



# RD - REQUIREMENT DOCUMENT

## NSTX-U RECOVERY PROJECT NEUTRAL BEAM DUCT REQUIREMENT

*NSTXU\_1-2-4-3-1\_RD\_100*

*Rev. 1*

Work Planning #:  
Effective Date: **02/26/2020**  
Prepared By: **Yusi Cao**

Reviewed By	Stefan Gerhardt, System Engineer	02/24/2020 12:23:42 PM
Reviewed By	Timothy N. Stevenson, Responsible Engineer	02/24/2020 16:25:40 PM
Approved By	Yuhu Zhai, Project Engineer	02/26/2020 09:53:29 AM



# Neutral Beam Duct Requirement Document

NSTXU\_1-2-4-3-1\_RD\_100

February 24, 2020

---

Prepared by: A. Cao, Project Cognizant Engineer

---

Reviewed by: S. Gerhardt, Systems Engineering and Integration

---

Reviewed By: T. Stevenson, NSTX-U Operations Head, OSS RE

---

Approved By: Y. Zhai, NSTX-U Project Engineer



### Record of Revisions

Date	Version	Brief Description of Changes
11/1/19	Rev 0	Initial Release
02/24/20	Rev 1	Consolidated HEAT-191031-YC-01 Memo into NSTXU_1-2-4-3-1_CALC_100

<b>Analysis Requirement</b>	<b>3</b>
Power Loading	3
Disruption Loads	3
<b>Materials and Design Requirements</b>	<b>3</b>

## References

- [1] NSTX-U-RQMT-SRD-007, Plasma Heating and Current Drive
- [2] NSTX-CRIT-0001-02, NSTX Structural Design Criteria
- [3] NSTXU\_1-2-4-3-1\_CALC\_100, Neutral Beam Duct Guard Calculation
- [4] NSTX-U-CALC-40-01-00, Analysis of Diagnostic and Diagnostic Shutter
- [5] NSTX-U-RQMT-RD-015, Recovery Project Bakeout Upgrades
- [6] NSTX-U-RQMT-RD-003, NSTX-U Disruption Analysis Requirements

## Scope

The scope of this document is limited to requirements for the NSTX-U Recovery Project, Neutral Beam Duct Shielding in Bay K, Project WBS 1.04.01.03.

These requirements flow from the statement in the NSTX-U Plasma Heating and Current Drive SRD [1] calling for appropriate armor in the beamline ducts.

This document does not address molybdenum shielding in the ducts that is not part of the Recovery Project WBS 1.04.01.03.

## Analysis Requirement

The design of duct shields shall satisfy the NSTX-U Structural Design Criteria [2].

Reionized power to the duct shields from the neutral beams shall be assumed to be  $184.5 \text{ kW/m}^2$  [3].

Radiation from plasma shall be assumed to be the 100% radiated power scenario to the first wall,  $130 \text{ kW/m}^2$  [4].

Disruption loads shall be computed from the methods in Ref. [5].

The shields must accommodate the bakeout scenarios as described in Ref. [6].

## Materials and Design Requirements

Shielding in Bay K shall cover all surfaces of the duct that are radial to the neutral beam path.

If Mo TZM is used as the duct material, then the recrystallization temperatures shall not be reached even after the predicted thermal ratcheting occurs.

If practical, thermocouples shall be installed on the duct shielding to assess the temperature evolution of the plates during operations and bakeout scenarios.