

Second Target Station: Target Systems Requirements



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Second Target Station

**SECOND TARGET STATION:
TARGET SYSTEMS REQUIREMENTS**

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LIST OF ABBREVIATIONS

SNS Spallation Neutron Source
STS Second Target Station

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DEFINITIONS

Shall, must, will, may, and should are used to define each individual requirement. The definitions of these terms are as follows:

- Shall – is a requirement that is binding and must be implemented
- Must – is an absolute, binding alternative to “shall” or “requirement”
- Will – is used to inform intent or declaration of purpose
 - This is not a requirement; the author must use the word ‘shall’ to indicate that a requirement is binding and must be implemented
- May – is used to indicate a desire or goal of a requirement
 - This can also be interpreted ‘as nice to have’ and is not binding
- Should – is used to indicate a desire or goal of a requirement
 - This can also be interpreted ‘as nice to have’ and is not binding

“Not” is used in combination with the above terms to indicate the opposite; that is, “shall not” and “must not” describe prohibited

CD-2

DOE Critical Decision 2 – Approve Performance Baseline

CD-4

DOE Critical Decision 4 – Approve Start of Operations or Project Completion

1. INTRODUCTION

This Requirements Document serves to establish the requirements of the L2 Target Systems for the Second Target Station (STS). Subsystems within Target Systems will generate L3 or lower level requirements based on these requirements as applicable and will maintain those requirements in separate requirements documents.

2. SCOPE

The scope for the STS Target Systems includes the design, procurement and installation of the equipment and associated technical systems necessary to generate cold neutrons using the pulsed proton beam delivered from the Spallation Neutron Source (SNS) accelerator and distribute those neutrons to twenty beamlines. Figure 1.

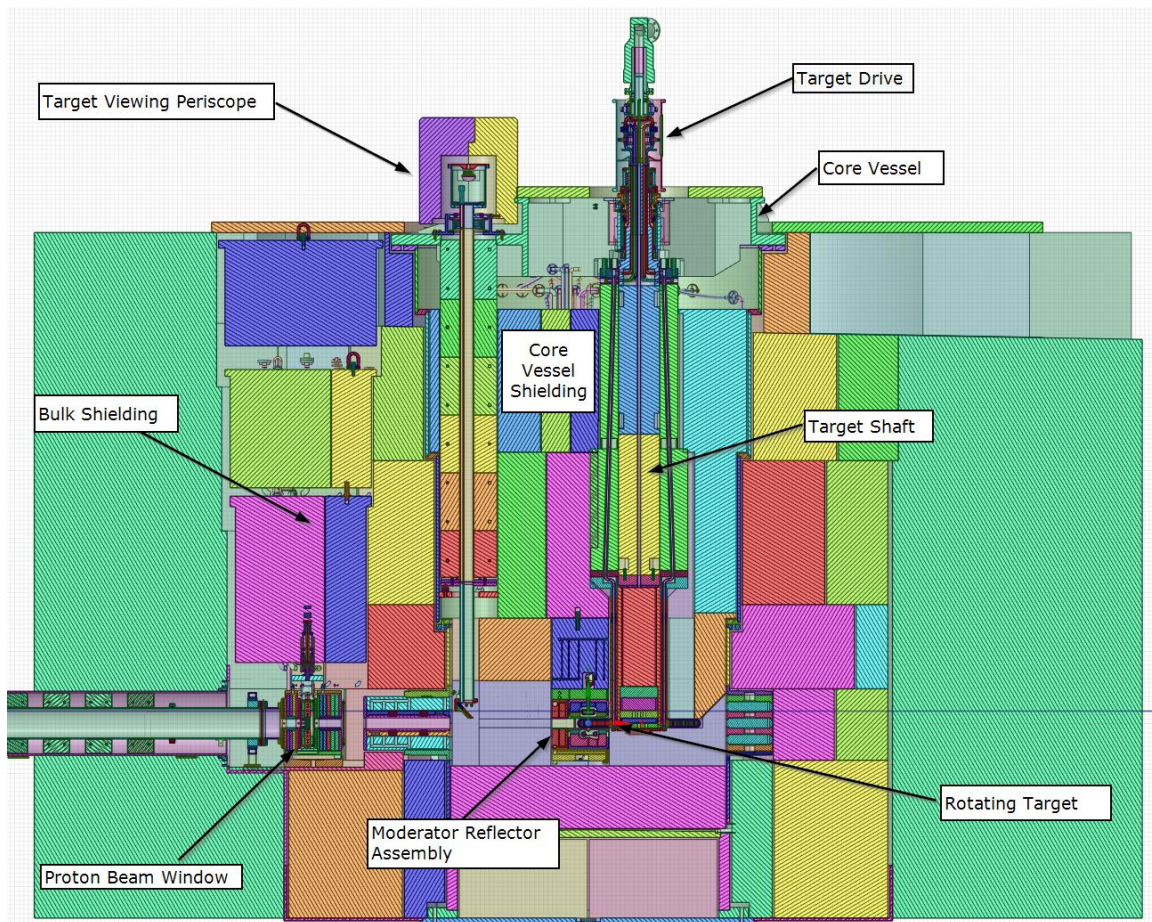


Figure 1. Target Systems hardware within the monolith

3. REQUIREMENTS

Requirement: 1028 - Accept Beam from Accelerator

The Target Systems shall accept a pulsed proton beam of 700 kW, 1.3 GeV, 15 Hz from Accelerator Systems.

Upstream References: 1008

Requirement: 1029 - Peak Brightness

The Target Systems shall convert the proton beam pulses into cold neutron pulses using high-brightness moderators that will meet or exceed the peak brightness of $2 \times 10^{14} \text{ n/cm}^2/\text{sr}/\text{\AA}/\text{s}$ at the neutron wavelength $5\text{\AA}$.

Upstream References: 1009

Requirement: 1030 - Number of Beamlines

The Target Systems shall distribute neutrons to 22 beamlines.

Upstream References: 1012

Requirement: 1031 - Consider Background Effects

The Target Systems design shall consider instrument background.

Upstream References: 1010

Requirement: 1032 - Operational Life

The Target Systems design shall allow for a lifetime of forty years of operation with a year as defined in [S00000000-IST10000] and the beams defined in [S01020500-IS0002].

Upstream References: 1013

Requirement: 1033 - Yearly Operating Hours

The Target Systems design shall allow for greater than five thousand hours of proton beam on target per year with accommodation for maintenance intervals in accordance with the STS operating schedule, [S00000000-IST10000].

Upstream References: 1014

Requirement: 1034 - Availability

The Target Systems design shall allow for greater than 95% availability.

Upstream References: 1015

Requirement: 3009 - Maintenance & Lifetime Criteria

Components shall meet one of the following criteria

Reliability and Maintainability Group	Replacement Time (Beam on-off)	Minimum Life-time*	Failure Indication
Life of Facility	N/A	40 yrs	Not anticipated
Group A (long outage, predictable failures)	1400 hours	5,000 hrs	predictable and with diagnostic warning
Group B (Long outage replacement, anticipated failures with significant consequences)	250 hrs**	2,500 hrs***	Less predictable, unreliable diagnostics
Group C (Short Outage replacement)	72 hrs	500 hrs	N/A
Group D (tuning outages)	16 hrs	192 hrs	N/A

Table 1

**Note 1: Represents the technical minimum required to meet availability. Replacement at these rates would be unrealistic for most components due to costs, labor, and disposal considerations. Further margin is recommended.*

***Note 2: The replacement time for replacement without exceeding the allowed downtime is 250 hours. This criterion is much more stringent than the long outage. Therefore, the more stringent value is the requirement.*

****Note 3: The budget would be 1,250 hours, but the project desires to avoid replacement of large expensive components more frequently than once per year."*

Group B down time of 250 hours come from the 95% availability requirement. For 5000 hours of run time, the most unscheduled down-time allowed is 250 hours (5% of 5000 hours).

The table above is based upon the following downtime schedule and assumptions below:

Group	QTY	Duration (hours)
Group A	2	1400
Group C	4	72
Group D	12	16

Table 2. Downtime Schedule & Assumptions

Note: The down time numbers come from the following: 8760 hours/year – 2(2500 hour run window) = 3760 hours available for maintenance. 3760 hours – 2(1400 hour long outages) = 960 hours remaining. 960 hours – 8(72 hour medium outage) = 384 hours remaining. 384 hours / 16 hour short outage = 24 short outage periods.

Assumes maintenance workers are available 12 hours per calendar day.

Assumes spares are available in accordance with each subsystems maintenance manual.

Upstream References: [1034](#), [1033](#)

Requirement: 1035 - Safe Operation

The Target Systems design shall allow safe operation.

Upstream References: [1017](#)

Requirement: 1036 - Radiation Safety

The Target Systems design shall prevent the release of contamination and limit exposure ALARA in accordance with the STS Radiation Safety Policy and Plan.

Upstream References: 1017

Requirement: 1037 - Replacement and Disposal Path

The Target Systems design shall include a replacement scheme and disposal path for all perishable components.

Upstream References: 1013, 1014, 1015, 1017

Requirement: 1038 - Remote Handling Equipment Lifetime

The Target Systems design shall allow for fifty years of operation for remote handling equipment.

Upstream References: 1013

Requirement: 1039 - Accelerator Systems Connection

The Target Systems shall provide a connection to the Accelerator Systems upstream of the Target Station Monolith for the transport of the proton beam to the Target.

Upstream References: 1008

Requirement: 1040 - Isolated Environments

The Target Systems shall isolate the Target environment from the Accelerator Systems beamline environment.

Upstream References: 1008

Requirement: 1041 - Measure beam profile & position

The Target Systems shall provide the means to measure proton beam position and profile delivered by the Accelerator Systems.

Upstream References: 1008

Requirement: 1042 - Accommodate timing & monitoring

The Target Systems design shall provide for monitoring and operation and will accommodate timing triggers provided via the SNS control system,

Upstream References: 1007

Requirement: 1043 - Interface - Conventional Facilities

The Target Systems shall be designed to make use of lifting capacity, power, chilled water and other utilities within the limits made available by Conventional Facilities where such service would be necessary for operation and maintenance.

Upstream References: 1008, 1009, 1012, 1013, 1014, 1015

Requirement: 1478 - Hydrogen Boundary interactions

Components shall not damage (inadvertent contact) the hydrogen boundaries, regardless of load combination.

"Note: This requirement specifically includes seismic loads"

Upstream References: