

NSTX-U Accelerator Safety Order Awareness Training

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Introduction to this Training

Who:

- All personnel who have card reader access to D-Site

What:

- General structure of the ASO, hazards, and their controls
- Configuration management and change control

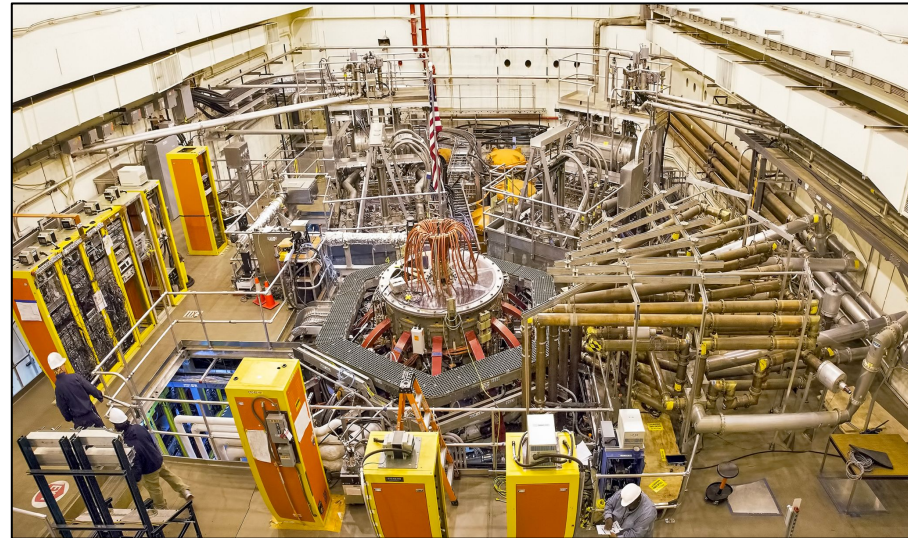
Why:

- To keep you and your colleagues safe
- To maintain compliance with PPPL policies and contract obligations*

* DOE O422.2D *Safety of Accelerators*

Goal:

- Understand the key ASO phrases
- Understand how to identify and work around credited controls
- Understand what to do if you find a compromised safety system
- Understand how to get more information



Key Requirements of the ASO

- Safety Assessment Document (SAD)*
 - The SAD summarizes the hazard analysis
- Accelerator Safety Envelope (ASE), defining the credited controls.
 - Credited Controls = systems and policies which form the first line of defense against Accelerator Specific Hazards
- Clearly defined roles and responsibilities for accelerator activities (training and procedures)
- An Unreviewed Safety Issue (USI) process
 - USI process assess designs, planned work, as-found conditions relative to the documented safety analysis and fielded credited controls.
- An Accelerator Readiness Review program

*SAD for NSTX-U is in final review (July 2023), will be available in the PPPL Document Management System

We Manage Hazards in One of Two Buckets

Hazards Managed Fully by PPPL Institutional Programs

| Hazards (examples) | Mitigations (examples) |
|----------------------------|---|
| Electrocution, Arc-Flash | LOTO program (ESH-016) |
| Activation & Contamination | Safety Manual (ES&H 5008), HP procedures |
| Pressure Vessel Rupture | Pressure System Program (ES-MECH-15) |
| Material Handling | Hoisting and Rigging program (ES-MECH-07) |
| Confined Space | Safety Manual (ES&H 5008) |

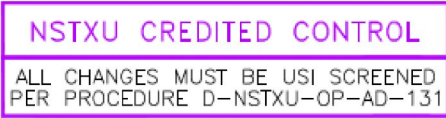
Accelerator Specific Hazards

| Hazards | Credited Controls - Specified in ASE |
|------------------------------|--|
| Direct Ionizing (D-D fusion) | PSS-SIS (PLC Access Control Systems) |
| | Test Cell Perimeter Guards (Locks and Cages) |
| | Test Cell Shielding |
| Cryogenic ODH | Alarming ODH Monitors |

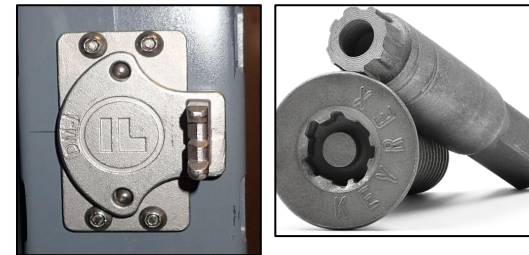
Configuration Management (CM) is Critical for Credited Controls to preserve their integrity

- CM policies from engineering and NSTX-U procedures*
- Defines controls such as:
 - Special stamps on drawings
 - Labeling of field components
 - Tamper resistant fasteners
- All credited controls are indicated by purple labels
 - Items with these labels can only be modified by the authorized completion of approved PPPL procedures
 - Example: Cable-tying something to a purple labelled conduit is considered a modification
 - If you see that one has an issue, don't fix it yourself; tell the shift supervisor, your supervisor or research contact, members of engineering leadership

* See D-NSTXU-OP-AD-134 *Configuration Management of NSTX-U Credited Controls*



Drawing Stamp



Bryce Fasteners

Labels



Unauthorized modification of Credited Controls can compromise a key safety system.

This is equivalent to "crossing the red tape"

Can trigger disciplinary actions including unpaid time off or termination.



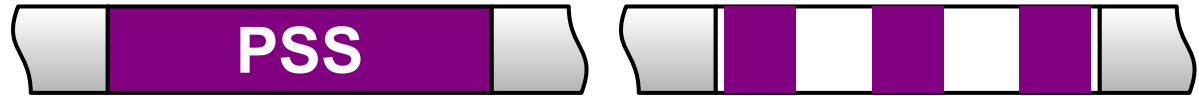
Examples of Enclosure and Conduit Labeling



SEARCH & SECURE STATION



CONDUIT LABELING IN THE FIELD



TYPICAL CONDUIT LABELING

Examples of Labeling on Devices and Shielding



PSS-SIS SENSORS IN RECTIFIERS AND NB POWER SUPPLIES



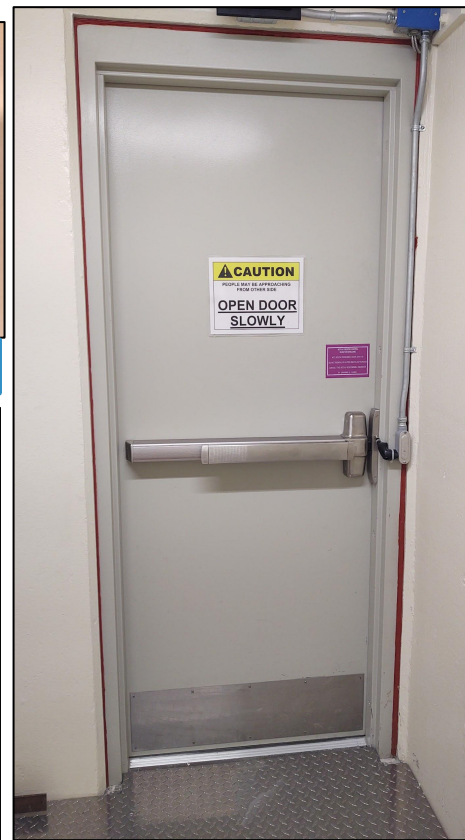
PSS-SIS INSTRUMENTED MEDIUM VOLTAGE BREAKER



BREAKERS ON THE AC DISTRIBUTION



SHIELDING



Credited Control #1: Shielding

Credited Shielding

- Test cell walls, floor, ceiling
- Southeast labyrinth
- Two motorized shield doors
 - Redundant PSS-SIS sensors
- One hinged shield door
 - Redundant PSS-SIS sensors
- Immobilized pass-through window shield blocks
- Penetration fill materials per approved drawings



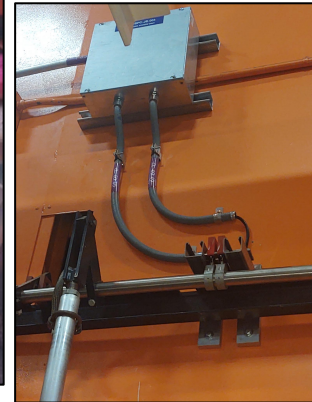
Unshielded penetrations

- A small number of large unshielded penetrations remain
 - Analysis shows that these present acceptably low risk



Credited Control #2: PSS-SIS

- PSS-SIS provides access control to the:
 - NSTX-U Test Cell (NTC)
 - MER Mezzanine (MERMEZ)
 - Caged area in the TFTR basement
 - Cable Spread Room
- Doors interlocked and emergency stop buttons monitored.
 - Disables coil and neutral beam power following a violation.
- Other key functions
 - Test Cell and MERMEZ search and secure coordinated.
 - Ensures power is not applied to coils or beams when test cell is in access.
- Distributed over essentially all of D-Site: Motor generator, Field Coil Power Conversion, NTC, TFTR Basement, NBPC, Tunnel, etc. plus C-Site Control Room and FCC
- Redundant and fail safe



Credited Control #3: Perimeter Guards

Perimeter guards are a set of trapped keys and vestibule cages, which supplement the PSS-SIS for access control, i.e. they lock a secondary barrier.

Test cell perimeter guards are defined as:

1. North door vestibule cage and trapped key lock
2. South door vestibule cage and trapped key lock
3. Trapped key interlock on the south motorized shield door controls
4. Trapped key interlock on the west motorized shield door controls



Test Cell Southgate



Test Cell Northgate



TFTR Shield
Door Control
Panel



NB Shield Door
Control Panel

Credited Control #4: Alarming ODH Monitors



Typical Redundant Monitor Installation

**Following a readiness review in May 2023, we are reevaluation the classification of this system*



Visible Alarms and Horns within and at entrances to spaces; triggered when the oxygen level drops beneath 19.5%

Typical Remote Sensing Locations



| | Location | Credited |
|---|--|-----------------------|
| 1 | NSTX-U Test Cell | Yes |
| 2 | Compressor Room | Yes |
| 3 | Penthouse (neutral beam) | Yes |
| 4 | Gallery | Reevaluating* |
| 5 | Southwest Stairs and Transformer Alley | No - Defense in Depth |

USI Process Is Key to Configuration Management under the ASO

Fundamental Purpose: Evaluate proposed changes and as-found conditions to determine if they will impact or require a change to the safety analysis or credited controls

Screening*: Rapid evaluation of the proposed change or as-found condition to determine if it *might* impact the safety analysis or credited controls. If “yes”, then...

Unreviewed Safety Issue Determination (USID):** Formal, reviewed, and documented evaluation of whether the change or as-found condition modifies a credited control or documented hazard analysis. If “yes”, then...

Unreviewed Safety Issue (USI): Actions taken to address the issue including halting operations, corrective actions, updates to the safety analysis, DOE approval to restart

*D-NSTXU-OP-AD-131 NSTX-U Unreviewed Safety Issue Screening Procedure

** ESH-028 Accelerator Unreviewed Safety Issue Procedure

Unreviewed Safety Issue (USI) Screening

- This process determines if proposed changes or as-found conditions MIGHT violate the conditions of the hazard analysis or impact a credited control. Typical instances:
 - “I want to make a new penetration in the shield wall.”
 - “My installation procedure shuts off power to a panel.”
 - “I was walking through the test cell and found a PSS-SIS conduit that was damaged.”
- Screening proposed activities for possible USIs including:
 - All D-Site Work Permits
 - All AC Power Switching Orders that impact D-Site
 - All D-Site facility work orders
 - The creation, revision, and minor changes to D-Site procedures
 - All NSTX-U design reviews
 - As-found conditions
- If the screening comes up “yes”, then the formal USI process is initiated (previous slide).

If you see a condition in the facility that is potentially unsafe, or the may compromise a safety system, say something

See procedure *D-NSTXU-OP-AD-131* for the details

Accelerator Safety Order Summary

- The NSTX-U SAD identifies hazards, summarizes their analysis, and documents the mitigation.
- The Accelerator Safety Envelope (ASE) is derived from the SAD and specifies the credited controls.
- Credited Controls are used to mitigate accelerator-specific hazards.
 - They have purple labels, tamper resistant fasteners, etc.
 - Do not touch unless you are authorized, and are using approved work documents (e.g. procedure, T-MOD, D-Site Work Permit, etc.)
- The USI process assesses the impacts of proposed changes and as-found conditions
 - If you find an unsafe condition or a modified/compromised safety system, we need to know it.
 - Tell the shift supervisor, your supervisor, any member of engineering or research management

Key References

- DOE O 420.2D, *Safety of Accelerator Facilities*
- DOE G 420.2-1A, *Accelerator Facility Safety Implementation Guide*
- *NSTX-U Safety Assessment Document (SAD)* - in final approval cycle
- ESH-027, *Accelerator Safety Procedure*
- ESH-028, *Accelerator Unreviewed Safety Issue Procedure*
- P-111, *Accelerator Safety Order Implementation*
- D-NSTXU-OP-AD-131, *NSTX-U Unreviewed Safety Issue Process*
- D-NSTXU-OP-AD-134, *Configuration Management of NSTX-U Credited Controls*