

NSTX-U Trapped Key System (TKS) Requirements

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Record of Revisions

Date	Version	Brief Description of Changes
6/12/19	Rev 0	Initial Release
11/25/19	Rev 1	Added references 4 and 5
		Minor changes to naming conventions in Table 3.1-2
		Updated Table 3.2-3
		Added 3.1e

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References

- [1] NSTX-U-RQMT-GRD-001, NSTX-U General Requirements Document
- [2] NSTX-U-RQMT-SRD-012, NSTX-U SRD – Operations and Safety Systems
- [3] NSTX-U-RQMT-RD-027, NSTX-U Configuration Managed Safeguard Requirements
- [4] NSTX-U-RQMT-RD-024, NSTX-U Personnel Safety System - Safety Instrumented System Requirements
- [5] NSTX-U-RQMT-RD-025, NSTX-U Centralized Control System Requirements

1: Scope

a. This document provides specific implementation requirements for the NSTX-U Trapped Key System (SBS # 1.7.3.10)

b. System requirements are provided in Operations and Safety Systems System Requirements Document [2].

2: Definitions

Definitions relevant to this RD are provided in the Ref. [2].

3: Requirements

3.1 Trapped Key System Locations

a. The trapped key system shall not allow the neutral beam system to transmit high voltage to the test cell, unless the conditions in Table 3.1-1 are met:

Table 3.1-1: *Trapped Key System Conditions required in order for Beam Acceleration*

#	Condition
1	South vestibule door closed
2	North vestibule door closed
3	South shield door closed
4	West shield door closed
5	TVPS cage closed
6	Neutral beam gallery cage closed.
7	MER Mezzanine vestibule door closed
8	TCB Ground Cage closed

b. The trapped key system shall not allow the FCPC high voltage to be placed into an unsafe configuration with regard to test cell hazards, unless the conditions in Table 3.1-2 are met:

Table 3.1-2: *Trapped Key System Conditions required to make the test cell unsafe with regard to voltage hazards from FCPC.*

#	Condition
1	South vestibule door closed
2	North vestibule door closed
3	South shield door closed
4	West shield door closed
5	TVPS cage closed
6	Neutral beam gallery cage closed
7	MER Mezzanine vestibule door closed
8	Moveable Safeguards in their proper location ¹
9	TCB caged area closed
10	Cable spread room closed
11	TCB ground cage closed

c. The trapped key system shall not allow the HHFW system to transmit RF power to the test cell unless the conditions in Table 3.1-3 are met.

¹ Specific safeguards are listed in NSTX-U-RQMT-RD-027

Table 3.1-3: Trapped Key System Conditions required in order to make the HHFW system unsafe with regard to the test cell hazards.

#	Condition
1	South vestibule door closed
2	North vestibule door closed
3	South shield door closed
4	West shield door closed
5	TVPS cage closed
6	TCB ground cage closed

d. The trapped key system shall not allow the HTHS to heat He unless the conditions in Table 3.1-4 are met.

e. The TKS shall support personnel accountability for the search and secure team for complex searchable areas.

Table 3.1-4: Trapped Key System Conditions required in order to heat He in the HTHS

#	Condition
1	Cage around heating skid closed
2	Safeguards on He pipes in correct configuration

3.2 Trapped Key System Interdiction Points

- a. For the control of neutral beam hazards, the TKS may interdict control circuitry in the local control centers until the conditions of Table 3.1-1 are met. The system may allow high voltage to be armed while test cell access is allowed, if the integrated operation of the beamline that prevents a NB to form is controlled by the TKS.
- b. For the control of FCPC hazards, the TKS shall prevent pressurization of the Safety Lockout Device when the conditions of Table 3.1-2 are not met, unless the TKS configuration ensures that the PCTS Dummy Load Shield guard is in place (and therefore, no coils are connected to FCPC).

- c. For the control of HHFW hazards, the TKS shall prevent the coaxial switches in Table 3.2-1 from directing power towards the NTC when the conditions of Table 3.1-3 are not met.

Table 3.2-1: Coaxial switches to be configuration controlled by the TKS

	Area
1	RFE Coaxial Switches HHFW #1
2	RFE Coaxial Switches HHFW #2
3	RFE Coaxial Switches HHFW #3
4	RFE Coaxial Switches HHFW #4
5	RFE Coaxial Switches HHFW #5
6	RFE Coaxial Switches HHFW #6

- d. For the control of hot He hazards from the HTHS, the TKS shall prevent prevent the heater from being energized if the conditions in Table 3.1-4 are met.

3.3 Trapped Key System HMI

- a. The status of specific key blocks shall be made available to the PSS-SIS for display in the NSTX-U control room as defined in REF [4].
- b. The status of specific key blocks shall be made available to the CCS for display in the NSTX-U control room as defined in REF [5].
- c. The Emergency Egress status of each TKS personnel access door so equipped shall be made available to the PSS-SIS for display in the NSTX-U control room.