design

The Blowdown Assurance Control is a major control that was developed specifically during the conduct of the PrHA. It is comprised of the combination of SSCs and SACs that, together, give assurance that the FW is protected from explosion of flammable gas in the IXC:

- TSCR Process Enclosure (Passive SS SSC)
- TSCR Process Enclosure Access Controls (MRP enclosure in the airlock, and process space; cable lock on MRP enclosure)
    - Pump lockout (AP-107 feed pump, potable water pump, caustic pump, sump pump)
        - Managed by administrative lock
        - This step includes de-pressurizing bladder tank.
    - Blowdown verification (filters and TWDT must be blown down before IXC)
- Blowdown SSCs
    - TWDT drain valve position indicator (active SS SSC)
        - Position verification performed by camera
    - Filter vessel drain valve position indicator (active SS SSC)
    - IXC Drain valve position indicator (active SS SSC)
    - Process air Pressure indicator (SSI)
    - IXC Blowdown Flowmeter (SSI)

The following is a summary of the events that were identified during the PrHA, which led to the initial proposed list of controls.

While loaded column is connected to the TSCR system, hydrogen accumulation, explosion, loss of confinement, release of loaded CST, exposure to dose

- Selected Control:
    - TSCR Process Enclosure (including MRP enclosure)
    - TSCR Process Enclosure Access Controls
    - Blowdown Verification (Pressure Indication, Air Flow Indication, Valve position Indication)
    - Sweep air flowmeter (SSI)
- Frequency:
    - Unmitigated frequency - “unlikely”.
- Consequences:
    - Facility Worker radiological and toxic chemical consequences exceed evaluation guidelines.
- Additional other defense-in-depth features:
    - Radiation Protection Program.

High pressure or explosion in IXC, leads to release of loaded CST and waste, dose exposure

- Selected Control:
  - TSCR Process Enclosure Access Controls
  - Vent Path
  - Requirement to establish vent
  - Valve Position Indicator
  - Pressure Indicator
  - Air Flow Indicator
- Frequency:
  - Unmitigated frequency - “anticipated”.
- Consequences:
  - Facility Worker radiological and toxic chemical consequences exceed evaluation criteria.
- Additional other defense-in-depth features:
  - Radiation Protection Program.

Failure of Piping, loss of confinement

- Selected Control:
  - TSCR Process Enclosure
  - ChemJoint
  - TSCR Process Enclosure Access Controls
- Frequency:
  - Unmitigated frequency - “anticipated”.
- Consequences:
  - Facility Worker radiological and toxic chemical consequences exceed evaluation criteria.
- Additional other defense-in-depth features:
  - PPE, Radiation Protection Program

Direct radiation exposure.

- Selected Control:
  - Ion Exchange Column (IXC)
  - TSCR Process Enclosure
  - TSCR Process Enclosure Access Controls
- Frequency:
  - Unmitigated frequency - “anticipated”.
- Consequences:
  - Facility Worker radiological consequences exceed evaluation criteria.
- Additional other defense-in-depth features:
- - Radiation Protection Program.

Impact to IXC, leads to release of loaded CST and waste, dose exposure

- Selected Control:
  - Vehicle Barriers (Positioned as necessary at TSCR process enclosure and IXC Interim Storage Pad)
  - Traffic Controls
- Frequency:
  - Unmitigated frequency - “anticipated”.
- Consequences:
  - Facility Worker radiological and toxic chemical consequences exceed evaluation criteria.
- Additional other defense-in-depth features:
  - Hoisting and rigging Program

Seismic event during operation, common cause failure of piping, IXC; leads to release of loaded CST and waste, dose exposure

- Selected Control:
  - IXC
  - TSCR Process Enclosure (structural integrity, seismic restraint)
  - TSCR Process Enclosure Access Controls
- Frequency:
  - Unmitigated frequency - “unlikely”.
- Consequences:
  - Facility Worker radiological and toxic chemical consequences exceed evaluation criteria.
- Additional other defense-in-depth features:

Seismic event post-IXC loading, common cause failure of IXC; leads to release of loaded CST, dose exposure

- Selected Control:
  - IXC
  - IXC Vent
  - IXC Interim Storage Pad (structural integrity, seismic restraint)*

  Frequency:
  - Unmitigated frequency - “unlikely”.
- Consequences:
  - Facility Worker and collocated worker radiological chemical consequences exceed evaluation criteria.
- Additional other defense-in-depth features:

*Pad shared with Project T1P190, Tank Farm Upgrades. While the Spent IXC Storage Pad seismic restraints will be fabricated and installed as part of Project T1P190, the design of the seismic restraints is in the scope of Project TD101.

Compromised outlet piping internal to the IXC leads to incomplete blowdown of the ICX; hydrogen accumulation, explosion, loss of confinement, release of loaded CST, exposure to dose

- Selected Control:
  - IXC outlet piping internal to CST bed

  Frequency:
  - Unmitigated frequency - “anticipated”.
- Consequences:
  - Facility Worker radiological and toxic chemical consequences exceed evaluation criteria.
- Additional other defense-in-depth features:

Connecting wrong pipe to the IXC outlet leads to ineffective blowdown; hydrogen accumulation, explosion, loss of confinement, release of loaded CST, exposure to dose

- Selected Control:
  - IXC Outlet Connection
- Frequency
  - Unmitigated frequency - “anticipated”.
- Consequences:
  - Facility Worker radiological and toxic chemical consequences exceed evaluation criteria.
- Additional other defense-in-depth features:

Drop of a single IXC; leads to release of loaded CST, dose exposure

- Selected Control:
  - IXC
- Frequency:
  - Unmitigated frequency - “anticipated”.
- Consequences:
  - Facility Worker radiological and toxic chemical consequences exceed evaluation criteria.
- Additional other defense-in-depth features:
  - Emergency Response, evacuation

Drop or Impact, damage to vent or topple to horizontal, vent no longer operable; hydrogen accumulation, explosion, loss of confinement, release of loaded CST, exposure to dose

- Selected Control:
  - Evacuation
  - Emergency Response
- Frequency:
  - Unmitigated frequency - “anticipated”.
- Consequences:
  - Facility Worker radiological consequences exceed evaluation criteria.
- Additional other defense-in-depth features:

Accumulation of debris in the vent of a column on the storage pad; hydrogen accumulation, explosion, loss of confinement, release of loaded CST, exposure to dose

- Selected Control:
  - Vent Design
  - SAC for vent inspection, repair, or replacement
- Frequency:
  - Unmitigated frequency - “anticipated”.
- Consequences:
  - Facility Worker radiological chemical consequences exceed evaluation criteria.
- Additional defense-in-depth features:
  - Ignition Controls

Compressor failure causing high-temperature air, during blowdown of transfer Hose-in-Hose Transfer Line between TSCR and either AP-106 or -107; HIHTL confinement boundary compromised, either releasing MAR immediately, or on subsequent transfer. Spray release causes aerosol.

- Selected Control:
  - SAC: administrative lock on transfer pump when doing blow down (only prevents immediate release).
- Frequency:
  - Unmitigated frequency - “anticipated”.
- Consequences:
  - Co-located Worker radiological and chemical consequences exceed evaluation criteria.
- Additional defense-in-depth features:
  - Temperature monitor.

Compressor failure with line pluggage, causing high-pressure air, during blowdown of transfer Hose-in-Hose Transfer Line between TSCR and either AP-106 or -107; HIHTL

confinement boundary compromised, either releasing MAR immediately, or on subsequent transfer.

- Selected Control:
  - Safety relief device on compressor
- Frequency:
  - Unmitigated frequency - “anticipated”.
- Consequences:
  - Co-located Worker radiological and chemical consequences exceed evaluation criteria.
- Additional defense-in-depth features:

Attachment 3

TSCR 30% Design
Control Selection Meeting Attendance Record
(See following pages for original sign-in sheets)

Michael Valentine (WRPS Nuclear Safety, PrHA Lead)
Roger Lanning (WRPS Nuclear Safety)
Brian Everett (WRPS Ops)
Derrick Seiner (WRPS Emergency Management)
James Franz (WRPS RadCon)
Stan Wallace (WRPS Fire Protection)
Ken Ewer (WRPS Project Engineer)
Ricky Hyson (ORP (DOE) Observer)
Jeff Buczek (Orano Mission Integration)
John Corbett (WRPS Training/ Commissioning)
Karen Sanders (WRPS Project Engineer)
Darren Merrill (WRPS IS/IH)
Kevin Ard (WRPS Project Engineer)
Brent Peterson (WRPS Project Engineer)
Kim Smith (WRPS Project Manager)
Nolan Wright (WRPS SIS SME)
James Devere (WRPS Property Management)
Blake Chamberlain (WRPS Project Engineering)
Michael Leonard (WRPS Project Engineering)
Tracy Barker (AVANTech Responsible Engineer)
Paul Haigh (WRPS Ops)
Michael Stafford (WRPS Project Engineering)

By Telephone:
Gary Kaplan (ORP (DOE) Observer)
Eddie Ashe (ORP (DOE) Observer)
Steve Thorne (Consultant, Fire Protection)

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Control Selection Attendance Record

Subject: TSCR 304 ☕ **Date:** 15 October 2018
Location: 2505 Conlin 1129

	Name	Signature	Responsible Area(s) (see codes† below)	Organization	Telephone
Lead:	Michael Valentine	Michael D. Valentine	1	WRPS Nuc Safety	376-2328
Scribe:	" "				
1.	Derrick Seiner		7, 9	WRPS EP	440-0326
2.	STAN WALLACE			SAFETY	373-7892
3.	JAMES EWERT		21	FACP MGMT	373-0778
4.	KEN EWER	Kenneth L. Ewer	14	WRPS PROJ	373-9639
5.	JOHN CORBETT	John Corbett	20	WRPS Comm.	372-2001
6.	Kevin Ard		14	WRPS Eng.	373-4475
7.	Jeff Buczek		27	WRPS Mission Int.	373-0602
8.	Karen Sanders	Karen Sanders	14	WRPS Eng.	373-0351
9.	BRENT PETERSON	Brent A. Peterson	14	WRPS ENG	373-3155
10.	Gary Kaplan	via phone	26	DOE ORP	
11.	Eddie Ashe	" "	26	DOE ORP	
12.	Brian K Everett	Brian K Everett	2	WRPS-OPS	372-0320
13.	Ricky Hyson		26	DOE ORP	376-0865
14.	Kim Smith	KE Smith		WRPS WFD	372-9691
15.					
16.					
17.					
18.					
19.					
20.					

†Responsible area codes :

1. **Nuclear Safety**
2. **Operations**
3. **Responsible Engineer**
4. Industrial Safety/Health
5. Radiological Control
6. Environmental Programs
7. Emergency Management
8. Operational Readiness
9. Quality Assurance
10. Safeguards and Security
11. Nuclear Criticality
12. Training
13. Procedures
14. Project Engineering/Management
15. System Engineering
16. Process Engineering
17. Maintenance Engineering
18. Engineering Discipline Lead
19. Fire Protection Engineering
20. Testing
21. Maintenance
22. Construction
23. Waste Packaging & Transport
24. AE/Design Engineering
25. Analytical Technical Services
26. DOE Observer
27. Other: _____

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Control Selection Attendance Record

Subject: TSCR 396

Date: 17 October 2018
Location: 2505 Entech 1129

Name	Signature	Responsible Area(s) (see codes† below)	Organization	Telephone
Lead:				
Scribe:				
1. MICHAEL LEONARD		14	TP Engineering	373-2730
2. Roger Lanning		1	WRPS NS	376-2891
3. BLAKE CHAMBERLAIN		3	ENG	376-5114
4. Tracy Barker		5	Avantech	865 405 6387
5. James Franz		5	WRPS RadCon	509-373-8610
6. PAUL HAIGH		2	OPS	372-3619
7. Nolan Wright		27	Eng	376-9549
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.				

†Responsible area codes :

1. **Nuclear Safety**
2. **Operations**
3. **Responsible Engineer**
4. Industrial Safety/Health
5. Radiological Control
6. Environmental Programs
7. Emergency Management
8. Operational Readiness
9. Quality Assurance
10. Safeguards and Security
11. Nuclear Criticality
12. Training
13. Procedures
14. Project Engineering/Management
15. System Engineering
16. Process Engineering
17. Maintenance Engineering
18. Engineering Discipline Lead
19. Fire Protection Engineering
20. Testing
21. Maintenance
22. Construction
23. Waste Packaging & Transport
24. AE/Design Engineering
25. Analytical Technical Services
26. DOE Observer
27. Other: I+C/ SFS

Control Selection Attendance Record

Subject: TSCR 396

Date: 16 October 2018
Location: 2505 Goethick 1129

Name	Signature	Responsible Area(s) (see codes† below)	Organization	Telephone
Lead: Michael Valentine	Michael S. Valentine	1	WRPS Nuc Safety	376-2328
Scribe:				
1. Brian Everett	Brian Everett	2	WRPS OPS	372-0320
2. Roger Lanning	Roger Lanning	1	WRPS NS	376-2547
3. BLAKE CHAMBERLAIN	Blake Chamberlain	3	ENG	376-5114
4. Tracy Barker	Tracy Barker	24	Avantech	965 405 6387
5. MICHAEL LEONARD	Michael W. Leonard	14	WRPS Eng.	509 373-2730
6. KEN EWER	Kenneth J. Ewer	14	WRPS PROJ	373-9639
7. Kevin Ard	Kevin Ard	14	WRPS Eng.	373-4475
8. MIKE STAFFORD	Mike Stafford	14	WRPS CM	376-7143
9. Karen Sanders	Karen M. Sanders	3, 14	WRPS Eng	373-0351
10. BRENT PETERSON	Brent A. Peterson	14	WRPS ENG	378-3155
11. PAUL HAIGH		2	OPS	372-3614
12. Jeff Bucek		27	WRPS Nuclear Materials	373-0602
13. STAN WALLACE	Stan Wallace	19	WRPS	373-7392
14. JOHN CORBETT	John Corbett	20	Commissioning	372-2001
15. Steve Thorne	via phone	19		
16. Ricky Hyson	Ricky Hyson	26	ORP	376-0865
17.				
18.				
19.				
20.				

†Responsible area codes :

1. **Nuclear Safety**
2. **Operations**
3. **Responsible Engineer**
4. Industrial Safety/Health
5. Radiological Control
6. Environmental Programs
7. Emergency Management
8. Operational Readiness
9. Quality Assurance
10. Safeguards and Security
11. Nuclear Criticality
12. Training
13. Procedures
14. Project Engineering/Management
15. System Engineering
16. Process Engineering
17. Maintenance Engineering
18. Engineering Discipline Lead
19. Fire Protection Engineering
20. Testing
21. Maintenance
22. Construction
23. Waste Packaging & Transport
24. AE/Design Engineering
25. Analytical Technical Services
26. DOE Observer
27. Other: _____

Control Selection Attendance Record

Subject: TSCR 306

Date: 17 October 2018
Location: 2505 Gatlick 1129

Name	Signature	Responsible Area(s) (see codes† below)	Organization	Telephone
Lead: Michael Valentine	Michael S. Valentine	1	WRPS Nuc Safety	376-2328
Scribe:				
1. Brian Everett	Brian Everett	2	WRPS Ops	372-0320
2. Roger Lanning	Roger Lanning	1	WRPS NS	376-2391
3. Blake Chamberlain	Blake Chamberlain	3	ENG	376-5114
4. Tracy Barker	Tracy Barker	24	AHAMTech	865 405 6387
5. Paul Hatch	Paul Hatch	2	Ops	372-3619
6. Brent Peterson	Brent Peterson	14	WRPS ENG	376-3165
7. Lauren Sanders	Lauren Sanders	3, 14	WRPS Eng	373-0351
8. Kevin Ard	Kevin Ard	14	WRPS Eng	373-4475
9. Michael Leonard	Michael Leonard	14	WRPS Eng	373-2730
10. Jeff Buecker	Jeff Buecker	27	WRPS Mission Integration	373-0602
11. John Corbett	John Corbett	20	WRPS Commissioning	372-2001
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.				

†Responsible area codes :

1. **Nuclear Safety**
2. **Operations**
3. **Responsible Engineer**
4. Industrial Safety/Health
5. Radiological Control
6. Environmental Programs
7. Emergency Management
8. Operational Readiness
9. Quality Assurance
10. Safeguards and Security
11. Nuclear Criticality
12. Training
13. Procedures
14. Project Engineering/Management
15. System Engineering
16. Process Engineering
17. Maintenance Engineering
18. Engineering Discipline Lead
19. Fire Protection Engineering
20. Testing
21. Maintenance
22. Construction
23. Waste Packaging & Transport
24. AE/Design Engineering
25. Analytical Technical Services
26. DOE Observer
27. Other: _____

Attachment 4

TSCR 60% Design
Control Selection Meeting Attendance Record
(See following pages for original sign-in sheets)

Michael Valentine (WRPS Nuclear Safety, PrHA Lead)
Daro Ferrara (WRPS Nuclear Safety, Scribe)
Roger Lanning (WRPS Nuclear Safety)
Brian Everett (WRPS Ops)
Ricky Hyson (ORP (DOE) Observer)
Jeff Buczek (Orano Mission Integration)
Darren Merrill (WRPS IS/IH)
Kevin Ard (WRPS Project Engineer)
Kim Smith (WRPS Project Manager)
Nolan Wright (WRPS SIS SME)
Blake Chamberlain (WRPS Project Engineering)
Tracy Barker (AVANTech Responsible Engineer)
Paul Haigh (WRPS Ops)
Chris Woehle (WRPS Performance Assurance)
Padraic Fox (DNFSB Site Representative)
Chris Strand (WRPS Environmental)
Bruce Carpenter (WRPS Project Management))
JP Witherspoon (WRPS Project Engineering)
Al Ramble (DOE EA-31)

By Telephone:
Gary Kaplan (ORP (DOE) Observer)
Eddie Ashe (ORP (DOE) Observer)

Control Selection Meeting Attendance Record

Subject: TSCR 60%

Date: 29 January 2019
Location: 2505 Garlick/CR 1130

Name	Signature	Responsible Area(s) (see codes† below)	Organization	Telephone
Lead: Michael Valentine	Michael D. Valentine	1	WRPS	376-2328
Scribe: Dara Ferrara	Dara Ferrara	1	WRPS	509 713 9213
1. Tracy Barker	Tracy Barker	3	Avantech	865 405 6387
2. Alan Rambo	Alan Rambo	1	EM-31	575-396-4152
3. Roger Lanning	Roger Lanning	1	WRPS	376-2391
4. Brian Everett	Brian Everett	2	WRPS	372-0320
5. BLAKE CHAMBERLAIN	Blake Chamberlain	3	WRPS	367-5114
6. CHRIS STRAND	Chris Strand	6	WRPS	376-6723
7. PAUL HAZEN	Paul Hazen	2	WRPS	372-3619
8. Darren Merrill	Darren Merrill	4	WRPS	373-2605
9. BRUCE CARLSON	Bruce Carlson	14	WRPS	372-2047
10. Nolan Wright	Nolan Wright	27	WRPS	376-9549
11. Kim Smith	Kim Smith	14	WRPS	372-9691
12. CHAD WEHLE	Chad Wehle	27	WRPS	373-2429
13. JP Witherspoon	JP Witherspoon	14	WRPS	375-6563
14. Jeff Buczek	Jeff Buczek	27	WRPS	373-0602
15. Ricky Hyson	Ricky Hyson	26	ORP	376-0865
16. PADRAIC FOX	Padraic Fox		DNFSB	373-5888
17. Kevin Aird	Kevin Aird	14	WRPS	373-4475
18. Eddie Ash	via telephone		ORP	
19. Gary Kaylan	via telephone		ORP	
20.				

†Responsible area codes (Control Selection quorum members indicated by ^):

1. ^Nuclear Safety
2. ^Operations
3. ^Responsible Engineer
4. ^Industrial Safety/Health
5. ^Radiological Control
6. Environmental Programs
7. Emergency Management
8. Operational Readiness
9. Quality Assurance
10. Safeguards and Security
11. Nuclear Criticality
12. Training
13. Procedures
14. Project Engineering/Management
15. System Engineering
16. Process Engineering
17. Maintenance Engineering
18. Engineering Discipline Lead
19. Fire Protection Engineering
20. Testing
21. Maintenance
22. Construction
23. Waste Packaging & Transport
24. AE/Design Engineering
25. Analytical Technical Services
26. DOE Observer
27. Other: D&C/SIS (Wright), Mission Integration (Buczek)

Wehle Performance Assurance

TSCR 60% Design Control Strategy Summary

Control		Safety Function	Example Event Description(s)	Implementation
Title	**Description**			
Chem Joint (Including Weld between TSCR Pipe and HIHTL)	Passive SS SSC	Provides confinement of the process stream.	Loss of Confinement for any reason	New control, part of design and construction
IXC Outlet connection	Passive SS SSC	Provides outlet hoses that cannot be switched during installation of the IXCs	Flammable gas explosion	New control, part of design and construction
IXCs	Passive SS SSC	Limits radiation dose rates at the outer surface of the IXC.	High Radiation Exposure from Fully Loaded IXCs	New control, part of design and construction
			Single IXC Drop or Tipover in the TSCR Enclosure, during Transport to the IXC Interim Storage Pad, or on the IXC Interim Storage Pad	
			Natural Phenomena Hazard Events	
		Maintains confinement of ion exchange media.	Single IXC Drop or Tipover in the TSCR Enclosure, during Transport to the IXC Interim Storage Pad, or on the IXC Interim Storage Pad (includes NPH events)	
			Natural Phenomena Hazard Events - Multiple IXC Tipover on the Spent IXC Interim Storage Pad (potentially more than 60 IXCs in seismic, fewer than 60 IXCs in wind events)	
		(Outlet Piping Internal to the CST Bed) Provides a flow path for removal of liquid from the bottom of the IXC.	Flammable Gas Explosion in IXC	
IXC Filtered Vents	Passive SS SSC	Limit the concentration of flammable gas that can accumulate in the IXC after the IXC has been disconnected from the TSCR process system.	Flammable Gas Explosion in IXC	New control, part of design and construction
Spent IXC Interim Storage Pad	Passive SS SSC	*Maintains structural integrity in a seismic event.	Natural Phenomena Hazard Events	New control, part of design and construction
		(Seismic Restraints) Prevent IXC from toppling in a seismic event.		
*TSCR Enclosure Pad	Passive SS SSC	Maintains structural integrity in a seismic event.	Natural Phenomena Hazard Events	New control, part of design and construction
*Restriction on forklift maximum lift height	Passive SS SSC	Limits height that IXC can be lifted.	IXC drop.	New control, part of design and construction.
*Vehicle Barriers (Positioned as Necessary at the TSCR Process Enclosure and IXC Interim Storage Pad)	Passive SS SSC	Provide a physical barrier to an impact between a vehicle and IXCs.	High-Energy Vehicle Impact with a Single or Multiple IXCs in the TSCR Process Enclosure, during Transport to the IXC Interim Storage Pad, or on the IXC Interim Storage Pad	New control, part of design and construction

Control		Safety Function	Example Event Description(s)	Implementation
Title	**Description**			
TSCR Process Enclosure (including the airlock process enclosure cabinet and pipe chase between the airlock process enclosure cabinet and the TSCR Process Enclosure)	Passive SS SSC	Provides knock-down of process stream supernate suspended as a spray leak.	Liquid Process Stream Spray or Leak	New control, part of design and construction
			Natural Phenomena Hazard Events	
		Provides knock-down of process stream supernate suspended during an explosion.	Flammable Gas Explosion in IXC	
			Flammable Gas Explosion in the Filter Unit	
			Natural Phenomena Hazard Events	
		Provides separation between FWs and process equipment that could be pressurized or are in a configuration that would allow the equipment to become pressurized.	Liquid Process Stream Spray or Leak	
			Natural Phenomena Hazard Events	
		Provides separation between FWs and process equipment that could be in a configuration that could generate and accumulate flammable gases.	Flammable Gas Explosion in IXC	
			Flammable Gas Explosion in the Filter Unit	
			Natural Phenomena Hazard Events	
		Maintains structural integrity in a seismic event (including mounting of TWDT and other process system components from impacting and breaching the process enclosure).	Natural Phenomena Hazard Events	
		(Seismic restraints) Prevents IXCs and filter units from impacting and breaching the process enclosure in a seismic event.		
		Maintains structural integrity under high snow, ash, and rain loading.	Natural Phenomena Hazard Events	
		Provides a barrier between the TSCR process system confinement boundary and high winds.	Natural Phenomena Hazard Events	
Blowdown Assurance Controls (BACs)	Active SS SSC	(Pressure Indication) Monitors the air pressure in the header from which air is to be supplied during blowdown and provides a readout of the measured pressure.	TBD	New control, part of design and construction. These indicators are all SSI that do not require a logic solver, safety alarm or immediate operator response to execute the TSCR Process Enclosure Access Controls SAC actions.
		(Air Flow Indication) Monitors the blowdown air flow rate and provides a readout of the measured rate.	TBD	
		(Valve Position Indicators) Provides visible indication of the configuration (i.e., open or closed) of valves downstream of IXCs, filters, and TWDT.	TBD	
Sweep Air Flow Indication	Active SS SSC	Measures and displays the sweep air flow rate through the head space of the IXC.	Flammable Gas Explosion in IXC	New control, part of design and construction. This indicator is an SSI that does not require a logic solver, safety alarm or immediate operator response to execute the TSCR Process Enclosure Access Controls SAC actions.
Pressure Relief Device	Passive SS SSC	Relieves pressure due to failure of compressor, before exceeding HIHTL design pressure.	Liquid Process Stream Spray or Leak	New control, part of design and construction.

Control		Safety Function	Example Event Description(s)	Implementation
Title	**Description**			
Traffic Control SAC	SAC	Prohibits vehicles from being in the vicinity of the TSCR process enclosure during removal of an IXC and prohibits vehicles from being on the transport path between the TSCR process enclosure and the interim storage pad. Vehicles involved in the IXC removal and transport are excluded from this prohibition.	Fire during IXC Transport, Single IXC Drop Events	Addition to existing Controls Because this control is only in place during certain operations, the Control Selection Team did not identify a practical SSC that could fulfill the function of this SAC.
Pump Lockout SAC	SAC	Prohibits operation of transfer pump between TSCR and either AP-106 or -107 when performing blowdown of HIHTL.	Liquid Process Stream Spray or Leak	Addition to existing Controls. Because this control is only in place during certain operations, the Control Selection Team did not identify a practical SSC that could fulfill the function of this SAC.
TSCR Process Enclosure Access Controls	SAC	Restrict access into areas and rooms in which process equipment is pressurized.	Liquid Process Stream Spray or Leak	New control. Requires SS Blowdown Assurance Controls and Sweep Air Flow Indication System to perform safety function. Upset condition is slow-developing and easily identified, operator has time to take appropriate action to prevent the event, or the operator action is taken pre-emptively (i.e., the action is taken to establish a safe configuration before the upset could occur).
		Restrict access to areas and rooms in which process equipment is in a configuration that could accumulate flammable gases.	Flammable Gas Explosion in IXC	
			Flammable Gas Explosion in the Filter Unit	
		Restrict access into areas and rooms in which process equipment is in an unsafe (i.e., potentially pressurized or potentially accumulating flammable gases) configuration.	Natural Phenomena Hazard Events	
TSCR Waste Acceptance Criteria	WAC-SAC	Prevent the accumulation of cesium-137 (within an IXC) in excess of analyzed values.	Initial Condition for Multiple Events	Existing SAC; Team did not identify practical SSC that could fulfil the function of this existing SAC.
		Limit the concentration of hazardous material in the process feed stream to those analyzed.		
		Limit the TSCR feed stream fissile material content to analyzed composition.	Inadvertent Criticality	
Hoisting Rigging Program	SMP	N/A	N/A	Existing Program
Emergency Response Program	SMP	N/A	N/A	Existing Program

Control		Safety Function	Example Event Description(s)	Implementation
Title	**Description**			
Vent Inspection	SAC	Prevent accumulation of hydrogen in excess of LFL.	Accumulation of debris in the vent of a column on the storage pad.	Ignition Controls
Requirement to Establish Vent	SAC	Prevent accumulation of hydrogen in excess of LFL.	Flammable Gas Explosion in IXC	Ignition Controls
Requirement to connect column to storage pad using seismic restraint.	SAC	Install IXCs onto the spent IXC interim storage pad seismic restraint.	Tipover on the IXC storage pad	New control. Upset condition is rapid and unpredictable, operator has no time to take appropriate action to prevent the event, so the operator action is taken pre-emptively (i.e., the action is taken to establish a safe configuration before the upset could occur).

*Table entries that are only applicable to Project T1P190, Tank Farm Upgrades. All other entries are applicable to Project TD101, TSCR. While the Spent IXC Storage Pad seismic restraints will be fabricated and installed as part of Project T1P190, the design of the seismic restraints is in the scope of Project TD101.