OAK RIDGE National Laboratory | SECOND TARGET STATION

Vessel Systems and Target Station Shielding Budget Estimates

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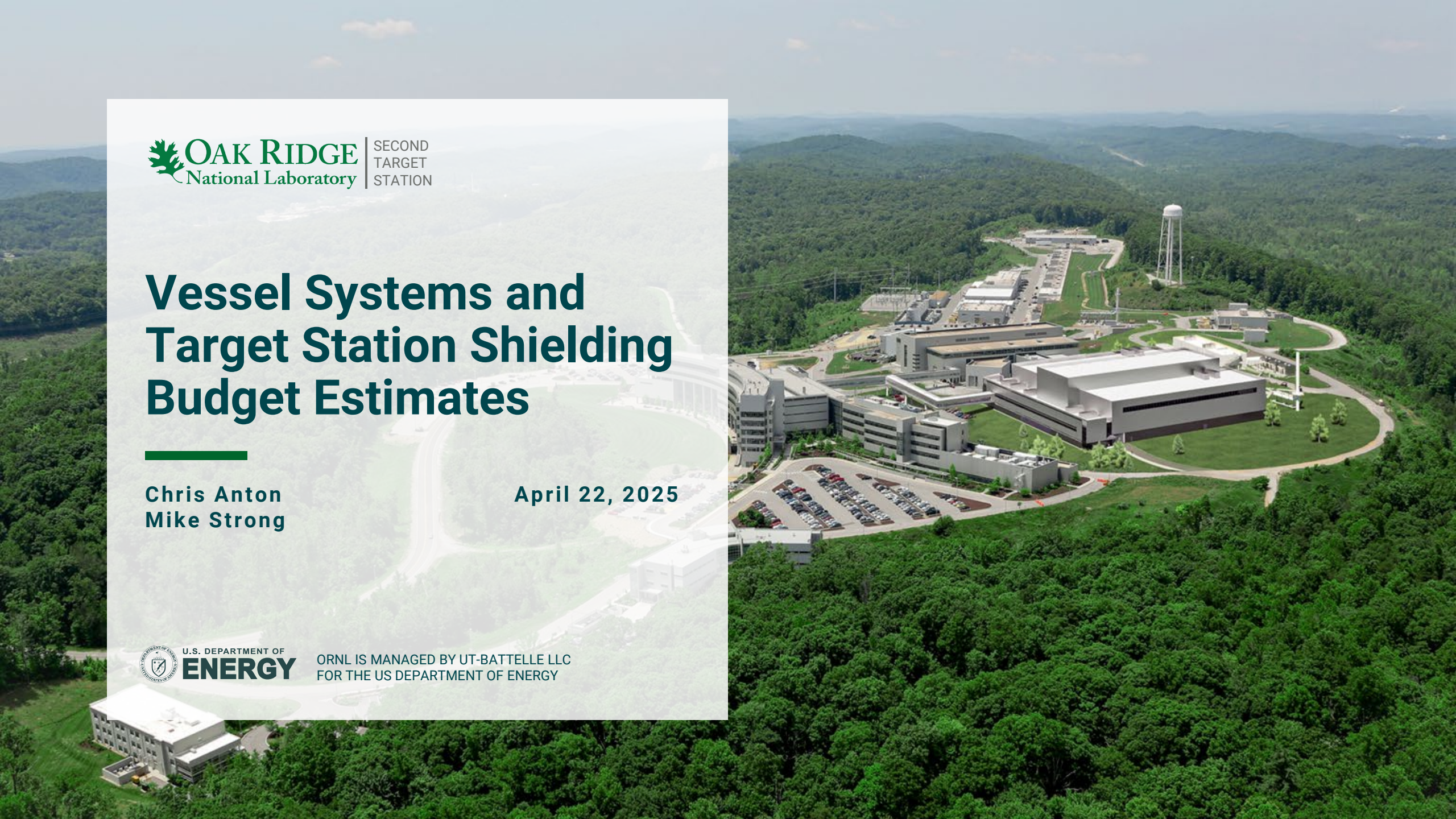
Mike Strong

April 22, 2025



U.S. DEPARTMENT OF ENERGY

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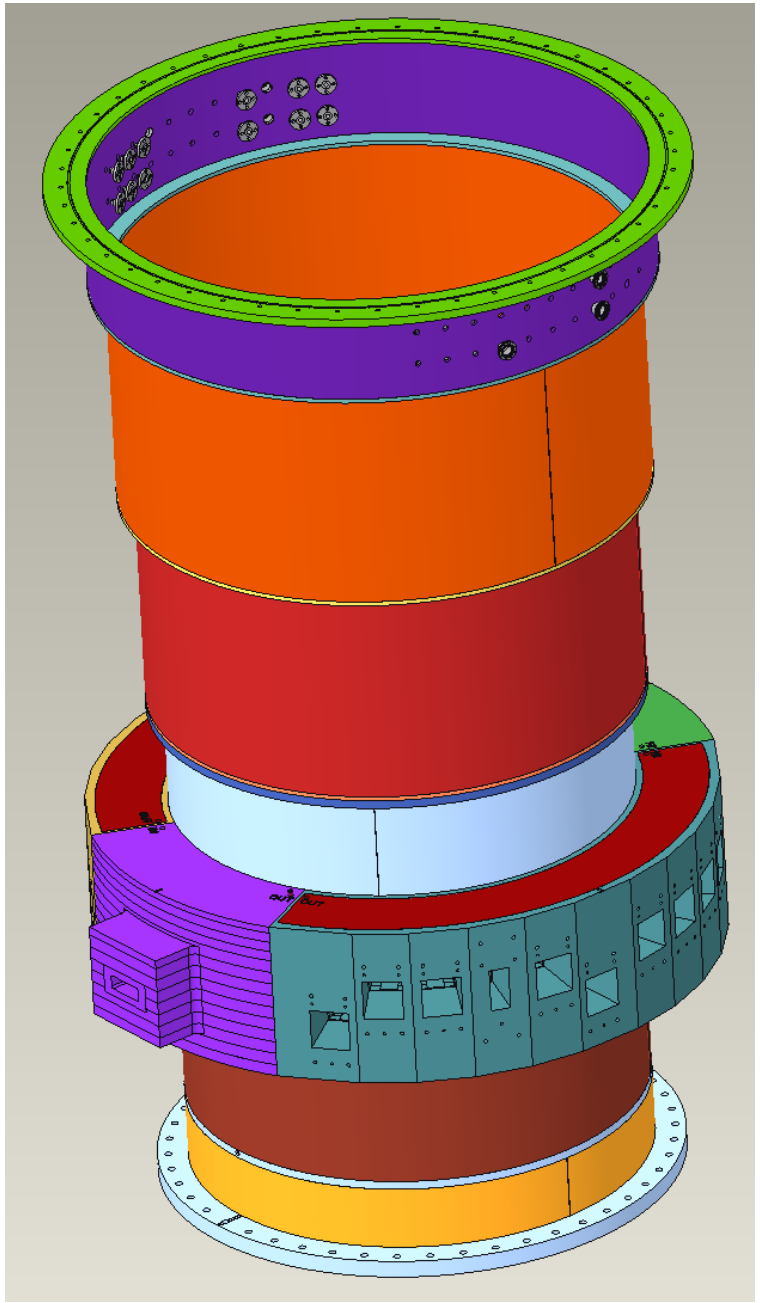
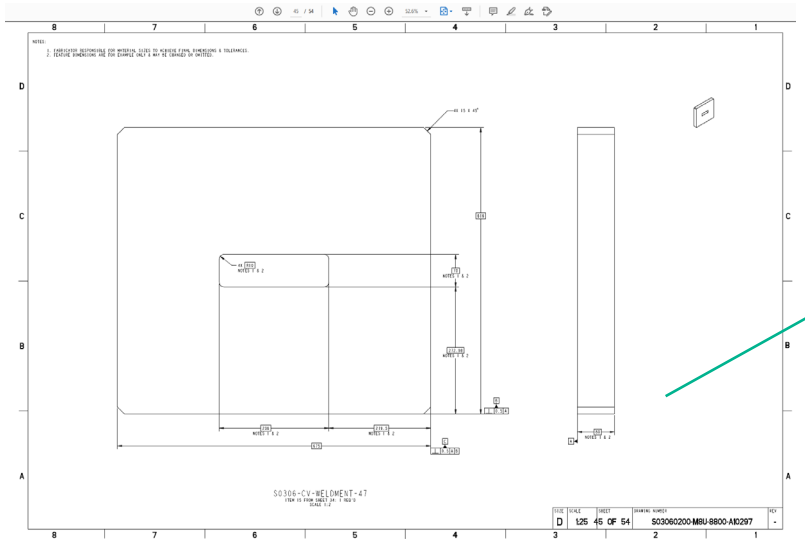
Cost Estimation Method

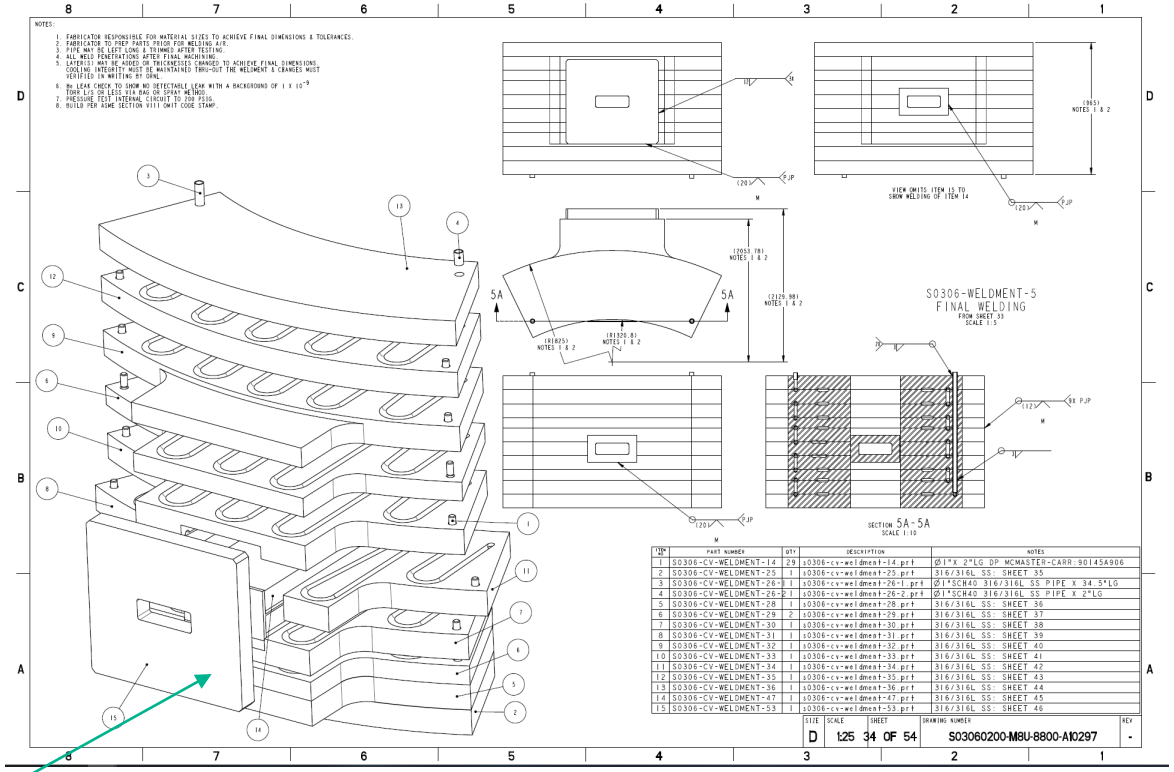
- Metalex was contracted in the Fall of 2022 to provide budgetary pricing on the STS Core Vessel weldment and standard nozzle extensions
- A fully detailed cost estimation from Metalex was received in Spring 2023
- The Metalex budgetary quote was broken into sections representing different components within the Core Vessel
- Changes to the beltline portion of the CV have occurred over the past 2 years as the design has been optimized for function and manufacturability



West beltline Plate -53

- Interface plate between Core Vessel and PBW assembly
- Material = Stainless Steel 316L
- 80mm x 616mm x 675mm

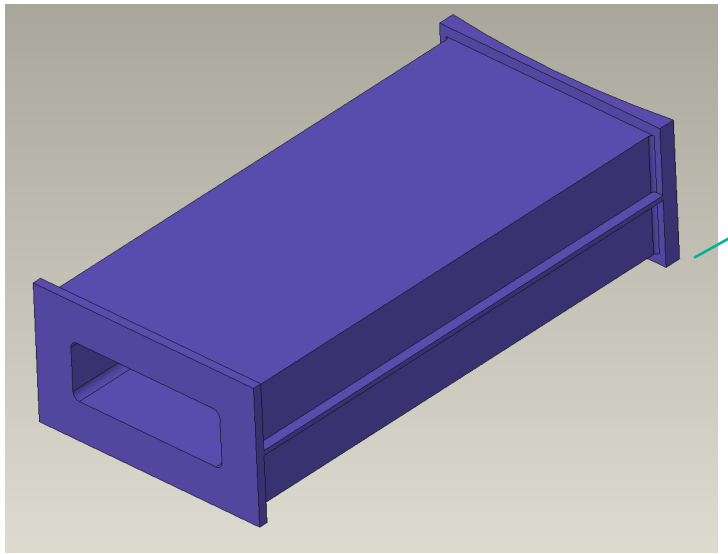


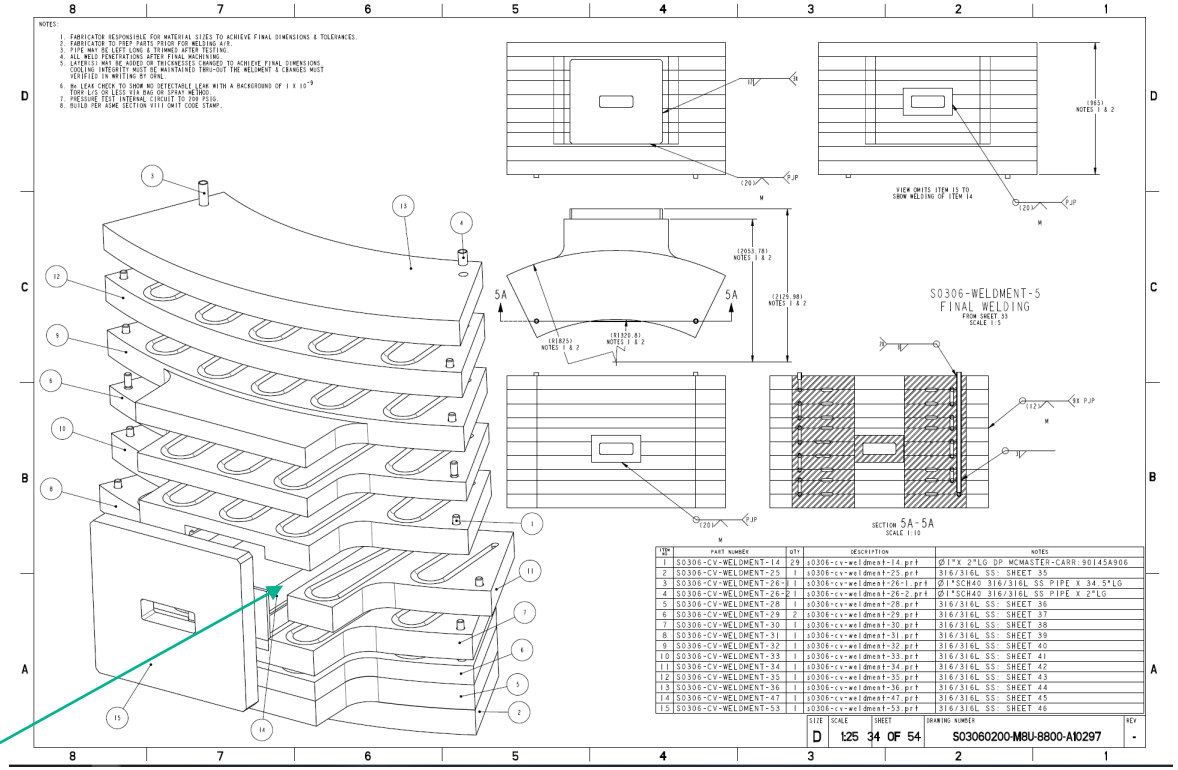


Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Shop Cost	NRE Cost	Labor Contingency Cost	Total Labor Cost	$ Labor/hour	Total Cost	Component Weight (kg)	Total Cost Per Kg
West Beltline Plates -53, Qty 1	Machining	32	1	32										
	Support (mfg, tig)	1.5	1	1.5										
	Non-reoccuring engineering	44.5	1	44.5										
	Assembly	4.5	1	4.5										
	Inspection	8	1	8										
	Contingency	24.5255	1	24.5255	115.0255	$ 4,673.63	$ 11,425.37	$ 9,054.00	$ 7,222.45	$ 27,701.82	$ 240.83	$ 32,375.45	249.5	$ 129.76

West beltline Plate -47

- Proton beam flight port through CV Beltline
- Material = Stainless Steel 316L
- Machined from single forging
- 200mm x 358mm x 745mm

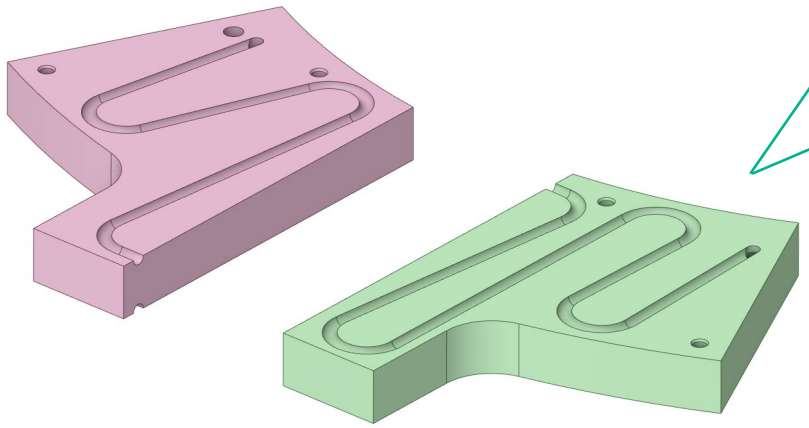


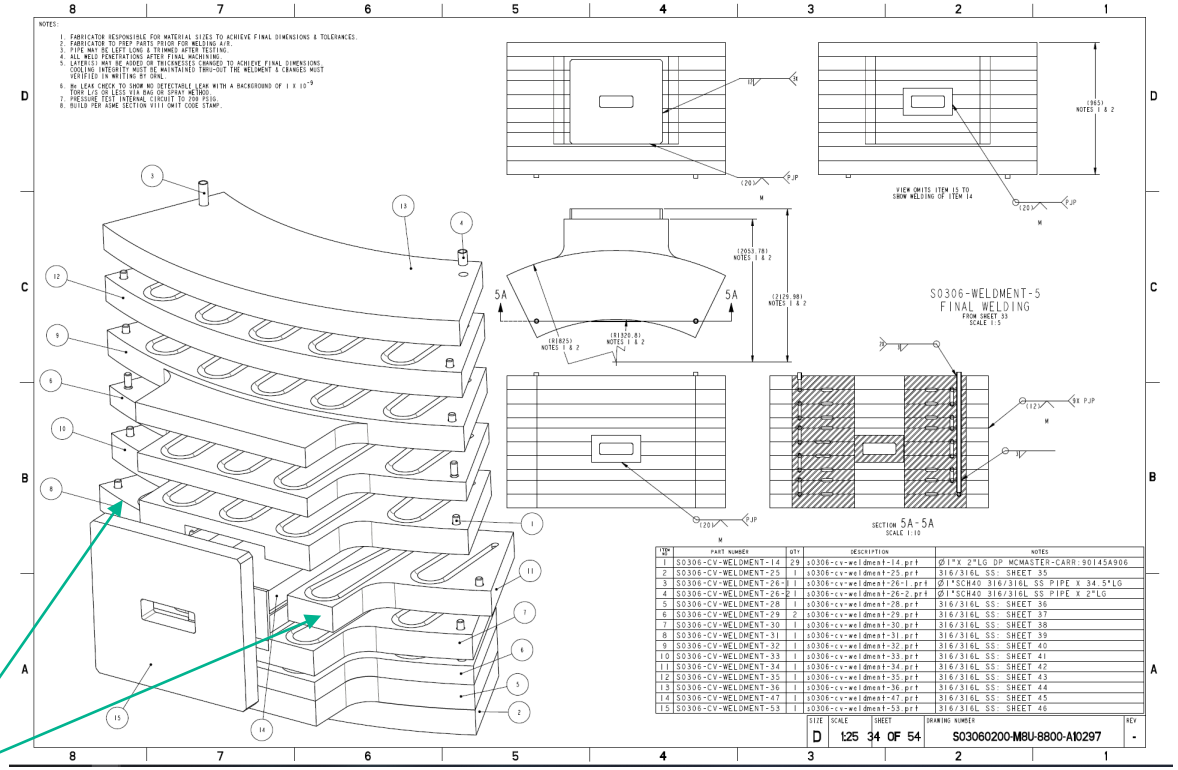


Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Shop Cost	NRE Cost	Labor Contingency Cost	Total Labor Cost	$ Labor/hour	Total Cost	Component Weight (kg)	Total Cost Per Kg
West Beltline Plates -47, Qty 1	Machining	105	1	105										
	Support (mfg, tig)	8	1	8										
	Non-reoccuring engineering	92.5	1	92.5										
	Assembly	11	1	11										
	Inspection	21	1	21										
	Contingency	64.3625	1	64.3625	301.8625	$ 15,942.52	$ 37,522.48	$ 18,528.00	$ 18,953.95	$ 75,004.43	$ 248.47	$ 90,946.95	214.6	$ 423.80

West beltline Plates -31, -34

- West beltline cooled plates
- Material = Stainless Steel 316L
- 102mm x 625mm x 700mm
- Water channels on both sides

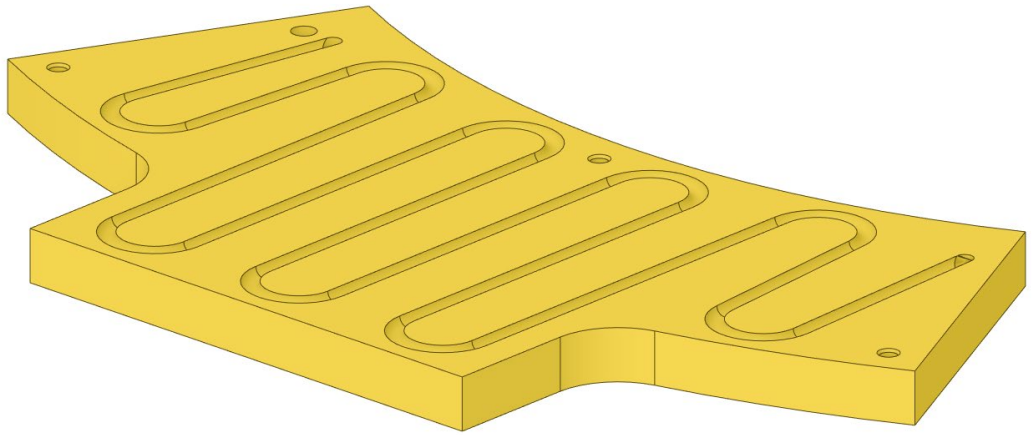


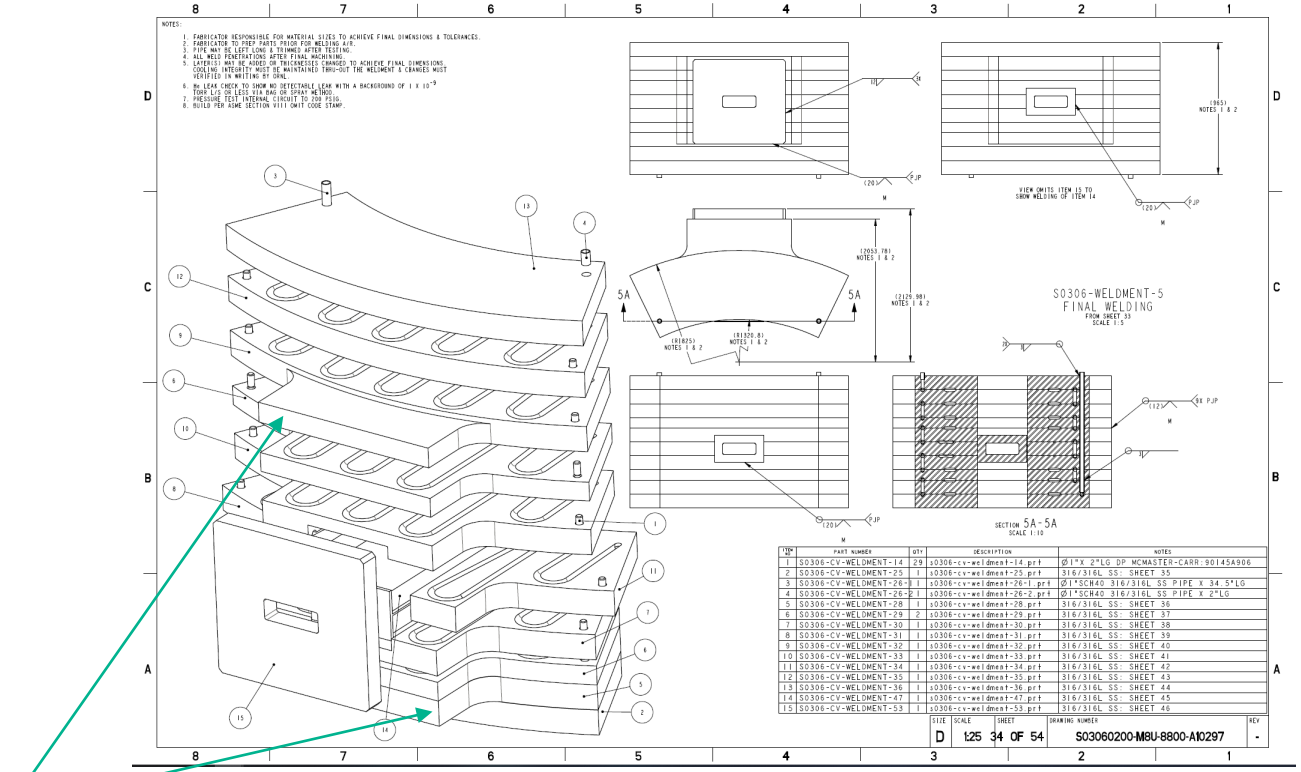


Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Shop Cost	NRE Cost	Labor Contingency Cost	Total Labor Cost	$ Labor/hour	Total Cost	Combined Weight (kg)	Total Cost Per Kg
West Beltline Plates -31, 34, Qty 2	Machining	40	2	80										
	Support (mfg, tig)	0.75	2	1.5										
	Non-reoccuring engineering	46.5	2	93										
	Assembly	3.75	2	7.5										
	Inspection	8	2	16										
	Contingency	26.829	2	53.658	251.658	$ 16,955.50	$ 27,846.50	$ 18,776.00	$ 15,801.61	$ 62,424.11	$ 248.05	$ 79,379.61	505	$ 157.19

West beltline Plates

- West beltline cooled plates
- Material = Stainless Steel 316L
- 100mm x 800mm x 1600mm
- Water channels on both sides

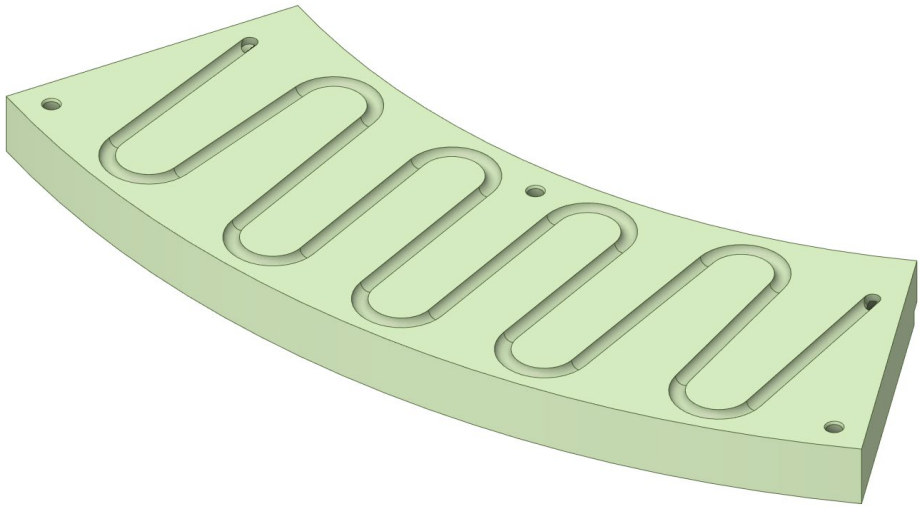


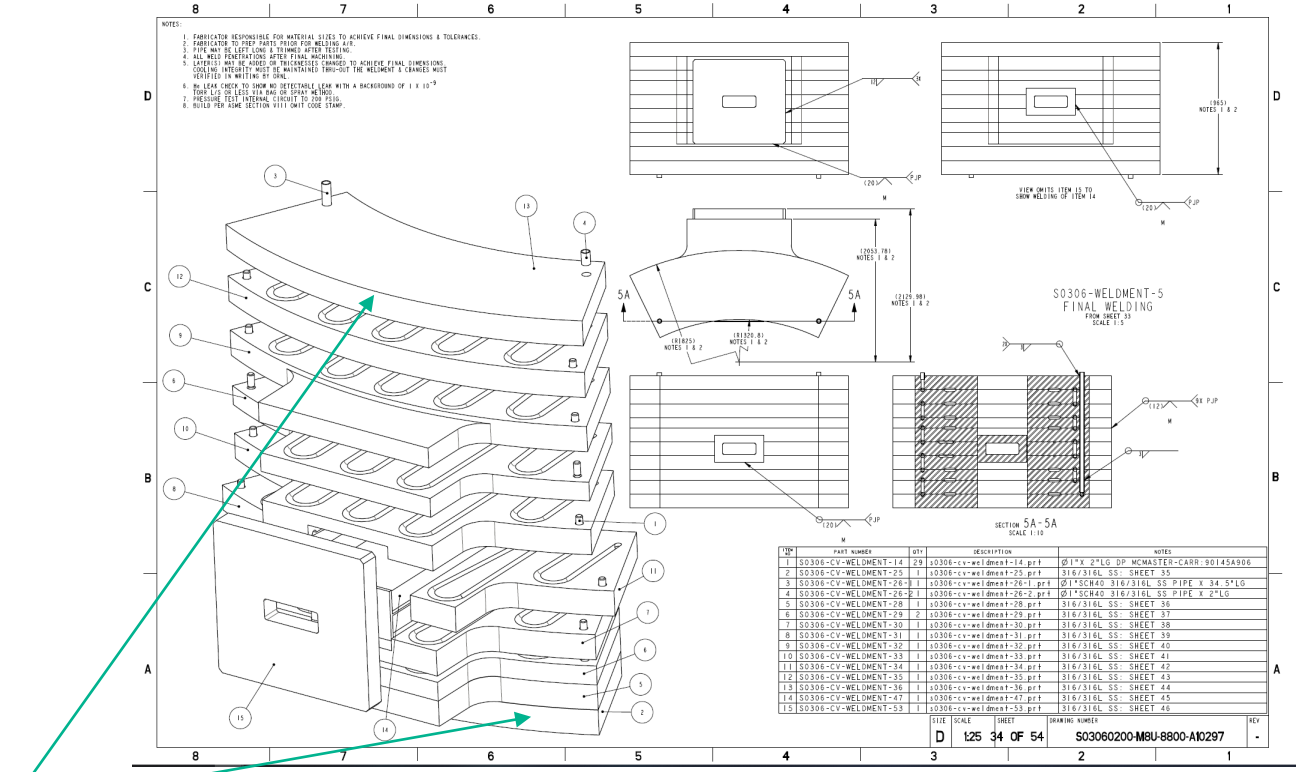


Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Shop Cost	NRE Cost	Labor Contingency Cost	Total Labor Cost	$ Labor/hour	Total Cost	Combined Weight (kg)	Total Cost Per Kg
West Beltline Plates -28, -29, -30, -32, -33, -35, Qty 7	Machining	52	7	364										
	Support (mfg, tig)	0.2	7	1.4										
	Non-reoccuring engineering	46.25	7	323.75										
	Assembly	6.2	7	43.4										
	Inspection	7	7	49										
	Contingency	30.25715	7	211.8001	993.35005	$ 94,624.25	$ 146,196.75	$ 65,716.00	$ 62,372.45	$ 274,285.20	$ 276.12	$ 368,909.45	4225	$ 87.32

West beltline Plates -25, -36

- West beltline cooled plates
- Material = Stainless Steel 316L
- 100mm x 500mm x 1600mm
- Water channels on 1 side

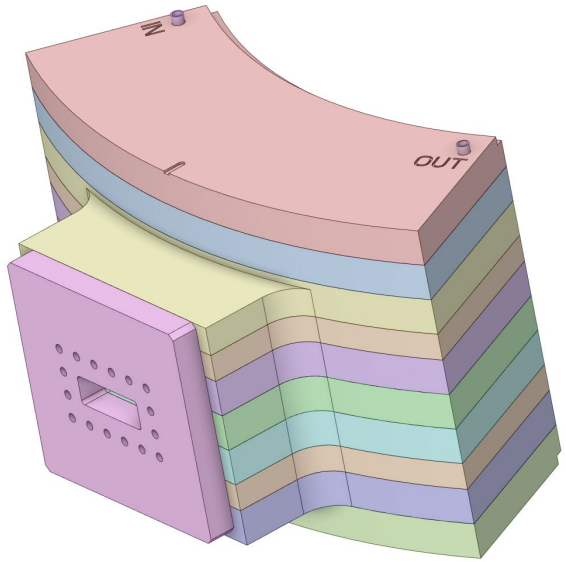


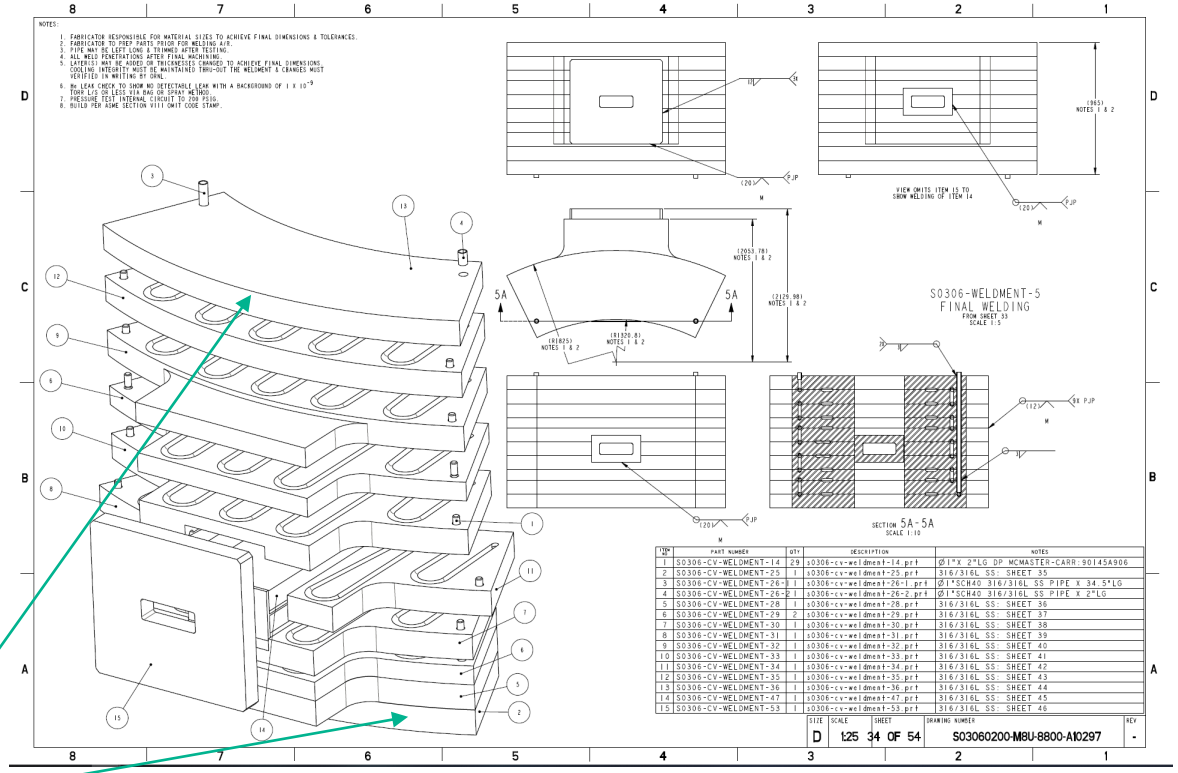


Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Shop Cost	NRE Cost	Labor Contingency Cost	Total Labor Cost	$ Labor/hour	Total Cost	Combined Weight (kg)	Total Cost Per Kg
West Beltline Plates -25, -36 Qty 2	Machining	91	2	182										
	Support (mfg, tig)	1.5	2	3										
	Non-reoccuring engineering	42.5	2	85										
	Assembly	7.5	2	15										
	Inspection	14	2	28										
	Contingency	42.4115	2	84.823	397.823	$ 44,304.92	$ 67,435.08	$ 17,136.00	$ 24,979.31	$ 109,550.39	$ 275.37	$ 153,855.31	1137	$ 135.32

West beltline Welding -5

- West beltline plates assembled and welded
- Material = Stainless Steel 316L
- Perimeter welding, 12mm groove
- 965mm tall

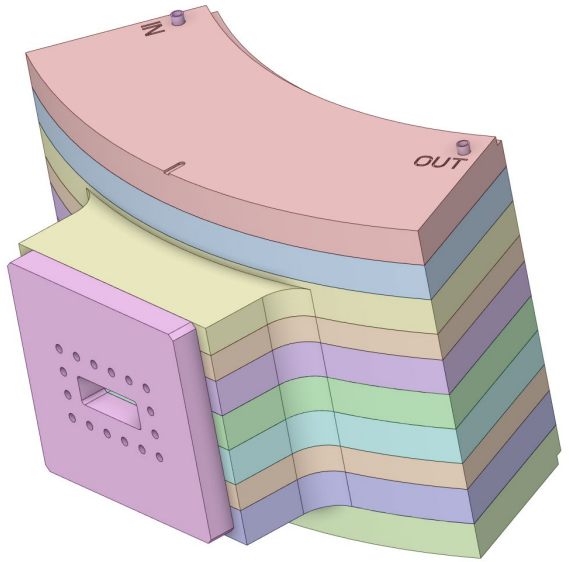


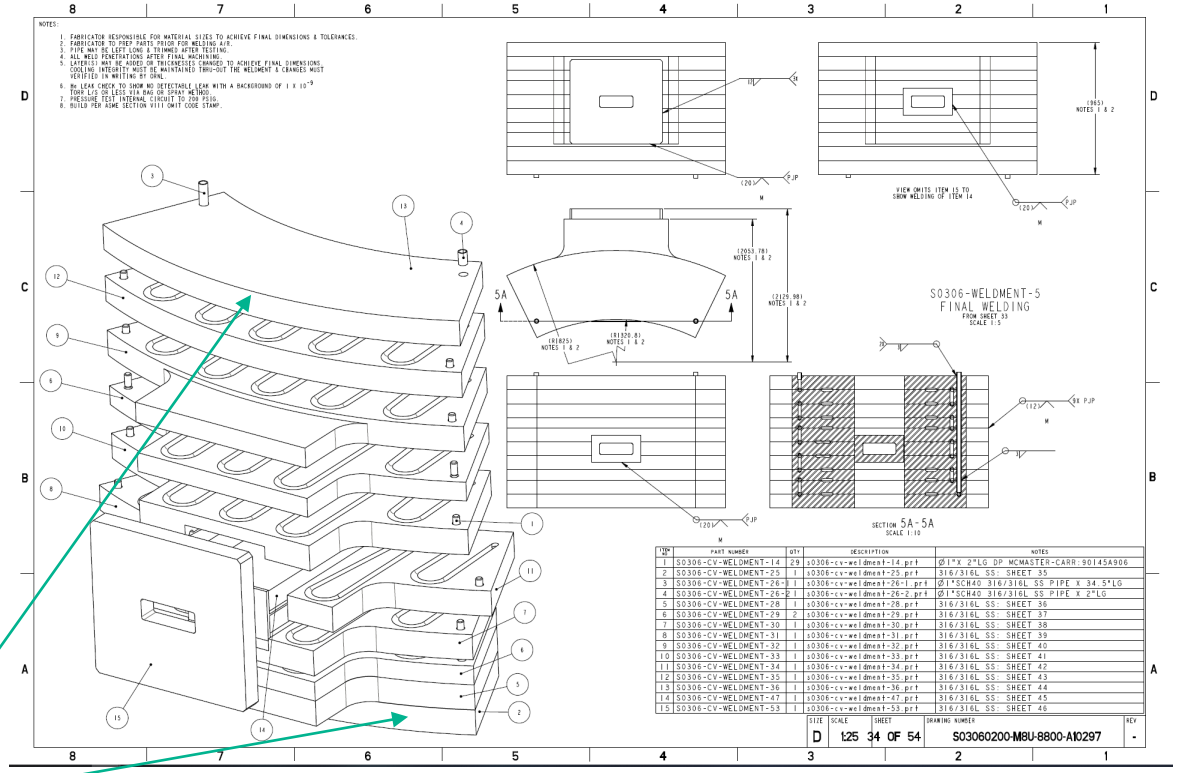


Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Shop Cost	NRE Cost	Labor Contingency Cost	Total Labor Cost	$ Labor/hour	Total Cost	Component Weight (kg)	Total Cost Per Kg
West Beltline Welding, Mach -5, Qty 1	Welding	28	1	28										
	Machining	14	1	14										
	Support (mfg, tig)	3	1	3										
	Non-reoccuring engineering	18.5	1	18.5										
	Assembly	8	1	8										
	Inspection	14	1	14										
	Contingency	23.1705	1	23.1705	108.6705	$ 662.41	$ 13,413.59	$ 3,516.00	$ 6,823.42	$ 23,753.01	$ 218.58	$ 24,415.42	6331.1	$ 3.86

West beltline Overall Cost -5

- Combined cost to fabricate west beltline to an intermediate state
- Final machining of proton port, ID and PBW flange face done later

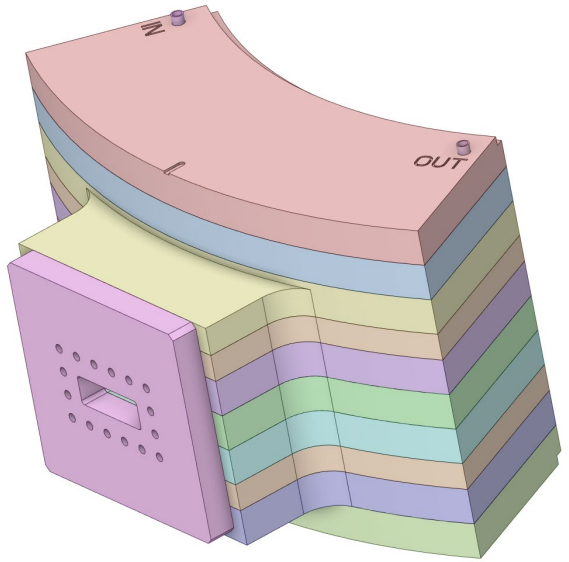


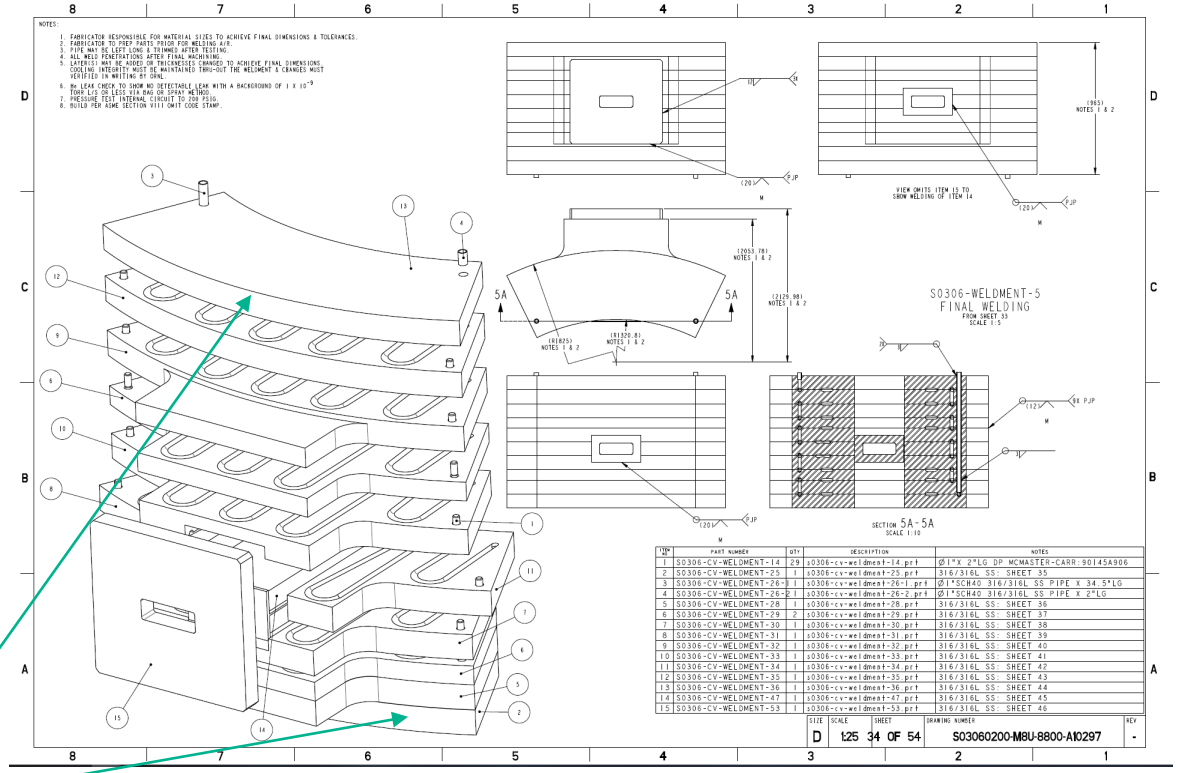


Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Shop Cost	NRE Cost	Labor Contingency Cost	Total Labor Cost	$ Labor/hour	Total Cost	Component Weight (kg)	Total Cost Per Kg
West Beltline Overall Cost, Qty 1	Welding		1	28										
	Machining		1	777										
	Support (mfg, tig)		1	18.4										
	Non-reoccuring engineering		1	657.25										
	Assembly		1	89.4										
	Inspection		1	136										
	Contingency		1	462.3396	2168.38955	$ 177,163.23	$ 303,839.77	$ 132,726.00	$ 136,153.18	$ 572,718.95	$ 264.12	$ 749,882.18	6331.1	$ 118.44

West beltline Overall Cost -5

- Combined cost to fabricate west beltline to an intermediate state
- Final machining of proton port, ID and PBW flange face done later

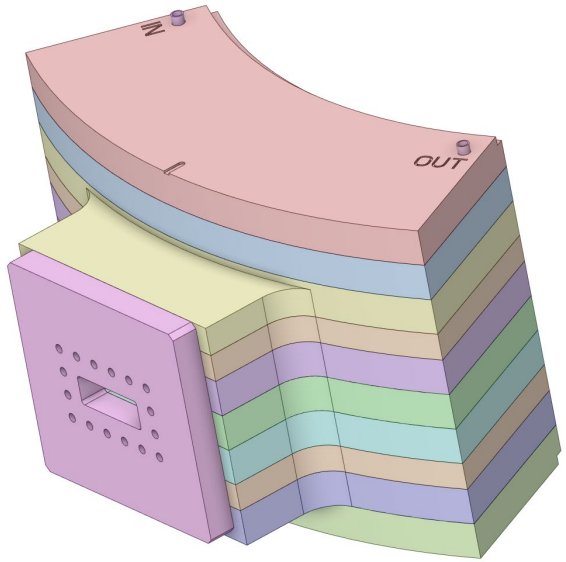


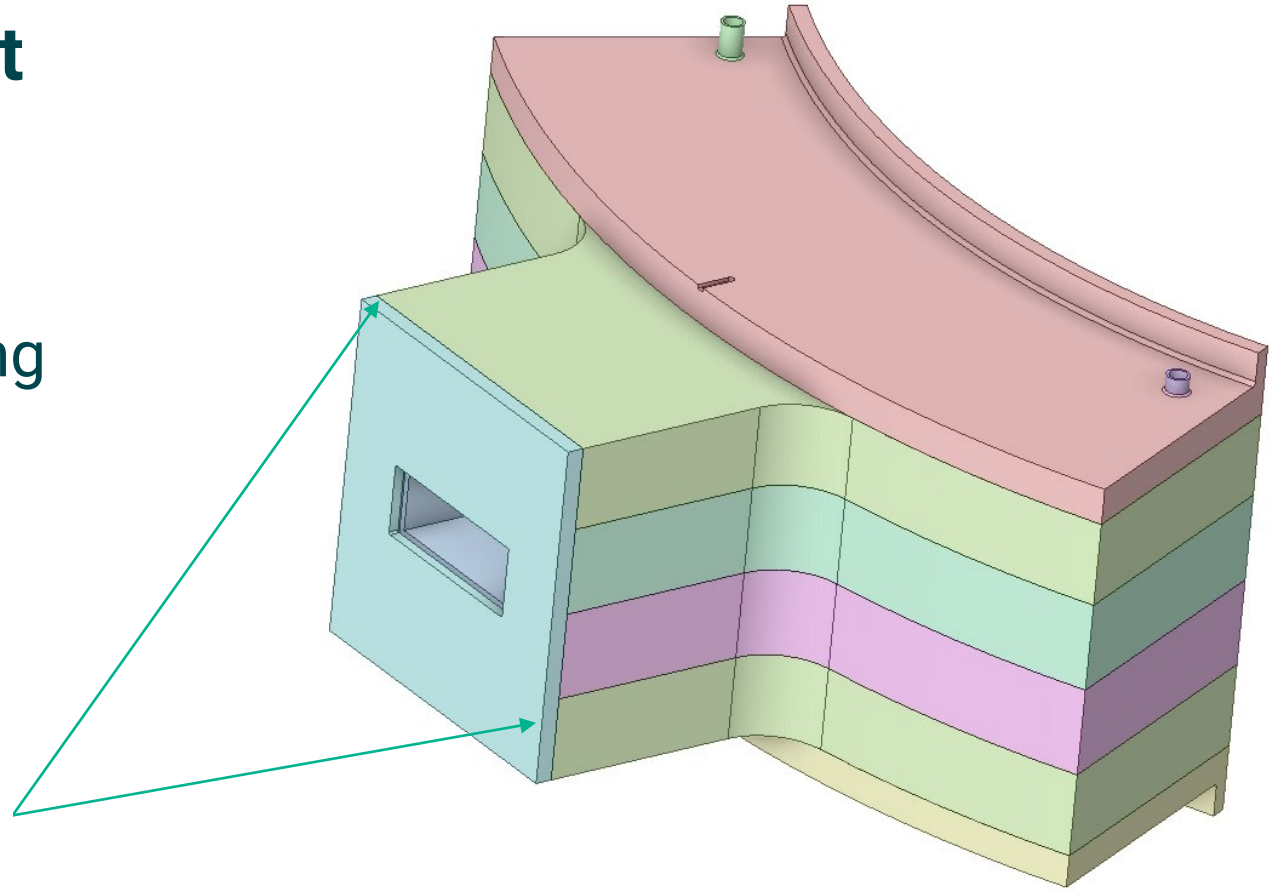


Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Shop Cost	NRE Cost	Labor Contingency Cost	Total Labor Cost	$ Labor/hour	Total Cost	Component Weight (kg)	Total Cost Per Kg
West Beltline Overall Cost, Qty 1	Welding		1	28										
	Machining		1	777										
	Support (mfg, tig)		1	18.4										
	Non-reoccuring engineering		1	657.25										
	Assembly		1	89.4										
	Inspection		1	136										
	Contingency		1	462.3396	2168.38955	$ 177,163.23	$ 303,839.77	$ 132,726.00	$ 136,153.18	$ 572,718.95	$ 264.12	$ 749,882.18	6331.1	$ 118.44

Updated West Beltline Overall Cost

- Reduced height and OD
- Reduced plate count
- We plan to update this block from plates to a forging with vertical cooling holes

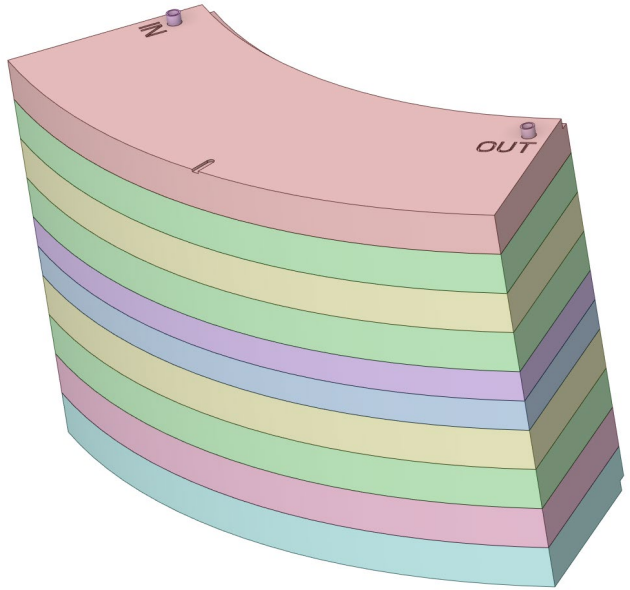


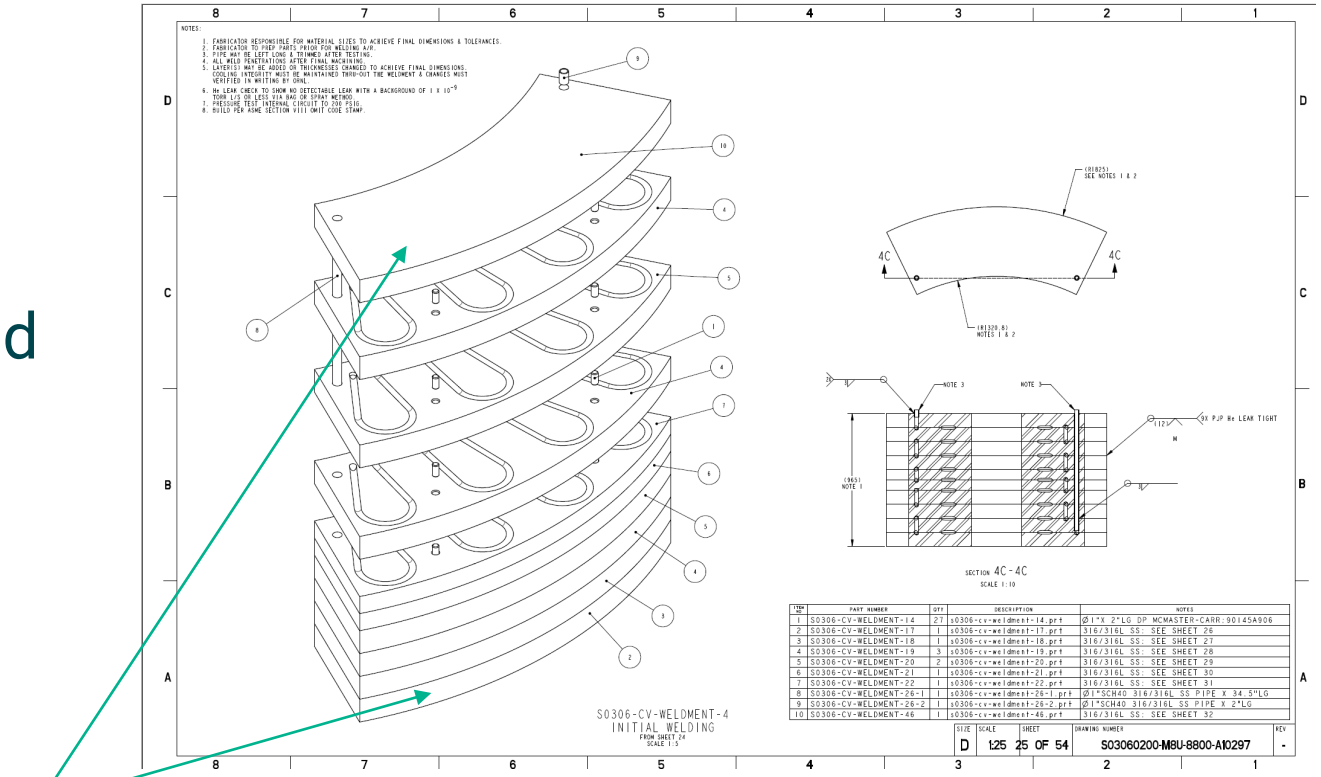


Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Total Labor Cost	$Labor/hour	Total Cost	Component Weight (kg)	Total Cost Per Kg
West Beltline Overall Cost, Qty 1	Welding		1	24							
	Machining		1	286							
	Support (mfg, tig)		1	16.3							
	Non-reoccuring engineering		1	461.5							
	Assembly		1	66.3							
	Inspection		1	86							
	Contingency		1	254.7671	1194.8671	$ 117,617.91	$ 315,588.30	$ 264.12	$ 433,206.21	6081.6	$ 71.23

East beltline Overall Cost -4

- Combined cost to fabricate west beltline to an intermediate state
- Final machining of proton port, ID and PBW flange face done later

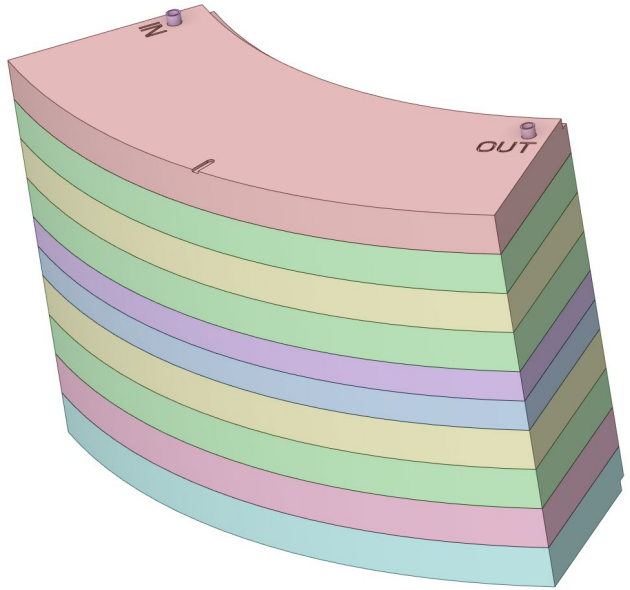


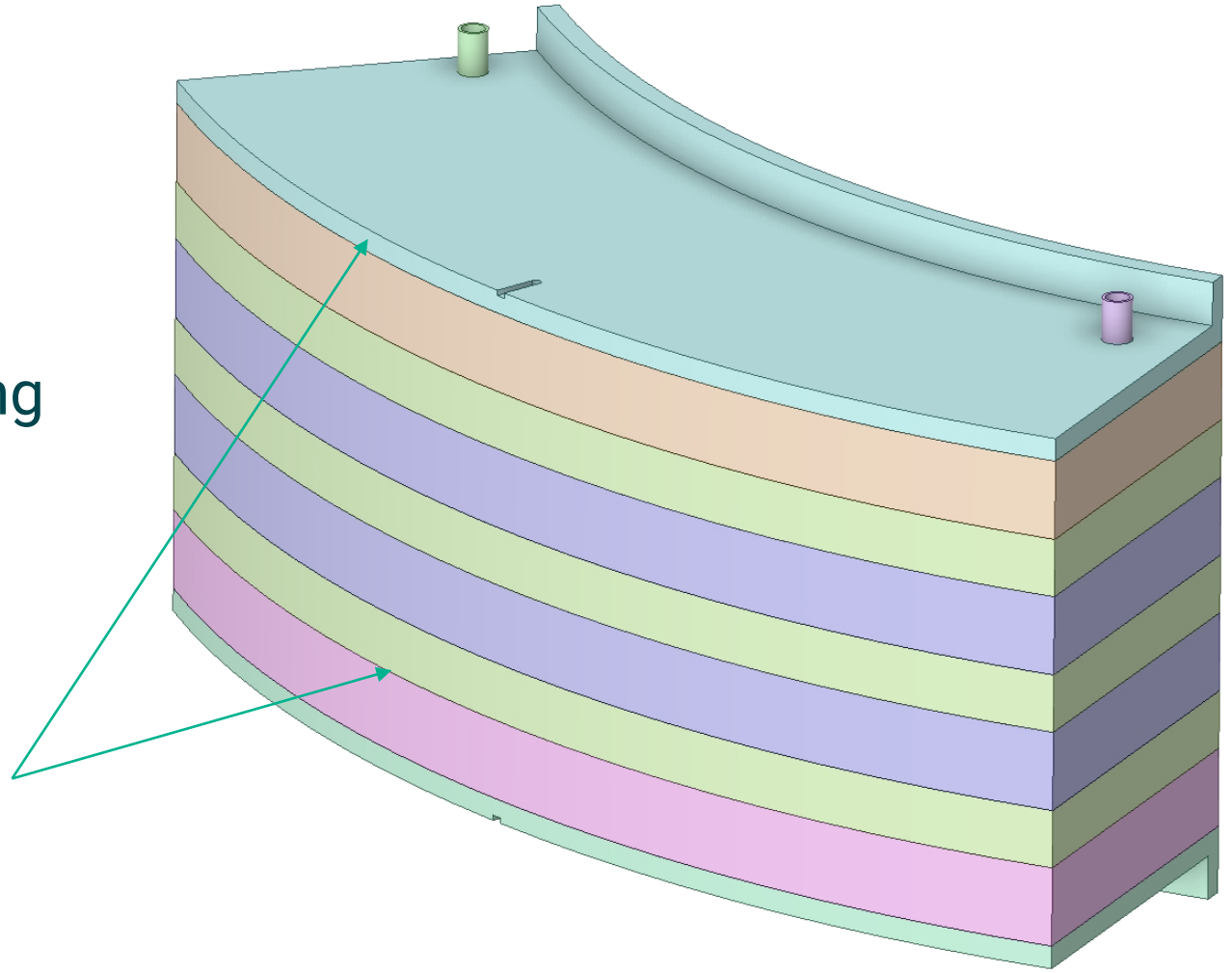


Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Shop Cost	NRE Cost	Labor Contingency Cost	Total Labor Cost	$ Labor/hour	Total Cost	Component Weight (kg)	Total Cost Per Kg
East Beltline Overall Cost, Qty 1	Welding		1	28										
	Machining		1	932										
	Support (mfg, tig)		1	18										
	Non-reoccuring engineering		1	475.5										
	Assembly		1	99										
	Inspection		1	151.6										
	Contingency		1	461.8111	2165.9111	$ 203,888.53	$ 356,047.47	$ 95,756.00	$ 135,997.56	$ 587,801.03	$ 271.39	$ 791,689.56	5376	$ 147.26

Updated East beltline Overall Cost

- Reduced height and OD
- Reduced plate count
- We plan to update this block from plates to a forging with vertical cooling holes

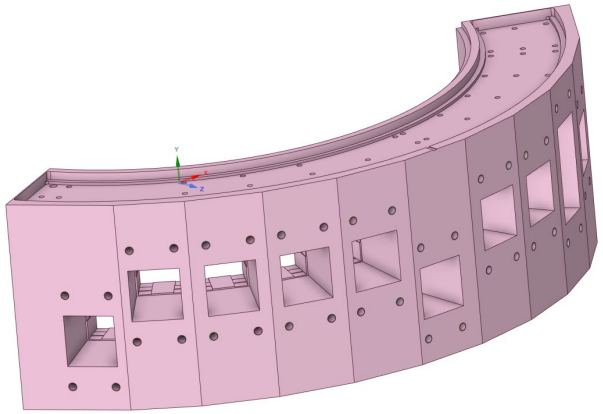


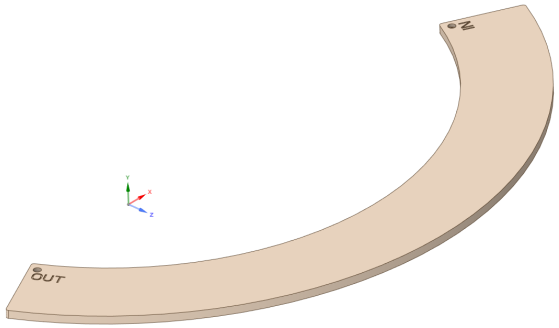


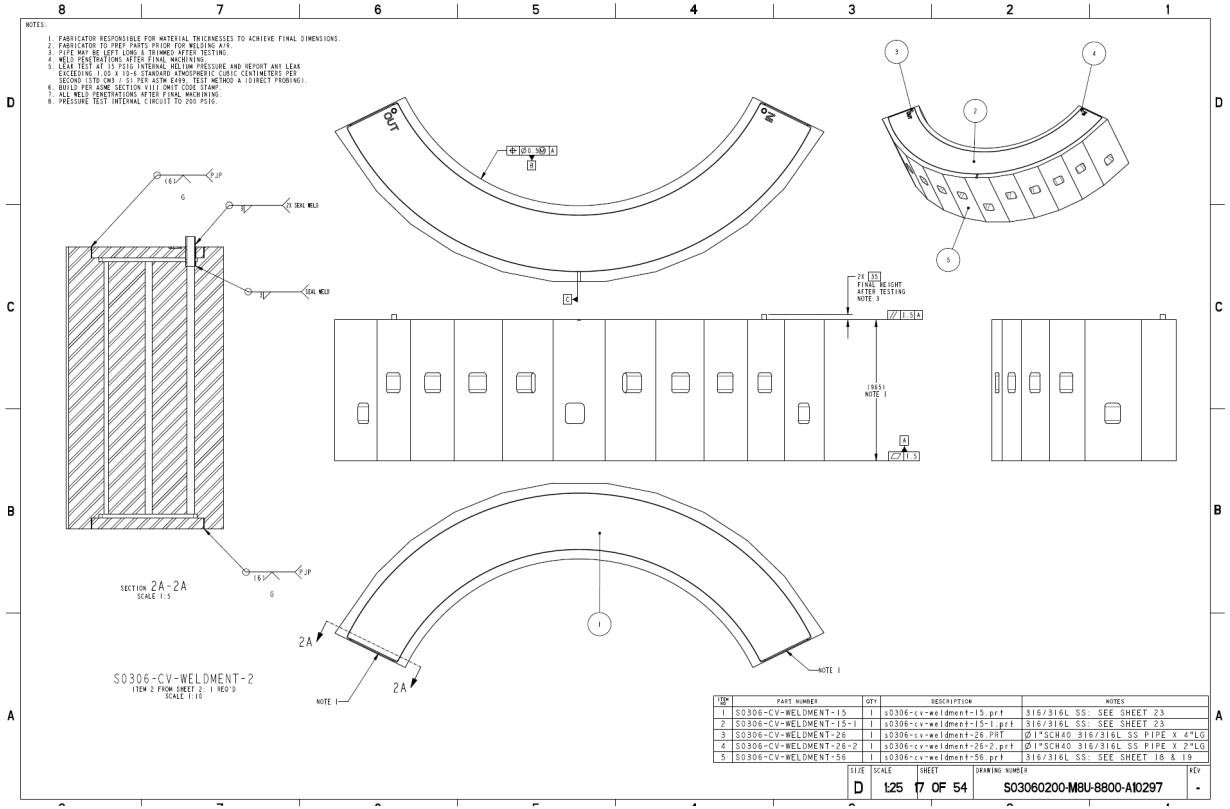
Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Total Labor Cost	$Labor/hour	Total Cost	Component Weight (kg)	Total Cost Per Kg
East Beltline Overall Cost, Qty 1	Welding		1	24							
	Machining		1	166							
	Support (mfg, tig)		1	13.5							
	Non-reoccuring engineering		1	336							
	Assembly		1	70.5							
	Inspection		1	94.5							
	Contingency		1	190.9195	895.4195	$ 112,467.33	$ 239,793.60	$ 767.84	$ 352,260.93	5376	$ 65.52

North and South beltline

- North and south beltline forged block pre-weld machining
- Material = Stainless Steel 316L
- 550mm x 1100mm x 3500mm forging
- Rough mill outer profile and beam port holes



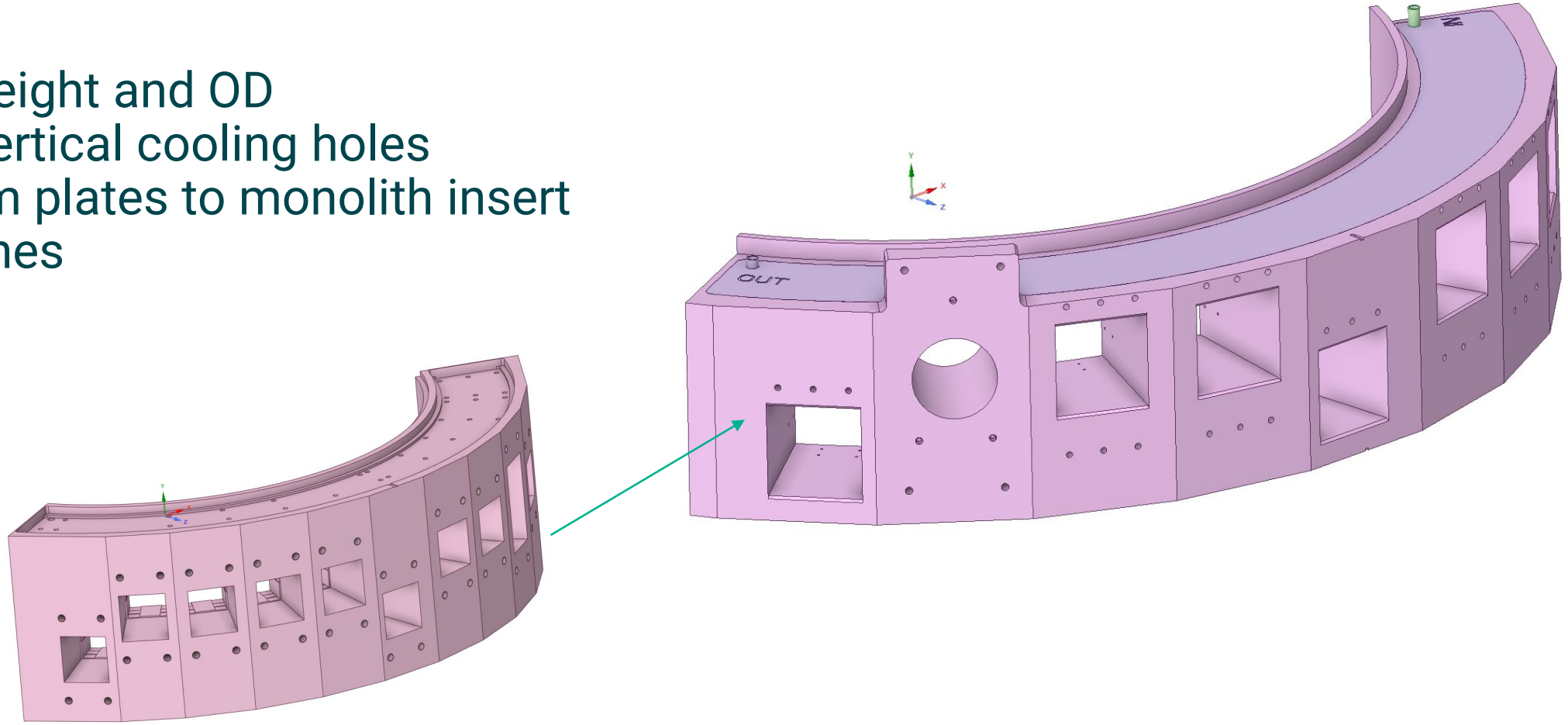




Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Shop Cost	NRE Cost	Labor Contingency Cost	Total Labor Cost	$ Labor/hour	Total Cost	Component Weight (kg)	Total Cost Per Kg
North and South Beltline Components	Machining			772										
	Support (mfg, tig)			40										
	Non-reoccuring engineering			357										
	Assembly			61.2										
	Inspection			54										
	Contingency			348.0182	1632.2182	$1,988,359.30	$ 391,262.70	$ 70,318.00	$ 102,486.98	$ 564,067.68	$ 345.58	$ 2,552,426.98	21887	$ 116.62

Updated East beltline Overall Cost

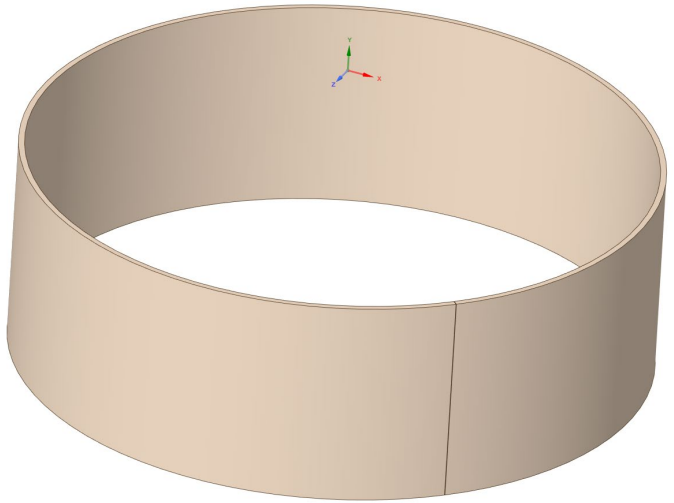
- Reduced height and OD
- Reduced vertical cooling holes
- Added shim plates to monolith insert landing zones

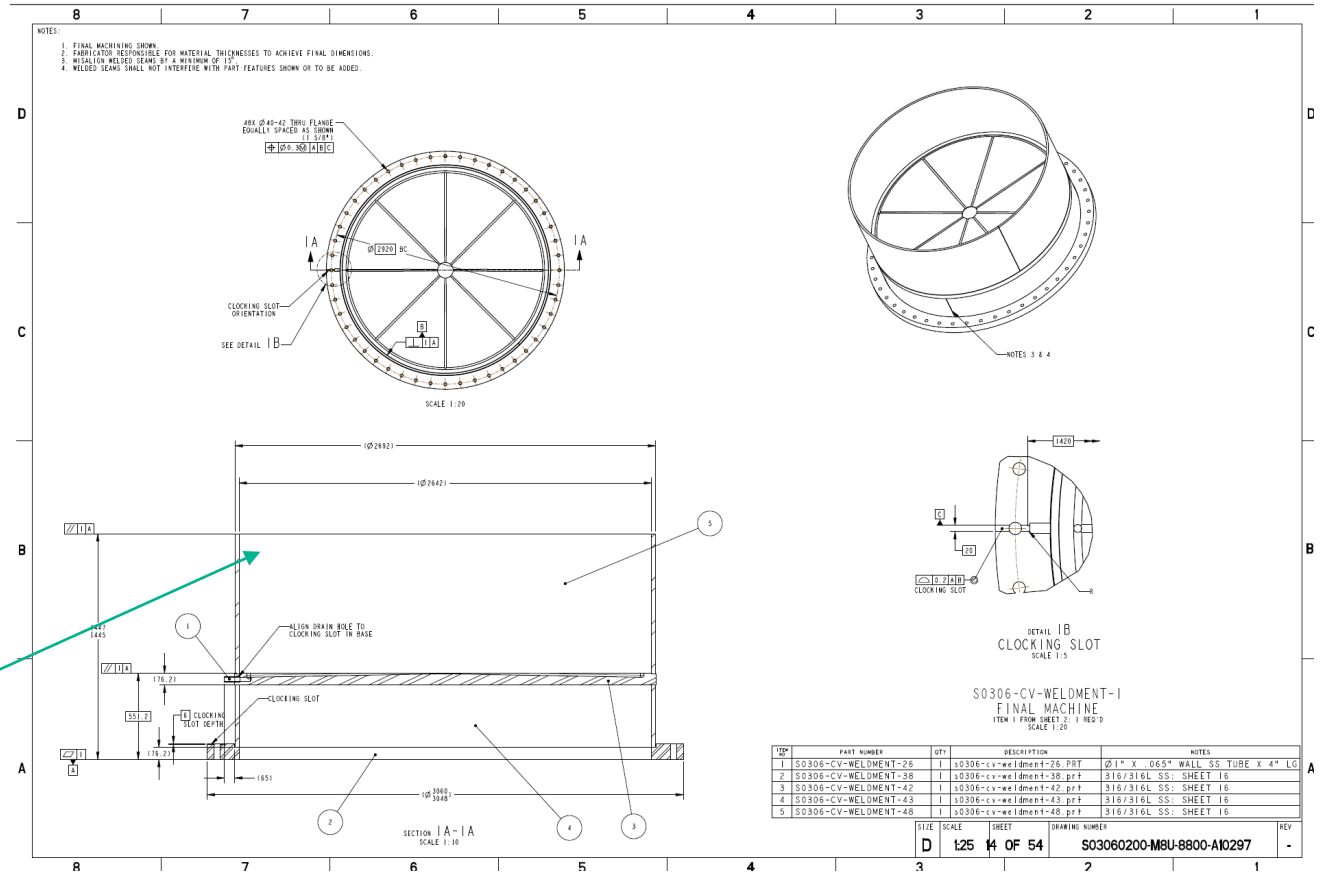


Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Total Labor Cost	$Labor/hour	Total Cost	Component Weight (kg)	Total Cost Per Kg
North and South Beltline Components	Machining			474							
	Support (mfg, tig)			40							
	Non-reoccuring engineering			288							
	Assembly			61.2							
	Inspection			50							
	Contingency			247.4772	1160.6772	$ 1,065,000.00	$ 401,106.83	$ 345.58	$ 1,466,106.83	21887	$ 66.99

Lower Weldment Upper Shell

- Material = Stainless Steel 316L
- 1” x 900mm x 2692mm OD
- Rolled and welded shell

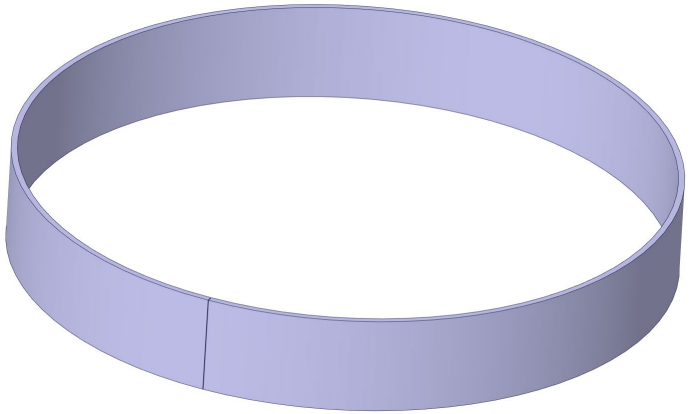


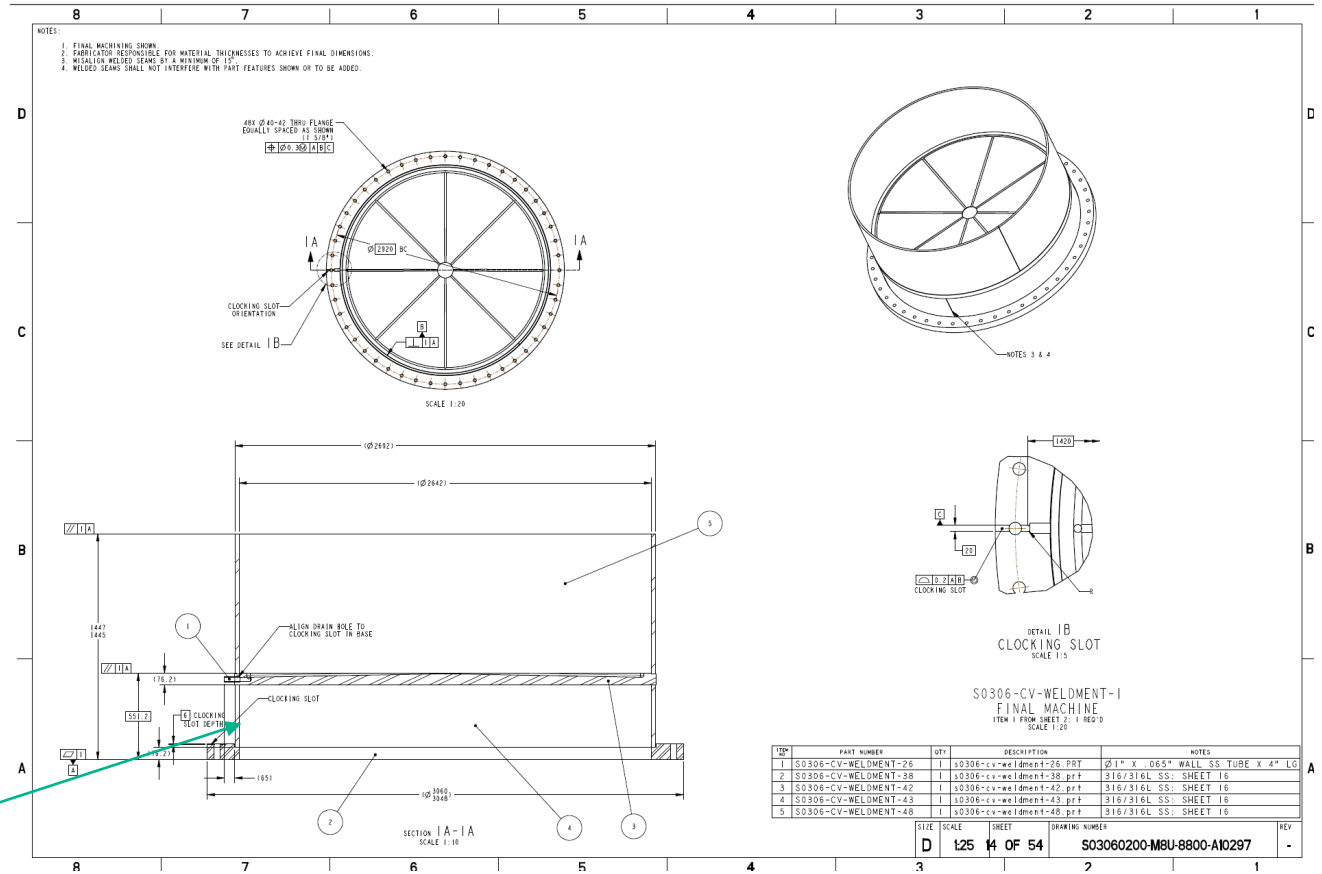


Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Shop Cost	NRE Cost	Labor Contingency Cost	Total Labor Cost	$ Labor/hour	Total Cost	Component Weight (kg)	Total Cost Per Kg
Lower weldment upper shell -48, Qty 1	Welding	34	1	34										
	Machining	43	1	43										
	Support (mfg, tig)	0	1	0										
	Non-reoccuring engineering	22.5	1	22.5										
	Assembly	8	1	8										
	Inspection	12	1	12										
	Contingency	32.3845	1	32.3845	151.8845	$ 33,675.90	$ 23,501.10	$ 4,468.00	$ 9,536.83	$ 37,505.93	$ 246.94	$ 71,181.83	1526	$ 46.65

Lower Weldment Lower Shell

- Material = Stainless Steel 316L
- 25.4mm x 400mm x 2692mm OD
- Rolled and welded shell

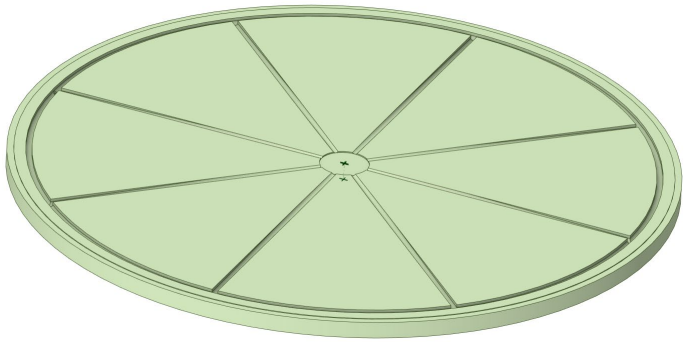


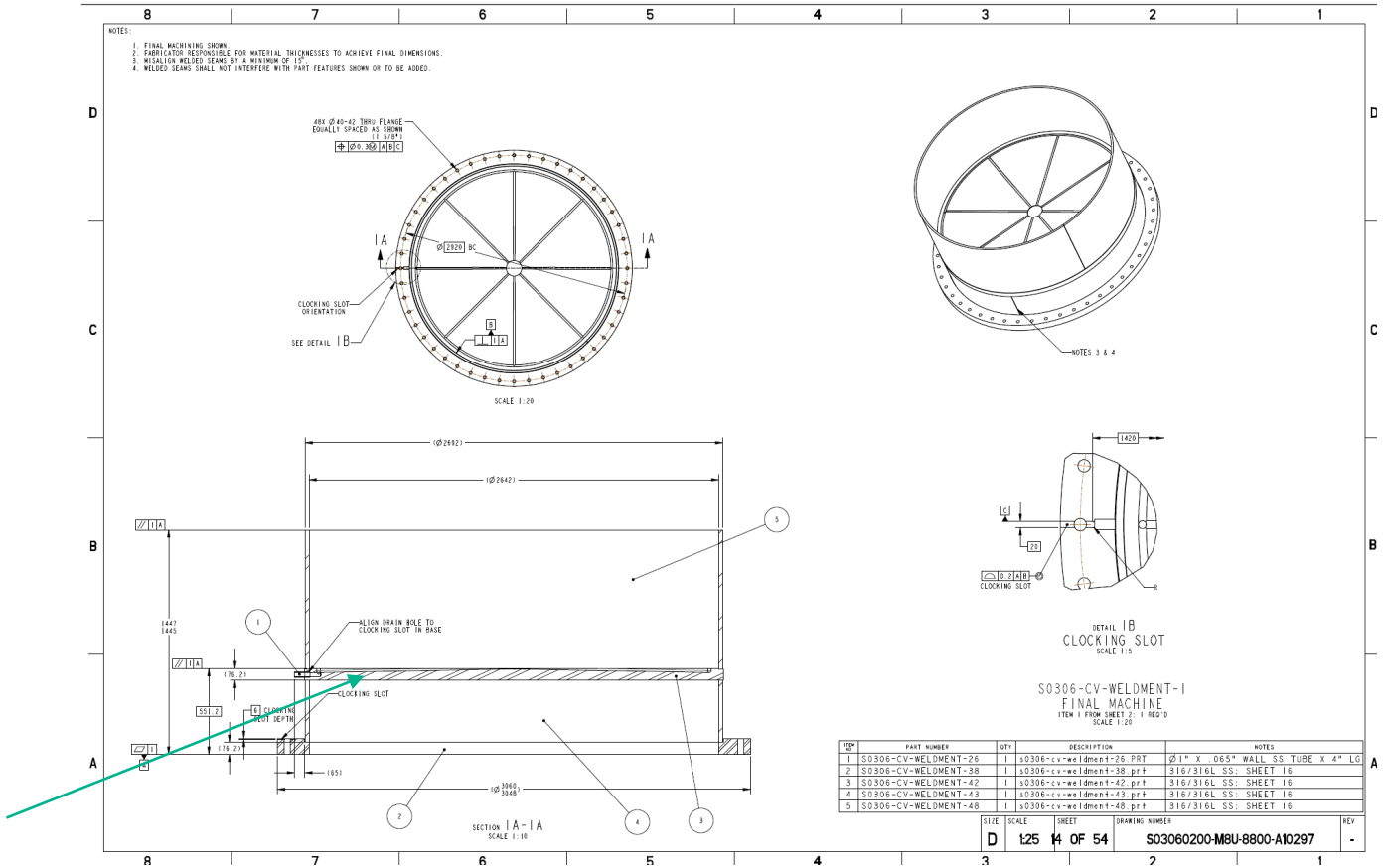


Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Shop Cost	NRE Cost	Labor Contingency Cost	Total Labor Cost	$ Labor/hour	Total Cost	Component Weight (kg)	Total Cost Per Kg
Lower weldment lower shell -43, Qty 1	Welding	22	1	22										
	Machining	40	1	40										
	Support (mfg, tig)	0	1	0										
	Non-reoccuring engineering	18.5	1	18.5										
	Assembly	8	1	8										
	Inspection	12	1	12										
	Contingency	27.2355	1	27.2355	127.7355	$ 16,698.00	$ 20,533.00	$ 3,648.00	$ 8,020.51	$ 32,201.51	$ 252.10	$ 48,899.51	684	$ 71.49

Lower Weldment Baseplate

- Material = Stainless Steel 316L
- 76.2mm x 2696mm OD
- Vendor has added weld necks to both sides of part (not shown) to ease plate to shell welding

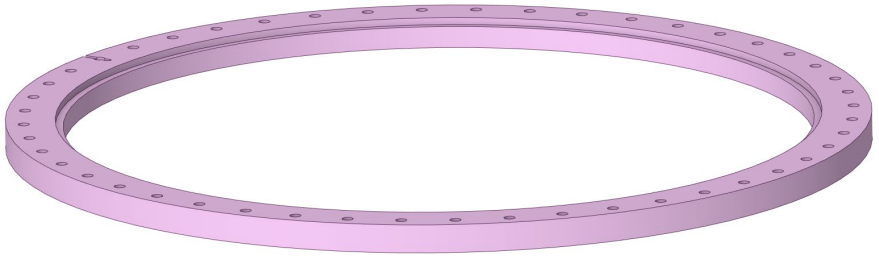


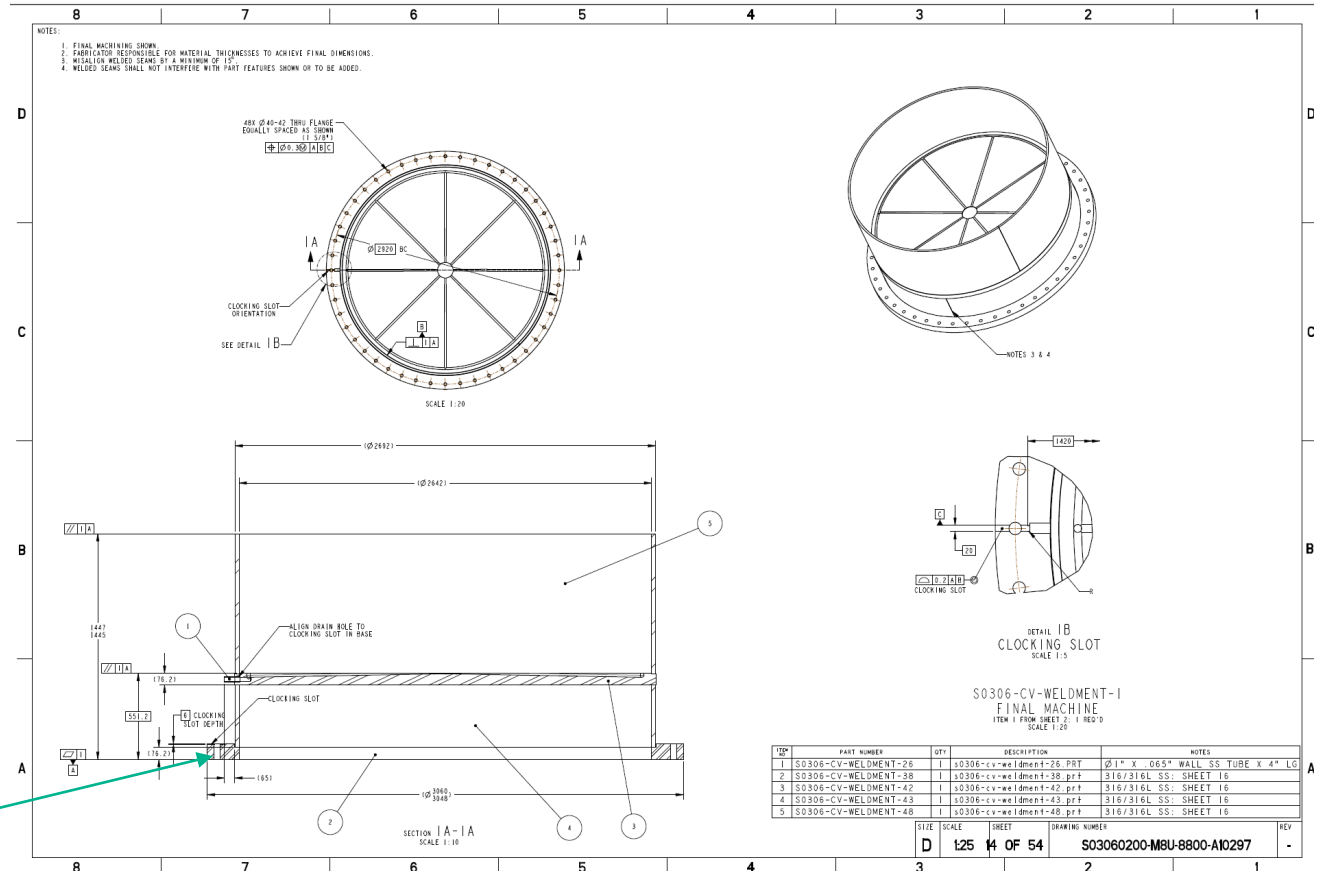


Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Shop Cost	NRE Cost	Labor Contingency Cost	Total Labor Cost	$ Labor/hour	Total Cost	Component Weight (kg)	Total Cost Per Kg
Lower weldment CV baseplate -42, Qty 1	Machining	403	1	403										
	Support (mfg, tig)	0	1	0										
	Non-reoccuring engineering	46.5	1	46.5										
	Assembly	8	1	8										
	Inspection	32	1	32										
	Contingency	132.6545	1	132.6545	622.1545	$ 164,329.19	$ 215,533.81	$ 9,212.00	$ 39,065.08	$ 263,810.89	$ 424.03	$ 428,140.08	3409	$ 125.59

Lower Weldment Bottom Flange

- Material = Stainless Steel 316L
- 101.6mm x 2641mm ID x 3048mm OD
- Vendor has added weld neck to top side of part (not shown) to ease plate to shell welding

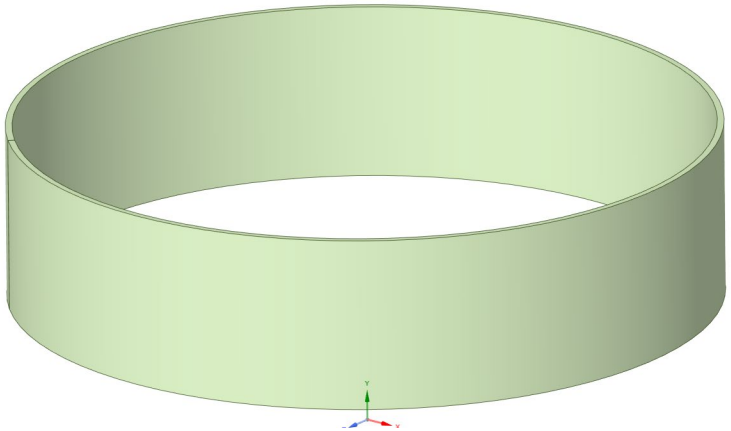


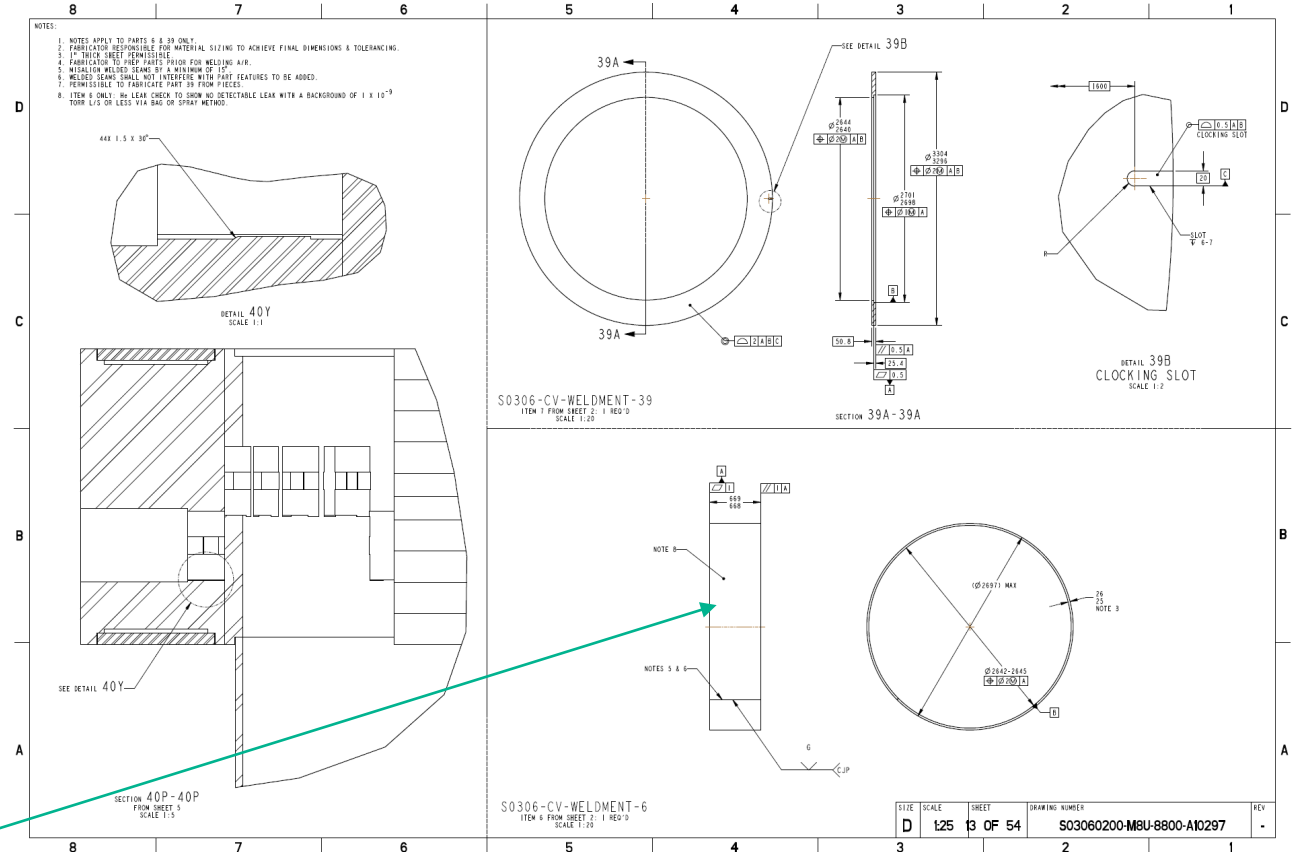


Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Shop Cost	NRE Cost	Labor Contingency Cost	Total Labor Cost	$ Labor/hour	Total Cost	Component Weight (kg)	Total Cost Per Kg
Lower weldment bottom flange -38, Qty 1	Machining	129	1	129										
	Support (mfg, tig)	0	1	0										
	Non-reoccuring engineering	42.5	1	42.5										
	Assembly	8	1	8										
	Inspection	16	1	16										
	Contingency	52.9805	1	52.9805	248.4805	$ 40,019.94	$ 70,706.06	$ 8,480.00	$ 15,602.09	$ 94,788.15	$ 381.47	$ 134,808.09	1380	$ 97.69

Lower Weldment Top Shell

- Material = Stainless Steel 316L
- 25.4mm x 670mm x 2692mm OD
- Rolled and welded shell

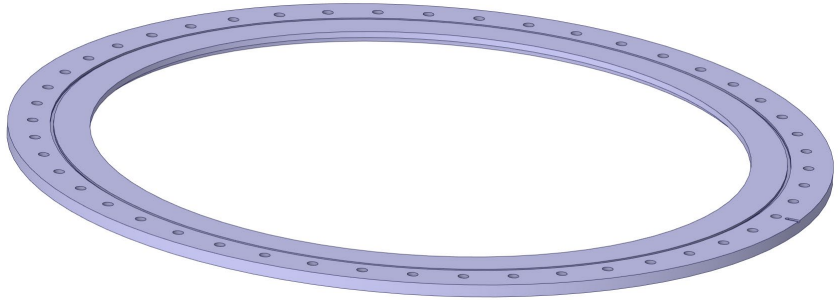


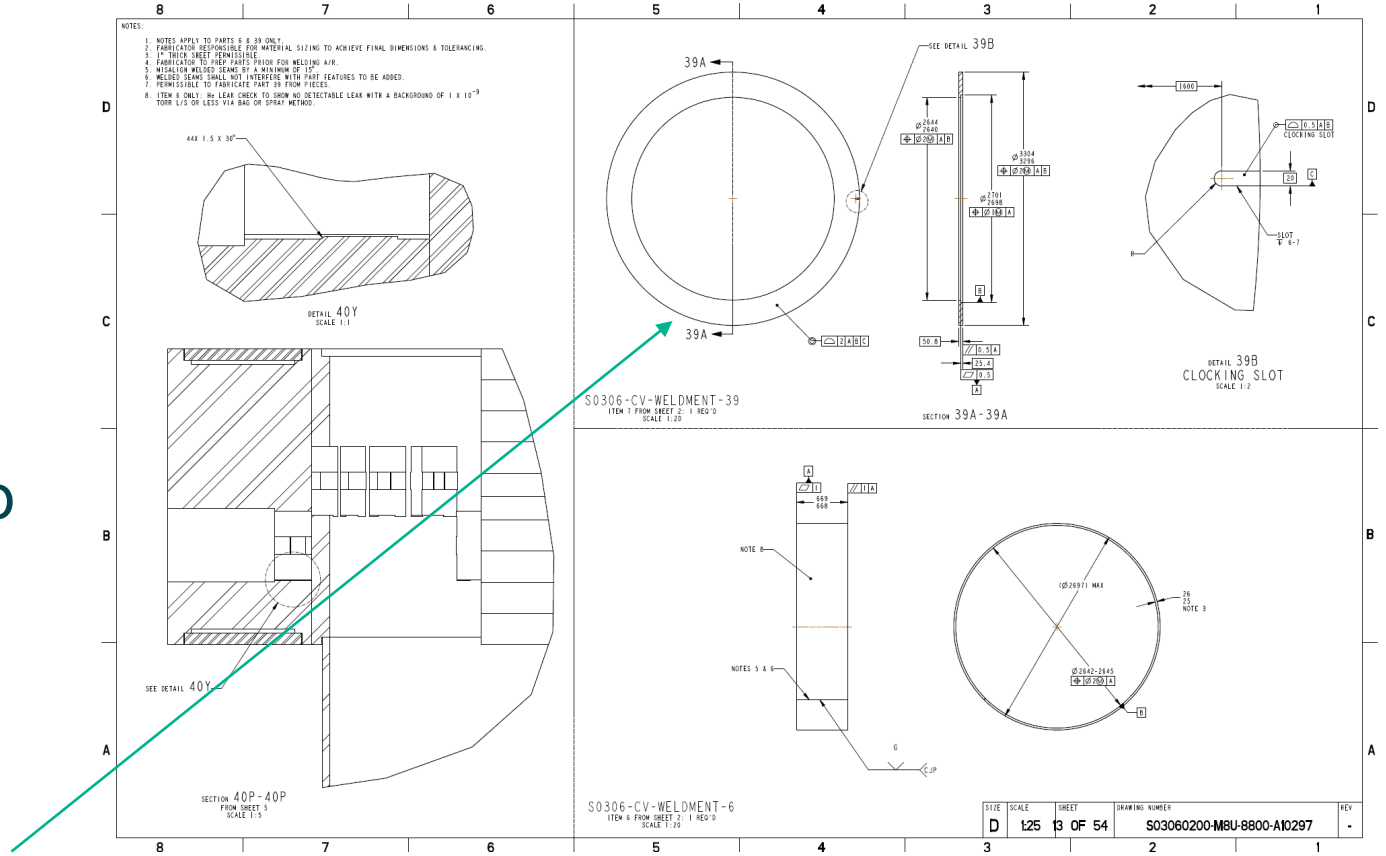


Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Shop Cost	NRE Cost	Labor Contingency Cost	Total Labor Cost	$ Labor/hour	Total Cost	Component Weight (kg)	Total Cost Per Kg
Lower weldment top shell -6, Qty 1	Welding	28	1	28										
	Machining	41	1	41										
	Support (mfg, tig)	0	1	0										
	Non-reoccuring engineering	22.5	1	22.5										
	Assembly	8	1	8										
	Inspection	12	1	12										
	Contingency	30.2165	1	30.2165	141.7165	$ 25,870.40	$ 22,116.60	$ 4,468.00	$ 8,898.38	$ 35,482.98	$ 250.38	$ 61,353.38	1136	$ 54.01

Lower Weldment Baseplate

- Material = Stainless Steel 316L
- 50.8mm x 2641mm ID x 3300mm OD
- Vendor has added weld neck to bottom side of part (not shown) to ease plate to shell welding

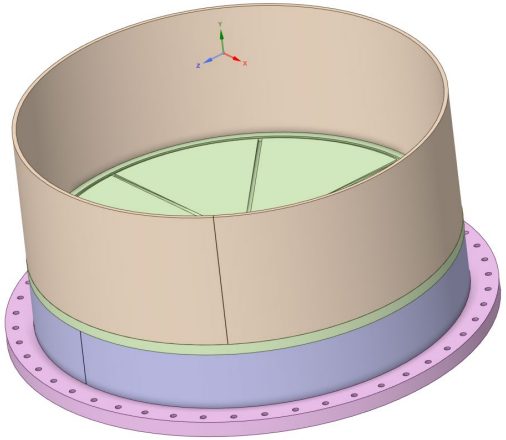


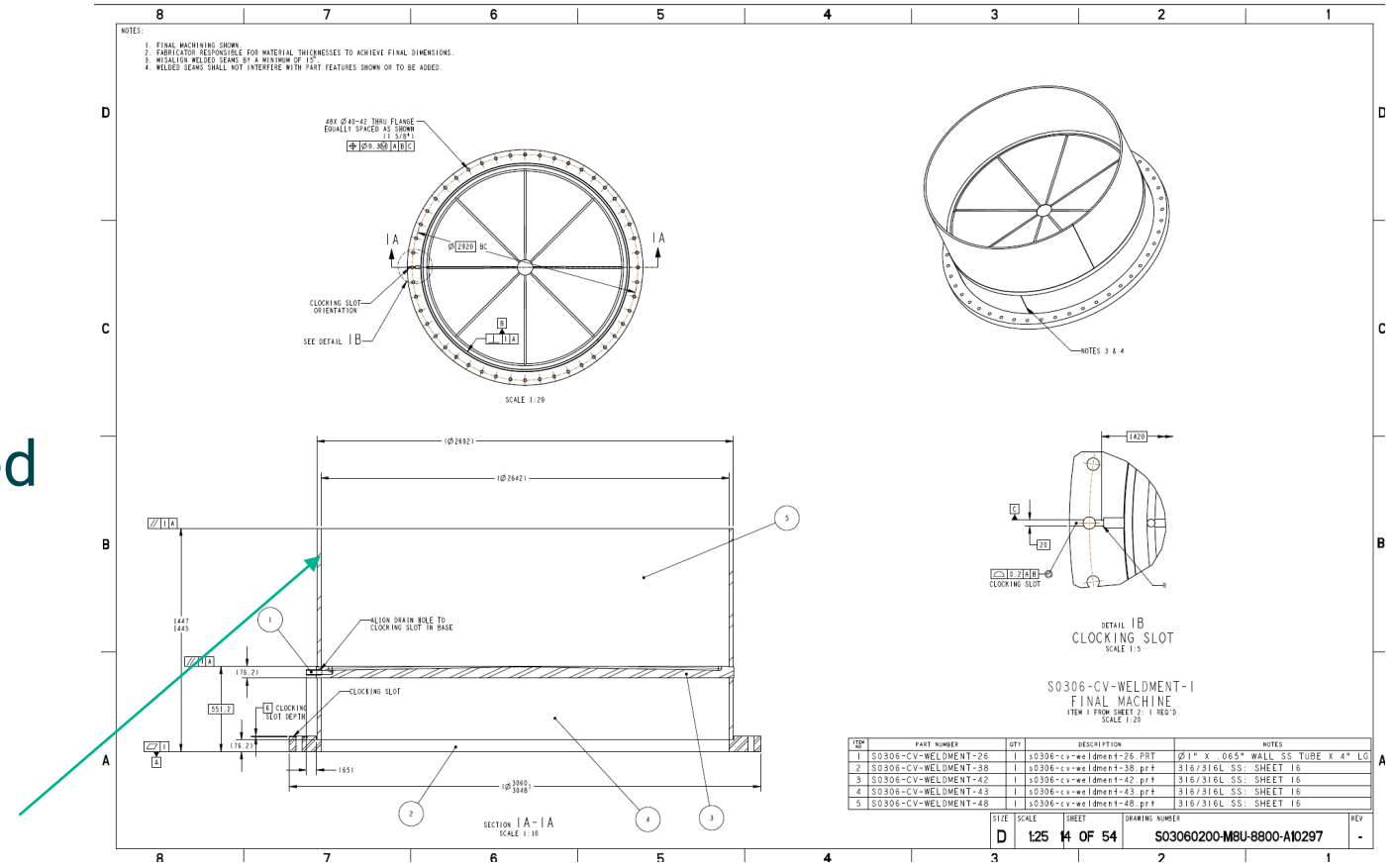


Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Shop Cost	NRE Cost	Labor Contingency Cost	Total Labor Cost	$ Labor/hour	Total Cost	Component Weight (kg)	Total Cost Per Kg
Lower weldment top flange -39, Qty 1	Machining	129	1	129										
	Support (mfg, tig)	0	1	0										
	Non-reoccuring engineering	42.5	1	42.5										
	Assembly	8	1	8										
	Inspection	16	1	16										
	Contingency	52.9805	1	52.9805	248.4805	$ 40,767.44	$ 70,706.56	$ 8,480.00	$ 15,602.09	$ 94,788.65	$ 381.47	$ 135,556.09	1160	$ 116.86

Lower Weldment Welding

- Material = Stainless Steel 316L
- Lower weldment assembled and welded
- Full penetration shell welds
- Intermediate machining completed

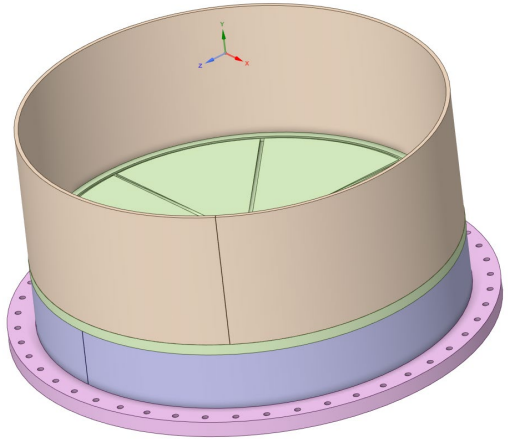


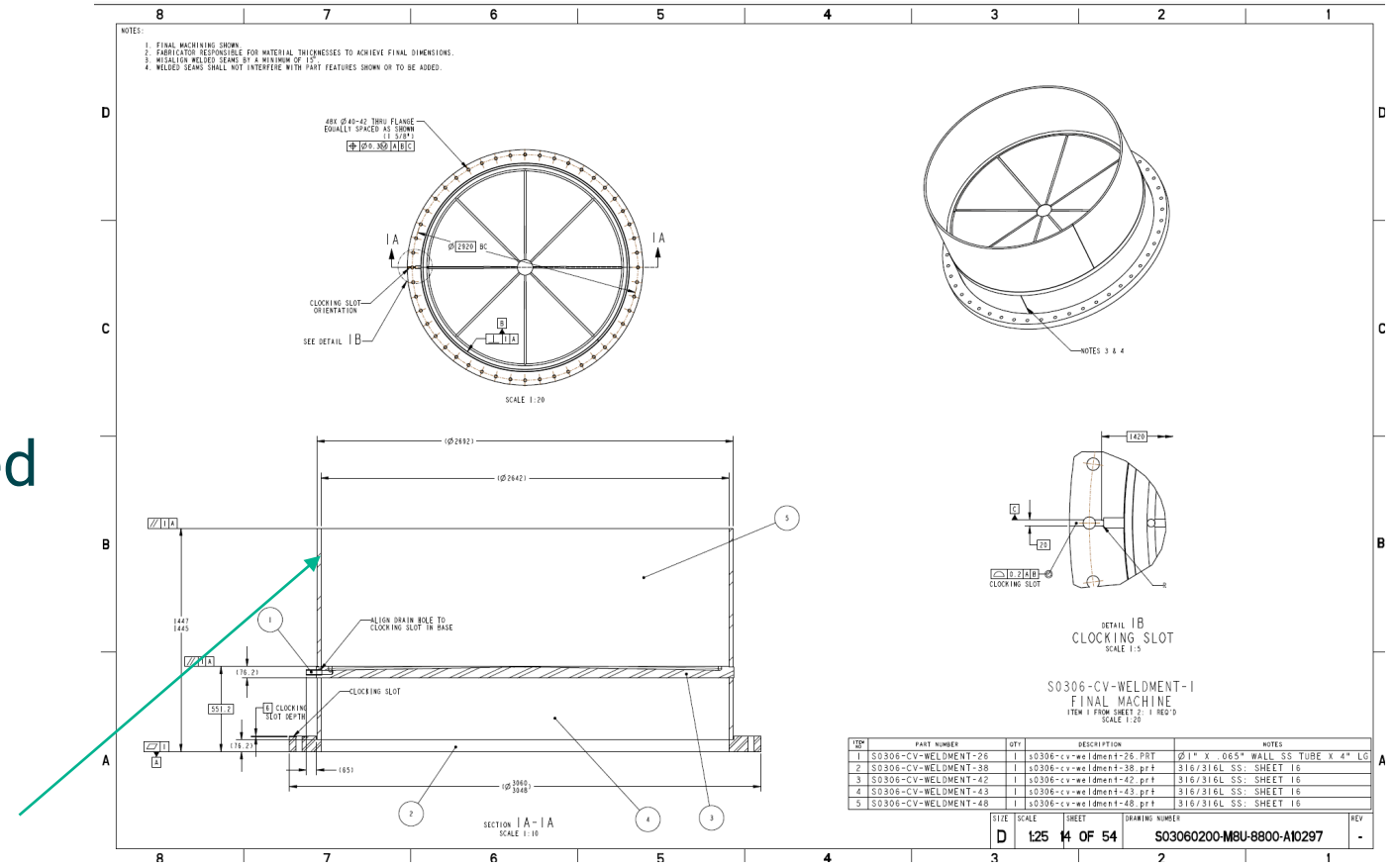


Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Shop Cost	NRE Cost	Labor Contingency Cost	Total Labor Cost	$ Labor/hour	Total Cost	Component Weight (kg)	Total Cost Per Kg
Lower shell bottom weldment -1, Qty 1	Welding	126	1	126										
	Machining	88	1	88										
	Support (mfg, tig)	14	1	14										
	Non-reoccuring engineering	40.5	1	40.5										
	Assembly	9	1	9										
	Inspection	36	1	36										
	Contingency	84.9585	1	84.9585	398.4585	$ 3,395.49	$ 76,747.51	$ 7,950.00	$ 25,019.21	$ 109,716.72	$ 275.35	$ 113,112.21	9295	$ 12.17

Lower Weldment Overall Cost

- Material = Stainless Steel 316L
- Lower weldment assembled and welded
- Full penetration shell welds
- Intermediate machining completed

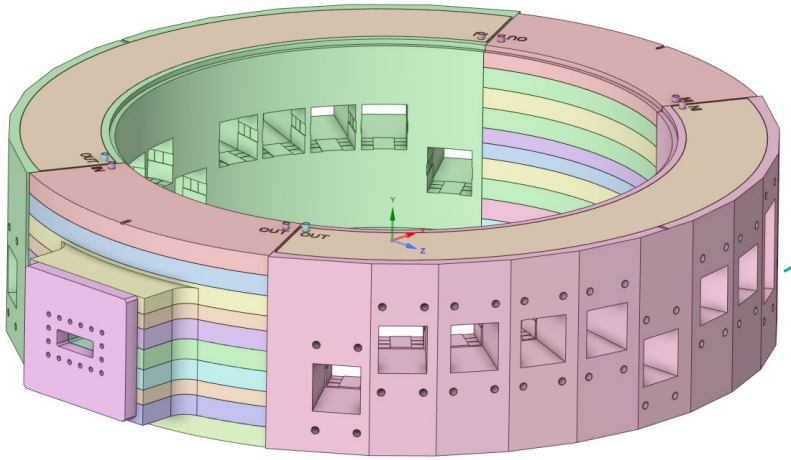


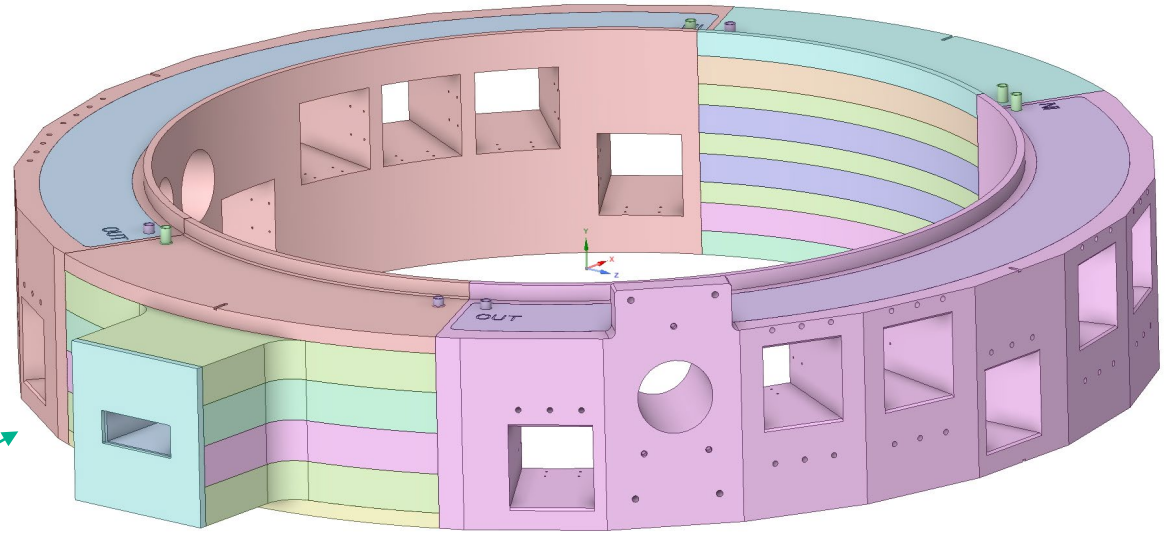


Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Shop Cost	NRE Cost	Labor Contingency Cost	Total Labor Cost	$ Labor/hour	Total Cost	Component Weight (kg)	Total Cost Per Kg
Lower shell weldment overall cost, Qty 1	Welding	210	1	210										
	Machining	873	1	873										
	Support (mfg, tig)	14	1	14										
	Non-reoccuring engineering	235.5	1	235.5										
	Assembly	57	1	57										
	Inspection	136	1	136										
	Contingency	413.4105	1	413.4105	1938.9105	$ 324,756.36	$ 499,844.64	$ 46,706.00	$ 121,744.19	$ 668,294.83	$ 344.68	$ 993,051.19	9295	$ 106.84

Beltline Final Welding

- Material = Stainless Steel 316L
- Beltline fitted and welded
- Intermediate machining completed



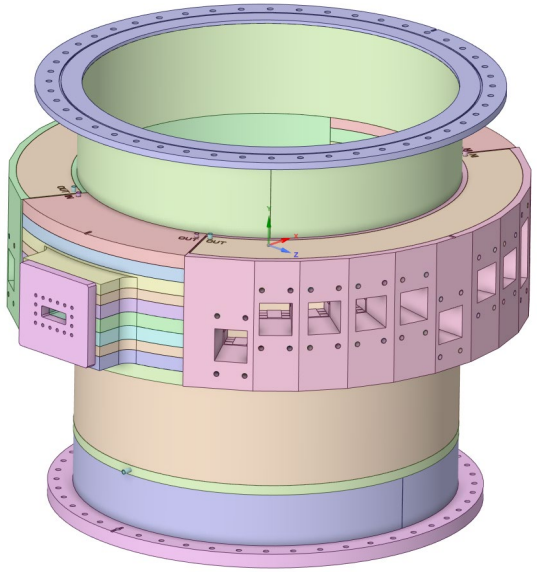


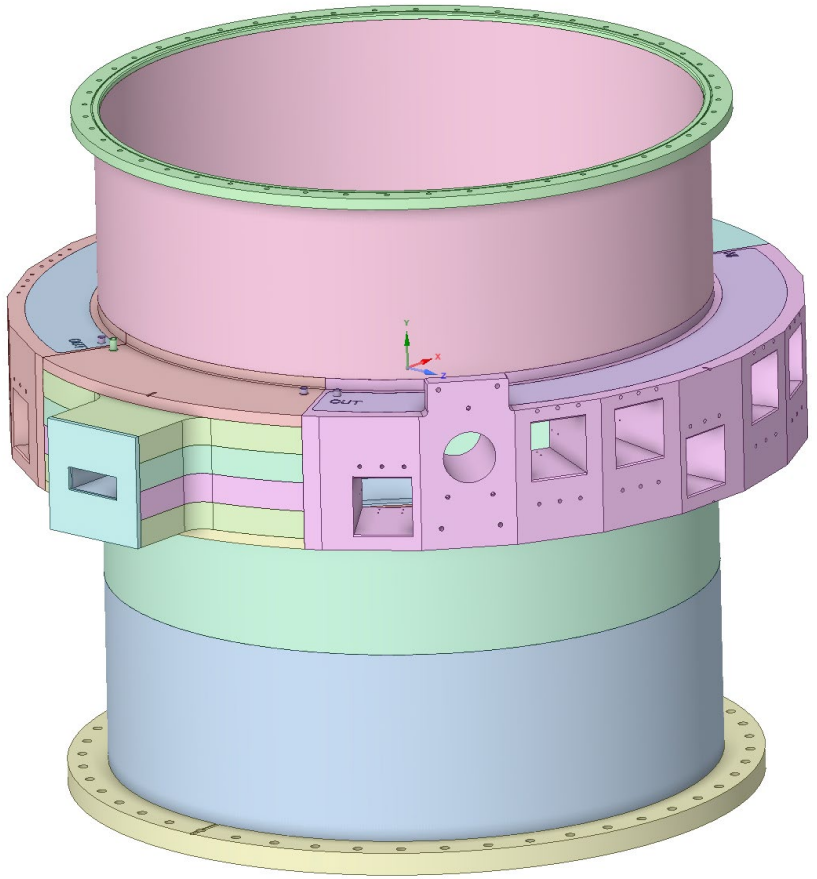
Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Shop Cost	NRE Cost	Labor Contingency Cost	Total Labor Cost	$ Labor/hour	Total Cost	Component Weight (kg)	Total Cost Per Kg
Beltline weldment, Qty 1	Welding	168	1	168										
	Machining	464	1	464										
	Support (mfg, tig)	20	1	20										
	Non-reoccuring engineering	165.5	1	165.5										
	Assembly	55	1	55										
	Inspection	83	1	83										
	Contingency	258.9405	1	258.9405	1214.4405	$ 22,019.07	$ 294,593.93	$ 32,783.00	$ 76,254.72	$ 403,631.65	$ 332.36	$ 425,650.72	33594.1	$ 12.67

Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Total Labor Cost	$Labor/hour	Total Cost	Component Weight (kg)	Total Cost Per Kg
Beltline weldment, Qty 1	Welding	140	1	140							
Reduced beltline size	Machining	246	1	246							
Reduced cooling hole count	Support (mfg, tig)	20	1	20							
Reduction to 18 beamlines	Non-reoccuring engineering	165.5	1	165.5							
	Assembly	55	1	55							
	Inspection	55	1	55							
	Contingency	184.6865	1	184.6865	866.1865	$ 22,019.07	$ 287,885.75	$ 332.36	$ 309,904.82	33344.6	$ 9.29

Lower Weldment Final Fab.

- Material = Stainless Steel 316L
- Final welding
- Final machining



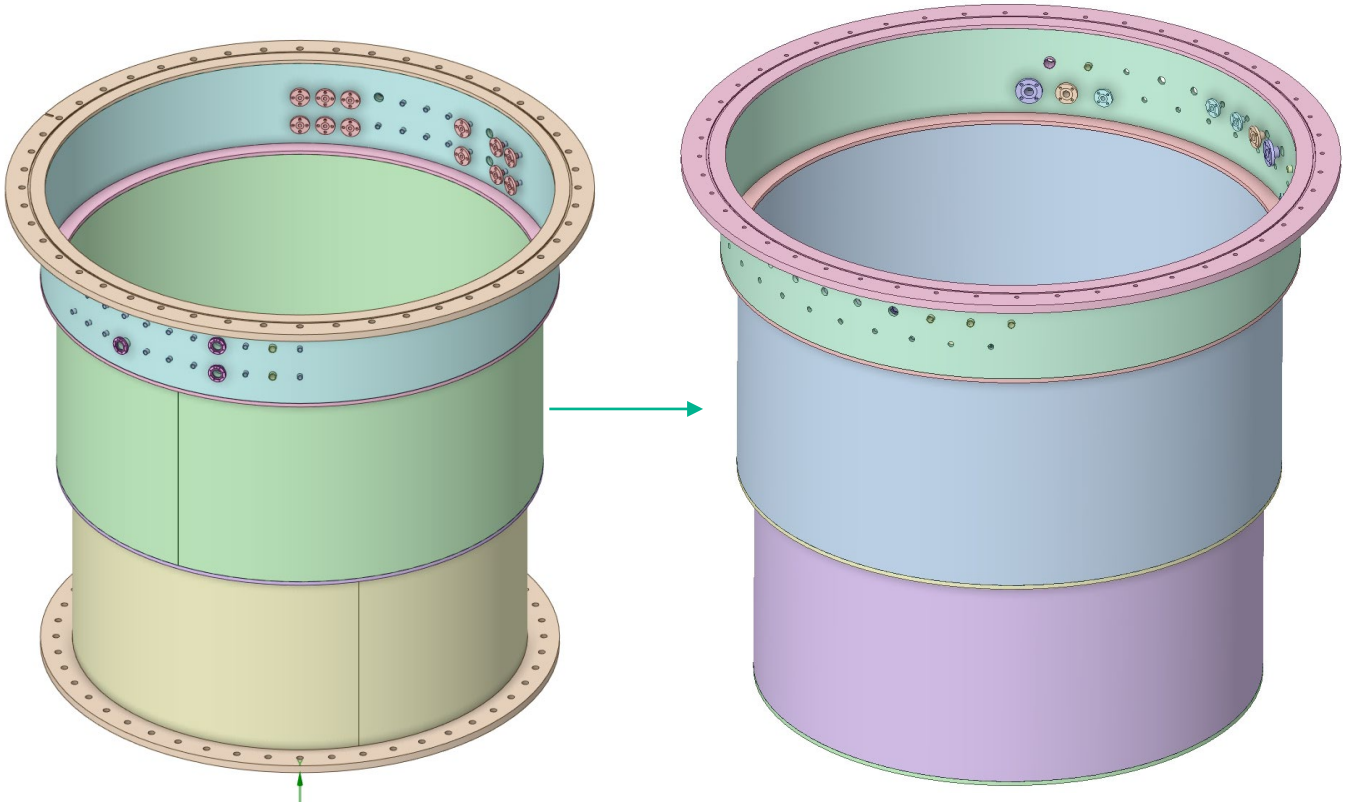


Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Shop Cost	NRE Cost	Labor Contingency Cost	Total Labor Cost	$ Labor/hour	Total Cost	Component Weight (kg)	Total Cost Per Kg
Bottom weldment overall cost -40, Qty 1	Welding			571										
	Machining			4801										
	Support (mfg, tig)			144.4										
	Non-reoccuring engineering			2363.25										
	Assembly			376.6										
	Inspection			752.6										
	Contingency			2441.398	11450.2484	$2,754,226.19	$2,421,435.81	$ 473,107.00	$ 718,961.09	$ 3,613,503.90	$ 315.58	$ 6,367,730.09	42889.1	$ 148.47

Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Total Labor Cost	$Labor/hour	Total Cost	Component Weight (kg)	Total Cost Per Kg
Bottom weldment overall cost -40, Qty 1	Welding			535							
	Machining			2455							
	Support (mfg, tig)			137.8							
	Non-reoccuring engineering			1736.5							
	Assembly			325							
	Inspection			521.5							
	Contingency			1547.627	7258.4268	$ 1,679,900.37	$ 2,334,203.61	$ 321.59	$ 4,014,103.98	42639.6	$ 94.14

Upper Weldment Final Cost

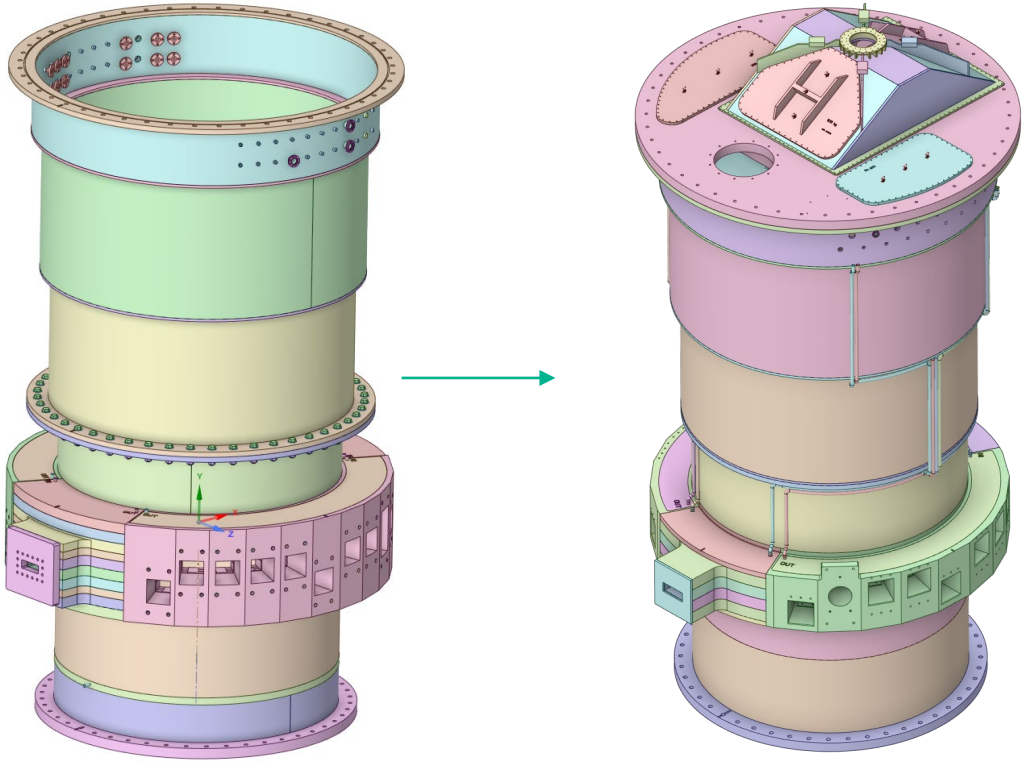
- Weldment fabricated by outside vendor (reflected in material costs)
- Final machining and nozzle welding by Metalex
- Minor revisions to upper weldment design not expected to impact overall cost estimation



Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Shop Cost	NRE Cost	Labor Contingency Cost	Total Labor Cost	$ Labor/hour	Total Cost	Component Weight (kg)	Total Cost Per Kg
Upper shell final machining -41, Qty 1	Welding	33	1	33										
	Machining	232	1	232										
	Support (mfg, tig)	8	1	8										
	Non-reoccuring engineering	122.5	1	122.5										
	Assembly	18	1	18										
	Inspection	101	1	101										
	Contingency	139.4295	1	139.4295	653.9295	$ 647,899.65	$ 160,189.35	$ 23,068.00	$ 41,060.23	$ 224,317.58	$ 343.03	$ 872,217.23	9030	$ 96.59

Core Vessel Overall Costs

- CV Lid was not included in original cost estimation
- An outdated CV lid cost estimate is included in the revised cost
- A cost reduction of ~ $ 1.8M is estimated due to design updates

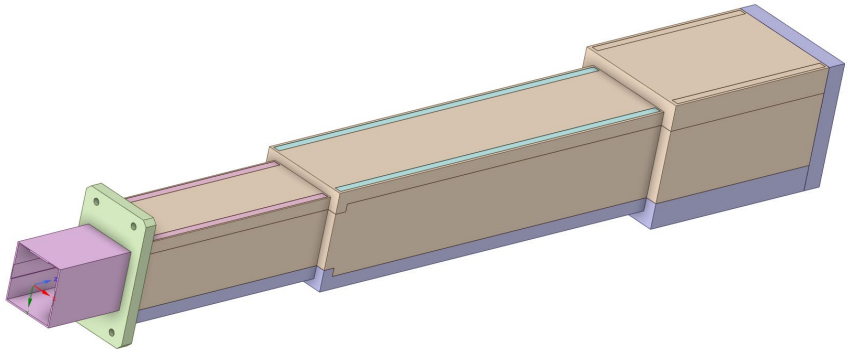


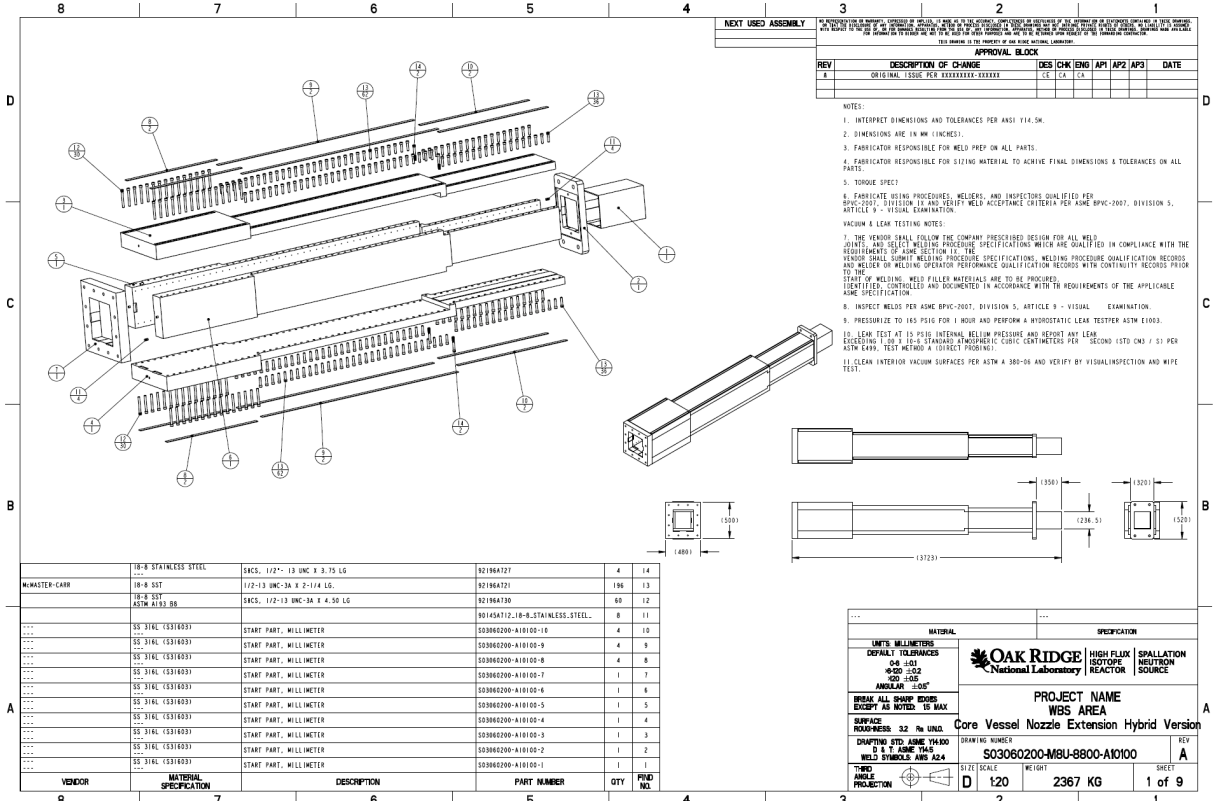
Overall Labor Breakdown														
Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Shop Cost	NRE Cost	Labor Contingency Cost	Total Labor Cost	$ Labor/hour	Total Cost	Component Weight (kg)	Total Cost Per Kg
Core Vessel, Qty 1	Welding			604										
	Machining			5033										
	Support (mfg, tig)			167.4										
	Non-reoccuring engineering			2566.25										
	Assembly			649.6										
	Inspection			884.6										
	Contingency			2684.214	12589.0644	$3,425,486.59	$2,615,339.41	$ 527,503.00	$ 790,467.35	$ 3,933,309.76	$ 312.44	$ 7,358,796.35	51919.1	$ 141.74

Full Core Vessel with Lid											
Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Total Labor Cost	$Labor/hour	Total Cost	Component Weight (kg)	Total Cost Per Kg
Full Vessel with lid	Welding			868							
	Machining			2887							
	Support (mfg, tig)			180.8							
	Non-reoccuring engineering			1986							
	Assembly			606							
	Inspection			685.5							
	Contingency			1954.804	9168.1043	$ 2,589,497.27	$ 2,923,811.27	$ 318.91	$ 5,513,308.54	51669.6	$ 106.70

Standard Nozzle Extension estimate

- Bolted and welded design
- Material = Stainless Steel 316L
- Both first article with NRE and Unit 2-22 costs shown below

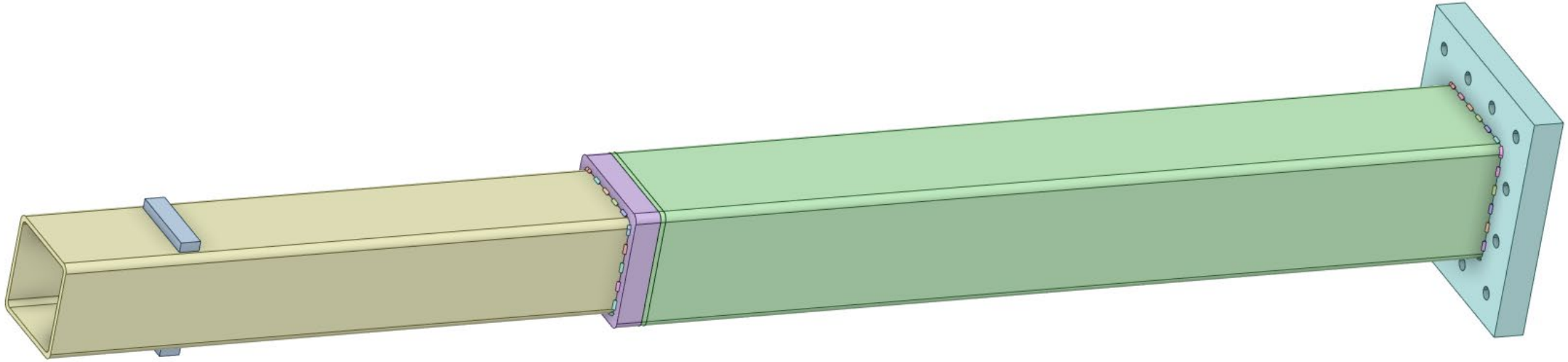




Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Shop Cost	NRE Cost	Total Labor Cost	$ Labor/hour	Total Cost	Component Weight (kg)	Total Cost Per Kg
Grand Total (First Article)	Machining		1	985.3									
	EDM		1	196.8									
	Welding		1	106									
	Support (mfg, tig)		1	46									
	Non-reoccuring engineering		1	453.5									
	Assembly		1	183									
	Inspection		1	205	2175.6	$ 172,625.33	$ 435,241.17	$ 88,763.20	$ 524,004.37	$ 240.86	$ 696,629.70	2398	$ 290.50
Item	**Operation**	**Hours**	**Qty**	**Total**	**Total Hours**	**Material Cost**	**Shop Cost**	**NRE Cost**	**Total Labor Cost**	**$ Labor/hour**	**Total Cost**	**Component Weight (kg)**	**Total Cost Per Kg**
Grand Total (Units 2-22)	Machining		1	985.3									
	EDM		1	196.8									
	Welding		1	106									
	Support (mfg, tig)		1	46									
	Non-reoccuring engineering		1	0									
	Assembly		1	183									
	Inspection		1	205	1722.1	$ 172,625.33	$ 435,241.17	$ -	$ 435,241.17	$ 252.74	$ 607,866.50	2398	$ 253.49

Standard Nozzle Extension estimate

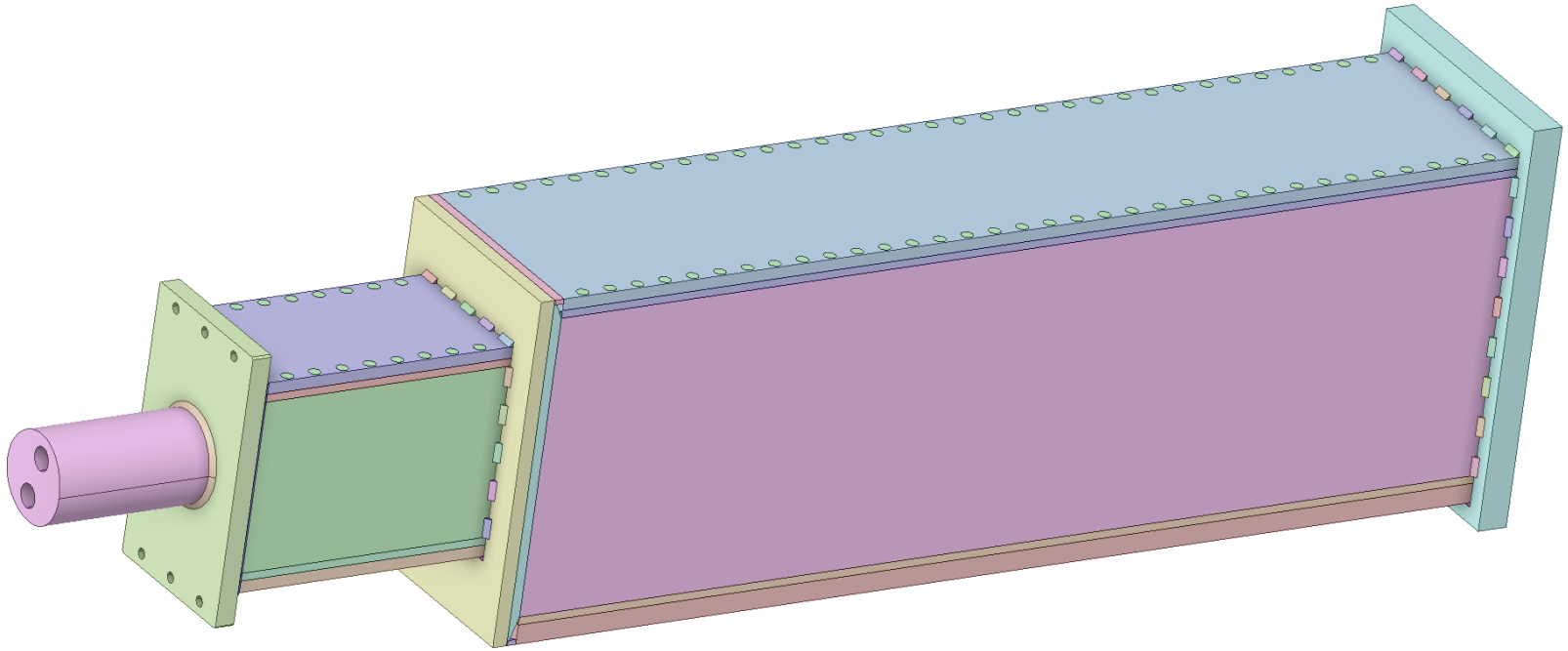
- COTS tube based design
- Material = Stainless Steel 316L
- Cost savings of ~ $485,000 per nozzle
- Much less welding and machining provides a more reliable design



Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Total Labor Cost	$Labor/hour	Total Cost	Margin	Total cost with margin	Total Cost per Nozzle
Total Tube Nozzle Cost, Qty 15	Welding			1440								
	Machining			1680								
	Support (mfg, tig)			150								
	Non-reoccuring engineering			130								
	Assembly			540								
	Inspection			810								
	Contingency			657	5407	$ 238,131.18	$ 1,367,971.00	$ 253.00	$ 1,606,102.18	1.15	**$ 1,847,017.50**	**$ 123,134.50**

QIKR Nozzle Extension estimate

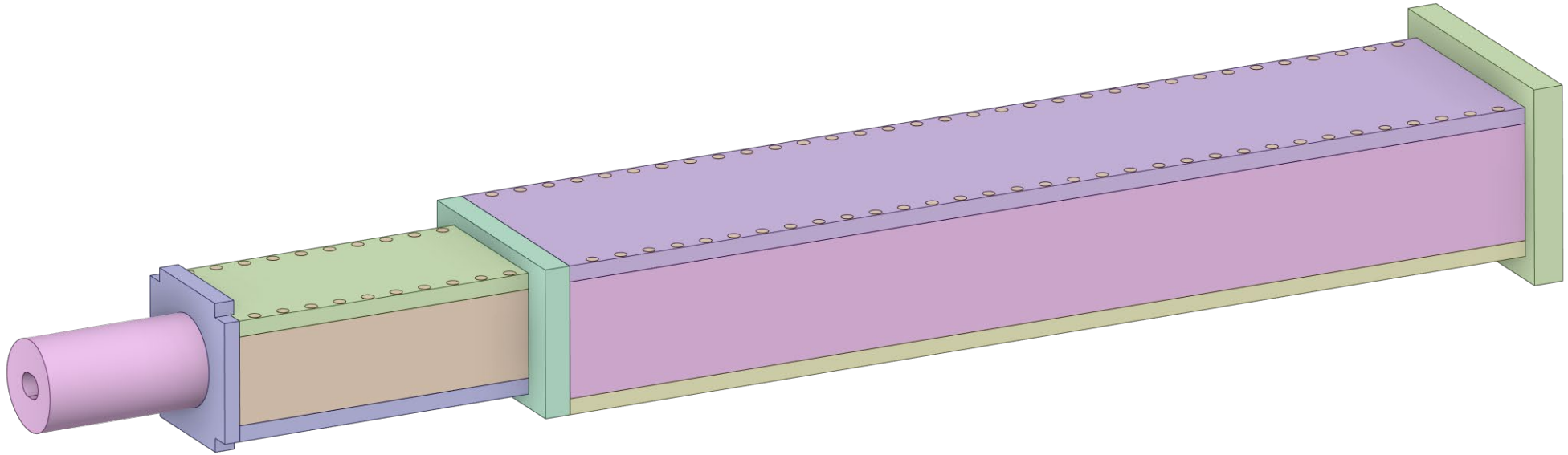
- Bolted and welded design (similar to original nozzle design)
- Material = Stainless Steel 316L
- Qty 1 QIKR nozzle



Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Shop Cost	NRE Cost	Total Labor Cost	$ Labor/hour	Total Cost
QIKR Nozzle Grand Total	Machining		1	1346							
	Welding		1	120							
	Support (mfg, tig)		1	54							
	Non-reoccuring engineering		1	439							
	Assembly		1	209							
	Inspection		1	206	2374	$ 171,443.57	$ 600,622.00	$ -	$ 600,622.00	$ 253.00	**$ 772,065.57**

Dual Channel Nozzle Extension estimate

- Added to the project scope in 2024
- Bolted and welded design (similar to original nozzle design)
- Material = Stainless Steel 316L
- Qty 2 Dual Channel nozzle

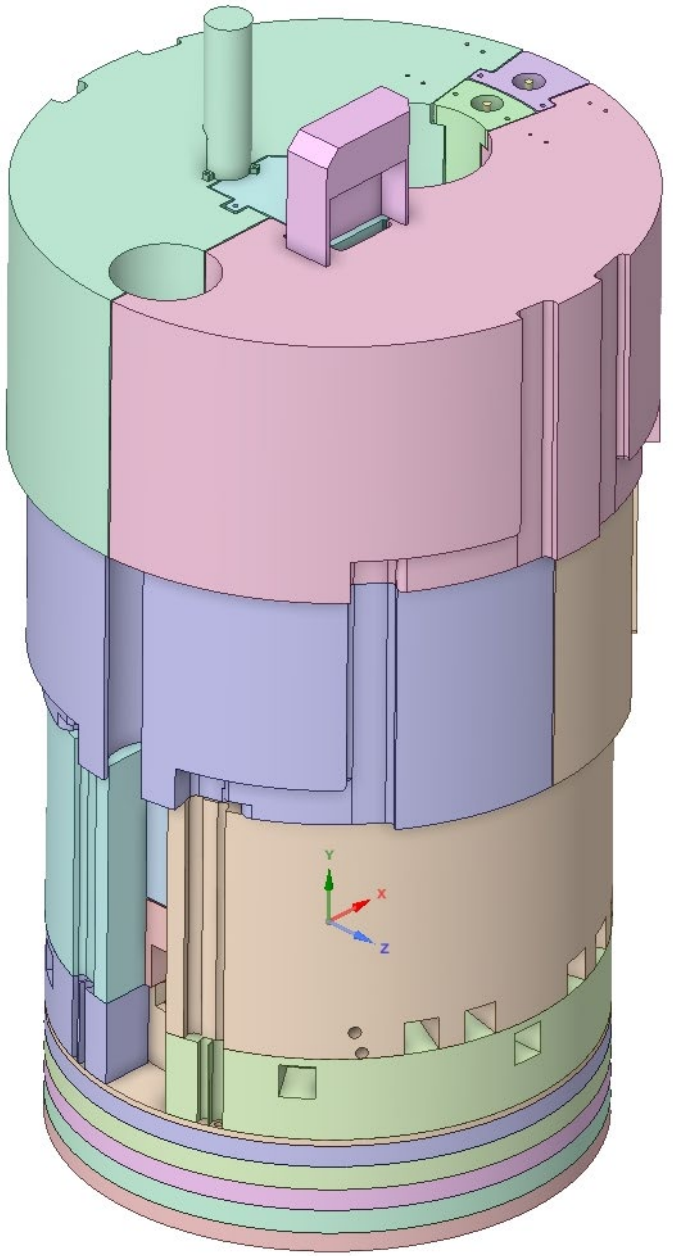


Item	Operation	Hours	Qty	Total	Shop Hours	Material Cost	Shop Cost	NRE Cost	Total Labor Cost	$ Labor/hour	Total Cost
Dual Channel Nozzle Grand Total, Qty 2	Machining		2	2056							
	EDM		2	0							
	Welding		2	212							
	Support (mfg, tig)		2	88							
	Non-reoccuring engineering		1	453.5							
	Assembly		2	363							
	Inspection		2	407	3579.5	$ 337,700.00	$ 826,736.00	$ 84,864.20	$ 911,600.20	$ 254.67	$ 1,249,300.20

Core Vessel Shielding Cost Estimate

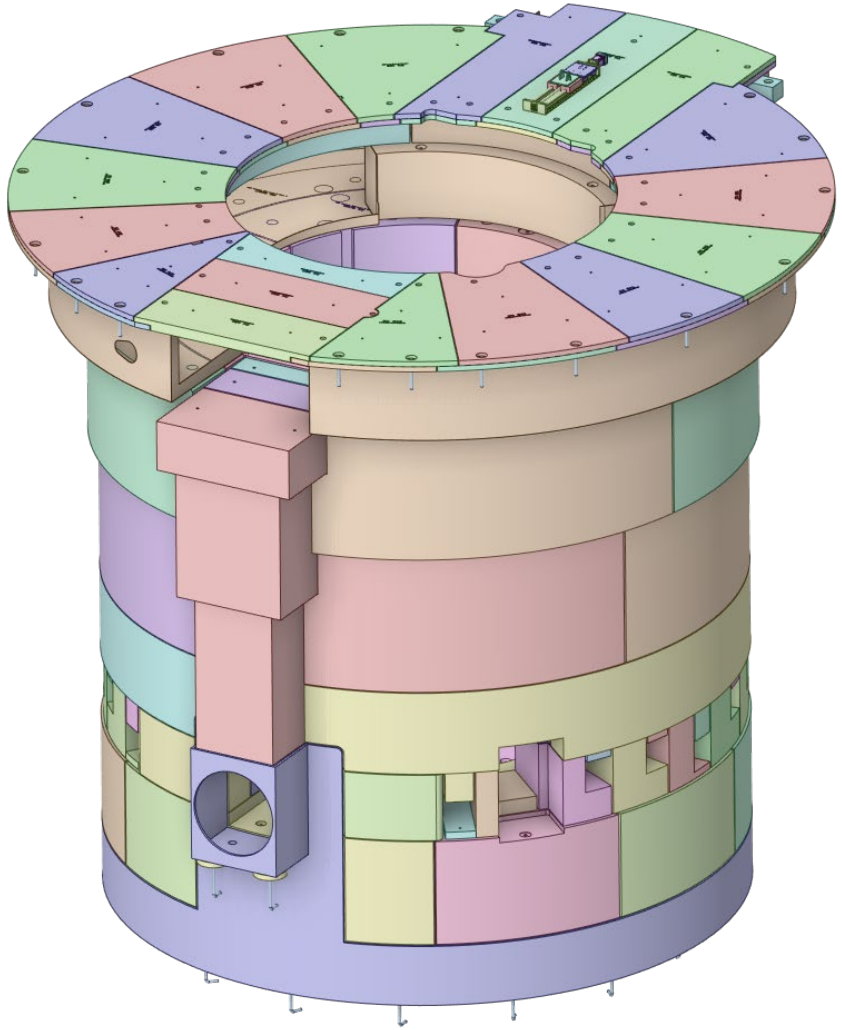
- Cooled shield blocks (316LSS) estimates based off of East and West beltline (laminated) designs
- Uncooled blocks made from low cost carbon secondary plate steel
- Rough estimates based on mass

Component	Mass (kg)	Location	Cost per Kg	Estimated Cost
S03060000-CV-SLD_BLK_1	25496	Layer 1 (cooled)	$ 57.55	$ 1,467,294.80
S03060000-CV-SLD_BLK_2	0	OMIT	$ 57.55	$ -
S03060000-CV-SLD_BLK_3	13321	Layer 2 (cooled)	$ 57.55	$ 766,623.55
S03060000-CV-SLD_BLK_4	13001	Layer 2 (cooled)	$ 57.55	$ 748,207.55
S03060000-CV-SLD_BLK_5	10694	Layer 3 (cooled)	$ 57.55	$ 615,439.70
S03060000-CV-SLD_BLK_6	6665	Layer 3 (cooled)	$ 57.55	$ 383,570.75
S03060000-CV-SLD_BLK_7	6717	Layer 3 (cooled)	$ 57.55	$ 386,563.35
S03060000-CV-SLD_BLK_8	27834	Layer 4	$ 8.00	$ 222,672.00
S03060000-CV-SLD_BLK_9	15592	Layer 4	$ 8.00	$ 124,736.00
S03060000-CV-SLD_BLK_10	16116	Layer 4	$ 8.00	$ 128,928.00
S03060000-CV-SLD_BLK_11	25183	Layer 5	$ 8.00	$ 201,464.00
S03060000-CV-SLD_BLK_12	16000	Layer 5	$ 8.00	$ 128,000.00
S03060000-CV-SLD_BLK_13	16000	Layer 5	$ 8.00	$ 128,000.00
S03060000-CV-SLD_BLK_14	8193	Blue Block (MRA)	$ 8.00	$ 65,544.00
S03060000-CV-SLD_BLK_15	7677	Blue Block (MRA)	$ 8.00	$ 61,416.00
S03060000-CV-SLD_BLK_21	3300	Orange Block (Hybrid)	$ 25.00	$ 82,500.00
S03060000-CV-SLD_BLK_22	2306	Orange Block (Hybrid)	$ 25.00	$ 57,650.00
Totals	214095			$ 5,568,609.70



Bulk and Removable Shielding Cost Estimate

- Shield blocks made from low cost carbon secondary plate steel
- Rough estimates based on mass
- Based on outdated block design, but overall mass is accurate



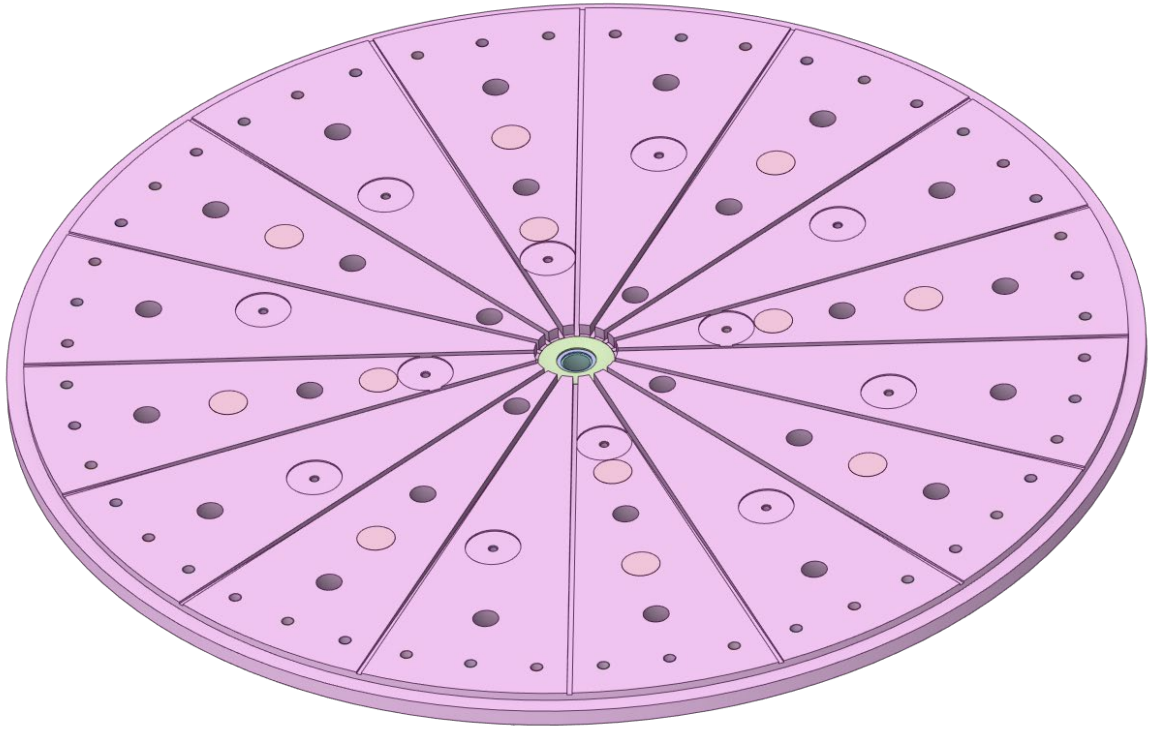
STS Target Station Shielding Weights - June 2023 Estimate

Component	Quantity	Mass (kg)	Mass (lbs)	Mass (Tons)	Metric Tonnes	Total Mass (kg)	Total Mass (lbs)	Cost per kg	Total Cost
CMA-TSS-RED-LAYER1-BLOCK1	1	7367	16241.4	8.1	7.4	7367.0	16241.4	$ 2.20	$ 16,192.67
CMA-TSS-RED-LAYER1-BLOCK2	1	7367	16241.4	8.1	7.4	7367.0	16241.4	$ 2.20	$ 16,192.67
CMA-TSS-RED-LAYER1-BLOCK3	1	7367	16241.4	8.1	7.4	7367.0	16241.4	$ 2.20	$ 16,192.67
CMA-TSS-RED-LAYER1-BLOCK4	1	7367	16241.4	8.1	7.4	7367.0	16241.4	$ 2.20	$ 16,192.67
CMA-TSS-RED-LAYER1-BLOCK5	1	10832	23880.4	11.9	10.8	10832.0	23880.4	$ 2.20	$ 23,808.74
CMA-TSS-RED-LAYER1-BLOCK6	1	10832	23880.4	11.9	10.8	10832.0	23880.4	$ 2.20	$ 23,808.74
CMA-TSS-RED-LAYER1-BLOCK7	1	10832	23880.4	11.9	10.8	10832.0	23880.4	$ 2.20	$ 23,808.74
CMA-TSS-RED-LAYER1-BLOCK8	1	10832	23880.4	11.9	10.8	10832.0	23880.4	$ 2.20	$ 23,808.74
CMA-TSS-RED-LAYER1-BLOCK9	1	16123	35545.1	17.8	16.1	16123.0	35545.1	$ 2.20	$ 35,438.35
CMA-TSS-RED-LAYER1-BLOCK10	1	16123	35545.1	17.8	16.1	16123.0	35545.1	$ 2.20	$ 35,438.35
CMA-TSS-RED-LAYER1-BLOCK11	1	16123	35545.1	17.8	16.1	16123.0	35545.1	$ 2.20	$ 35,438.35
CMA-TSS-RED-LAYER1-BLOCK12	1	16123	35545.1	17.8	16.1	16123.0	35545.1	$ 2.20	$ 35,438.35
CMA-TSS-RED-LAYER2-BLOCK1	1	10096	22257.8	11.1	10.1	10096.0	22257.8	$ 2.20	$ 22,191.01
CMA-TSS-RED-LAYER2-BLOCK2	1	10129	22330.6	11.2	10.1	10129.0	22330.6	$ 2.20	$ 22,263.54
CMA-TSS-RED-LAYER2-BLOCK3	1	10129	22330.6	11.2	10.1	10129.0	22330.6	$ 2.20	$ 22,263.54
CMA-TSS-RED-LAYER2-BLOCK4	1	10045	22145.4	11.1	10.0	10045.0	22145.4	$ 2.20	$ 22,078.91
CMA-TSS-RED-LAYER2-BLOCK5	1	19235	42405.9	21.2	19.2	19235.0	42405.9	$ 2.20	$ 42,278.53
CMA-TSS-RED-LAYER2-BLOCK6	1	19235	42405.9	21.2	19.2	19235.0	42405.9	$ 2.20	$ 42,278.53
CMA-TSS-RED-LAYER2-BLOCK7	1	18834	41521.8	20.8	18.8	18834.0	41521.8	$ 2.20	$ 41,397.13
CMA-TSS-RED-LAYER2-BLOCK8	1	19235	42405.9	21.2	19.2	19235.0	42405.9	$ 2.20	$ 42,278.53
CMA-TSS-RED-LAYER3-BLOCK1	1	1295	2855.0	1.4	1.3	1295.0	2855.0	$ 2.20	$ 2,846.41
CMA-TSS-RED-LAYER3-BLOCK2	1	1410	3108.5	1.6	1.4	1410.0	3108.5	$ 2.20	$ 3,099.18
CMA-TSS-RED-LAYER3-BLOCK3	1	1410	3108.5	1.6	1.4	1410.0	3108.5	$ 2.20	$ 3,099.18
CMA-TSS-RED-LAYER3-BLOCK4	1	1295	2855.0	1.4	1.3	1295.0	2855.0	$ 2.20	$ 2,846.41
CMA-TSS-RED-LAYER3-BLOCK5	1	1791	3948.5	2.0	1.8	1791.0	3948.5	$ 2.20	$ 3,936.62
CMA-TSS-RED-LAYER3-BLOCK6	1	1410	3108.5	1.6	1.4	1410.0	3108.5	$ 2.20	$ 3,099.18
CMA-TSS-RED-LAYER3-BLOCK7	1	1410	3108.5	1.6	1.4	1410.0	3108.5	$ 2.20	$ 3,099.18
CMA-TSS-RED-LAYER3-BLOCK8	1	1791	3948.5	2.0	1.8	1791.0	3948.5	$ 2.20	$ 3,936.62
CMA-TSS-RED-LAYER3-BLOCK9	1	1791	3948.5	2.0	1.8	1791.0	3948.5	$ 2.20	$ 3,936.62
CMA-TSS-RED-LAYER3-BLOCK10	1	1410	3108.5	1.6	1.4	1410.0	3108.5	$ 2.20	$ 3,099.18
CMA-TSS-RED-LAYER3-BLOCK11	1	1410	3108.5	1.6	1.4	1410.0	3108.5	$ 2.20	$ 3,099.18
CMA-TSS-RED-LAYER3-BLOCK12	1	1791	3948.5	2.0	1.8	1791.0	3948.5	$ 2.20	$ 3,936.62
CMA-TSS-RED-LAYER3-BLOCK13	1	1295	2855.0	1.4	1.3	1295.0	2855.0	$ 2.20	$ 2,846.41
CMA-TSS-RED-LAYER3-BLOCK14	1	923	2034.9	1.0	0.9	923.0	2034.9	$ 2.20	$ 2,028.75
CMA-TSS-RED-LAYER3-BLOCK15	1	923	2034.9	1.0	0.9	923.0	2034.9	$ 2.20	$ 2,028.75
CMA-TSS-RED-LAYER3-BLOCK16	1	1295	2855.0	1.4	1.3	1295.0	2855.0	$ 2.20	$ 2,846.41
CMA-TSS-RED-LAYER3-BLOCK17	1	2101	4631.9	2.3	2.1	2101.0	4631.9	$ 2.20	$ 4,618.00
CMA-TSS-RED-LAYER3-BLOCK18	1	2665	5875.3	2.9	2.7	2665.0	5875.3	$ 2.20	$ 5,857.67
CMA-TSS-RED-LAYER3-BLOCK19	1	6562	14466.7	7.2	6.6	6562.0	14466.7	$ 2.20	$ 14,423.28
CMA-TSS-RED-LAYER3-BLOCK20	1	7316	16129.0	8.1	7.3	7316.0	16129.0	$ 2.20	$ 16,080.57
CMA-TSS-RED-LAYER3-BLOCK21	1	211	465.2	0.2	0.2	211.0	465.2	$ 2.20	$ 463.78
CMA-TSS-RED-LAYER3-BLOCK22	1	656	1446.2	0.7	0.7	656.0	1446.2	$ 2.20	$ 1,441.89
CMA-TSS-RED-LAYER3-BLOCK23	1	656	1446.2	0.7	0.7	656.0	1446.2	$ 2.20	$ 1,441.89
CMA-TSS-RED-LAYER3-BLOCK24	1	656	1446.2	0.7	0.7	656.0	1446.2	$ 2.20	$ 1,441.89
CMA-TSS-RED-LAYER3-BLOCK25	1	211	465.2	0.2	0.2	211.0	465.2	$ 2.20	$ 463.78
CMA-TSS-RED-LAYER3-BLOCK26	1	656	1446.2	0.7	0.7	656.0	1446.2	$ 2.20	$ 1,441.89
CMA-TSS-RED-LAYER3-BLOCK27	1	656	1446.2	0.7	0.7	656.0	1446.2	$ 2.20	$ 1,441.89
CMA-TSS-RED-LAYER3-BLOCK28	1	656	1446.2	0.7	0.7	656.0	1446.2	$ 2.20	$ 1,441.89
CMA-TSS-RED-LAYER3-BLOCK29	1	211	465.2	0.2	0.2	211.0	465.2	$ 2.20	$ 463.78
CMA-TSS-RED-LAYER3-BLOCK30	1	211	465.2	0.2	0.2	211.0	465.2	$ 2.20	$ 463.78
CMA-TSS-RED-LAYER3-BLOCK31	1	656	1446.2	0.7	0.7	656.0	1446.2	$ 2.20	$ 1,441.89
CMA-TSS-RED-LAYER3-BLOCK32	1	656	1446.2	0.7	0.7	656.0	1446.2	$ 2.20	$ 1,441.89
CMA-TSS-RED-LAYER3-BLOCK33	1	656	1446.2	0.7	0.7	656.0	1446.2	$ 2.20	$ 1,441.89
CMA-TSS-RED-LAYER3-BLOCK34	1	211	465.2	0.2	0.2	211.0	465.2	$ 2.20	$ 463.78
CMA-TSS-RED-LAYER3-BLOCK35	1	656	1446.2	0.7	0.7	656.0	1446.2	$ 2.20	$ 1,441.89
CMA-TSS-RED-LAYER3-BLOCK36	1	278	612.9	0.3	0.3	278.0	612.9	$ 2.20	$ 611.04
CMA-TSS-RED-LAYER3-BLOCK37	1	656	1446.2	0.7	0.7	656.0	1446.2	$ 2.20	$ 1,441.89
CMA-TSS-RED-LAYER3-BLOCK38	1	211	465.2	0.2	0.2	211.0	465.2	$ 2.20	$ 463.78
CMA-TSS-RED-LAYER3-BLOCK39	1	2101	4631.9	2.3	2.1	2101.0	4631.9	$ 2.20	$ 4,618.00
CMA-TSS-RED-LAYER3-BLOCK40	1	2665	5875.3	2.9	2.7	2665.0	5875.3	$ 2.20	$ 5,857.67
CMA-TSS-RED-LAYER4-BLOCK1	1	10318	22747.3	11.4	10.3	10318.0	22747.3	$ 2.20	$ 22,678.96
CMA-TSS-RED-LAYER4-BLOCK2	1	11066	24396.3	12.2	11.1	11066.0	24396.3	$ 2.20	$ 24,323.07
CMA-TSS-RED-LAYER4-BLOCK3	1	11066	24396.3	12.2	11.1	11066.0	24396.3	$ 2.20	$ 24,323.07
CMA-TSS-RED-LAYER4-BLOCK4	1	11813	26043.2	13.0	11.8	11813.0	26043.2	$ 2.20	$ 25,964.97
CMA-TSS-RED-LAYER4-BLOCK5	1	9820	21649.4	10.8	9.8	9820.0	21649.4	$ 2.20	$ 21,584.36
CMA-TSS-RED-LAYER4-BLOCK6	1	11077	24420.6	12.2	11.1	11077.0	24420.6	$ 2.20	$ 24,347.25
CMA-TSS-RED-LAYER4-BLOCK7	1	9676	21331.9	10.7	9.7	9676.0	21331.9	$ 2.20	$ 21,267.85
CMA-TSS-RED-LAYER4-BLOCK8	1	10817	23847.4	11.9	10.8	10817.0	23847.4	$ 2.20	$ 23,775.77
CMA-TSS-RED-LAYER4-BLOCK9	1	3685	8124.0	4.1	3.7	3685.0	8124.0	$ 2.20	$ 8,099.63
CMA-TSS-RED-LAYER4-BLOCK10	1	3951	8710.5	4.4	4.0	3951.0	8710.5	$ 2.20	$ 8,684.30
CMA-TSS-RED-LAYER4-BLOCK11	1	3951	8710.5	4.4	4.0	3951.0	8710.5	$ 2.20	$ 8,684.30
CMA-TSS-RED-LAYER4-BLOCK12	1	4217	9296.9	4.6	4.2	4217.0	9296.9	$ 2.20	$ 9,268.97
CMA-TSS-RED-LAYER4-BLOCK13	1	3508	7733.8	3.9	3.5	3508.0	7733.8	$ 2.20	$ 7,710.58
CMA-TSS-RED-LAYER4-BLOCK14	1	5091	11223.7	5.6	5.1	5091.0	11223.7	$ 2.20	$ 11,190.02
CMA-TSS-RED-LAYER4-BLOCK16	1	5217	11501.5	5.8	5.2	5217.0	11501.5	$ 2.20	$ 11,466.97
CMA-TSS-RED-LAYER4-BLOCK17	1	594	1309.5	0.7	0.6	594.0	1309.5	$ 2.20	$ 1,305.61
CMA-TSS-RED-LAYER4-BLOCK18	1	150	330.7	0.2	0.2	150.0	330.7	$ 2.20	$ 329.70
CMA-TSS-RED-LAYER4-BLOCK20	1	150	330.7	0.2	0.2	150.0	330.7	$ 2.20	$ 329.70
CMA-TSS-RED-LAYER4-BLOCK21	1	594	1309.5	0.7	0.6	594.0	1309.5	$ 2.20	$ 1,305.61
CMA-TSS-RED-LAYER4-BLOCK22	1	150	330.7	0.2	0.2	150.0	330.7	$ 2.20	$ 329.70
CMA-TSS-RED-LAYER4-BLOCK23	1	150	330.7	0.2	0.2	150.0	330.7	$ 2.20	$ 329.70
CMA-TSS-RED-LAYER4-BLOCK24	1	150	330.7	0.2	0.2	150.0	330.7	$ 2.20	$ 329.70
CMA-TSS-RED-LAYER4-BLOCK25	1	594	1309.5	0.7	0.6	594.0	1309.5	$ 2.20	$ 1,305.61
CMA-TSS-RED-LAYER4-BLOCK26	1	594	1309.5	0.7	0.6	594.0	1309.5	$ 2.20	$ 1,305.61
CMA-TSS-RED-LAYER4-BLOCK27	1	150	330.7	0.2	0.2	150.0	330.7	$ 2.20	$ 329.70
CMA-TSS-RED-LAYER4-BLOCK28	1	150	330.7	0.2	0.2	150.0	330.7	$ 2.20	$ 329.70
CMA-TSS-RED-LAYER4-BLOCK29	1	150	330.7	0.2	0.2	150.0	330.7	$ 2.20	$ 329.70
CMA-TSS-RED-LAYER4-BLOCK30	1	594	1309.5	0.7	0.6	594.0	1309.5	$ 2.20	$ 1,305.61
CMA-TSS-RED-LAYER4-BLOCK31	1	150	330.7	0.2	0.2	150.0	330.7	$ 2.20	$ 329.70
CMA-TSS-RED-LAYER4-BLOCK32	1	150	330.7	0.2	0.2	150.0	330.7	$ 2.20	$ 329.70
CMA-TSS-RED-LAYER4-BLOCK33	1	150	330.7	0.2	0.2	150.0	330.7	$ 2.20	$ 329.70
CMA-TSS-RED-LAYER4-BLOCK34	1	594	1309.5	0.7	0.6	594.0	1309.5	$ 2.20	$ 1,305.61
CMA-TSS-RED-LAYERS-BLOCK1	1	9580	21120.3	10.6	9.6	9580.0	21120.3	$ 2.20	$ 21,056.84
CMA-TSS-RED-LAYERS-BLOCK2	1	9670	21318.7	10.7	9.7	9670.0	21318.7	$ 2.20	$ 21,254.66
CMA-TSS-RED-LAYERS-BLOCK3	1	9670	21318.7	10.7	9.7	9670.0	21318.7	$ 2.20	$ 21,254.66
CMA-TSS-RED-LAYERS-BLOCK4	1	9670	21318.7	10.7	9.7	9670.0	21318.7	$ 2.20	$ 21,254.66
CMA-TSS-RED-LAYERS-BLOCK5	1	15578	34343.6	17.2	15.6	15578.0	34343.6	$ 2.20	$ 34,240.44
CMA-TSS-RED-LAYERS-BLOCK6	1	15578	34343.6	17.2	15.6	15578.0	34343.6	$ 2.20	$ 34,240.44
CMA-TSS-RED-LAYERS-BLOCK7	1	15578	34343.6	17.2	15.6	15578.0	34343.6	$ 2.20	$ 34,240.44
CMA-TSS-RED-LAYERS-BLOCK8	1	5908	13024.9	6.5	5.9	5908.0	13024.9	$ 2.20	$ 12,985.78
CMA-TSS-RED-LAYERS-BLOCK9	1	5908	13024.9	6.5	5.9	5908.0	13024.9	$ 2.20	$ 12,985.78
CMA-TSS-RED-LAYER6-BLOCK1	1	11005	24261.8	12.1	11.0	11005.0	24261.8	$ 2.20	$ 24,188.99
CMA-TSS-RED-LAYER6-BLOCK2	1	11005	24261.8	12.1	11.0	11005.0	24261.8	$ 2.20	$ 24,188.99
CMA-TSS-RED-LAYER6-BLOCK3	1	11005	24261.8	12.1	11.0	11005.0	24261.8	$ 2.20	$ 24,188.99
CMA-TSS-RED-LAYER6-BLOCK4	1	9956	21949.2	11.0	10.0	9956.0	21949.2	$ 2.20	$ 21,883.29
CMA-TSS-RED-LAYER6-BLOCK5	1	9447	20827.0	10.4	9.4	9447.0	20827.0	$ 2.20	$ 20,764.51
CMA-TSS-RED-LAYER6-BLOCK6	1	13108	28898.2	14.4	13.1	13108.0	28898.2	$ 2.20	$ 28,811.38
CMA-TSS-RED-LAYER6-BLOCK7	1	12375	27282.2	13.6	12.4	12375.0	27282.2	$ 2.20	$ 27,200.25
CMA-TSS-RED-LAYER6-BLOCK8	1	13108	28898.2	14.4	13.1	13108.0	28898.2	$ 2.20	$ 28,811.38
CMA-TSS-RED-LAYER7-BLOCK1	1	8371	18454.9	9.2	8.4	8371.0	18454.9	$ 2.20	$ 18,399.46
CMA-TSS-RED-LAYER7-BLOCK2	1	8371	18454.9	9.2	8.4	8371.0	18454.9	$ 2.20	$ 18,399.46
CMA-TSS-RED-LAYER7-BLOCK3	1	8194	18064.7	9.0	8.2	8194.0	18064.7	$ 2.20	$ 18,010.41
CMA-TSS-RED-LAYER7-BLOCK4	1	8194	18064.7	9.0	8.2	8194.0	18064.7	$ 2.20	$ 18,010.41
CMA-TSS-RED-LAYER7-BLOCK5	1	18070	39837.5	19.9	18.1	18070.0	39837.5	$ 2.20	$ 39,717.86
CMA-TSS-RED-LAYER7-BLOCK6	1	18070	39837.5	19.9	18.1	18070.0	39837.5	$ 2.20	$ 39,717.86
CMA-TSS-RED-LAYER7-BLOCK7	1	18068	39833.1	19.9	18.1	18068.0	39833.1	$ 2.20	$ 39,713.46
CMA-TSS-RED-LAYER7-BLOCK8	1	12014	26486.3	13.2	12.0	12014.0	26486.3	$ 2.20	$ 26,406.77
CMA-TSS-RED-LAYER8-BLOCK1	1	9307	20518.4	10.3	9.3	9307.0	20518.4	$ 2.20	$ 20,456.79
CMA-TSS-RED-LAYER8-BLOCK2	1	9583	21126.9	10.6	9.6	9583.0	21126.9	$ 2.20	$ 21,063.43
CMA-TSS-RED-LAYER8-BLOCK3	1	9961	21960.2	11.0	10.0	9961.0	21960.2	$ 2.20	$ 21,894.28
CMA-TSS-RED-LAYER8-BLOCK4	1	7022	15480.8	7.7	7.0	7022.0	15480.8	$ 2.20	$ 15,434.36
CMA-TSS-RED-LAYER8-BLOCK5	1	11633	25646.3	12.8	11.6	11633.0	25646.3	$ 2.20	$ 25,569.33
CMA-TSS-RED-LAYER8-BLOCK6	1	11738	25877.8	12.9	11.7	11738.0	25877.8	$ 2.20	$ 25,800.12
CMA-TSS-RED-LAYER8-BLOCK7	1	8954	19740.2	9.9	9.0	8954.0	19740.2	$ 2.20	$ 19,680.89
CMA-TSS-RED-LAYER8-BLOCK8	1	7717	17013.1	8.5	7.7	7717.0	17013.1	$ 2.20	$ 16,961.97
CMA-TSS-RED-LAYER9-BLOCK1	1	8284	18263.1	9.1	8.3	8284.0	18263.1	$ 2.20	$ 18,208.23
CMA-TSS-RED-LAYER9-BLOCK2	1	9112	20088.5	10.0	9.1	9112.0	20088.5	$ 2.20	$ 20,028.18
CMA-REMOVABLE-PBW-Plate	1	2538	5595.3	2.8	2.5	2538.0	5595.3	$ 2.20	$ 5,578.52
REMOVABLE-PBW-BLOCK1	1	14093	31069.7	15.5	14.1	14093.0	31069.7	$ 2.20	$ 30,976.41
REMOVABLE-PBW-BLOCK2	1	4465	9843.6	4.9	4.5	4465.0	9843.6	$ 2.20	$ 9,814.07
REMOVABLE-PBW-BLOCK3	1	4823	10632.9	5.3	4.8	4823.0	10632.9	$ 2.20	$ 10,600.95
REMOVABLE-PBW-BLOCK4	1	7706	16988.8	8.5	7.7	7706.0	16988.8	$ 2.20	$ 16,937.79
REMOVABLE-PBW-BLOCK5	1	6889	15187.6	7.6	6.9	6889.0	15187.6	$ 2.20	$ 15,142.02
CMA-REMOVABLE-BLOCK1	1	4815	10615.2	5.3	4.8	4815.0	10615.2	$ 2.20	$ 10,583.37
CMA-REMOVABLE-BLOCK2	1	3961	8732.5	4.4	4.0	3961.0	8732.5	$ 2.20	$ 8,706.28
CMA-REMOVABLE-BLOCK3	1	4469	9852.4	4.9	4.5	4469.0	9852.4	$ 2.20	$ 9,822.86
CMA-REMOVABLE-BLOCK4	1	3961	8732.5	4.4	4.0	3961.0	8732.5	$ 2.20	$ 8,706.28
CMA-REMOVABLE-BLOCK5	1	4815	10615.2	5.3	4.8	4815.0	10615.2	$ 2.20	$ 10,583.37
Total	**138**	**872880**	**1924368.7**	**962.184353**	**872.88**	**872880**	**1924369**		**$ 1,918,590.24**

Total			**138**	**872880**	**1924368.7**	**962.184353**	**872.88**	**872880**	**1924369**		**$ 1,918,590.24**

Core Vessel Baseplate Cost Estimate

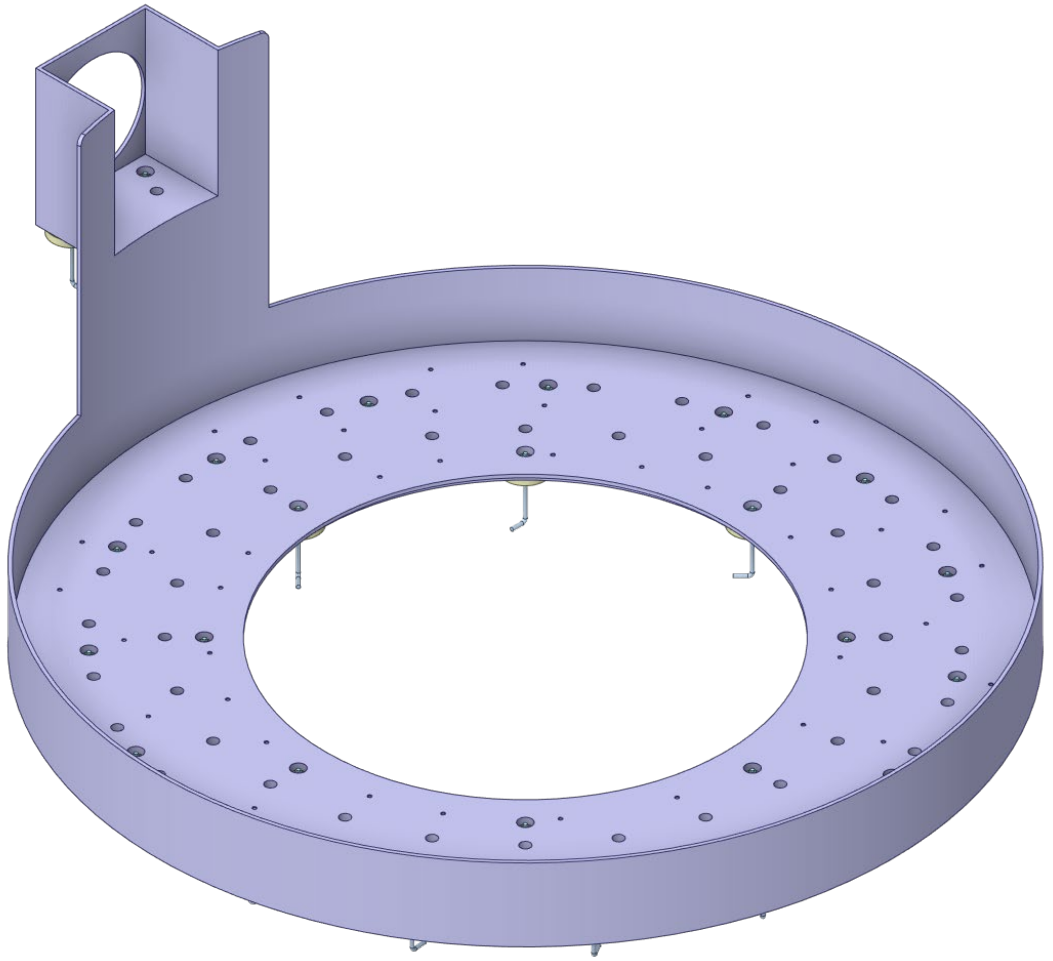
- Made from A36 carbon steel plate
- Estimate based on a more simplified design with less thru holes
- Based on 2023 material pricing
- Latest design has increased in thickness from 75 mm to 100 mm



Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Total Labor Cost	$ Labor/hour	Total Cost	Component Weight (kg)	Total Cost Per Kg
Inbedded Plate	Machining	240	1	240							
	Welding	0	1	0							
	Support (mfg, tig)	40	1	40							
	Non-reoccuring engineering	40	1	40							
	Assembly (painting)	50	1	50							
	Inspection	32	1	32							
	Contingency	60.3	1	60.3	462.3	$ 5,250.00	$ 196,015.20	$ 424.00	$ 201,265.20	14763	$ 13.63

Bulk Shielding Liner Cost Estimate

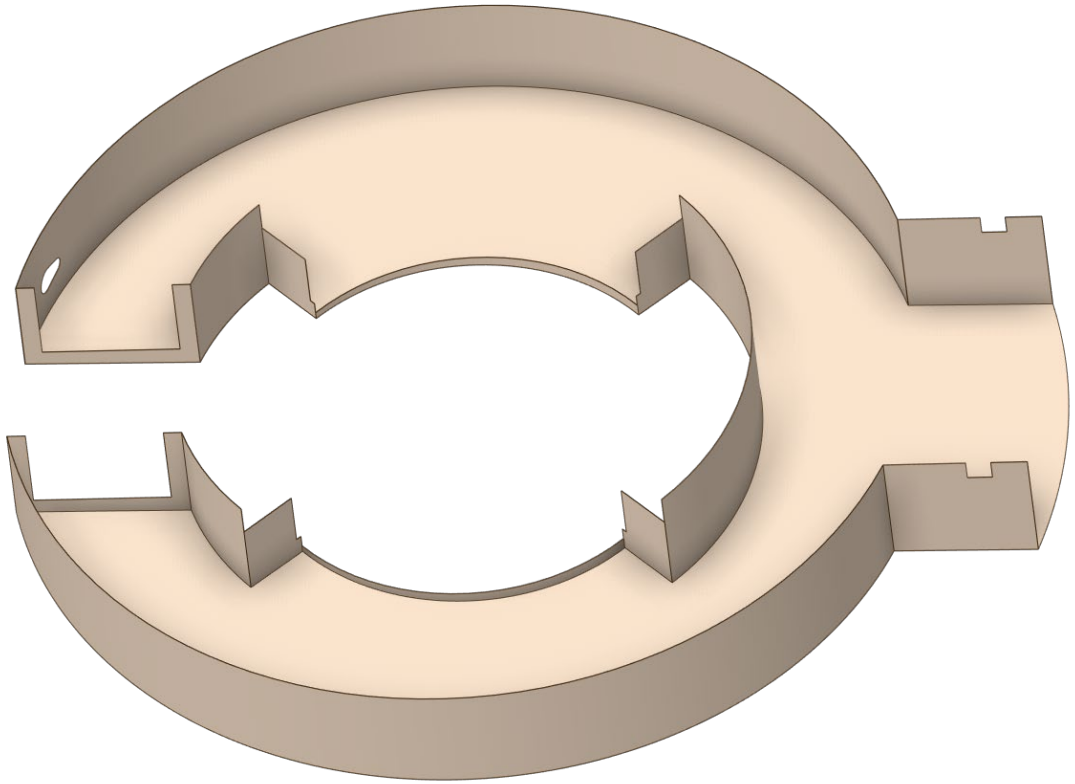
- Made from A36 carbon steel plate
- Estimate based on a more simplified design with less thru holes
- Based on 2023 material pricing
- Latest design bottom plate has increased in thickness from 25 mm to 75 mm



Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Total Labor Cost	$ Labor/hour	Total Cost	Component Weight (kg)	Total Cost Per Kg
Bulk Shielding Liner 1" thick	Machining/rolling	120	1	120							
	Welding	350	1	350							
	Support (mfg, tig)	40	1	40							
	Non-reoccuring engineering	100	1	100							
	Assembly	24	1	24							
	Inspection	32	1	32							
	Contingency	99.9	1	99.9	765.9	$ 35,162.50	$ 114,885.00	$ 150.00	$ 150,047.50	12868	$ 11.66

Pipe Pan Cost Estimate

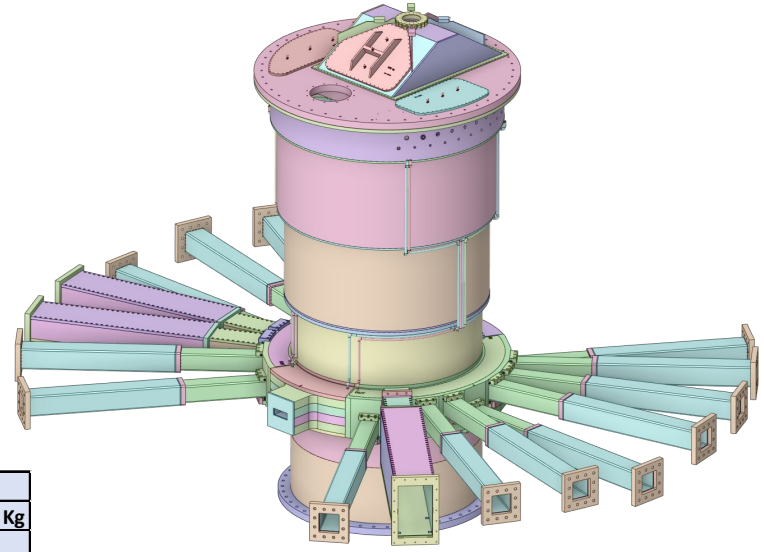
- Made from 16 Ga 316LSS sheet
- Welded in place during installation
- Based on 2023 material pricing
- Sheet laser cut to size
- Rolling costs included in material cost



Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Total Labor Cost	$ Labor/hour	Total Cost	Component Weight (kg)	Total Cost Per Kg
Piping Pans	Machining	0	1	0							
	Welding	80	1	80							
	Support (mfg, tig)	10	1	10							
	Non-reoccuring engineering	40	1	40							
	Assembly	32	1	32							
	Inspection	32	1	32							
	Contingency	29.1	1	29.1	223.1	$ 30,000.00	$ 44,620.00	$ 200.00	$ 74,620.00	700	$ 106.60

Vessel Systems Cost Estimate Summary

- Total estimated procurement cost = $9.382M
- Based on 2023 cost estimations in non-escalated state



Full Core Vessel with Lid											
Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Total Labor Cost	$Labor/hour	Total Cost	Component Weight (kg)	Total Cost Per Kg
Full Vessel with lid	Welding			868							
	Machining			2887							
	Support (mfg, tig)			180.8							
	Non-reoccuring engineering			1986							
	Assembly			606							
	Inspection			685.5							
	Contingency			1955	9168.1043	$ 2,589,497.27	$ 2,923,811.27	$ 318.91	$ 5,513,308.54	51669.6	$ 106.70

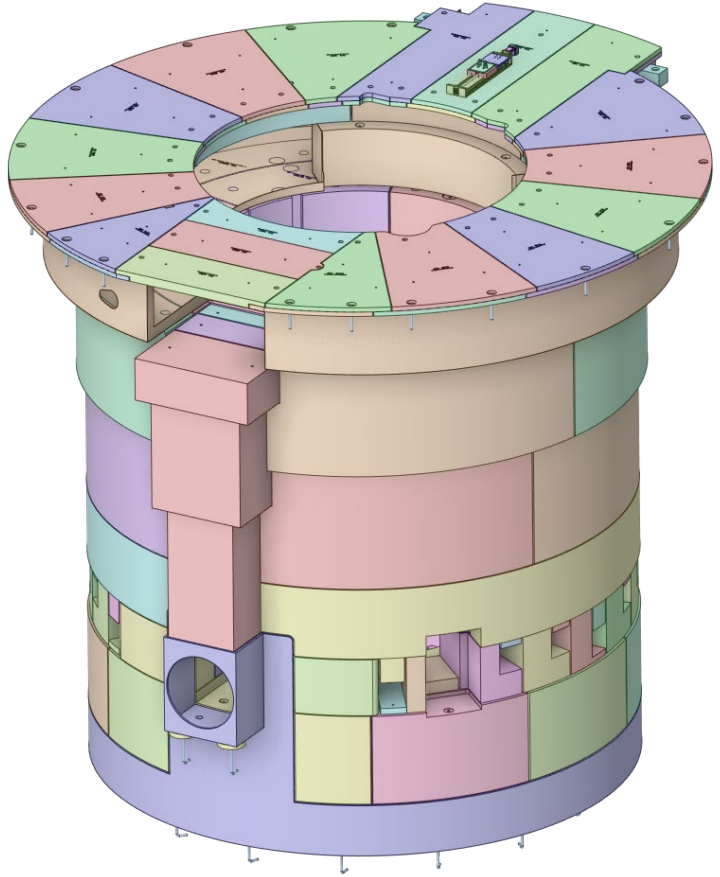
Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Total Labor Cost	$Labor/hour	Total Cost	Margin	Total cost with margin	Total Cost per Nozzle
Total Tube Nozzle Cost, Qty 15	Welding			1440								
	Machining			1680								
	Support (mfg, tig)			150								
	Non-reoccuring engineering			130								
	Assembly			540								
	Inspection			810								
	Contingency			657	5407	$ 238,131.18	$ 1,367,971.00	$ 253.00	$ 1,606,102.18	1.15	**$ 1,847,017.50**	**$ 123,134.50**

Item	Operation	Hours	Qty	Total	Total Hours	Material Cost	Shop Cost	NRE Cost	Total Labor Cost	$ Labor/hour	Total Cost
QIKR Nozzle Grand Total	Machining		1	1346							
	Welding		1	120							
	Support (mfg, tig)		1	54							
	Non-reoccuring engineering		1	439							
	Assembly		1	209							
	Inspection		1	206	2374	$ 171,443.57	$ 600,622.00	$ -	$ 600,622.00	$ 253.00	**$ 772,065.57**

Item	Operation	Hours	Qty	Total	Shop Hours	Material Cost	Shop Cost	NRE Cost	Total Labor Cost	$ Labor/hour	Total Cost
Dual Channel Nozzle Grand Total, Qty 2	Machining		2	2056							
	EDM		2	0							
	Welding		2	212							
	Support (mfg, tig)		2	88							
	Non-reoccuring engineering		1	453.5							
	Assembly		2	363							
	Inspection		2	407	3579.5	$ 337,700.00	$ 826,736.00	$ 84,864.20	$ 911,600.20	$ 254.67	$ 1,249,300.20

Target Station Shielding Cost Estimate Summary

- Total estimated procurement cost = $2.344M
- Based on 2023 cost estimations in non-escalated state
- Assumes use of secondary steel fabricated to shape at a cost of $2.20/lb



Future Cost Estimation Efforts during final design

- Revise cost estimations based on current market material costs
- Detailed cost estimate of CV lid
  - Current lid complexity is significantly increased
- Add cost of nozzle extension brackets and hardware
- Add cost of CV lid hatches
- Add cost of TVP utility shields
- Add cost of gamma gate assembly