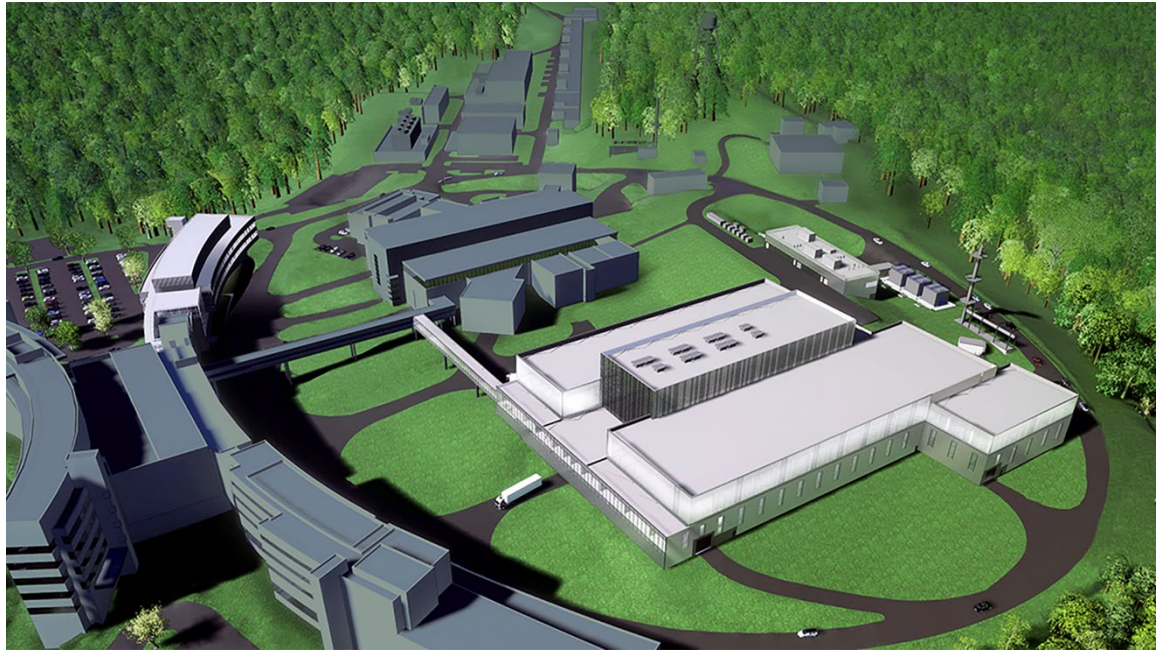


Second Target Station (STS): Target Station Shielding Requirements



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Second Target Station Project

Second Target Station (STS) Target Station Shielding Requirements

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March 2025

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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 prohibitions.

Target Station Shielding Requirements

1 General

General Target Station Shielding Requirements

CodeBeamer reference: [S.03.07-7195](#)

1.1 Carbon Steel Temperature Limit

Target Station Shielding carbon steel structures should have a maximum operating temperature of 200 C.

CodeBeamer reference: [S.03.07-6138](#)

Upstream References (1)

S.03-3009	Maintenance & Lifetime Criteria
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2 Safety Requirements

Requirements derived from the Preliminary Hazzard Analysis Report.

CodeBeamer reference: [S.03.07-6988](#)

2.1 Non-Flammable Shielding

Target Station Shielding components shall be made of non-flammable materials.

PHAR References:

*BG1-1, BG6-9, **BG6-9 (Credited)**, BG7-1A, BG7-11*

CodeBeamer reference: [S.03.07-6982](#)

Upstream References (2)

S.03-1036	Radiation Safety
S.03-1035	Safe Operation

2.2 Protect Cryogenic Transfer Lines

Target Station Shielding shall not permit motion of the shielding to cause the cryogenic transfer lines to release Hydrogen under SDC2 seismic conditions.

PHAR References:

AIC7-1, BG6-9 (Credited), BG7-1A (Credited), BG7-2, BG7-11, BG7-12, CMS7-1, CMS7-5

CodeBeamer reference: [S.03.07-6983](#)

Upstream References (2)

S.03-1035	Safe Operation
S.03-1036	Radiation Safety

2.3 Shielding Anchoring

The Target Station Shielding shall be anchored in such a way to limit motion of the bulk shielding relative to the monolith floor or relative to different shielding layers to < 0.1 mm under SDC Level 2 seismic loads.

PHAR References:

AIC7-11, BG7-2, BG7-12, CMS7-1, CMS7-3, HPV3-4B

CodeBeamer reference: [S.03.07-6984](#)

Upstream References (2)

S.03-1036	Radiation Safety
S.03-1035	Safe Operation

2.4 Radiation Shielding Performance

Target Station Shielding, along with the other Target Systems components in the Monolith and Target Drive Room, shall not prevent necessary operations in the high bay due to radiation dose.

PHAR References:

VS4-1 (Credited)

CodeBeamer reference: [S.03.07-6986](#)

Upstream References (2)

S.03-1036	Radiation Safety
S.03-1035	Safe Operation

2.5 Target Protection during LOCA

Target Station Shielding hardware shall assist in keeping the target temperature below 800C under loss of cooling event.

Note: The shielding acts as a thermal sink that helps maintain target temperatures of < 800 C during a loss of cooling event.

PHAR References:

BG7-8, BG7-9A, BG7-12, CMS7-1, CMS7-3, CMS7-5, TS3-2, TS3-3, TS3-5, TS3-6, TS3-7

CodeBeamer reference: [S.03.07-6987](#)

Upstream References (2)

S.03-1035	Safe Operation
S.03-1036	Radiation Safety

2.6 Target Temperature Limit During Facility Fire

Monolith shielding shall assist in keeping target temperature below 800C under reasonable fire conditions.

PHAR References:

BG1-1, BG6-9 (Credited), BG7-1A, BG7-11, CMS7-3, CMS7-5

CodeBeamer reference: [S.03.07-6977](#)

Upstream References (2)

S.03-1036	Radiation Safety
S.03-1035	Safe Operation

2.7 Impact Damage Protection

The Monolith steel shielding shall protect the Target Feet and Moderator Reflector Assembly from physical impact damage when installed and in the operational configuration.

Note: Target Station Shielding does not protect Moderator Reflector Assembly or Target feet that have been removed from their home positions within the monolith.

Note: Target station shielding provides less protection when removable shielding is not in place during maintenance activities.

PHAR References:

BG6-9 (Credited), BG6-10, BG7-4, CMS2-5

CodeBeamer reference: [S.03.07-6978](#)

Upstream References (2)

S.03-1035	Safe Operation
S.03-1036	Radiation Safety

2.8 Bulk Shielding Liner Leak Collection

A bulk shielding liner shall capture water leaks at the bottom of the Monolith and drain to a connected leak collection system.

PHAR References:

CMS1-4, CMS2-5, LCS1-1, LCS2-1, LCS3-1, LCS3-2, LCS3-3, LCS4-1, VS3-1

CodeBeamer reference: [S.03.07-6979](#)

Upstream References (4)

S.03.05.02-3795	PBW Cooling
S.03.05.06-3786	PBW Shielding Cooling
S.03-1036	Radiation Safety
S.03-1035	Safe Operation

2.9 Pipe Pan Drain

Pipe Pans shall capture water leaks in the Target Drive Room and drain to a connected leak collection system.

PHAR References:

CMS1-4, CMS2-5, LCS1-1, LCS2-1, LCS3-1, LCS3-2, LCS3-3, LCS4-1, VS3-1

CodeBeamer reference: [S.03.07-6980](#)

Upstream References (2)

S.03-1035	Safe Operation
S.03-1036	Radiation Safety

3 TSS-CMS Interface

Requirements derived from Interface Sheet S03000000-IST10011.

CodeBeamer reference: [S.03.07-7199](#)

3.1 Transfer line Clearance

Target Station Shielding shall provide an unobstructed path through the pipe pan for the hydrogen transfer line per Interface Sheet S03000000-IST10011.

CodeBeamer reference: [S.03.07-7201](#)

Upstream References (1)

S.03.03.01-6102	Hydrogen Transfer Line Routing Requirement - Credited
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3.2 Transfer Line Seismic Protection

Target Station Shielding shall prohibit the pipe pan from damaging the hydrogen transfer line during a seismic event per Interface Sheet S03000000-IST10011.

CodeBeamer reference: [S.03.07-7202](#)

Upstream References (1)

S.03.03.01-6102	Hydrogen Transfer Line Routing Requirement - Credited
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3.3 Transfer Line Drop Damage Protection

Target Station Shielding shall provide removable covers above the hydrogen transfer line to protect it from damage due to falling objects within the target drive room per Interface Sheet S03000000-IST10011.

CodeBeamer reference: [S.03.07-7203](#)

Upstream References (1)

S.03.03.01-6102	Hydrogen Transfer Line Routing Requirement - Credited
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3.4 Transfer Line Support Features

Target Station Shielding shall provide features in the pipe pan for mounting of transfer line supports per Interface Sheet S03000000-IST10011.

CodeBeamer reference: [S.03.07-7204](#)

Upstream References (1)

S.03.03.01-6102	Hydrogen Transfer Line Routing Requirement - Credited
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3.5 Hydrogen Transfer Line Welding Access

Target Station Shielding shall provide access for welding of the hydrogen transfer line during facility construction per Interface Sheet S03000000-IST10011.

CodeBeamer reference: [S.03.07-8052](#)

Upstream References (1)

S.03.03.01-2397	Hydrogen Transfer Line Construction Requirement
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4 TSS-AIC Interface

Requirements derived from Interface sheet IST01020500-IST10217

CodeBeamer reference: [S.03.07-7206](#)

4.1 AIC Support

Target Station Shielding shall align and support the baseplate that the Proton Beam Window, Proton Beam Window Shielding and Proton Beam Tube Assembly remote clamp are mounted to. Gravitational and seismic loads will be supported while maintaining the alignment tolerances specified in Interface Sheet S01020500-IST10217.

CodeBeamer reference: [S.03.07-7207](#)

Upstream References (2)

S.03-1040	Isolated Environments
S.03.05.02-4780	PBW Structural Integrity

4.2 Proton Beam Window Access

Target Station Shielding shall allow access to the Proton Beam Window within 8 hours per Interface Sheet S01020500-IST10217.

Note: The clock starts when the removable shielding removal above the PBW begins

CodeBeamer reference: [S.03.07-7211](#)

Upstream References (2)

S.03.05.02-3792	PBW Replacement and Disposal
S.03.05.02-3210	PBW Maintenance & Lifetime Criteria

4.3 Proton Beam Window Shielding Access

Target Station Shielding shall allow access to the Proton Beam Window Shielding Assembly within 24 hours per Interface Sheet S01020500-IST10217.

Note: The clock starts when the removable shielding removal above the PBW Shielding assembly begins.

CodeBeamer reference: [S.03.07-7212](#)

Upstream References (2)

S.03.05.02-3792	PBW Replacement and Disposal
S.03.05.02-3210	PBW Maintenance & Lifetime Criteria

4.4 Utility Line Clearance

Target Station Shielding shall provide clearance for the Proton Beam Window and Proton Beam Window Shielding utility lines per Interface Sheet S01020500-IST10217.

CodeBeamer reference: [S.03.07-7213](#)

Upstream References (1)

S.03.05.02-3795	PBW Cooling
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4.5 Proton Beam Tube Assembly Remote Clamp Access

Target Station Shielding shall allow access to the Proton Beam Tube Assembly remote clamp within 24 hours per Interface Sheet S01020500-IST10217.

Note: The clock starts when the removable shielding removal above the Proton Beam Tube Assembly begins.

CodeBeamer reference: [S.03.07-7214](#)

Upstream References (1)

S.03.05.05-3780	PBTA Replacement and Disposal
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4.6 Proton Beam Tube Assembly Clearance

Target Station Shielding shall provide clearance in the bulk shielding liner for the Proton Beam Tube Assembly per Interface Sheet S01020500-IST10217.

CodeBeamer reference: [S.03.07-7215](#)

Upstream References (1)

S.03.05.05-3780	PBTA Replacement and Disposal
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4.7 Target Viewing Periscope Clearance

Target Station Shielding shall provide appropriate clearance around the Target Viewing Periscope assembly per Interface Sheet S01020500-IST10217.

CodeBeamer reference: [S.03.07-7813](#)

Upstream References (1)

S.03.05.03-5746	TVP Beam Position Measurement
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5 TSS-Process Systems Interface

Requirements derived from Interface Sheet S03000000-IST10005.

CodeBeamer reference: [S.03.07-7216](#)

5.1 Utility Pipe Clearance

Target Station Shielding shall supply sufficient clearance for utility piping inside the pipe pan per Interface Sheet S03000000-IST10005.

CodeBeamer reference: [S.03.07-7217](#)

Upstream References (1)

S.03.09.02-6448	Piping Design
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5.2 Pipe Pan Drainage

Target Station Shielding shall slope the bottom of the pipe pan a minimum of 1 degree downward slope towards the hot process vault and provide an interfacing feature for water routing to the leak collection system per Interface Sheet S03000000-IST10005.

CodeBeamer reference: [S.03.07-7218](#)

Upstream References (1)

S.03.09-6118	Leak Collection
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5.3 Pipe Pan Pipe Supports

Target Station Shielding shall provide features within the pipe pan for mounting of pipe supports designed and provided by Process Systems per Interface Sheet S03000000-IST10005.

CodeBeamer reference: [S.03.07-7219](#)

Upstream References (1)

S.03.09.02-6448	Piping Design
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5.4 Utility Pipe Access

Target Station Shielding shall allow for access to the utility pipes contained within the pipe pan per Interface Sheet S03000000-IST10005.

CodeBeamer reference: [S.03.07-7220](#)

Upstream References (1)

S.03-3009	Maintenance & Lifetime Criteria
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5.5 Utility Pipe Clearance

Target Station Shielding shall allow for utility pipes to pass through the pipe pan covers into the target drive room per Interface Sheet S03000000-IST10005.

CodeBeamer reference: [S.03.07-7221](#)

Upstream References (1)

S.03.09.02-6448	Piping Design
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5.6 Bulk Shielding Liner Drain

Target Station Shielding shall provide a connection pipe to the bulk shielding liner drain per Interface Sheet S03000000-IST10005.

CodeBeamer reference: [S.03.07-7222](#)

Upstream References (1)

S.03.09-6118	Leak Collection
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5.7 Target Water Line Support

Target Station Shielding shall support target water line support assemblies per Interface Sheet S03000000-IST10005.

CodeBeamer reference: [S.03.07-7223](#)

Upstream References (1)

S.03.09.02-6425	Target Assembly Cooling
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5.8 Core Vessel Drain Line Clearance

Target Station Shielding shall provide clearance around the Core Vessel drain line per Interface Sheet S03000000-IST10005.

CodeBeamer reference: [S.03.07-7815](#)

Upstream References (1)

S.03.09-6118	Leak Collection
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6 TSS-Remote Handling Interface

Requirements derived from Interface Sheet S03000000-IST10007.

CodeBeamer reference: [S.03.07-7224](#)

6.1 Removable Component Lifting Interfaces

Target Station Shielding shall provide lifting interfaces for all removable Target Station Shielding components per Interface Sheet S03000000-IST10007.

CodeBeamer reference: [S.03.07-7225](#)

Upstream References (1)

RH-AIC-Conv_Req-2244	Conveyance Systems - AIC
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7 TSS-Instrument Systems Interface

Requirements derived from Interface Sheet S01020500-IS0025.

CodeBeamer reference: [S.03.07-7227](#)

7.1 Monolith Port Clearance

Target Station Shielding shall provide appropriate physical clearance between the monolith insert rear flanges, utility connections and the monolith ports per Interface Sheet S01020500-IS0025.

CodeBeamer reference: [S.03.07-7228](#)

Upstream References (1)

S.03-1029	Peak Brightness
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8 TSS-Conventional Facilities Interface

Requirements derived from Interface Sheet S01020500-IST10064.

CodeBeamer reference: [S.03.07-7229](#)

8.1 Monolith internal concrete profile

Target Station Shielding shall supply the required monolith internal concrete profile to Conventional Facilities per Interface Sheet S01020500-IST10064.

CodeBeamer reference: [S.03.07-7230](#)

Upstream References (2)

S.03-1036	Radiation Safety
S.03-1035	Safe Operation

8.2 Concrete Anchor Details

Target Station Shielding shall supply the location, size, connection type and mechanical loading of the concrete anchors required by Target Station Shielding per Interface Sheet S01020500-IST10064.

CodeBeamer reference: [S.03.07-7232](#)

Upstream References (1)

S.03-1035	Safe Operation
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8.3 Mechanical Loading Details

Target Station Shielding shall supply the mechanical loads imparted on the concrete by the monolith interior components per Interface Sheet S01020500-IST10064.

CodeBeamer reference: [S.03.07-7233](#)

Upstream References (1)

S.03-1035	Safe Operation
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8.4 Grout Holes

Target Station Shielding shall include features that allow grouting of Target Station Shielding hardware per Interface Sheet S01020500-IST10064.

CodeBeamer reference: [S.03.07-7234](#)

Upstream References (1)

S.03-1032	Operational Life
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8.5 Monolith Port Geometry

Target Station Shielding shall supply the required interior profile of the monolith ports per Interface Sheet S01020500-IST10064.

CodeBeamer reference: [S.03.07-7235](#)

Upstream References (1)

S.03-1036	Radiation Safety
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8.6 Concrete Temperature

Target Station Shielding shall ensure that the monolith concrete temperature does not exceed 65 C for prolonged periods due to radiation heating per Interface Sheet S01020500-IST10064.

CodeBeamer reference: [S.03.07-7236](#)

Upstream References (1)

S.03-1032	Operational Life
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9 TSS - Integrated Controls

Requirements derived from interface sheet S01020500-IST10220.

CodeBeamer reference: [S.03.07-7409](#)

9.1 Pipe Pan Side Wall Penetrations

Target Station Shielding shall provide penetrations in the pipe pan side wall for instrumentation wiring per Interface Sheet S01020500-IST10220.

CodeBeamer reference: [S.03.07-7410](#)

Upstream References (1)

S.06-1120	S.6-R001 Integrated Control Systems shall provide remote control, monitoring, alarms, and data archiving to enable supervisory control, automation, and operational analysis from an appropriate control room for STS scope including accelerator, target, conv
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9.2 Instrumentation Wire Pipe Chase

Target Station Shielding shall provide a pipe chase through the bulk shielding for instrumentation wiring per Interface Sheet S01020500-IST10220.

CodeBeamer reference: [S.03.07-7411](#)

Upstream References (1)

S.06-1120	S.6-R001 Integrated Control Systems shall provide remote control, monitoring, alarms, and data archiving to enable supervisory control, automation, and operational analysis from an appropriate control room for STS scope including accelerator, target, conv
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