



Second Target Station (STS) Project

Introduction to Target Assembly and Moderator Reflector Assembly Final Design Reviews

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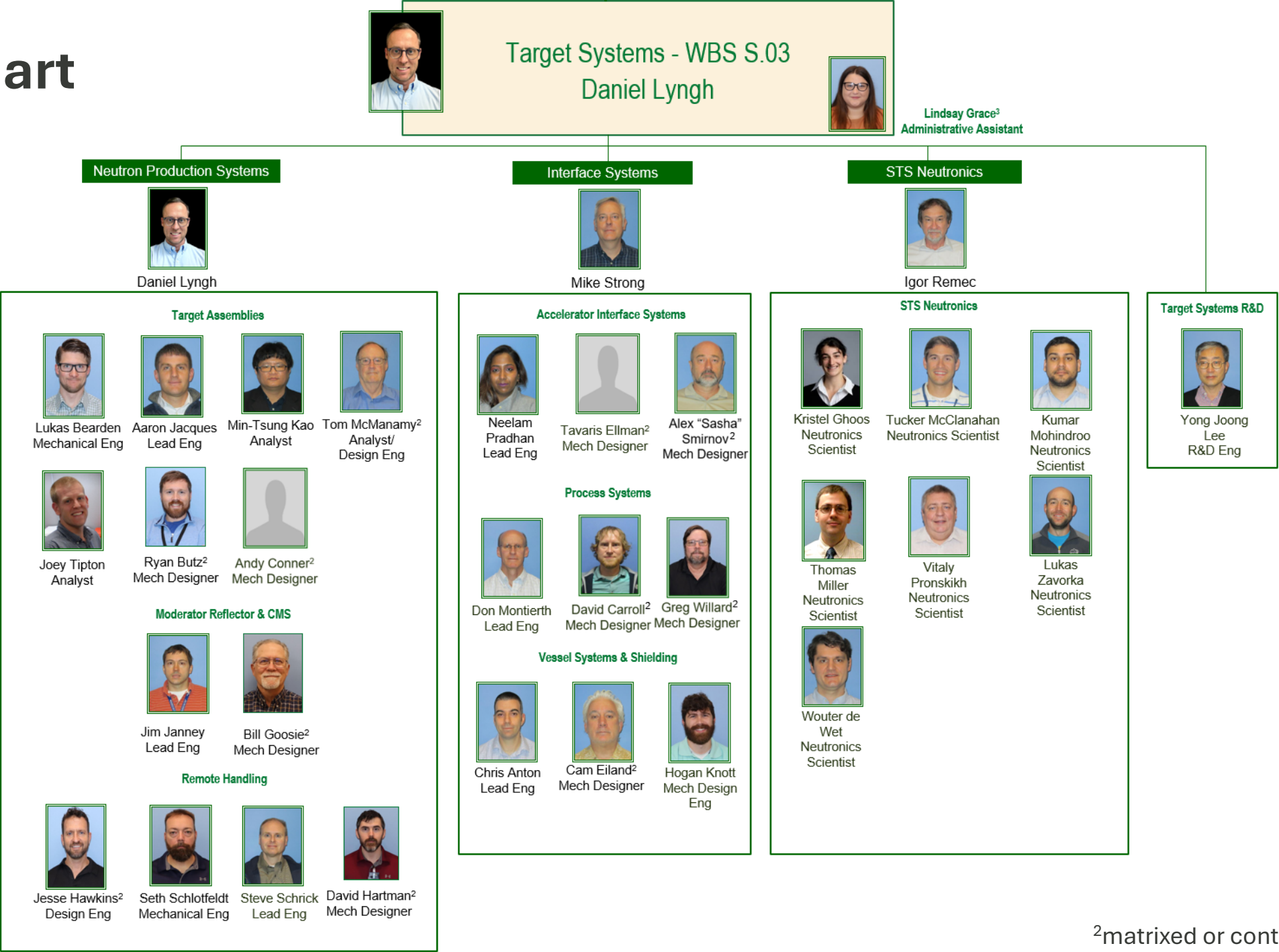


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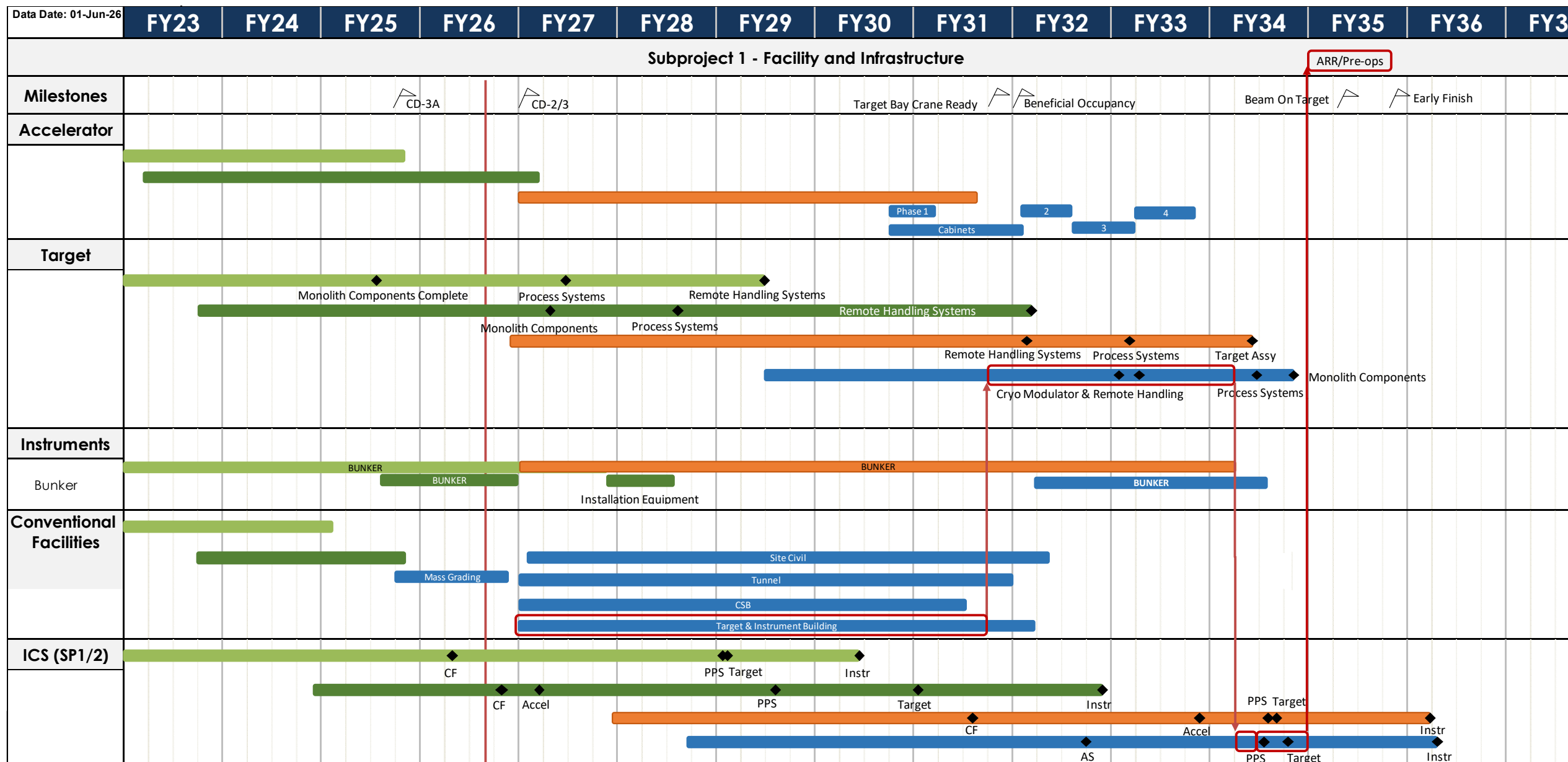
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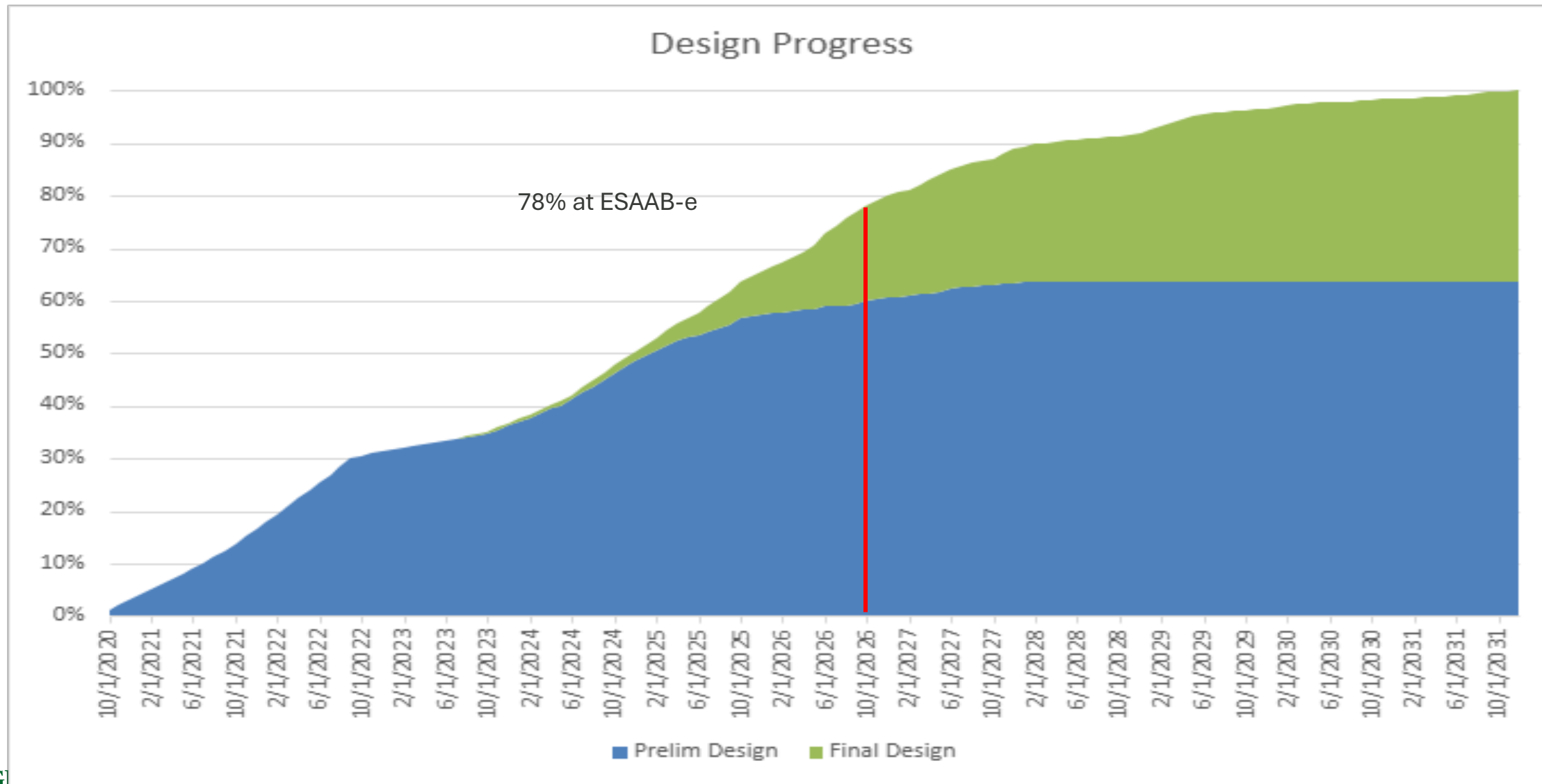
Org Chart



Schedule Overview



Design Status – Target Systems



Design is mature and most PDRs have been Completed

WBS Level 3 Scope	PDR	FDR
Target Assembly	June 2024 ✓	Aug 2026
Cryogenic Moderator System	Aug 2025 ✓	Jul 2027
Moderator Reflector Assembly	Mar 2024 ✓	Aug 2026
Accelerator Interface Components	Aug 2024 (PBW/PBTA) ✓ Feb. 2025 (TVP) ✓	Aug 2026
Vessel Systems	Apr 2025 ✓	Oct 2026
Target Station Shielding	Apr 2025 ✓	Oct 2026
Target Process Systems	ACLS - Oct 2025 ✓ LLLW/LCS/He/N ₂ - Jan 2027	ACLS – Mar 2027 LLLW/LCS/He/N ₂ – May 2028
Remote Handling	Service Cell - Dec 2026 Casks - May-Aug 2027	Service Cell - Aug 2028

- Systems planned to be completed post-CD-3:
- Cryogenics Moderator System
 - Remote Handling Facilities
 - Process Systems

Project Successfully Completed Integrated Project Review for CD-2 & CD-3 approval

Overall Project Deliverables for CD-2/3

CD-2

- Fully detailed project plan for all projects
- Estimates consisting of >80 vendor estimates
- Preliminary Design Report

CD-3

Design Completion

- All interfaces released
- All requirements released
- Designs complete
- 80% of drawings completed
- DACs complete

FDR Definition

Do we know exactly what the system is supposed to do?

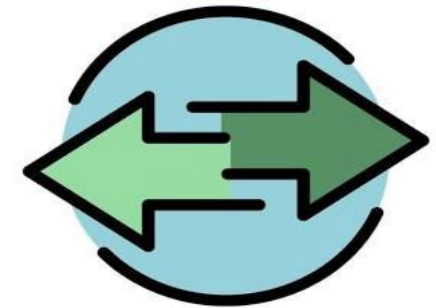
- Requirements 100 % defined and implemented

Is it compatible with the rest of the facility?

- Interfaces Descriptions

Can we prove that it will perform the required functionality

- Design Descriptions
- Design Analysis Calculations
- Hazard Analysis Report
- Verifications



Design deliverable matrix

System / Subsystem Deliverable	Conceptual Design Review	Preliminary Design Review	Final Design Review	Begin Fab / procure
CAD models, sketches and other design expression tools	N	N	U	
related items on risk registry*	N	U	U	
Interface Control Documents / Interface Sheets		N	U	
System Requirements Document		N	U	
Design Description Document		N	U	
configuration level determination		N	U	
QA Level Determination Form		N	U	
System Safety Classification†		N	U	
Design Analysis Calculations (DACs)‡		N	N	
Safety Assessment Document‡‡		N	U	
acquisition strategy*		N	U	
manufacturing / fabrication strategy*		N	U	
installation plan*		N	U	
System Verification Plan†††		N	U	U
Drawings				F
Technical Specifications				F
P&ID			N	
Acceptance Criteria List				F

System / Subsystem Deliverable	Conceptual Design Review	Preliminary Design Review	Final Design Review	Begin Fab / procure
Statements of Work				N
Manufacturing and Inspection Plans (MIP)				
Manufacturing Verification Reports‡‡‡				
Installation verification reports ††				
System Verification Reports				
System Operation and Maintenance Manuals				
Radiation Safety Committee Recommendation				
Review Committee Report	N	N	N	
Responses to Review Committee Recommendations	N	N	N	

Next Gateway: Procurement Readiness Approval

Verification of completion for Procurement initiation

- All drawings and P&ID reviewed and released
- All Equipment Specifications / Data Sheets / Statement of Works reviewed and Released
- Verification Plans defined
- Confirmation that QA level determination / Safety Assessments remain valid
- Requirements comprehensively linked with hazard analysis report requirements
- Acceptance Criteria Limits established
- Confirmation that Interface documentation remain valid
- Confirmation requirements valid
- Engineering Configuration Notices (ECN) released

Second Target Station (STS) Project Design Deliverables
by Project Phase Matrix S01020500-PCD10000.pdf



Target Systems requirements are established and stable

Selected requirements:

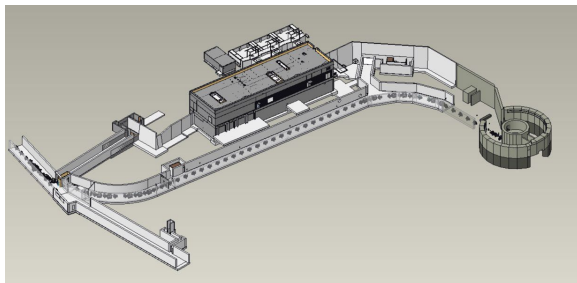
- ✓ Accept a pulsed proton beam of 700 kW, 1.3 GeV, 15 Hz
- ✓ Convert the proton beam pulses into cold neutron pulses using high-brightness moderators that will meet or exceed the peak brightness of 2×10^{14} n/cm²/sr/Å/s at the neutron wavelength of 5Å
- ✓ Distribute neutrons to ~21 instrument end-stations
- ✓ Include a service or replacement scheme and disposal path for all perishable components
- ✓ Provide connection to, and isolation from, the Accelerator Systems environment upstream of the Target Station Monolith for transport of the proton beam to the Target
- ✓ Operate for 40 years @ 5,000 hours/year
- ✓ Provide the potential to evaluate component failures via post irradiation examination (PIE)

HAR Requirements

- Target Systems Hydrogen Boundary Requirement: "Components shall not damage (inadvertent contact) the hydrogen boundaries, regardless of load combination. *Note: This requirement specifically includes seismic loads.*"
- Large components are structurally anchored and building structures seismically qualified to prevent collapse, protect evacuation paths, and protect applicable confinement of hazardous material.

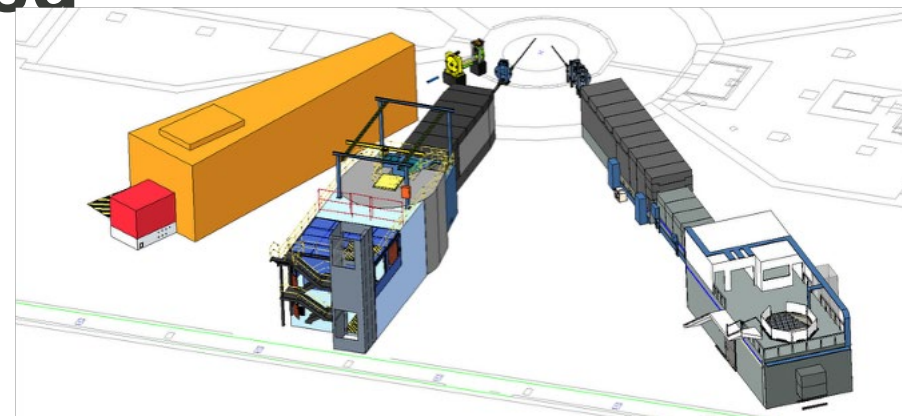
S03010000-SR0001- System Requirements Document for Target Systems

Target Systems Interfaces are Established



Accelerator Systems

- 3 interface sheets under revision control
- **Proton Beam parameters at the Target, Vacuum Interface with Accelerator, Backscatter impact on Accelerator**



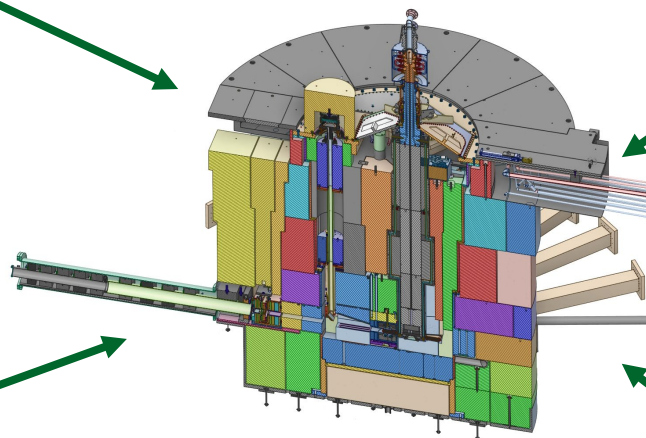
Instrument Systems

- 3 interface sheets under revision control
- **Moderator Reflector Assembly Neutronics performance, Vessel and Shielding Interface to Bunker and Monolith Inserts, Cooling of Monolith Inserts**



Integrated Control Systems

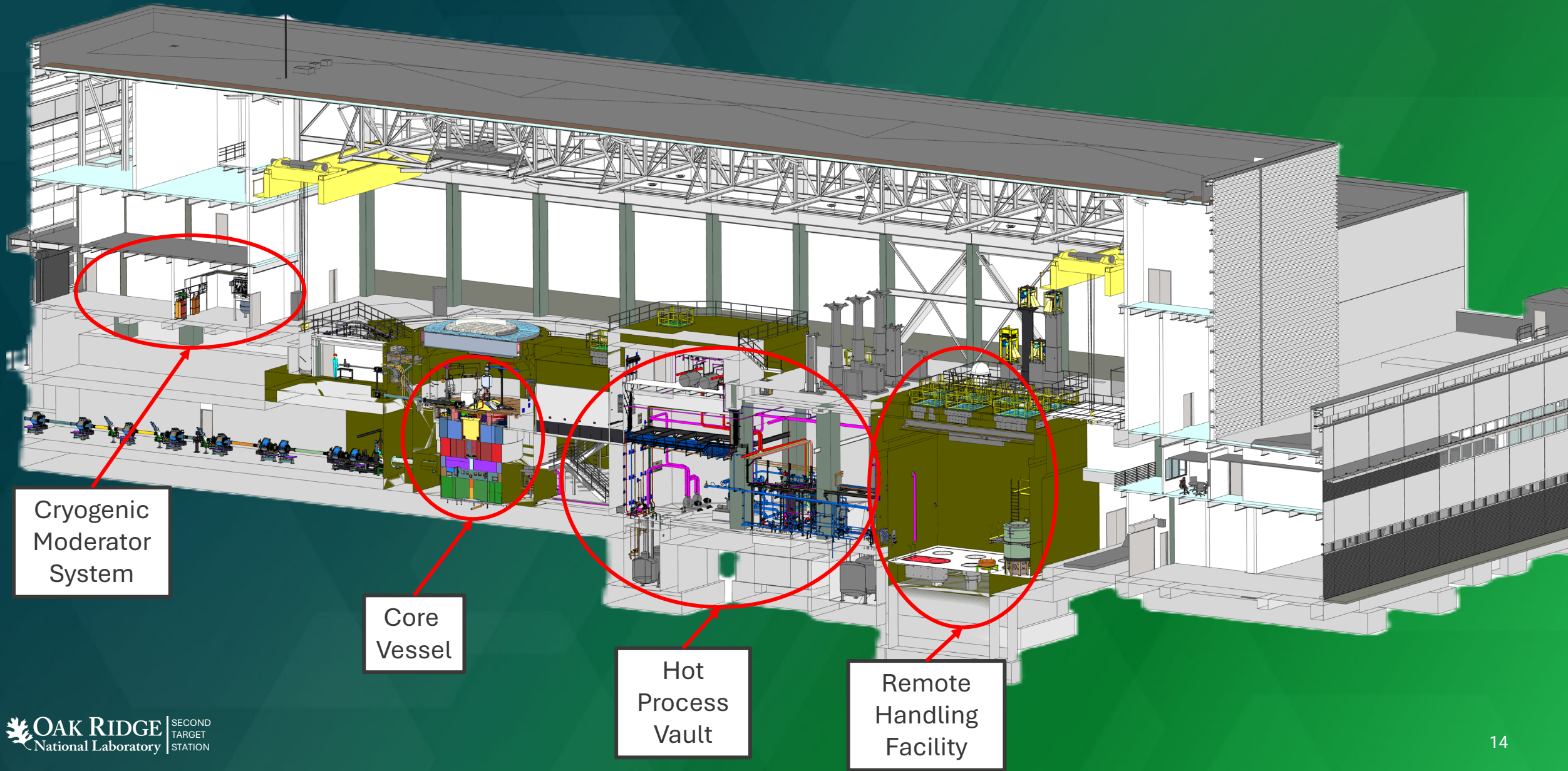
- 13 interface sheets under revision control
- **Instrumentation and Control for all Target Systems, Target Protection System interfaces to Activated Cooling Loop 1 and Target Assembly**



Conventional Facilities

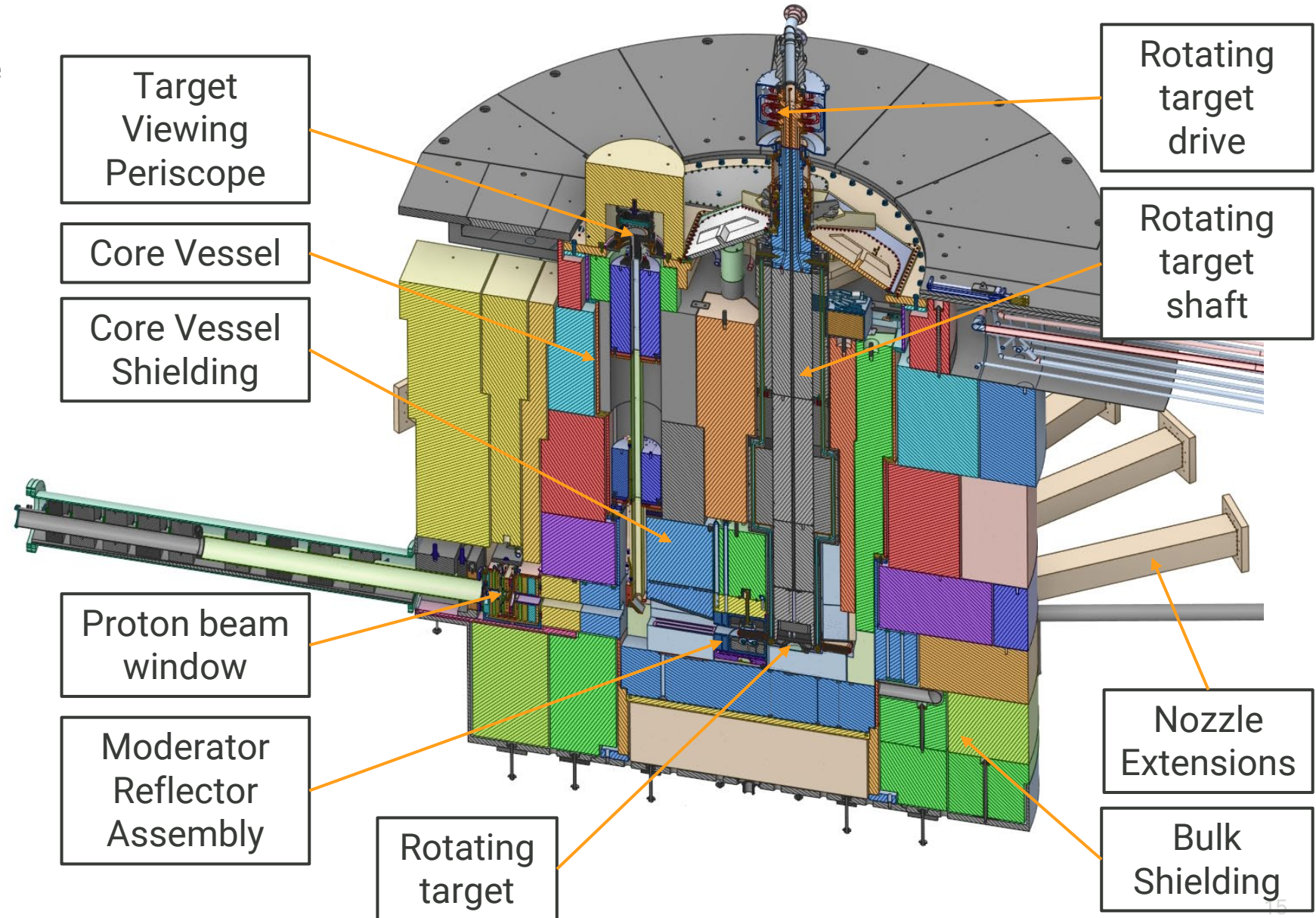
- 10 interface sheets under revision control, 4 additional identified and in process (Remote Handling)
- **All facility and MEP interfaces to Target Systems**

A World Class Neutron Source- Layout



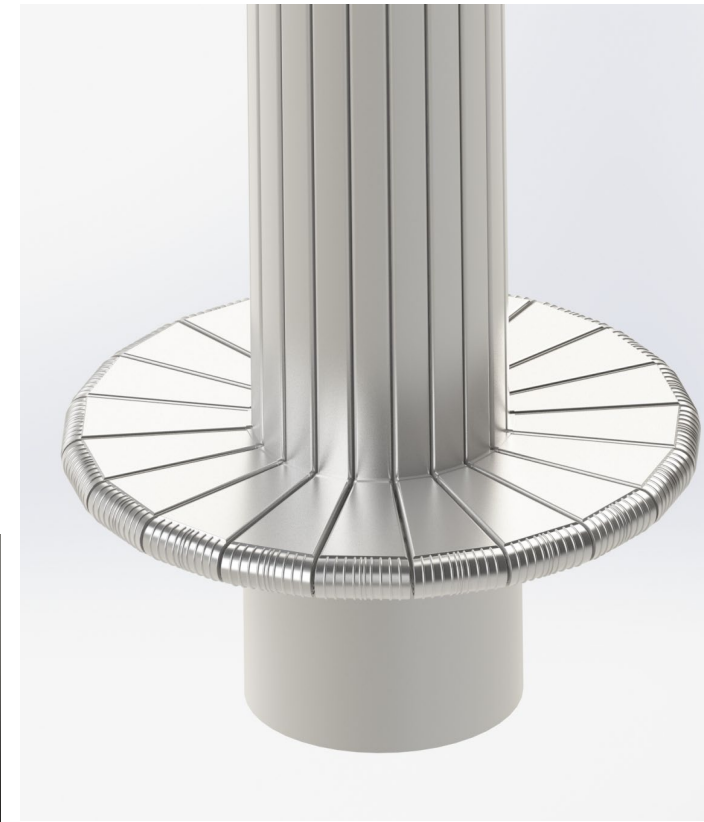
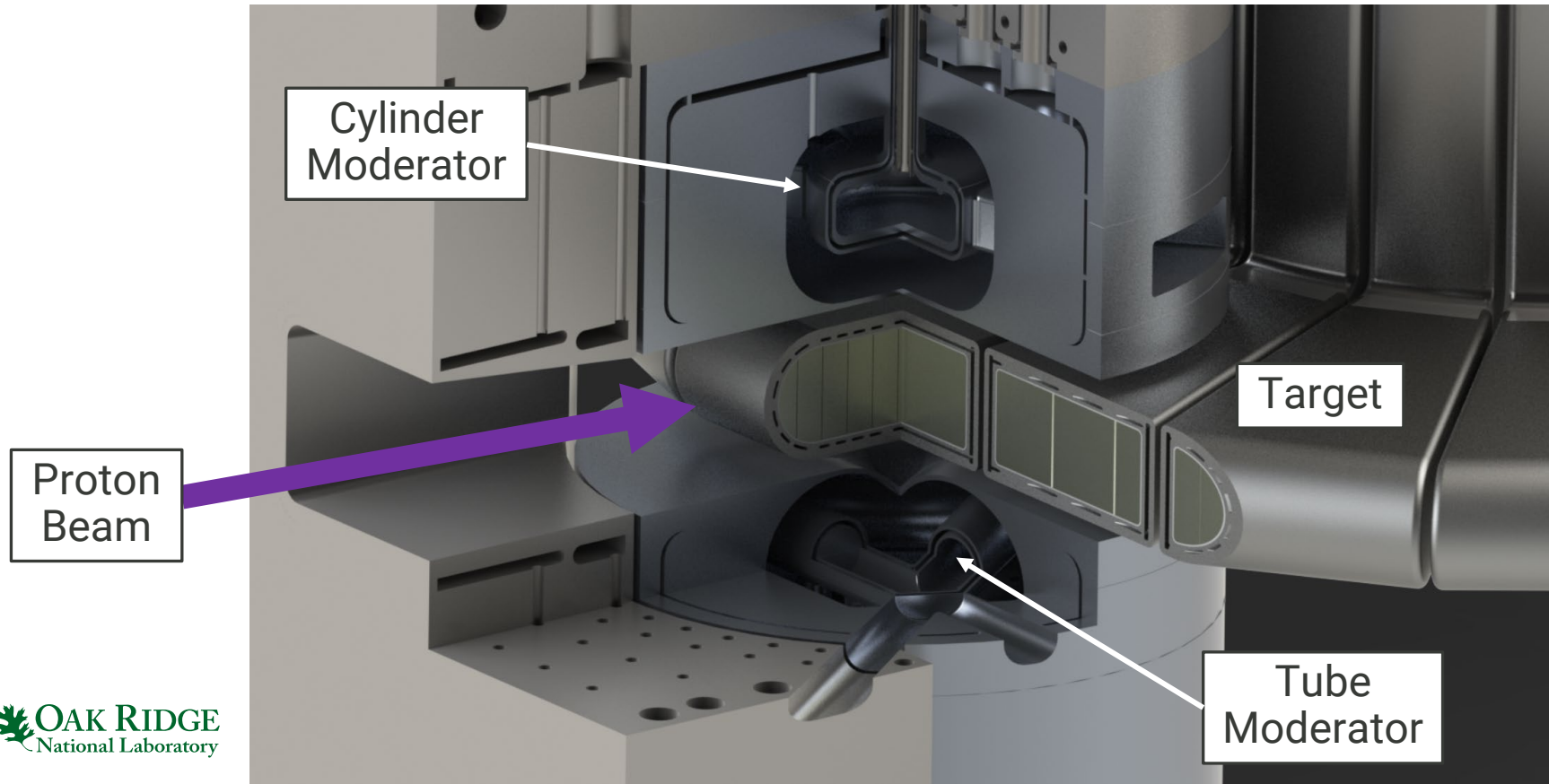
The rest of the Monolith provides:

- ✓ Proton Beam Interface
- ✓ Shielding
- ✓ Isolation from Accelerator
- ✓ Inert Atmosphere
- ✓ Neutron Beam Path
- ✓ Instrument Systems Interface



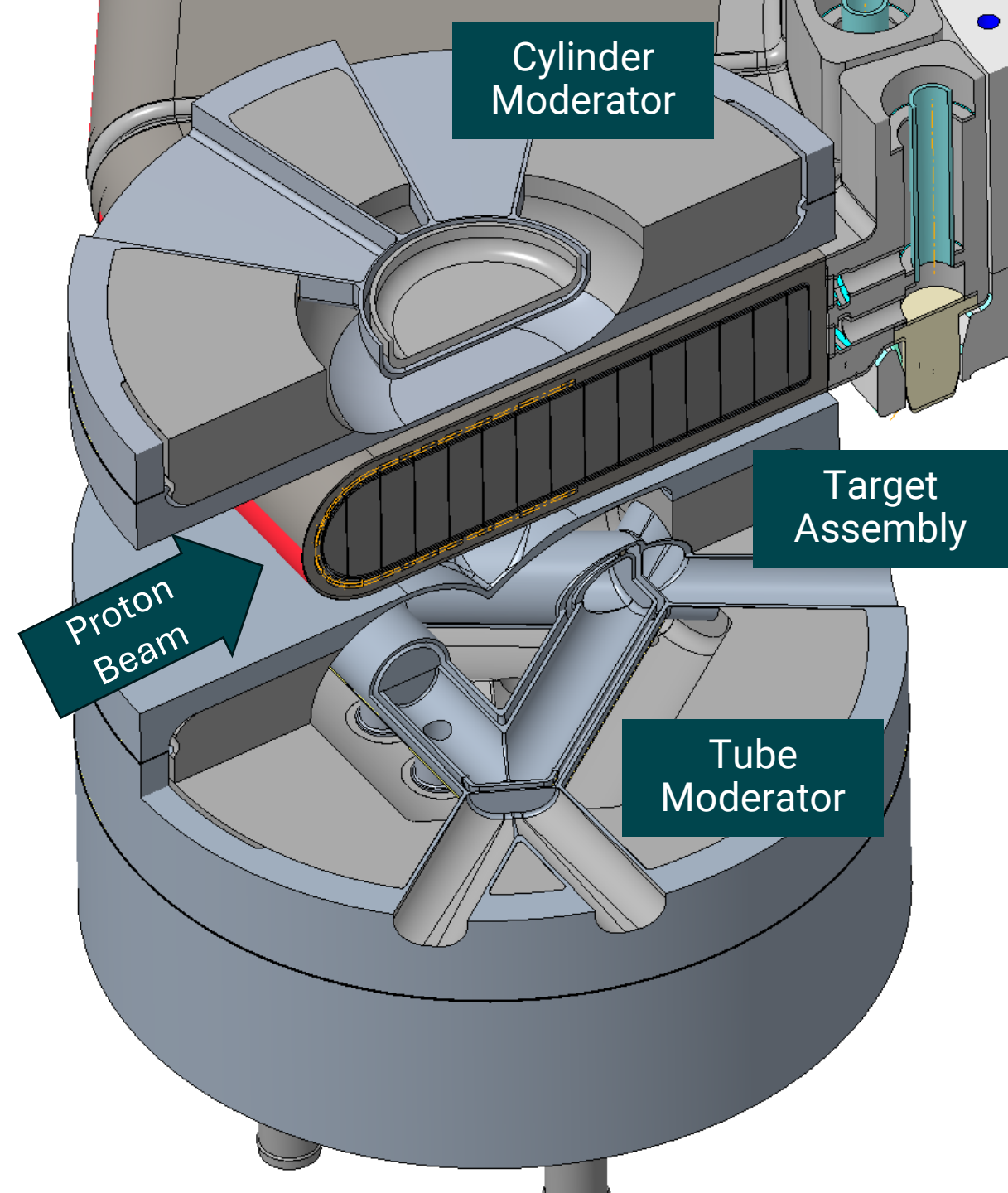
Target Assembly and Moderator & Reflector Assembly interaction

- High-density compact tungsten target
- Small coupled 20 K parahydrogen moderators
- Beryllium reflectors



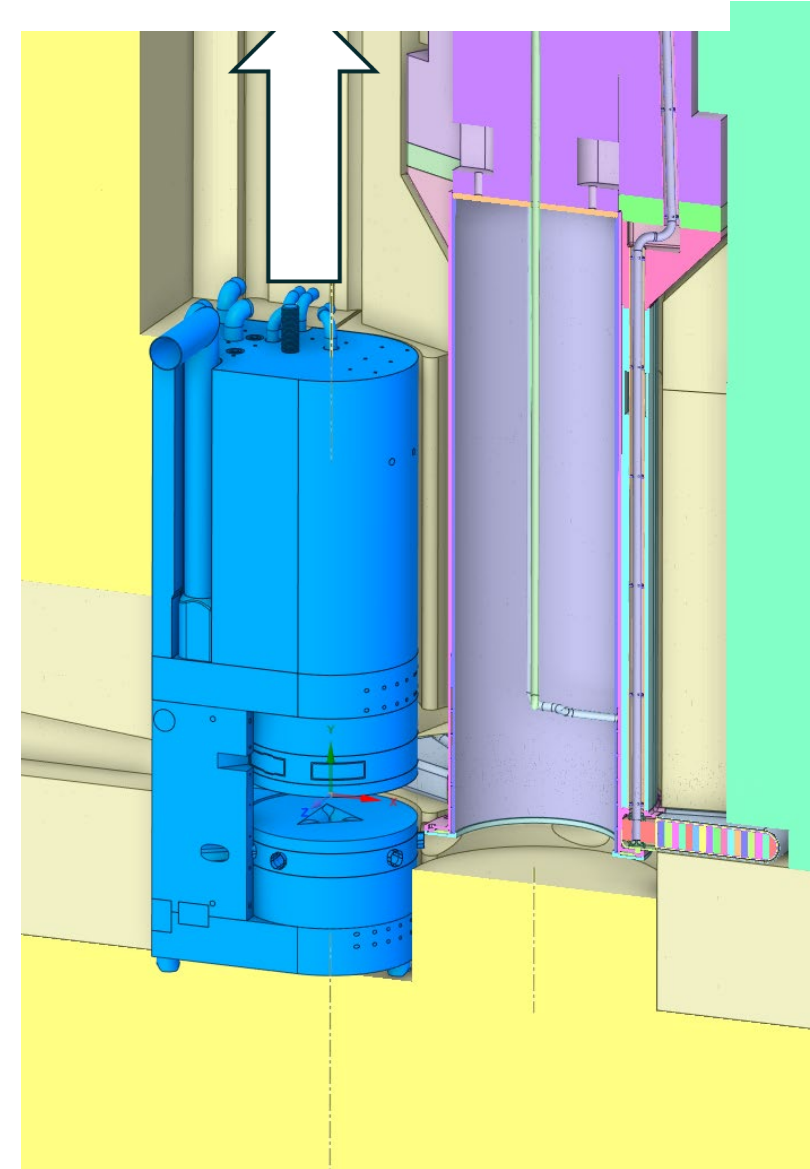
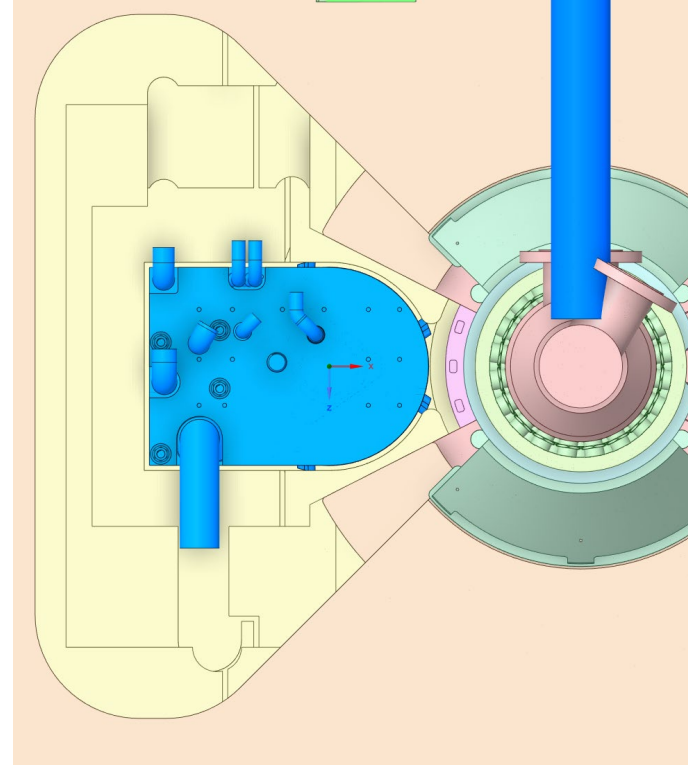
Moderator Reflector Assembly

- MRA geometry was determined by final MRA neutronics optimization
 - Included combined optimization with Target Assembly design parameters
- Optimal MRA configuration was not highly sensitive to Target Design



The Target Assembly and Moderator Reflector Assembly is a highly integrated design

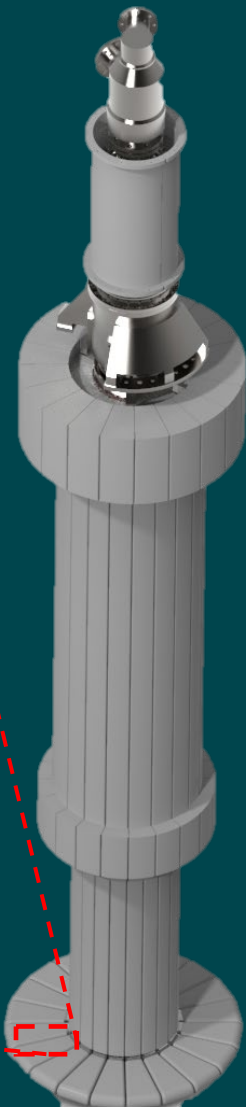
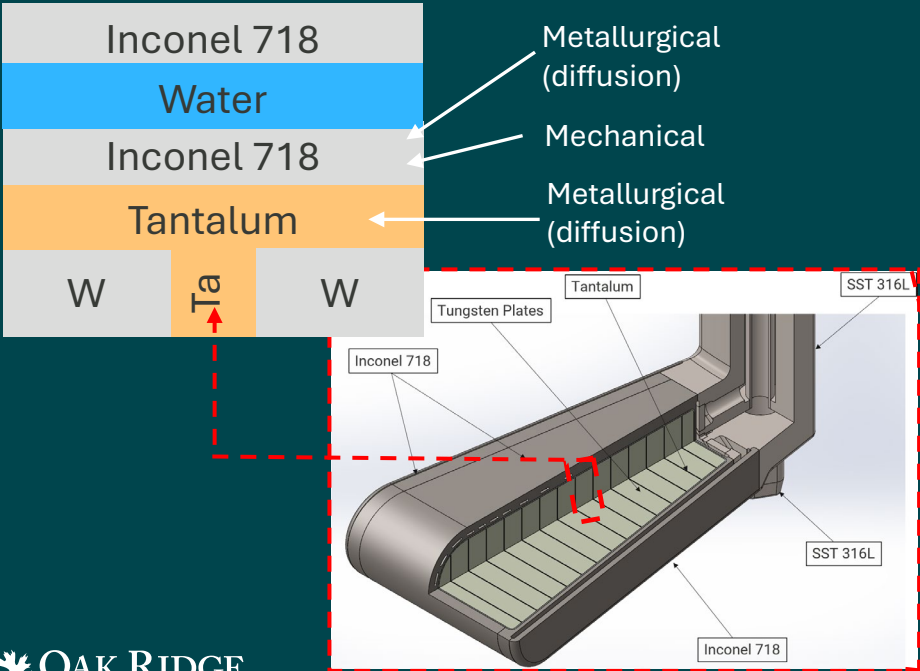
- 3 Segments removed
- Gap rotated under MRA
- **Straight vertical MRA removal lift**
- 3 segment replacements aligns with planned segment replacement cadence
- Vertical installation onto alignment features



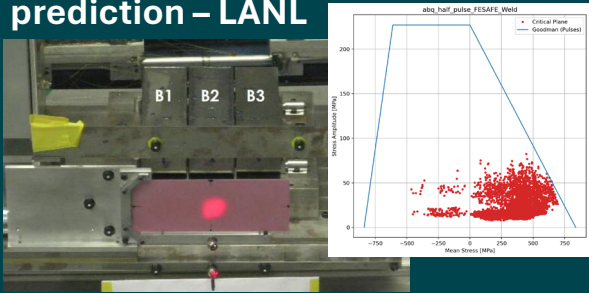
Achieving a robust target for a high-brightness neutron beam is a result of extensive R&D

CHALLENGES

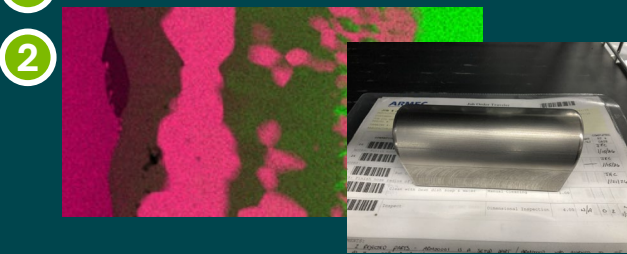
- 1 Fatigue prediction
- 2 W/Ta/Inconel Bond
- 3 Weld Closure



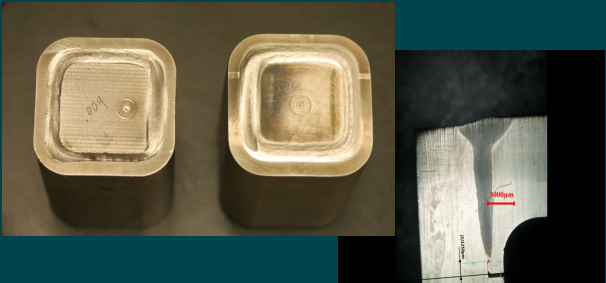
1 Beam-stress Wave prediction – LANL



1 Inconel forging characterization



2 W – Ta – Inconel bonding & machining



3 Inconel weld development



Full Scale Mock-Up



Questions and Discussion

