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Defense Nuclear Facilities Safety Board (DNFSB) – Savannah River Site (SRS) Visit – Savannah River Tritium Enterprise (SRTE) Discussions

SRTE Operations / Engineering / N&CSE
Area Managers

May 9, 2023 – Afternoon Session with SRTE and NNSA

Topic: Adequacy of Currently Implemented Safety Basis Control Set

Presenter: Jason Whitson, N&CSE Area Manager – Tritium / TFF Support

Adequacy of Currently Implemented SB Control Set

- TF and TEF SAR/TSR was developed in accordance with 10 CFR 830 and DOE STD 3009-94. Includes hierarchy of controls to first eliminate hazard, passive before active, engineered before administrative.
- Per SCD-11 CHA process, associated hazards and resulting events were developed to include Fire, Explosion, Loss of Confinement, Exposure, External, and Natural Phenomena Hazard categories.
- Controls developed in SAR chapters 3-5 and led to TSR controls
- Passive Design Features include

Robust Containers	Secondary Containers	HIVES
Glovebox Secondary Confinement	234-7H Environmental Chamber #1 Enclosures	Z-Bed Water Traps
Room 54 Electrical Equipment	234-7H Environmental Chamber #1 Electrical Equipment	TEF Building and Structure
TEF Furnace Module	Transfer Line Protection and Jackets	TEF Trolley Guide Plate
	TEF Truck Bay Bridge Crane	

Adequacy of Currently Implemented SB Control Set (cont.)

- Active Engineered Controls (LCOs) include

Fire Suppression Systems (233-H, 234-H, 234-7H, 217-H, 233-1H, 264-H, 264-2H)	Tritium Air Monitors (233-H, 234-7H, 264-H, 264-2H)	Area Radiation Monitors (264-2H)
Oxygen Monitor Systems (233-H GB, 233-H EC, 264-H, 264-2H)	Environmental Conditioning Electrical Isolation System (233-H)	Environmental Chamber #1 Heater High Temperature Interlock (234-7H)
Air Intrusion Check Valves (233-H, 264-H)	Truck Bay Bridge Crane Braking System (264-2H)	

Adequacy of Currently Implemented SB Control Set (cont.)

- SACs include the following:

Non Robust Container (LCO)	Transient Combustibles (LCO)	Inventory Control
Open Glovebox Maintenance	Empty Container Verification	Explosion Prevention Program
Secondary Container	Fire Water Volume Determination	

- Programs include the following:

Emergency Preparedness	Fire Protection	Radiological
Structural Integrity	Critical Lift	Traffic Control
Cask / Waste Container Tractor Control		

Adequacy of Currently Implemented SB Control Set (cont.)

- All evaluated events resulted in no required SC controls for the MOI
- CW mitigated down based on crediting controls as well as worker training / procedures and emergency preparedness.
- Recent Improvements based on CTF
  - TSR Inventory Reductions
  - Surveillances for Fire Water availability
  - O2 monitors (75% complete, 12 remaining, 2 of 10 in progress)
  - 217-H Vault
- NNSA has accepted the risk envelope and approved the SAR/TSR via SER.

Topic: Combined Tritium Facilities Safety Basis Implementation

Presenter: Jason Whitson, N&CSE Area Manager – Tritium / TFF Support

CTF Safety Basis Implementation

- Combines existing two SB into one, updating to latest MACCS2 requirements
- Revision 0 approved December 2019, but not implemented
- Progress to date
  - Working with NNSA, agreed to submit Revision 1 in advance of completing the 233-H fire barrier project, to deconflict from the CY25 outage, thus implementing two years ahead of schedule.
  - Revision 1 to CTF was submitted to NNSA for approval on 5/1/23.
- Adequacy of future control set for protecting SRS workers
  - In accordance with SCD-11 process
  - Clean sheet development of hazards and events in CTF. A similar set of controls from current SB with updates.

CTF Safety Basis Implementation (cont.)

- Adequacy of future control set for protecting SRS workers (cont.)
  - New Engineered and Design Features include 217-H Vault Fire Barrier, 234-7H SS Fire Suppression, and 233-H Fire Barrier
    - *217-H SC Vault*
      - Installation of Fire Damper (LCO 3.1.1)
      - Structure Fire Barrier (DF 6.7)
      - Complete
    - *234-7H SS Fire Suppression System*
      - Installation of sprinklers in the Environmental Chamber hoods (LCO 3.1.4)
      - On schedule to complete by August 2023
    - *233-H SC Fire Barrier*
      - Installation of two new SC Fire Dampers to prevent the spread of fire between 233-H and 234-H/234-7H via the 233-1H corridor (LCO 3.1.1)
      - Structure Fire Barrier (DF 6.7)
      - Expected to be installed and implemented in FY25
      - Discussed in Chapter 3 of CTF DSA, but no credit is taken.

CTF Safety Basis Implementation (cont.)

- Adequacy of future control set for protecting SRS workers (cont.)
  - Elevation of Critical Lift and Traffic Control elements to SACs along with addition of 217-H Vault Transient Combustibles SAC
  - Discontinuance of crediting of ACs
  - Inventory Reductions
  - Inclusion of Thermal Lofting for facility fire events (CW)
  - Tritide Distribution

CTF Safety Basis Implementation (cont.)

- Implementation schedule
  - Pre-implementation actions underway (SBIP checklists, Procedure reviews, LDDs)
  - 9 month implementation upon receipt of SER from NNSA
- Future Improvements
  - CLWDR Efforts
  - Installation of the 233-H Fire Barrier
  - Application of Deposition Velocity Research
  - Structural Evaluations for 217-H Vault and 296-H Stack

CTF Safety Basis Implementation (cont.)

- 296-H Stack Collapse scenario
  - Structural Mechanics determined that the stack would survive the seismic event, however SRTE and NNSA decided to take a conservative approach, which was to assume stack collapses during seismic, hits the 217-H Vault and initiates a fire that releases Tritium.
  - Loss of SC Vault Fire Barrier related to NPH events
  - New DBA MAR of 20kg vice 15kg previously
  - Increase in postulated MOI dose from 18 Rem to 24 Rem

Topic: SRTE Facilities Tritium Inventory

Presenter: Stephen Mazurek, SRTE Engineering Manager – Project Design Authority and Regulatory Programs

Topic: Co-Located Worker Dose Reduction (CLWDR)

Presenter: Jacob Suits, SRTE Engineering Manager – Regulatory Programs

Co-Located Worker Dose Reduction Conception

- NNSA directed formulation of a plan to address high postulated consequences to the CW upon submittal of the CTF DSA.
- Strategy started with 19 deliverables pursuing 9 initiatives with the aim to reduce postulated high consequences to the CW.
  - Strategy pursues structural analyses and control development feasibility.
  - Strategy pursues refinement of overly conservative analyses.
- To date the strategy has completed 36 deliverables and identified 20 deliverables in the future.

CW: Co-located Worker CTF: Combined Tritium Facilities DSA: Documented Safety Analysis

Co-Located Worker Dose Reduction Strategy Progress

- Initiatives are down selected for further maturation based on cumulation of results from analyses.
  - *In pursuit of Co-Located Worker Dose Reduction, SRNS has issued over 50 detailed engineering output documents*
  - Since submittal of the CTF DSA, SRNS has completed/projectized the following initiatives which reduce consequence to the CW:
    - ✔ *217-H Vault Fire Barrier**
    - ✔ *234-7H Hood Fire Suppression**
    - ✔ Plume Rise
    - ✔ *Tritide Distribution**
    - *233-H Fire Barrier**
    - *Tritium Finishing Facility**
  - Initiatives determined unfeasible:
    - 234-7H seismic controls
    - Secondary Container survivability
    - H-Area Fire Water Supply seismic upgrades

**Not one of the 9 original strategy initiatives*

CW: Co-located Worker CTF: Combined Tritium Facilities DSA: Documented Safety Analysis SRNS: Savannah River Nuclear Solutions

Co-Located Worker Dose Reduction Strategy Overview

SRNS

Initiative	Description	CW/FW Benefit[1]	MOI Benefit Potential
TFF	Constructs a modern facility to replace 234-H and 217-H.	Provides Safety Class SSCs to house the MAR currently in 234-H and 217-H.	Yes[2]
HANM Fire Suppression	Provide SDC-3 capable fire suppression system(s) within 233-H.	Bin Reduction for post seismic fire event in 233-H.	Yes[2]
TEF Fire Suppression	Provide SDC-3 capable fire suppression system(s) within TEF.	Bin Reduction for post seismic fire event in TEF.	Yes[2]
HANM STCS (Backfit)	Backfit existing PS system to credit the confinement of MAR within qualified vessels.	Confines MAR during and after DBE.	Yes[2]
HANM STCS (HT-TCAP)	Install a confinement system to credit the confinement of MAR within existing qualified vessels.	Confines MAR during and after DBE.	Yes[2]
TEF STCS	Install a confinement system to credit the confinement of MAR within existing qualified vessels.	Confines MAR during and after DBE.	Yes[2]
HANM Exhaust Stack	Backfit and/or install new ducts, fans and diesel generator to credit the ability to exhaust air to a new 200 foot tall seismically qualified stack during and after a DBE.	Bin Reduction for LOC and explosion events in 233-H, This SSC will likely not provide any benefit to the FW.	No
Tritium Oxidation	Perform research to define a technically justifiable oxidation fraction for use in CTF DSA.	Removes overly conservative assumption of stoichiometric conditions in CTF DSA.	Yes

[1] Every SSC listed in this table is an active SSC with exception to Tritium Oxidation. Per DOE-STD-3009-94, only qualitative reductions will be taken in the safety basis.
[2] Information provided in this chart is based on SRNS experience using the preliminary information available.

CW: Co-located Worker CTF: Combined Tritium Facilities DSA: Documented Safety Analysis DBE: Design Basis Earthquake FW: Facility Worker HANM: H-Area New Manufacturing
HT-TCAP: Hydrogen Tritium Thermal Cycling Absorption Process LOC: Loss of Confinement MAR: Material at Risk MOI: Maximally-exposed Offsite Individual SDC-3: Seismic Design Category –3
SSCs: Structures/Systems/Components STCS: Seismic Tritium Confinement System TEF: Tritium Extraction Facility TFF: Tritium Finishing Facility

Co-Located Worker Dose Reduction Strategy Overview

Initiative	Progress			CW and FW Benefit[1]	MOI Benefit Potential	RM Cost[2]	Notional Duration[2]
	Evaluate Supporting SSCs	Evaluate Existing SSCs	Feasibility / Decision to Proceed				
TFF	30% Design Complete, Site Prep in progress			Provides Safety Class SSCs to house the MAR currently in 234-H and 217-H.	Yes[2]	Line Item >$300M	10-15 years
HANM Fire Suppression	2 ESR	4 ESR 1 CLC 2 RD		Bin Reduction for post seismic fire event in 233-H	Yes[2]	Line Item >$80M	10-15 years
TEF Fire Suppression	2 ESR	3 ESR 2 CLC 2 RD		Bin Reduction for post seismic fire event in TEF	Yes[2]	Line Item >$80M	10-15 years
HANM STCS (Backfit)	2 CLC 2 ESR 1 CDP	10 CLC	1 CDP 1 SDD 9 ESR	Confines MAR during and after DBE	Yes[2]	Project >$12M	8-12 years
HANM STCS (HT-TCAP)	2 ESR	2 CLC		Confines MAR during and after DBE	Yes[2]	Project >$12M	10-15 years
TEF STCS	2 ESR	2 CLC	1 ESR	Confines MAR during and after DBE	Yes[2]	Project >$12M	10-15 years
HANM Exhaust Stack	2 ESR	6 CLC 1 ESR		Bin Reduction for LOC and explosion events in 233-H, this SSC will likely not provide any benefit to the FW.	No	Line Item >$150M	15-20 years

[1] Every SSC listed in this table is an active SSC. Per DOE-STD-3009-94, only qualitative reductions will be taken in the safety basis.

[2] Information provided in this chart is based on SRNS experience using the preliminary information available. These estimations are subject to change as each of these scopes mature.

Completed In Progress Not Started

CDP: Conceptual Design Package CLC: Calculation CW: Co-located Worker DBE: Design Basis Earthquake ESR: Engineering Study/Report FW: Facility Worker HANM: H-Area New Manufacturing
HT-TCAP: Hydrogen Tritium Thermal Cycling Absorption Process LOC: Loss of Confinement M: Million MAR: Material at Risk MOI: Maximally-exposed Offsite Individual RD: Requirements Document
RM: Relative Magnitude SDD: System Design Description SSCs: Structures/Systems/Components STCS: Seismic Tritium Confinement System TEF: Tritium Extraction Facility TFF: Tritium Finishing Facility

Topic: Mass Casualty Event Drill & Exercises

Presenter: Wendy Lark, SRTE Training / Procedures / Emergency Preparedness Manager

Mass Casualty Event Drill and Exercises

- Savannah River Tritium Enterprise (SRTE) emergency management program
  - Four team members
    - *Program manager*
    - *Emergency preparedness coordinator*
    - *Lead controller*
    - *Scenario writer*

- Site emergency management department
  - Strengthened matrix between SRTE and site functional organization in May 2022
  - Enhanced overall SRTE development and response capabilities through collaboration

- Approved the Emergency Preparedness Performance Improvement Plan in August 2022

Emergency Preparedness Performance Improvement Plan

- Objective
  - Use structure, communication, and teamwork to improve the drill program by developing a higher level of preparedness
- Action categories
  - Drill conduct
  - Training
    - *Site EM requirement*
    - *SCD-7 Section 12 training requirements*
    - *Continuing training*
  - Drill Scenarios
    - *Approved*
    - *Exercise builder*
  - Programmatic / Administrative improvements
- Customer focused
  - Regular NNSA and DNFSB progress briefs
- Standardize approach
- Senior Management Oversight
  - Continuous improvements
  - Assist site transition process

- Mass Casualty Event Drill and Exercises
  - DOE O 151.1D: An incident in which the number of patients and the severity of their injuries exceed the medical systems and facilities as identified by the site/facility/activity. The incident produces more patients than the responding jurisdiction is routinely capable of handling, and necessitates an uncommon level of mobilization of resources.
    - *There are four ambulances on site, and each accommodates two casualties*
  - SRNS will execute a mass casualty exercise in Summer 2023
    - *SRTE benefits of Site Level Mass Casualty Exercise*
      - Management of patients, deceased, and post incident affairs
      - Exercises Sitewide radiological protection and occupational medicine program

Emergency Preparedness

- Scenario development (Per 6Q-006 Standards for the Development and Conduct of Drills and Exercises)
  - ✓ Involves direct participants as stakeholders in process
  - ✓ Establishes a Drill and Exercise Development Committee
    - *Selected with technical accuracy and validity of data in mind*
      - Dependent upon type, scope, and systems affected
    - ✓ *Complete pre-event walkdowns*
    - ✓ *Determine drill objectives and extent of play and simulation*
    - ✓ *Identifies participating organizations (fire department, Centerra, etc.)*
    - ✓ *Obtains subject matter expert review upon development (realism, accuracy)*
    - ✓ *Tabletop (If applicable)*
  - ✓ Final product includes purpose, scope, objectives, parameters, and drill play and cues
  - ✓ Stakeholder Reviews include: Site EM and drill team, SRSFD, PF, RPD, site exercise safety officer, interfacing EPC (H-Area), FMs, and NNSA/ DOE representatives
- SRTE Mass Casualty Drill & Exercise
  - Execution in FY 2024

EM	Emergency Management	PF	Protective Force
EPC	Emergency Preparedness Coordinator	RPD	Radiological Protection Department
FM	Facility Manager	SRSFD	Savannah River Site Fire Department

Topic: 233-H Inadvertent Stack Release

Presenter: Kevin Cross, SRTE Area Operations Manager

233-H Stack Release – Background

- January 30, 2022, SRTE experienced an inadvertent release of tritium from the 233-H stack, due to improper dispositioning of process tank contents.
- A rare meteorological condition (deep temperature inversion with high wind speeds) caused a portion of the inadvertent release (~1,000 curies of tritium) to be drawn down to the ground, of which approximately 1 curie of tritium re-entered the 233-H Facility via the building ventilation supply inlet.
- DNFSB issued a letter of concern on August 11, 2022, requesting a briefing to the Board regarding:
  - any plans to address this scenario in the hazards analysis, and
  - any improvements to SRTE's operations, safety controls, and planned responses.
- In November, 2022, the DNFSB was briefed on this subject

233-H Stack Release – Background (Cont.)

- SRNS has evaluated the events of January 30th related to the inadvertent release of tritium from the 233-H stack and re-entry, against the forthcoming Combined Tritium Facility (CTF) Safety Basis and determined that no additional analysis is required.
- N&CSE Programs has developed a Site-Wide applicable Engineering Study Report (ESR) documenting the impact of deep inversions with high wind speeds to dose consequence accident analysis methodology.
- The CTF Consolidated Hazard Analysis (CHA) will acknowledge the event and reference the ESR in inadvertent stacking events 233H-3-016 and 264H-3-009, pending final CHA revision.
- SRTE has developed and implemented operational improvements to minimize and address the possibility of tritium re-entry.

233-H Stack Release – Operational Improvements

Improvements to the SRTE Operations, Safety Controls, and Planned Responses to Abnormal Conditions (Protection of Workers)

- Response to Tritium Air Monitor (TAM) alarms
  - Personnel move away from alarms. Radiological Protection Department (RPD) provides escort / direction to lower areas of Tritium concentration.
- New protocols
  - Thresholds for expected and unexpected releases established at >500 Ci/hr of tritium or >2,000 Ci/day of tritium via a new Abnormal Operating Procedure (AOP).
  - Exceeding thresholds drives remain indoors, supervisory accountability, and follow-on discretionary bioassay.
  - Includes administrative buildings.
- Drills and exercises
  - Accountability has been drilled frequently and exercised (2Q-3Q FY22) to familiarize personnel with new protocols.

233-H Stack Release – Operational Improvements (cont.)

Review of Procedures Governing Gas Movements

- Technical Rigor added to Flammable Mix Disposition and Internal Gas Transfers procedures.
  - Procedures modified to explicitly require use of tritium processing systems for potential flammable mix disposition.

Improving the Safety of Planned Releases

- Proceduralized involvement of Savannah River National Lab (SRNL)Meteorology
- Proactive 'Remain Indoors' issuance

233-H Stack Release – Operational Improvements (cont.)

Conclusion

- The issue of Tritium re-entry into our facilities is being addressed rigorously. NNSA and SRTE have implemented measures to improve facility worker safety, based on application of DOE guidance and Conduct of Operations principles.
- SRTE has developed and implemented operational improvements to minimize the possibility of and address the response to potential Tritium re-entry. This includes a new AOP, proceduralized engagement with SRNL on planned releases, and improved technical rigor in gas movements.

Topic: CY25 Outage Brief

Presenter: Michael Collins, SRTE Deputy Senior Vice President

CY25 Outage – Bottom Line up Front

- HANM operations will continue during the outage
- The Thermal Cycling Absorption Process (TCAP) outage is required to provide continued support to the Weapons Stockpile
  - TCAP is the system capable of producing Tritium required to maintain the Stockpile
  - TCAP and the support equipment, Hot/Cold Nitrogen, are past the end of expected life
    - *Systems will be approximately 35 years old at the time of replacement*
    - *TCAP production has sacrificed the quantity of gas produced to maintain quality, and replacement is required to restore the system capacity*
    - *Room 17 Valves are obsolete and create a radiological hazard*
  - Based on reservoir production directives, CY25 is the best time frame to perform this outage
    - *Any other time frame will require significant changes to the Limited Life Component Exchange (LLCE) and Life Extension Program (LEP) schedules to accommodate an outage window*
    - *Specific programs have minimal loading requirements in CY25*
    - *Hydrogen/Tritium-Thermal Cycling Absorption Process (HT-TCAP) System can meet all other Tritium needs during this window*

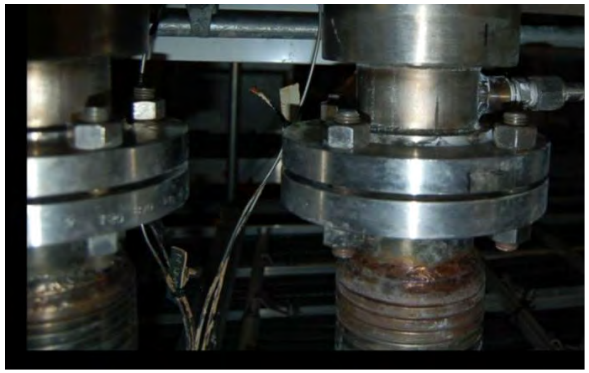
CY25 Outage – Scope of Projects

- Six discrete projects
  - Y839 HANM Rm 17 Valves Replacement
  - Y840 HANM Rm 16 Chillers Replacement
  - Y841 HANM Rm 17 TCAP Restoration
  - Y842 HANM Rm 16 Cold Compressors Replacement
  - Y843 HANM Rm 16 Hot Compressors Replacement
  - Y844 HANM Rm 16 Remaining Valves Replacement

One of two existing TCAP Columns to be replaced

- One design complete; all critical procurements awarded

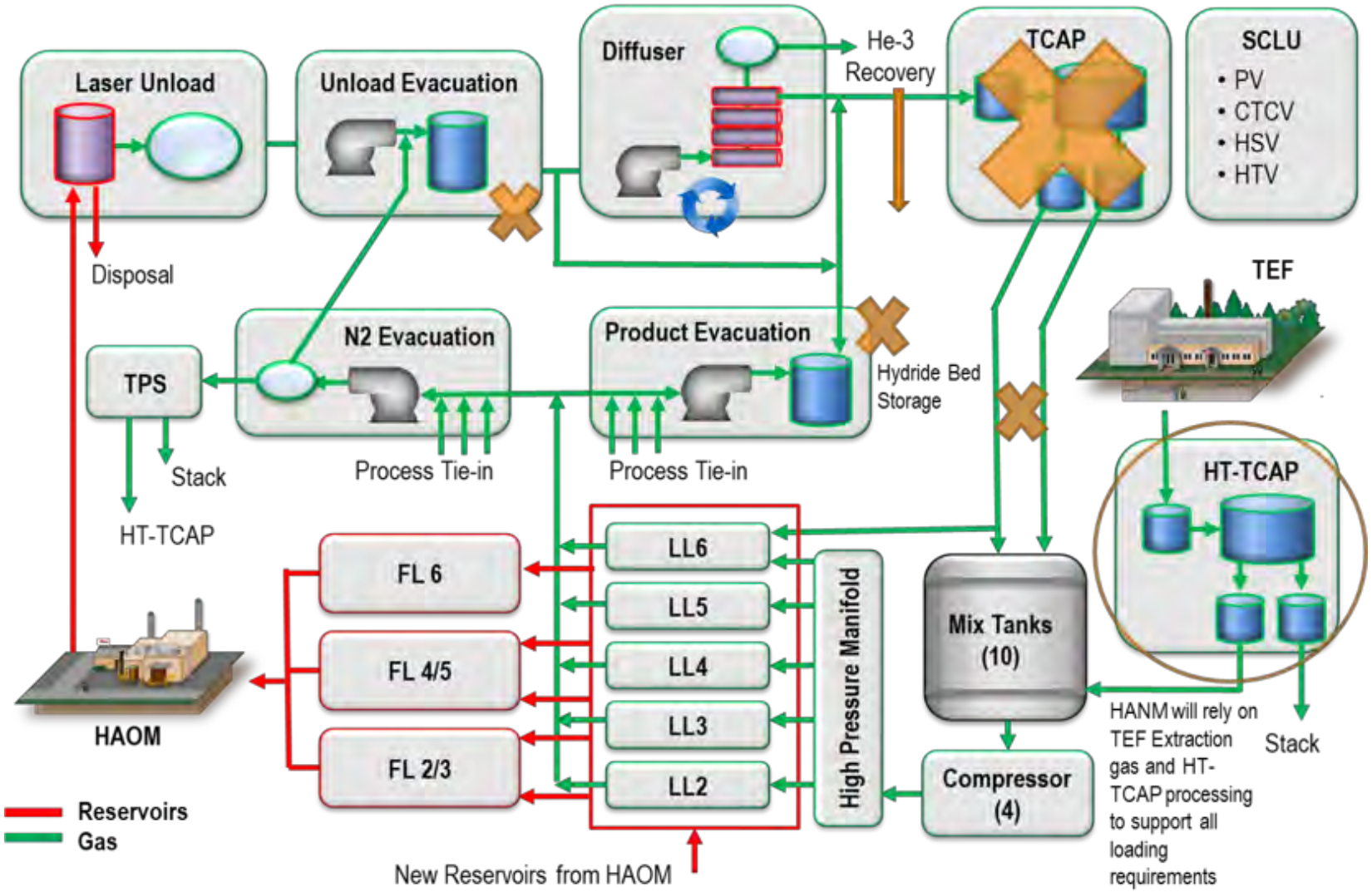
Existing valves to be replaced with cryogenic valves



One of six Glovebox Penetration Plates to be replaced

Existing Hydride Bed Stages shown above (14 will be replaced)

CY25 Outage – Process Impacts



CY25 Outage – Additional Considerations

- Overall total workload in HANM increases during the Outage
  - *Decreased Unloading and Helium processing requirements*
    - The facility goal is to have all CY25 unloading needs complete in early CY24
    - HANM must maintain the ability to unload
  - *All other gas processing will still operate ~ at normal (including isotopic separation)*
    - HT-TCAP, N-EVAC, Stripper, Z-Bed Recovery, Tritium Process Stripper, Mixing, Loading, Finishing P-EVAC, Reservoir Surveillance, Lab, SCLU, etc.
  - *All normal Surveillance and Preventative and Corrective Maintenance is still required*
    - Glovebox O2 Functionals, TAM Functionals, Stack functionals, etc.
    - Routine repairs
  - *Some HANM ops increase to support the outage (Construction activities 20 hours, 5 days a week)*
    - OGM Rounds and Fire Patrols
    - Rooms 16 and 17 condensed functional checks
    - Special HVAC/operation controls required (Hatch Pulls)
    - Pre-Job Briefs and work release/monitoring
    - Increased RadCon monitoring
    - Escorting Craft personnel
    - Air Balance support
    - Increased waste, laundry, and supplies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