



August 2026

Target Assembly Manufacturing Plan

Aaron Jacques

Second Target Station



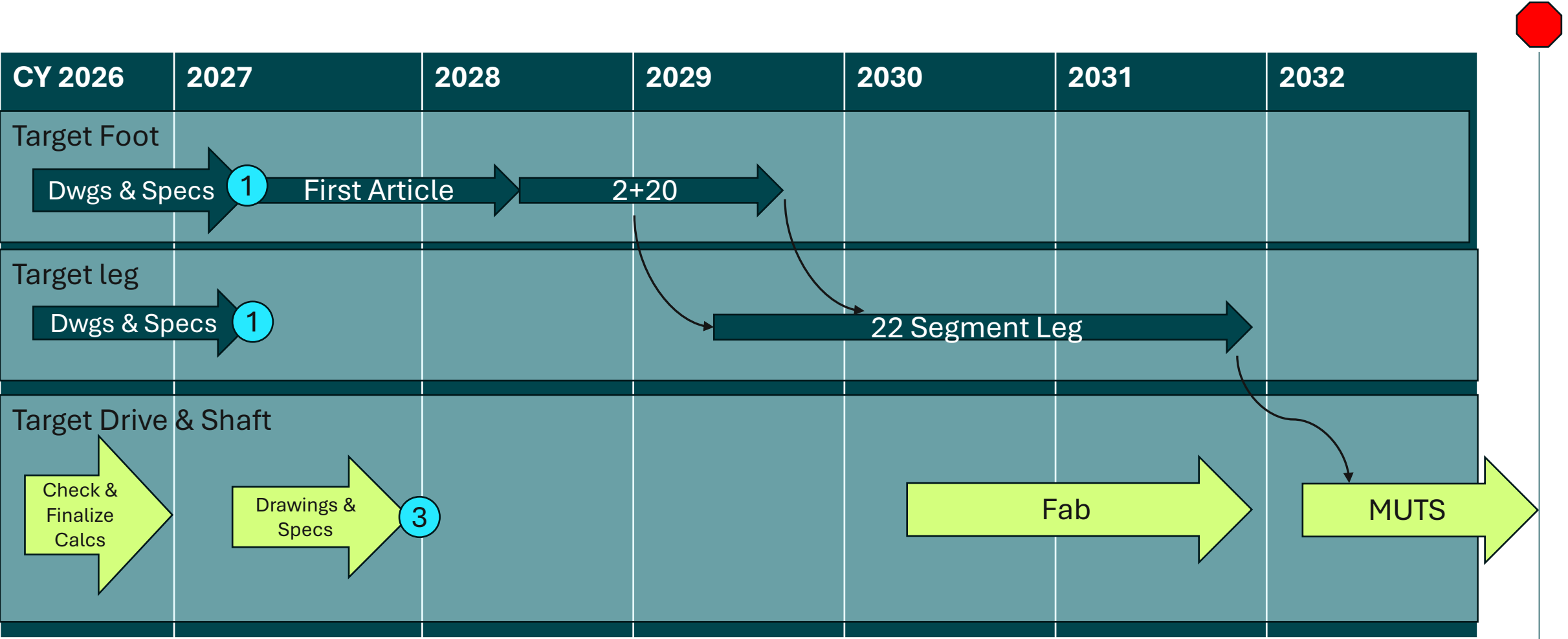
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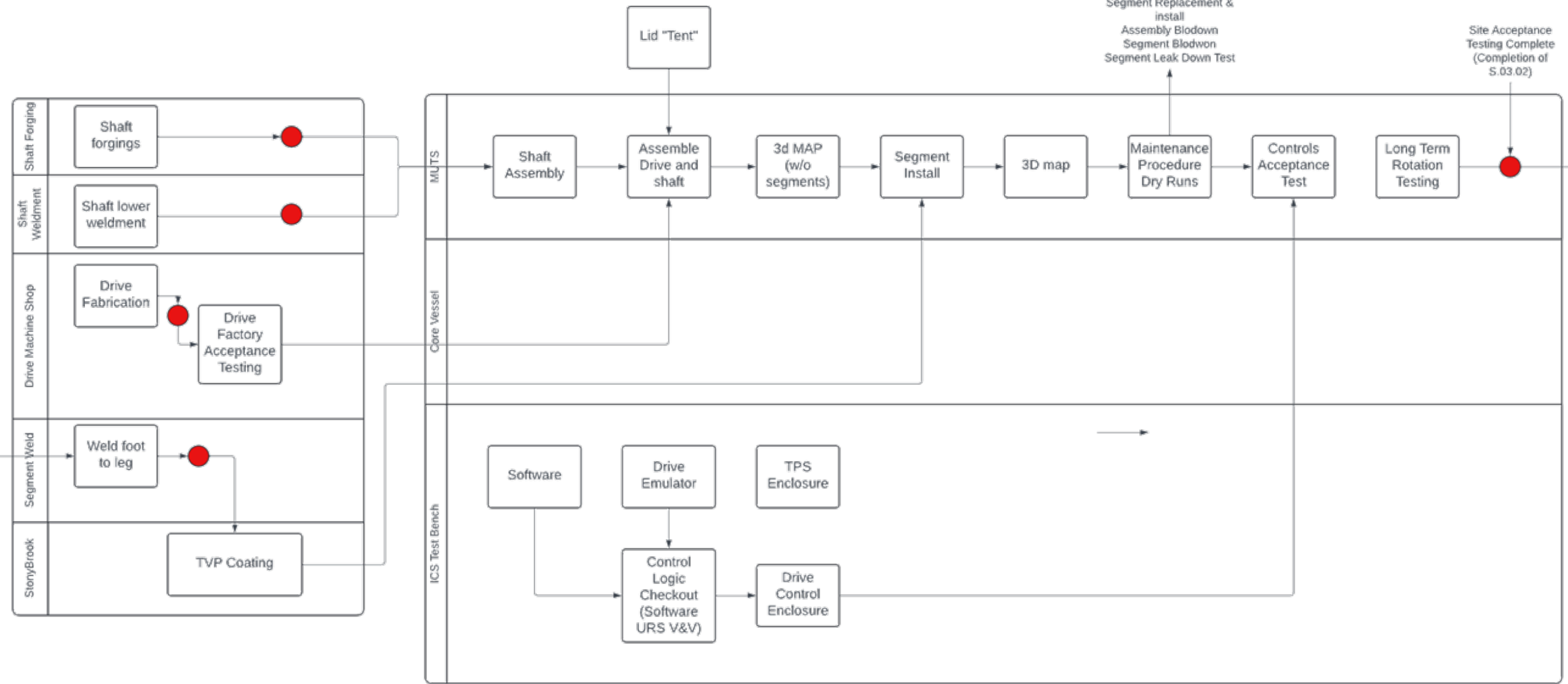


Charge Question 4: Are the acquisition and manufacturing plans feasible?

The target assembly will be released with two production readiness reviews (PRR)



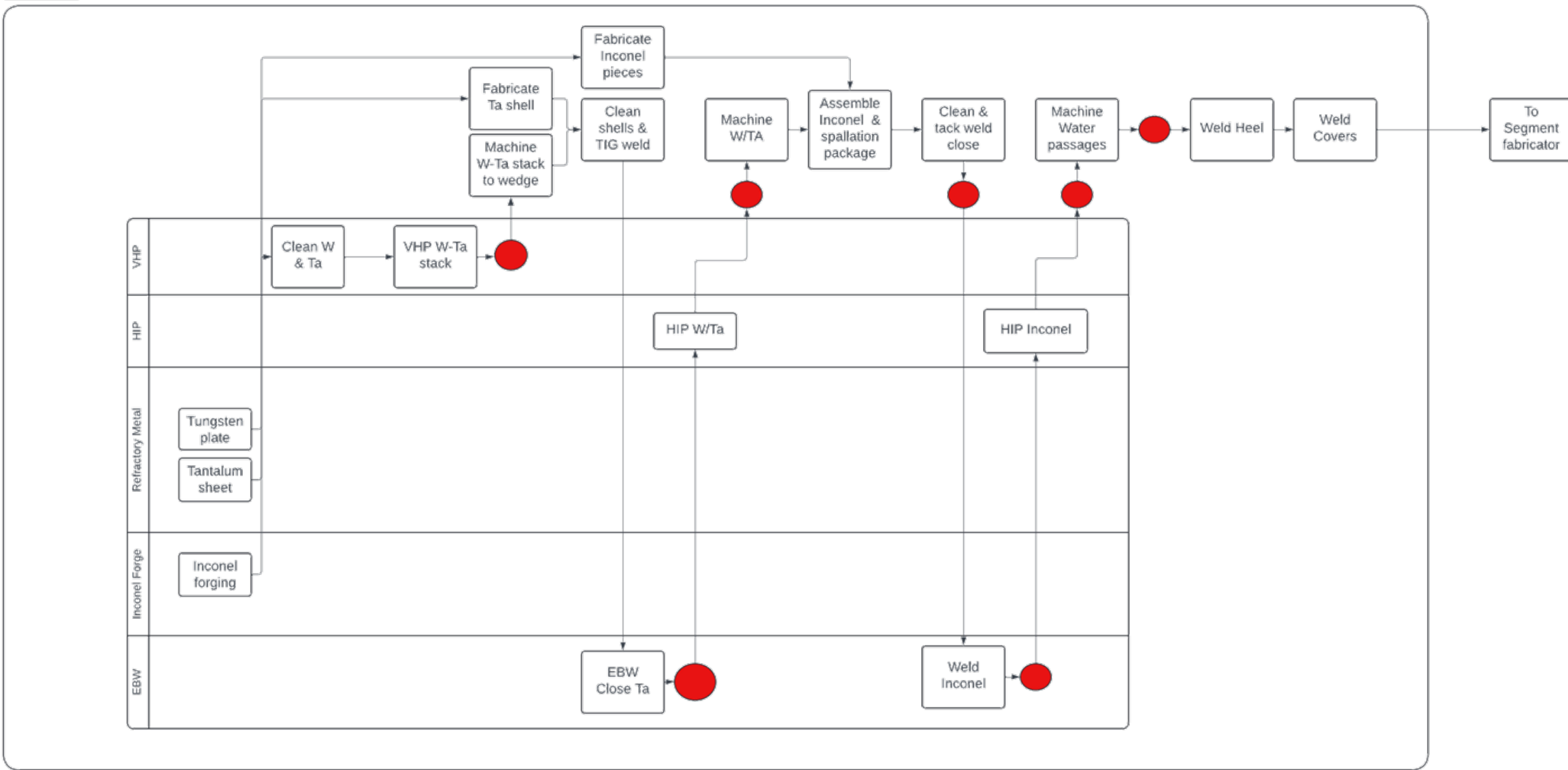
Overall assembly process



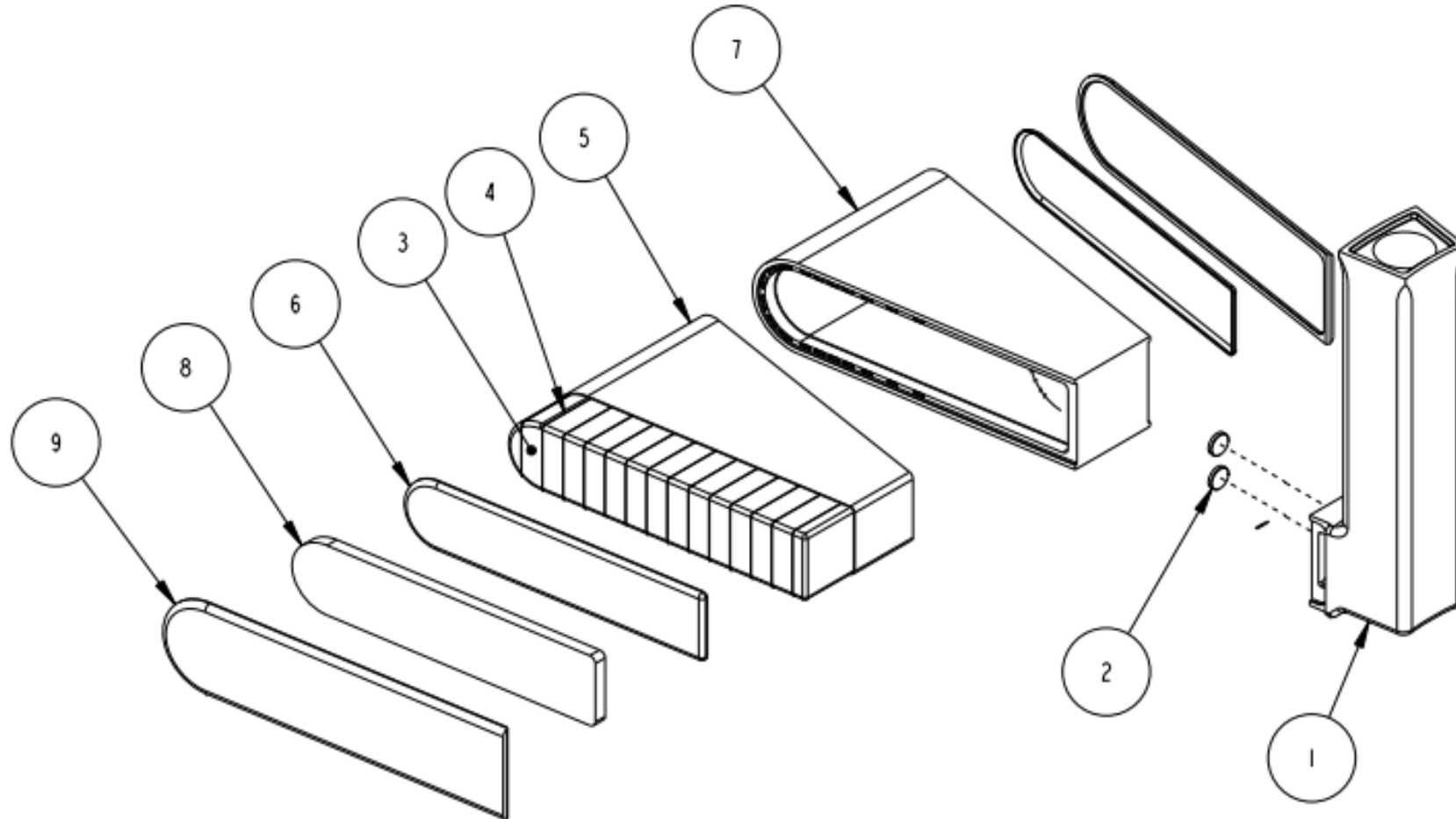
Foot manufacturing details

Foot fabrication process

Foot Supplier



Exploded view demonstrates the general as-machined arrangement



EXPLODED REFERENCE VIEW
SCALE 1:4

Tungsten & tantalum are cut from stock material by Plansee and sent to VHP vendor (via machine shop)

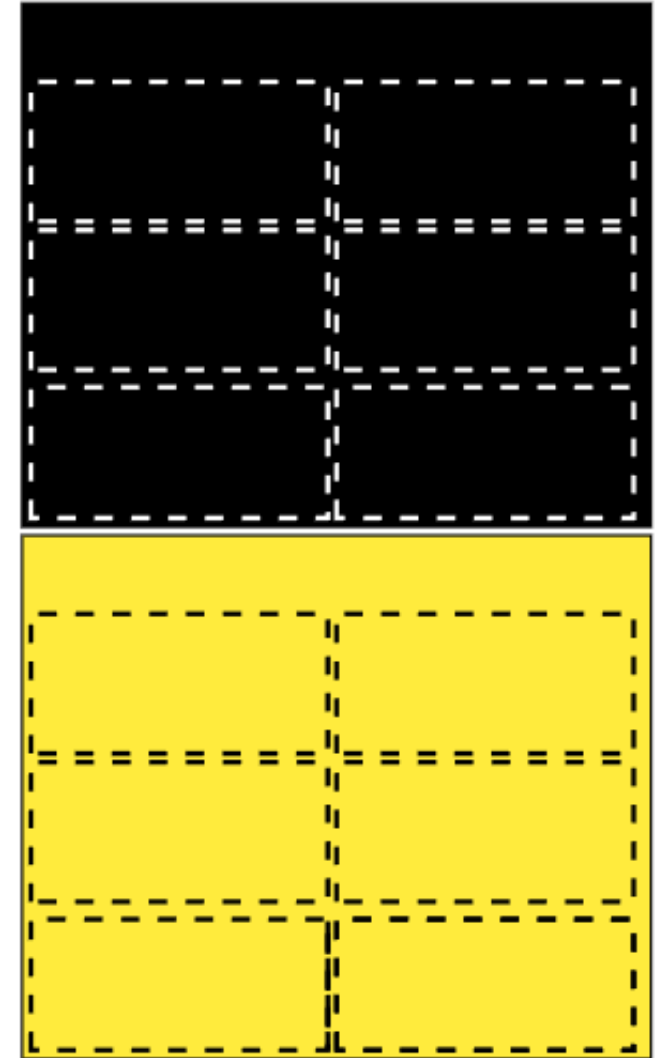
Tungsten – ORNL Spec 000001253
Tantalum – ASTM B708

The latest version of ASTM B777 shall apply with the following modifications and clarifications.

- Test bar locations and orientations shall be taken from the final product in location proposed by the vendor and with written agreement from ORNL.
- Tungsten shall be in the rolled condition (cross-rolled in two dimensions)
- Tungsten shall be Class 4, 97% density (% nominal tungsten weight)
- Tungsten shall be marked and labeled
- Tungsten shall have a purity greater than 99.95% pure.
- Maximum Pore Size: $35\mu\text{m}^2$
- Minimum Mechanical Properties
 - Hardness: 490 kg/mm²
 - Ultimate Strength: 689 MPa
 - 0.2% Offset Yield: 517 MPa
 - Elongation: 2%

Inspection

- Flatness
- Surface finish



Tungsten & tantalum are bonded to form a rough spallation block at the VHP vendor.

Cleaning by VHP vendor
VHP Spec - 000020001

1.3 PROCESS PARAMETERS

1.3.1 Atmosphere

The VHP shall maintain a vacuum level less than 1×10^{-4} torr.

1.3.2 Hold Temperature

The parts shall be processed at temperatures of $1200^{\circ}\text{C} \pm 10^{\circ}\text{C}$.

1.3.3 Hold Time

The parts shall be held at the specified temperature and Pressure and environment for a minimum duration of 2.5 hours, but not to exceed 3.5 hours.

1.3.4 Pressure

The parts shall have an applied pressure of at least 150 MPa.

Inspection

- Visual
- Dye penetrant

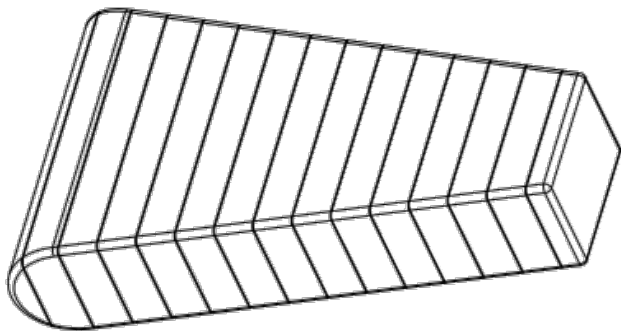


Hold Point A - The monolithic block is machined and contoured

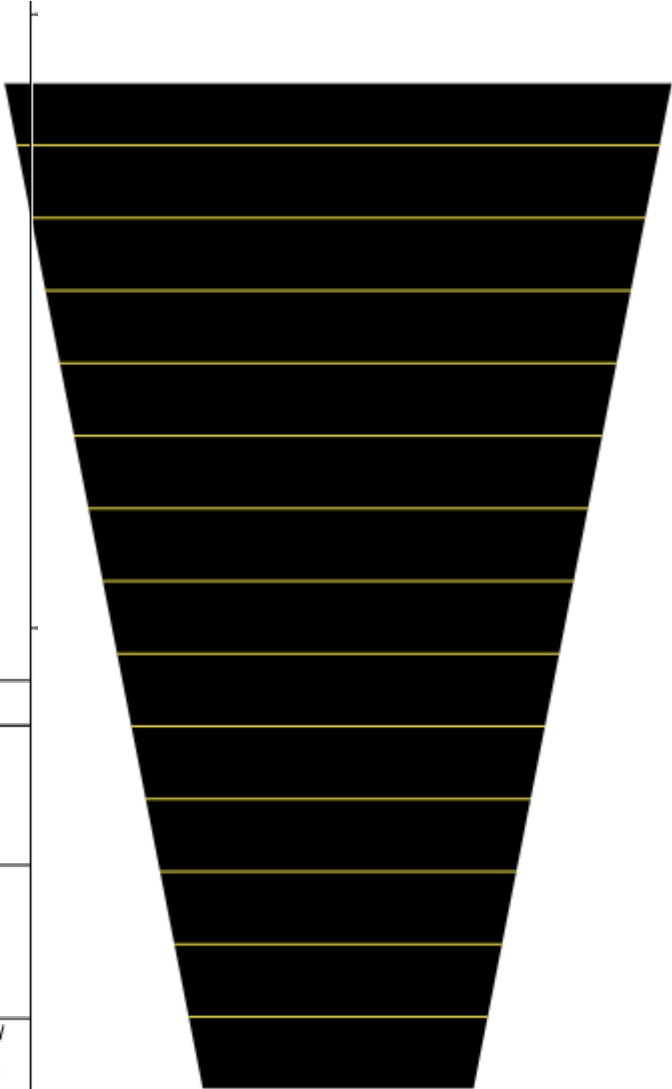
Machine to print

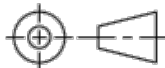
Remove all EDM case layer
(for HIP)

- Inspection
- Geometric
 - Visual cracks



REFERENCE VIEW
SCALE 1:2



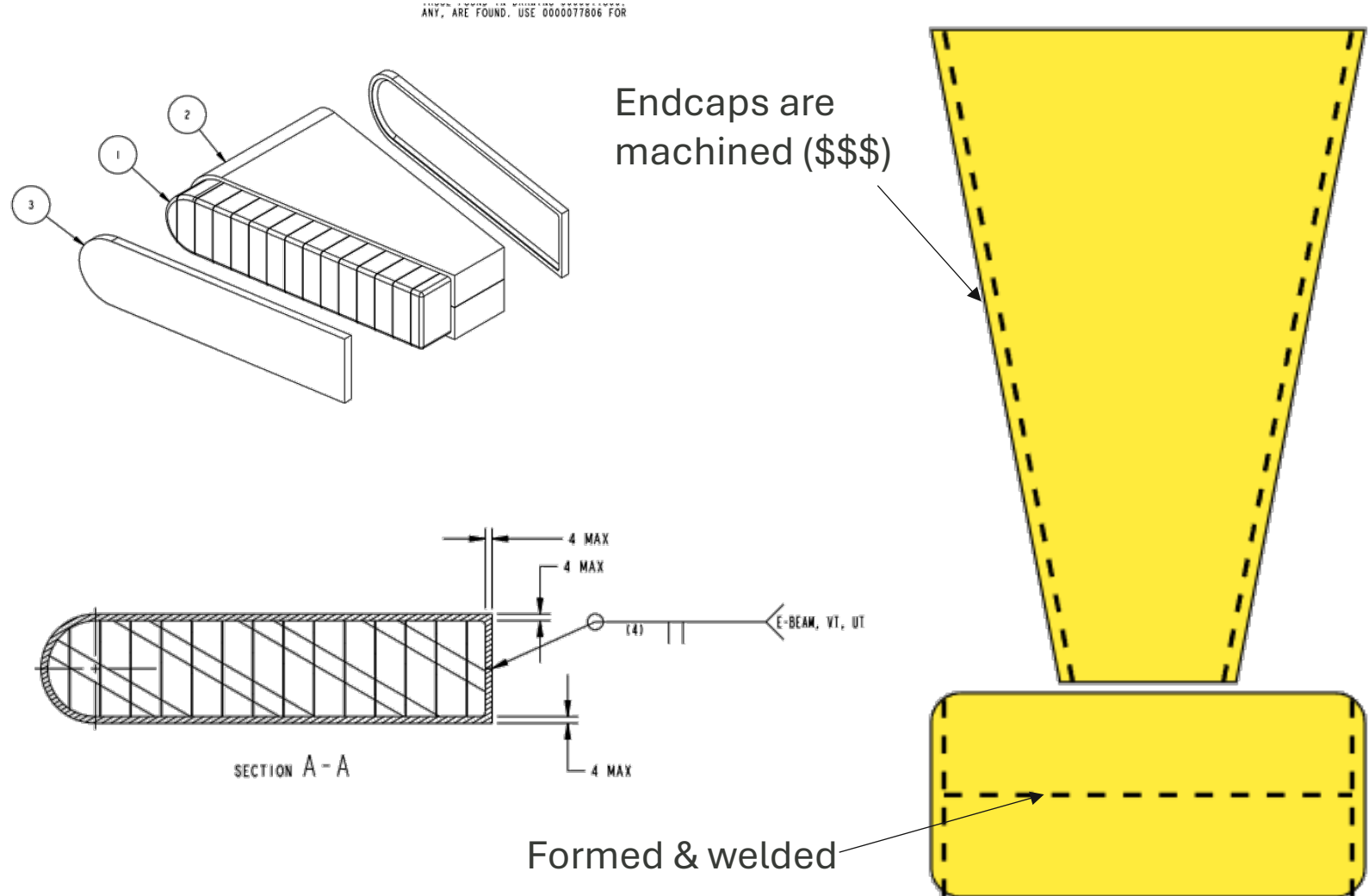
WIP-NOT APPROVED FOR CONSTRUCTION					
UNITS: MILLIMETERS		 OAK RIDGE National Laboratory HIGH FLUX ISOTOPE REACTOR SPALLATION NEUTRON SOURCE			
DEFAULT TOLERANCES					
0-6 ±0.1		--- TUNGSTEN & TANTALUM PACKAGE HOLD POINT A			
»6-120 ±0.2					
»120 ±0.5					
ANGULAR ±0.5°					
BREAK ALL SHARP EDGES EXCEPT AS NOTED: 1.5 MAX					
SURFACE ROUGHNESS: 3.2 Ra UNO.		DRAWING NUMBER 0000011614			
DRAFTING STD: ASME Y14.100 GDT: ASME Y14.5 WELD SYMBOLS: AWS A2.4					
HOLD POINT INJECTION		SIZE	SCALE	WEIGHT	SHEET
		D	1:2	31 KG	1 of 1
				REV 0	

Tantalum surrounds are formed, machined, and welded around the spallation core

- Center section – formed sheet
- Endcaps – machined Ta
- TIG in glovebox or EBW
- Vacuum/EBW closure
- Oversize Ta to permit cleanup after HIP

Inspection

- Geometric
- Weld – VT, RT
- ASTM E493 “Helium Bomb test”

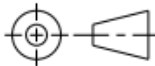


Hold Point B - The spallation package and tantalum are HIP'd together

- Clean according to SPEC - 000001356
- HIP according to SPEC - 000020002



- Inspection
- Ultrasound
 - Thermal

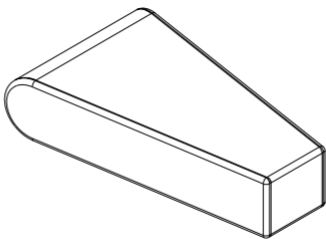
EXPLODED REFERENCE VIEW SCALE 1:2		WIP-NOT APPROVED FOR CONSTRUCTION			
GRADE	1-SERIOUS	UNITS: MILLIMETERS	 OAK RIDGE National Laboratory		
FACILITY	STS	DEFAULT TOLERANCES			
BUILDING	8800-STG.TARGET.BUILDING.II	0-6 ±0.1	SPALLATION PACKAGE PRE-HIP HOLD POINT B		
MAJOR SYSTEM	TARGET.SYSTEMS	>6-120 ±0.2			
SYSTEM	TARGET.ASSEMBLIES	>120 ±0.5			
SUBSYSTEM	TARGET.BLOCK	ANGULAR ±0.5°	DRAWING NUMBER 0000083592		
SUB-SUBSYSTEM	XXX	BREAK ALL SHARP EDGES EXCEPT AS NOTED: 15 MAX			
		SURFACE ROUGHNESS: 0.8 Ra U.N.O.	REV 0		SHEET 1 of 1
		DRAFTING STD: ASME Y14.100 GDT: ASME Y14.5 WELD SYMBOLS: AWS A2.4	SIZE	SCALE	
		THIRD ANGLE PROJECTION 	D	1:2	WEIGHT 38 KG

Hold Point C - Tantalum is machined down to fit the Inconel housing

Machine to drawing

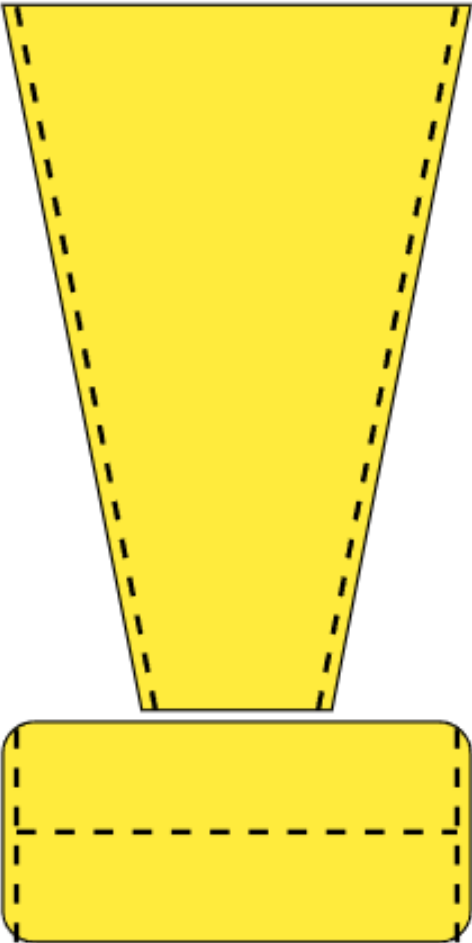
Remove all EDM case layer
(for HIP)

- Inspection
- Geometric



REFERENCE VIEW
SCALE 1:2

WIP-NOT APPROVED FOR CONSTRUCTION	
GRADE 1-SERIOUS	UNITS: MILLIMETERS
	DEFAULT TOLERANCES
FACILITY STS	0-6 ±.01
	6-120 ±0.2
BUILDING 8800-STS.TARGET BUILDING II	120 ±0.5
	ANGULAR ±0.5°
MAJOR SYSTEM TARGET SYSTEMS	BREAK ALL SHARP EDGES EXCEPT AS NOTED: 15 MAX
	SURFACE ROUGHNESS: 0.8 Ra UNO.
SYSTEM TARGET ASSEMBLIES	DRAFTING STD: ASME Y14.100
	QOT: ASME Y14.5
SUBSYSTEM TARGET BLOCK	WELD SYMBOLS: AWS A2.4
	THIRD ANGLE PROJECTION
SUB-SUBSYSTEM XXX	OAK RIDGE National Laboratory
	HIGH FLUX ISOTOPE REACTOR
	SPALLATION NEUTRON SOURCE
	SPALLATION PACKAGE POST-HIP & MACHINING HOLD POINT C
	DRAWING NUMBER 0000083613
	REV 0
	SIZE SCALE D 1:2
	WEIGHT 32 KG
	SHEET 1 of 1



Inconel forgings are machined to accept the spallation package

- Forgings are purchased to SPEC 000020000
- Machined to match tantalum clearances
- One side open for inserting spallation package
- ORNL to approve cleanup allowances to ensure HIP closure
- NO EDM Case Layer to remain



Inspection

- Geometric

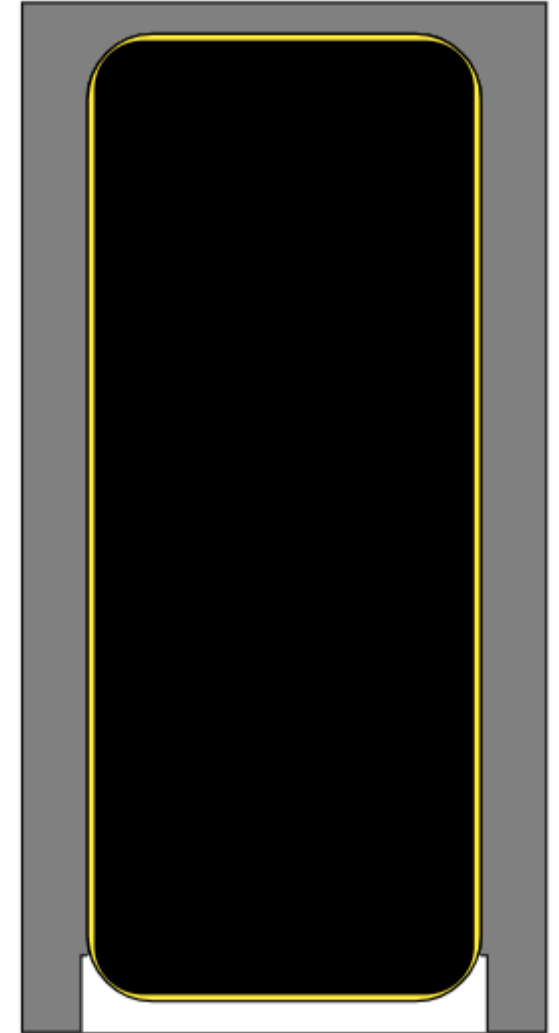
The spallation package is inserted into the Inconel and gaps are verified.

- Clean prior to insertion per 00001356
- Clearances verified
- Likely install Inconel over spallation package

7. THE GAP BETWEEN THE TANTALUM AND THE INCONEL COMPONENTS SHALL NOT EXCEED 0.1 MILLIMETERS. VERIFY BY THE INSPECTION REPORT OF 0000083613 AND INCONEL PRE-HIP COMPONENTS.

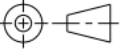
Inspection

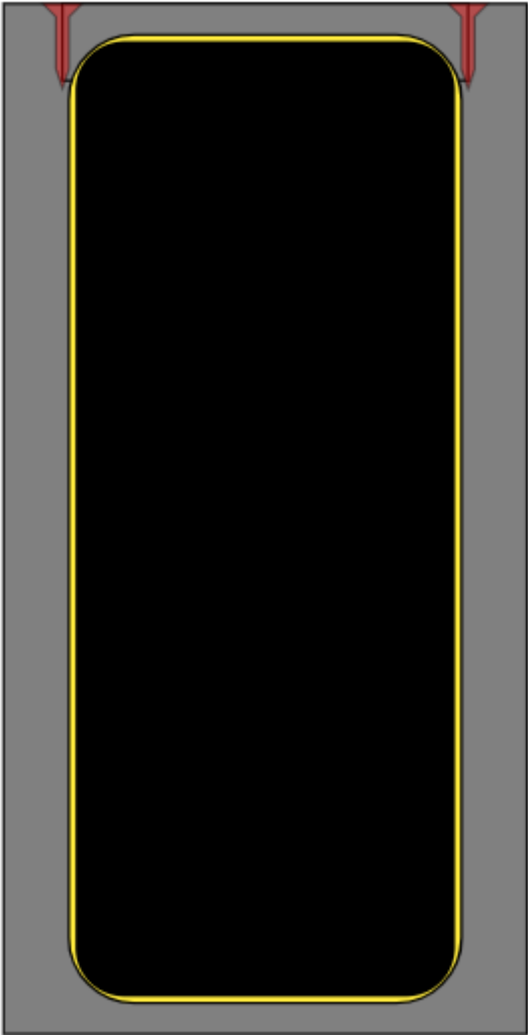
- Geometric



Hold Point D - The lid is inserted into the Inconel shroud and then EBW closed

- Weld joint is to be pre-qualified on geometry of same
- Weld goes past shelf
- Avoid tantalum radii

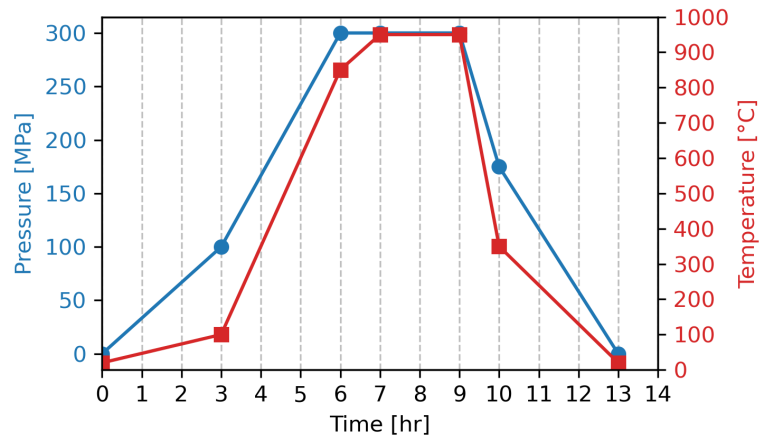
WIP-NOT APPROVED FOR CONSTRUCTION					
GRADE	1-SERIOUS	UNITS: MILLIMETERS	 OAK RIDGE National Laboratory		
FACILITY	STS	DEFAULT TOLERANCES			
		0-6 ±0.1	HIGH FLUX ISOTOPE REACTOR		
		6-120 ±0.2			
		120 ±0.5	SPALLATION NEUTRON SOURCE		
		ANGULAR ±0.5°			
BUILDING	8800-STS.TARGET.BUILDING.II	BREAK ALL SHARP EDGES EXCEPT AS NOTED: 15 MAX	INCONEL SURROUND PRE-HIP HOLD POINT D		
MAJOR SYSTEM	TARGET.SYSTEMS	SURFACE ROUGHNESS: 3.2 Ra UNO.			
SYSTEM	TARGET.ASSEMBLIES	DRAFTING STD: ASME Y14.100	DRAWING NUMBER		REV
SUBSYSTEM	TARGET.SEGMENT	GDT: ASME Y14.5	0000083639		0
		WELD SYMBOLS: AWS A2.4			
SUB-SUBSYSTEM	XXX	THIRD ANGLE PROJECTION 	SIZE	SCALE	WEIGHT
			D	1:2	43 KG
					SHEET
					1 of 1



- Inspection
- VT, RT, UT

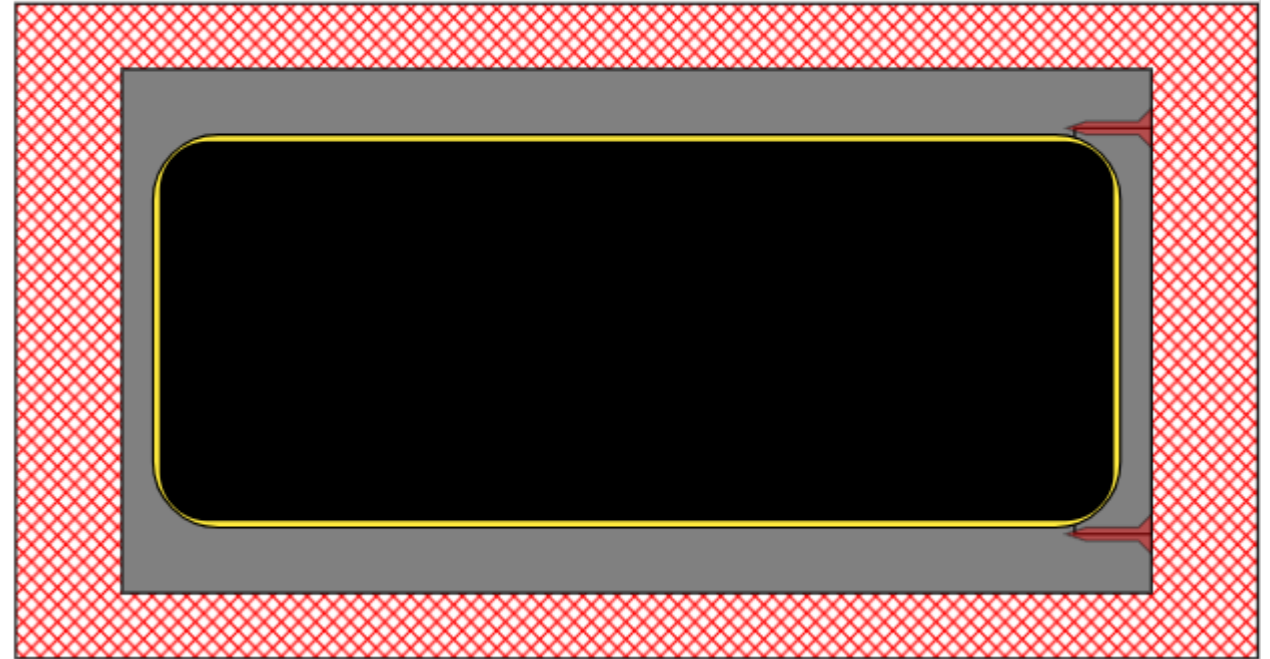
HIP the Inconel to the spallation package

- HIP per S07030100-TSP10001 with getters and shortly after EBW



Inspection

- UT (bond & thickness)
- Transient Thermal (WIP)

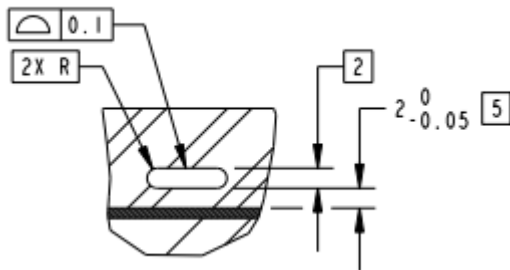
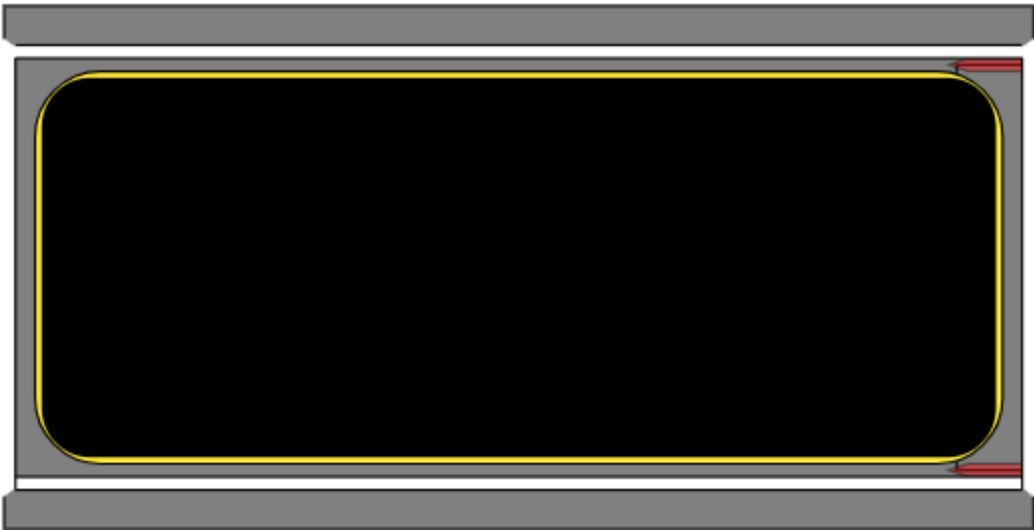


Hold Point E - Machine the Inconel for water passages

- Hole drilling
- Machining water passages
- Compressive stress on surface of water passages

Inspection

- UT thickness (distances to W)
- CMM



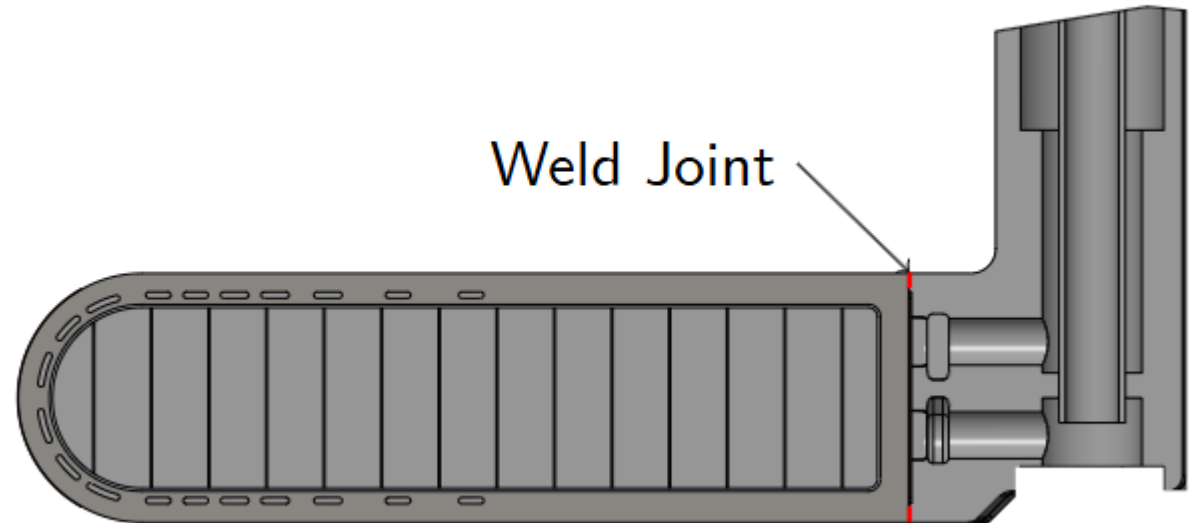
		EXPLODED REFERENCE VIEW SCALE 1:2	
WIP-NOT APPROVED FOR CONSTRUCTION			
GRADE	1-SERIOUS	UNITS: MILLIMETERS DEFAULT TOLERANCES 0-6 ±0.1 >6-120 ±0.2 >120 ±0.5 ANGULAR ±0.5°	OAK RIDGE National Laboratory
FACILITY	STS	BREAK ALL SHARP EDGES EXCEPT AS NOTED: 15 MAX	HIGH FLUX ISOTOPE REACTOR
BUILDING	8800-STG.TARGET.BUILDING.II	SURFACE ROUGHNESS: 3.2 Ra UNO.	SPALLATION NEUTRON SOURCE
MAJOR SYSTEM	TARGET.SYSTEMS	DRAFTING STD: ASME Y14.100 GDT: ASME Y14.5 WELD SYMBOLS: AWS A2.4	INCONEL SURROUND POST-HIP MACHINING HOLD POINT E
SYSTEM	TARGET.ASSEMBLIES	DRAWING NUMBER	REV
SUBSYSTEM	TARGET.SEGMENT	0000077032	0
SUB-SUBSYSTEM	XXX	SIZE SCALE	WEIGHT
		D 1:2	39 KG
		THIRD ANGLE PROJECTION	SHEET
			1 of 1

Join the heel section to the target package

- Weld to heel (CJP)

Inspection

- Geometric (heel before weld)
- VT, UT, RT



Weld on the water covers and machine to final geometry

- TIG weld

Inspection

- Geometric – Covers before weld
- Geometric - Complete
- VT, UT, RT

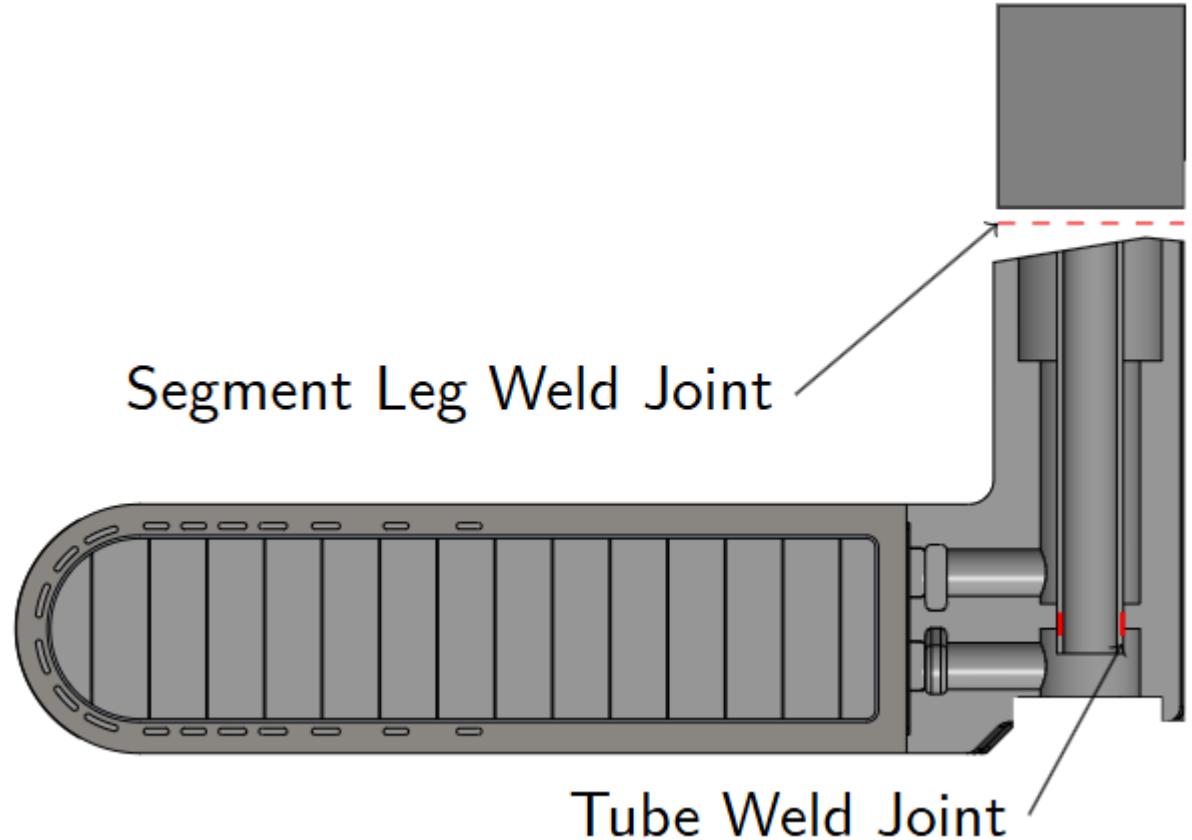


The complete foot is shipped to the leg vendor for welding to the leg

- TIG weld

Inspection

- VT, UT, RT

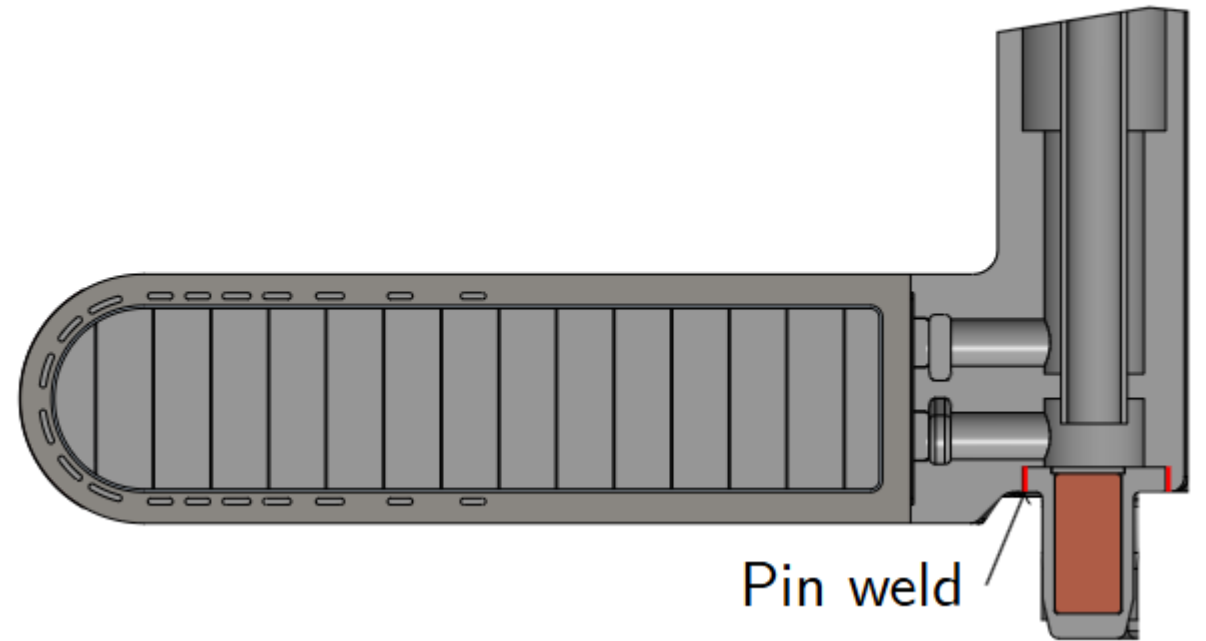


The locating pin is welded to the bottom of the segment

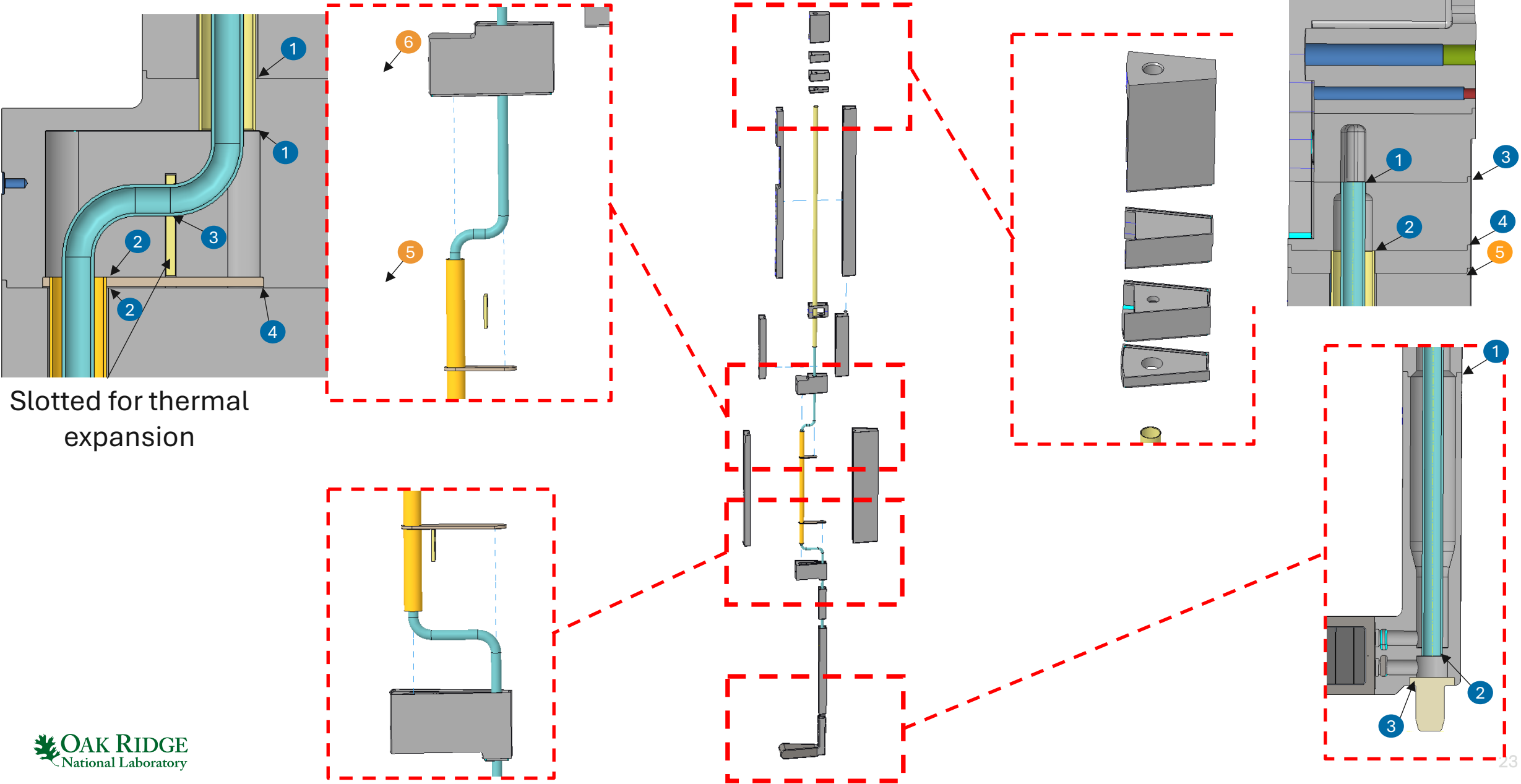
- TIG weld

Inspection

- VT, UT, RT

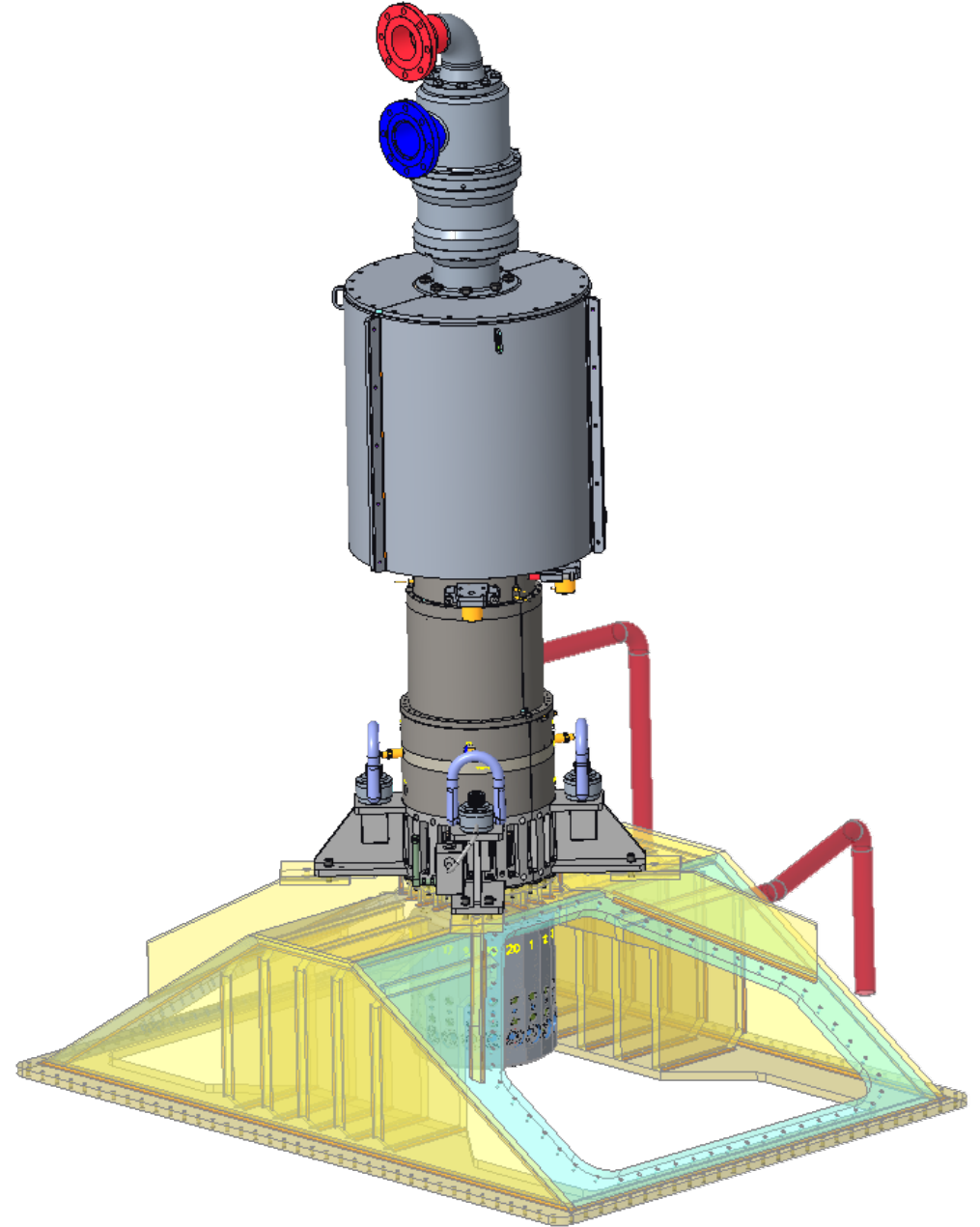


The segment is a welded series of manifolds with a nested tube

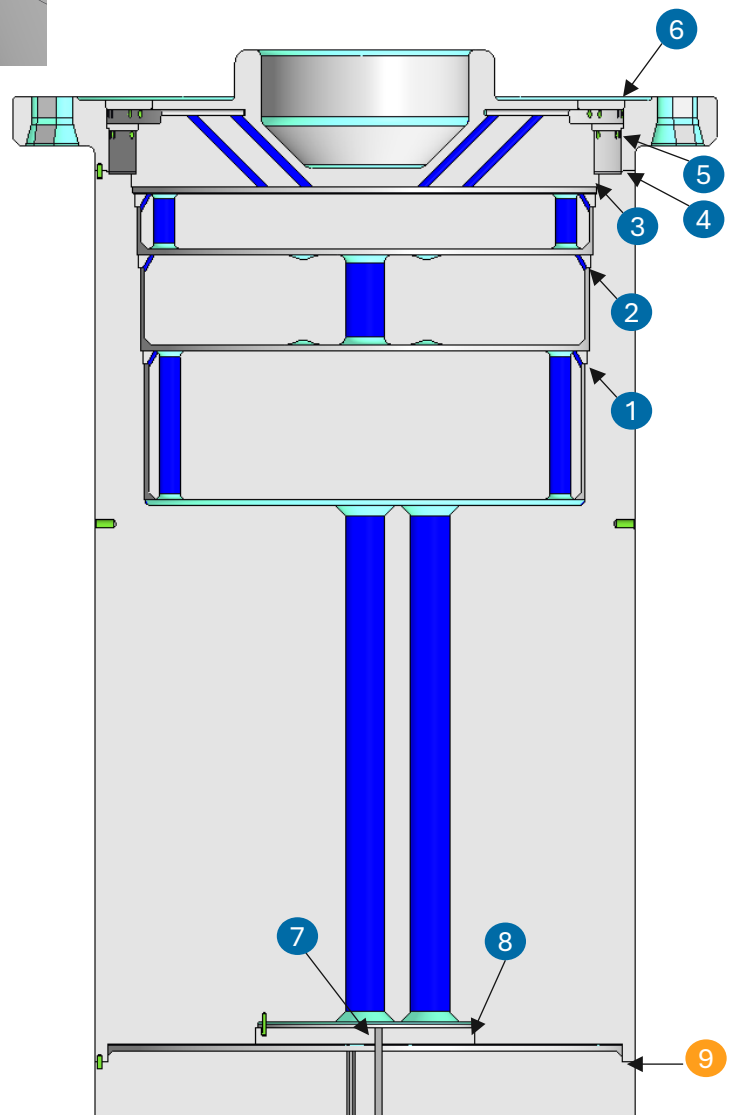
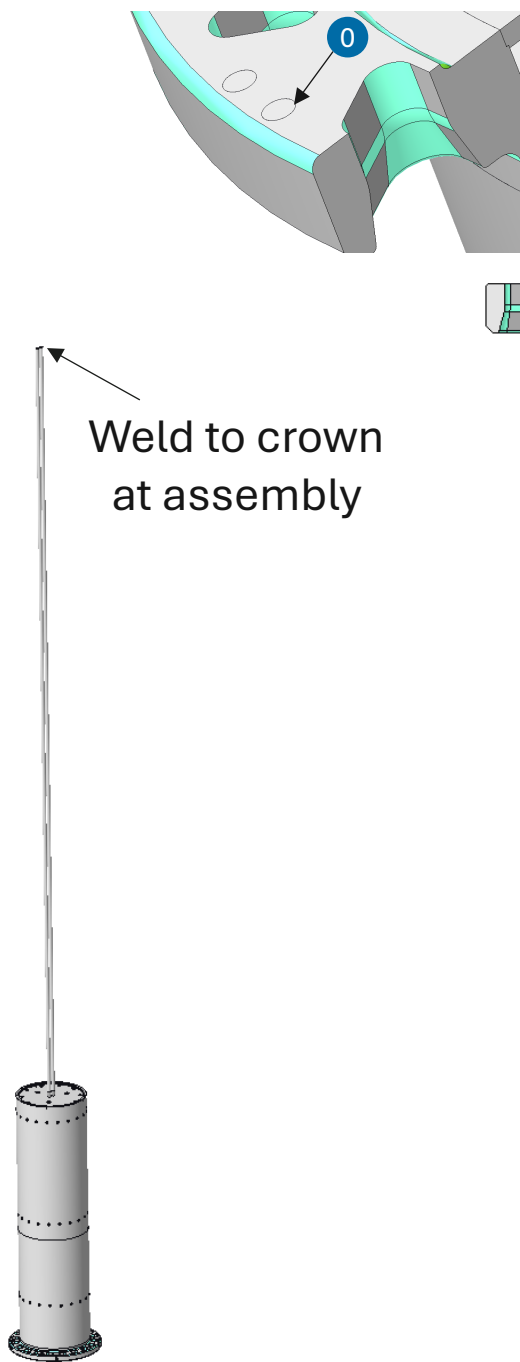
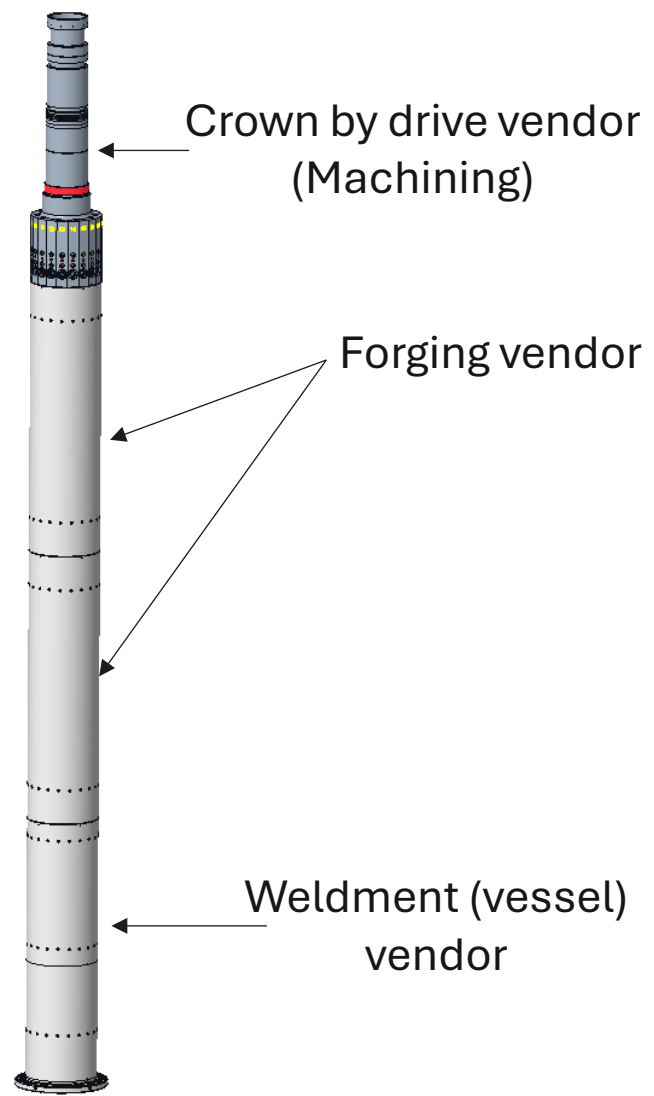


Drive manufacturing

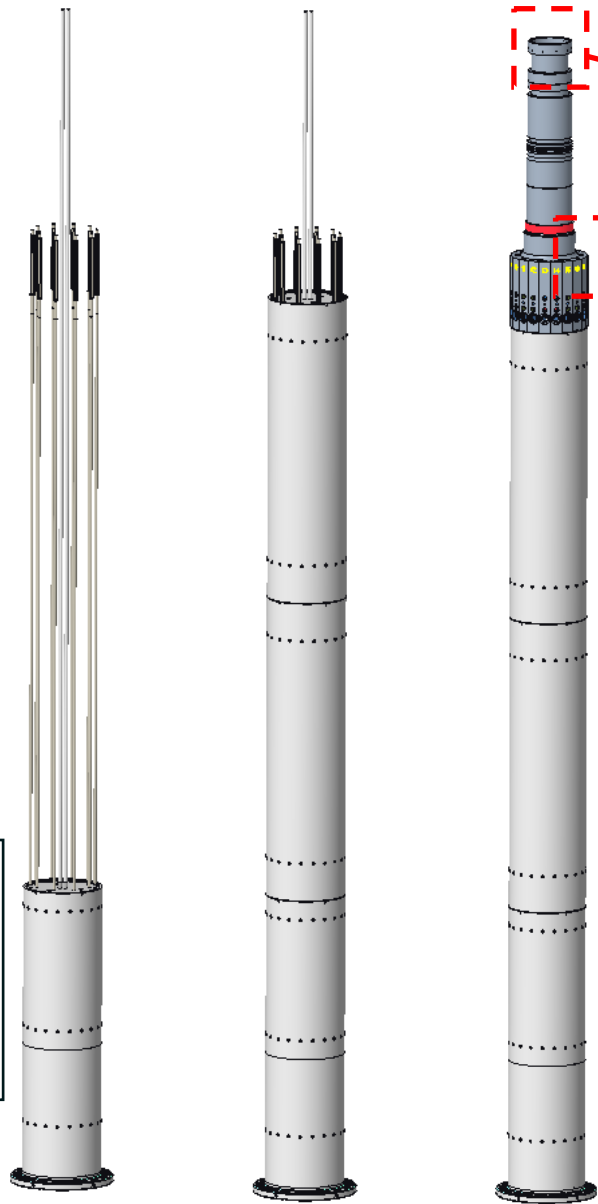
- Single vendor for machining, assembly and demonstration
- Advantageous approach for resolving design issues as they arise
- Alleviates dispute resolution between vendors & delays in purchasing
- Ensures ownership of fitment and small judgements
- Very common for many local and national vendors
- Often comes with some level of controls and engineering support for the factory acceptance test
- Drive should be operating well before arriving at ORNL



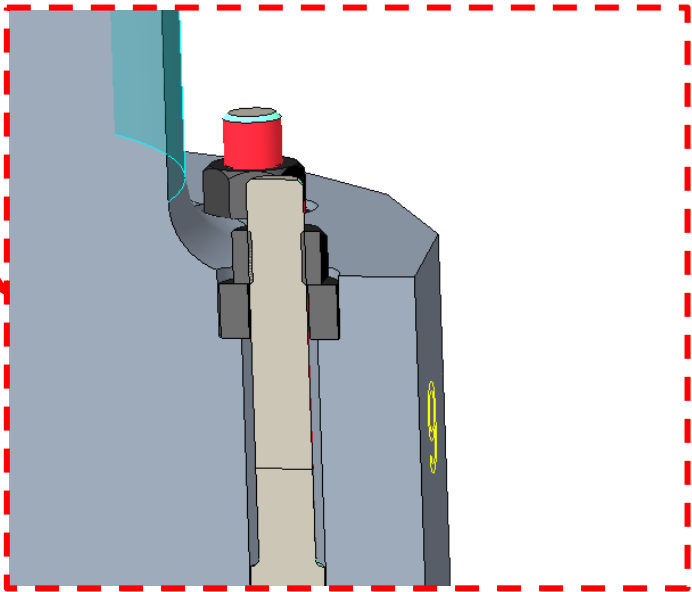
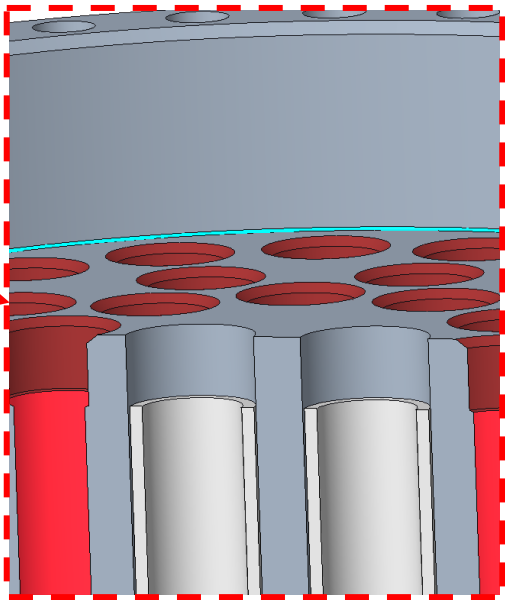
Shaft fabrication



Shaft assembly (MUTS)



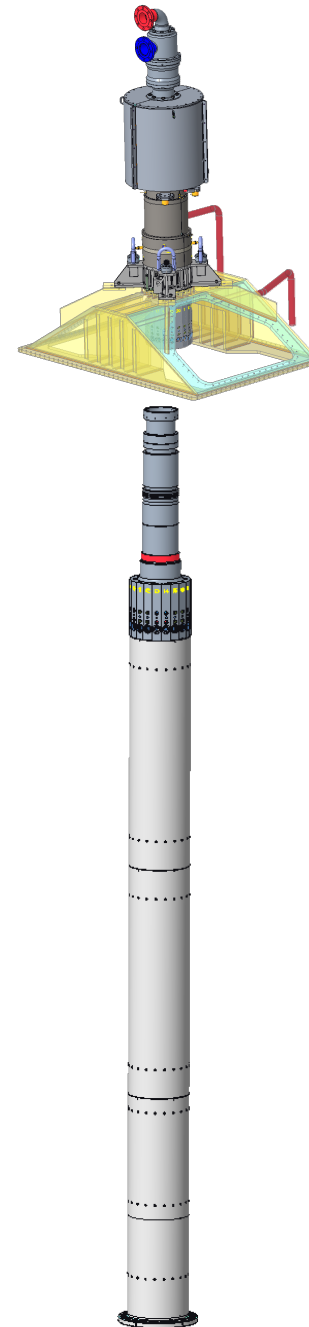
Runout adjustments
(if required) by local
vendor during
assembly



Join the drive to the shaft in MUTS (Assemble drive in parts)

- Core Vessel lid is in position over shaft
- Drive is assembled onto lid and shaft
- Full metrology sweep of shaft & drive
- Runout checks
- Add Segments

Talk by L. Bearden on Wednesday
“MUTS Installation & Checkout”



Charge Question 4: Are the acquisition and manufacturing plans feasible?

Yes – Plans for the target foot have been well prototyped and have appropriate plans for fabrication



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