

NCSX Work Approval Form (WAF)

WBS Number: 171

WBS Title: Cryostat

Job Numbers: 1701 and 1751

Job Titles: Cryostat Design (1701) and Cryostat

Procurements (1751)

Job Manager:G. Gettelfinger

Description:

This WBS element includes the efforts to design and fabricate the cryostat shell & structure, the wall insulation for the cryostat shell & structure, attachments for the structural support of internal components, and the required electrical, cooling and mechanical penetrations. Provisions shall be established to maintain thermal and electrical isolation, local I&C, and appropriate interface control with the other WBS elements.

Schedule:

Approvals:

Job Manager

Date

Responsible Line Manager

Date

Project Manager

Date

Engineering Department Head

Date

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TABLE I - DESIGN LABOR

WBS Number: 171
WBS Title: Cryostat
Job Number: 1701
Job Titles: Cryostat Design
Job Manager:G. Gettelfinger

Description:

This tab covers all Title I, II, and III engineering for the insulating cryostat, which includes penetrations for all piercing conduits, pipes, and structures. This system will be fabricated in-house by PPPL. All Title III engr associated with installation is included in WBS In this job. Shop fab hours are covered in tab 3. Test cell installation time (approx. 1200 hrs.) is in WBS 7xx.

Job 1701

Task ID	Multiplier	Unit	Number of Units	Hours	HOURS											Basis of Estimate
					ORNLEM	ORNLDN	ORNOLRM	EMEM	EMSM	EMSB	EMTB	EAEM	EASB	EEEM	EESM	
Title I and II Design																
Pro-E models (avg)	8	hrs/model	21	168										168	Based on recent experience on similar projects	
assy dwgs	12	hrs/dwg	18	216										216	Based on recent experience on similar projects	
Detail drawings	12	hrs/dwg	20	240										240	Based on recent experience on similar projects	
installation dwg	12	hrs/dwg	15	180										180	Based on recent experience on similar projects	
designer oversight	320	hrs	1	320				320							Engineering judgement based on recent experience tempered by WBS manager	
electrical schematic	0	hrs/dwg	0	0	0											
I&C schematic	0	hrs/dwg	0	0	0											
stress analysis	200	hrs/calc	1	200							200				Engineering judgement based on recent experience tempered by WBS manager	
thermal analysis	160	hrs/calc	0	0							0					
special analysis (electromagnetics)	0	hrs/calc	0	0	0											
Procurement Specifications	0	hrs/spec	0	0	0											
preliminary and final design reviews	80	hrs/rev	1	80				80							Engineering judgement based on recent experience tempered by WBS manager	
<i>Subtotal Title I & II Design</i>				1404	0	0	0	400	0	0	200	804	0	0		
Title III																
vendor inspection & oversight	0	hrs per	1	0	0											
Disposition of deviation requests and non-conformances	0	hrs/wk	20	0	0											
In-House fab/assy oversight & inspection	14	hrs/wk	20	280				280								
Preliminary shake-down testing	40	hrs/wk	2	80				80							Based on past system start-ups.	
As-built drawings	0	hrs/dwg	84	0	0											
<i>Subtotal Title III Design</i>				360	0	0	0	360	0	0	0	0	0	0		

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TABLE II- Materials and Subcontracts

WBS Number: 171
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Job Numbers: 1751
Job Title: Cryostat Procurements
Job Manager: G. Gettelfinger

Materials and Subcontracts (M&S)						
Materials			Assumptions		Basis of Estimate	
Purchased raw goods:	\$/unit	# units	Line Total			
Cryostat						
Extren Boards - Ribs	\$493	36	\$17,748	1017.9 sq ft	1017.878 sqft	See McMaster Carr Catalogue Item (see Table V)
Extren Boards - Flats	\$493	48	\$23,664	31.8 4x8 sheets (no waste)	31.8087 31 sheets no waste 1 layer	See McMaster Carr Catalogue Item (see Table V)
Urethane Foam - Cans	\$7	200	\$1,400	47.7 sheets (assumes 50% waste)	47.71305 48 sheets, 33% waste	Current retail price (Home Depot)
1" Rigid Urethane Foam	\$19	288	\$5,472			Current retail price (Home Depot)
Solimide Foam - Joints (bd ft)	\$9	4750	\$42,750	Ribs assume 18 ribs and 2 sheets per rib	Assume 18 longitudinal & 10 horizontal joints	See vendor quote (Table V)
Alum Unistrut (10 ft)	\$25	203.6016	\$5,090		1018.008 linear feet joints long only	
Acrylic Beauty Cover Panels	\$129	48	\$6,192	Assume 18 longitudinal & 10 horizontal joints		See McMaster Carr Catalogue Item (see Table V)
Mylar/Polyester Seal Goods	\$20	20	\$400	1018.008	1583.568 linear feet joints both dir	See McMaster Carr Catalogue Item (see Table V)
Humidity Sensor	\$300	1	\$300		Assume avg solimide joint 6" wde, 6 layers	Omega quote - see Table V
Compliant Penetrations						
Solimide Foam - Penetrations (bd ft)	\$9	800	\$7,200	1583.568	4750.704 board feet	See vendor quote (Table V)
Mylar/Polyester Seal Goods (50 sq ft)	\$20	40	\$800	Assume avg solimide joint 6" wde, 6 layers		See McMaster Carr Catalogue Item (see Table V)
Rigid Penetrations						
Extren Pipe (3" x 10")	\$153	4	\$612			See McMaster Carr Catalogue Item (see Table V)
Urethane Foam - Cans	\$7	40	\$280			Current retail price (Home Depot)
Misc M&S	\$10,000	1	\$10,000			Engineering Judgement
Subtotal M&S			\$121,908			
PPPL Fabrication Support Labor				EMTB	Basis of Estimate	
Mech Tech Time (RESA, hrs)				800	Experience in jobs 1409 & 1414	
Water Jet Tech Time (RESA, hrs)				240	Estimate based on interview with waterjet operator	
Test Cell Tech Time (Test Cell, hrs)					Covered in WBS 7	
Subtotal PPPL Support Labor				1040		

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TABLE III - Fabrication and Assembly

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Fabrication and Assembly

Included in M&S Table II

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TABLE IV - Uncertainty of Estimate and Residual Risk Assessment

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Uncertainty of the Estimate

	<u>High</u>	<u>Medium</u>	<u>Low</u>	<u>Uncertainty Range (%)</u>	<u>Comments/Other Considerations</u>
Job 1701				-20%/+40%	
Design Maturity			X		Only have conceptual designs
Design Complexity		X			Experience dealing with material gained, but flexible joints must be demonstrated
Job 1751				-5%/+10%	
Design Maturity	X				Majority of materials are catalogue items
Design Complexity			X		Standard materials

Note: High/Medium/Low uncertainty assessment from Job Manager. Uncertainty range based on ACEI recommended practice 18R-97 as amended for NCSX.

Residual Impacts

Job	Risk Description	Likelihood of Occurring	Mitigation Plan	Basis of estimate	Cost Impact		Schedule Impact	
					Low	High	Low	High
Job 1701 - NONE								
Job 1751 - NONE								

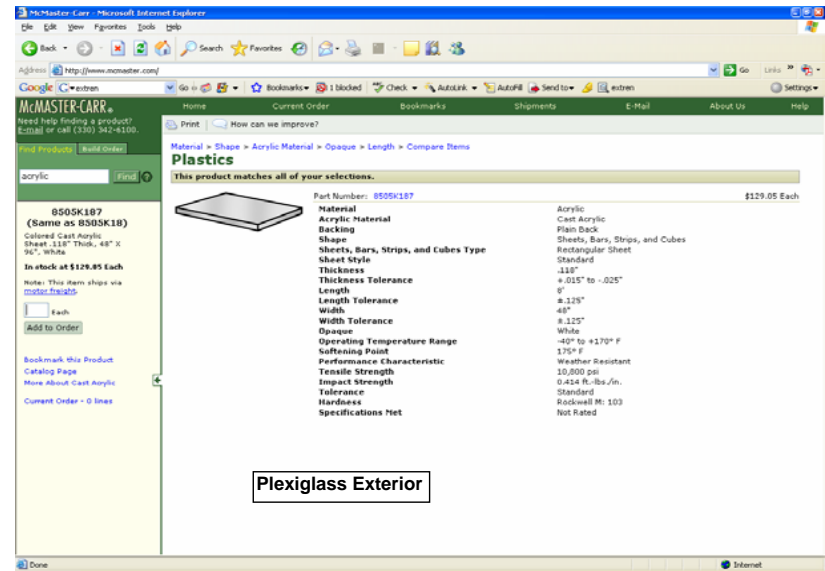
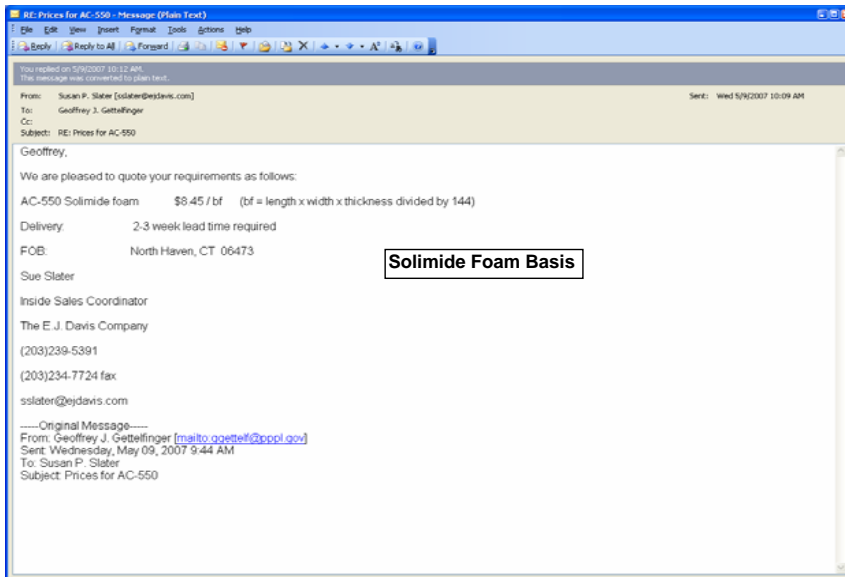
Notes:

- [1] Low cost and schedule impacts are considered the minimum (0-percentile) impacts should the event occur. High cost and schedule impacts are considered the maximum (100-percentile) impacts should the event occur
- [2] Cost impacts should be entered as man-hours (by demographic) and M&S direct cost under basis of estimate. Cost impacts should NOT include standing army costs which are separately calculated from the schedule impact. Project control is responsible for quantifying the low and high cost impacts based on the labor hours and M&S identified
- [3] The schedule impacts should be entered as the min and max impacts on the critical path. If there is no critical path impact then the schedule entries should be zero.
- [4] Likelihood of occurrence should be entered consistent with our risk classification methodology, i.e. VL= Very Likely (P>80%), L=Likely (80%>P>40%), U=Unlikley (40%>P>10%), VU=Very Unlikely (P<10%), NC=Non-credible (P<1%)

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TABLE V - Basis of Estimate

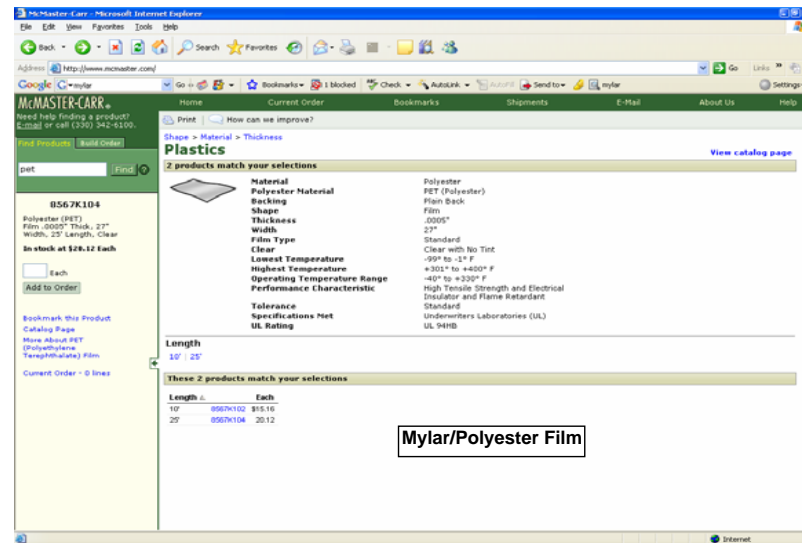
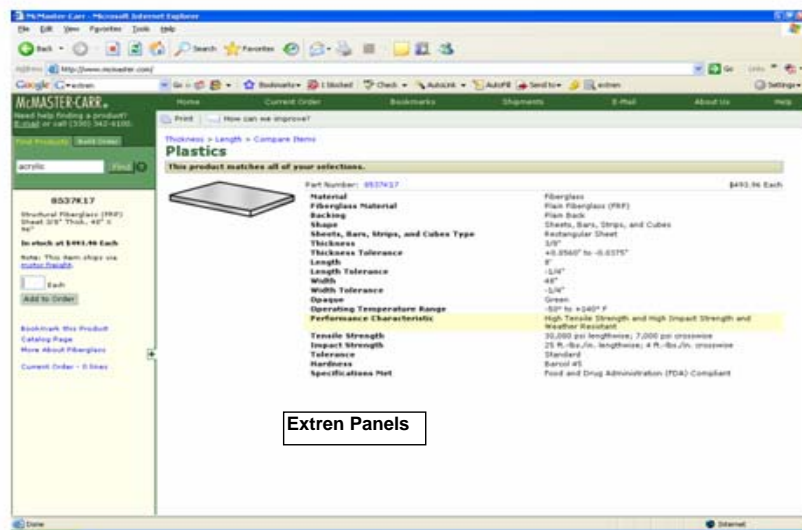
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Job 1751 Backup



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Aluminum Unistrut

Material	1 to 4-ft Lengths*	5-ft Length Each	6-ft Length Each	6'2" Length Each	8-ft Length Each	10-ft Length Each
1 1/2" x 1 1/2" Unslotted—12 Gauge						
Oxalvanized Steel	33101103					
Oxalvanized Steel	33101101	84.15	33101137	117.80	33101132	119.39
Oxalvanized Steel	33101101	4.15	33101441	17.80	33101112	19.39
Black-Painted Steel	33101102	4.28	33101442	20.32	33101122	22.11
Aluminum	3220121	4.87	3220155	23.12	3220122	25.20
Type 304 SS	3308115	17.80	3308121	84.55	3308116	96.12
Type 316 SS	3308125	21.90	3308139	104.02	3308126	116.28
Polyester	3261161	6.30	3261126	31.54	3261162	40.10
1 1/2" x 1 1/2" Slotted Hole—14 Gauge						
Oxalvanized Steel	33101104	3.10	33101147	13.18	33101162	14.90
Oxalvanized Steel	33101104	3.09	33101581	13.18	33101142	14.88
Black-Painted Steel	33101105	3.09	33101582	14.88	33101152	16.89
Aluminum	3220176	3.20	3220175	15.90	3220152	17.28
Type 304 SS	33081411	11.61	3308123	55.15	33081421	62.69
Type 316 SS	33081481	14.41	3308139	66.45	33081471	77.81
1 1/2" x 1 1/2" Slotted Hole—14 Gauge						
Oxalvanized Steel	33101201	3.74	3310179	15.90	33101212	17.96
Oxalvanized Steel	33101201	3.74	33101481	15.90	33101172	17.96
Black-Painted Steel	33101108	3.95	33101482	18.76	33101182	21.33
Aluminum	3220181	4.41	3220147	20.95	3220162	23.81
Type 304 SS	33081531	16.65	3308122	78.61	33081541	89.37
Type 316 SS	33081521	20.37	3308176	96.76	33081581	110.00
Polyester	3261162	8.67	3261136	39.94	3261166	52.03
1 1/2" x 1 1/2" Slotted Hole—14 Gauge						
Oxalvanized Steel	33101204	2.87	3310174	12.91	33101242	13.78
Oxalvanized Steel	33101202	2.87	33101621	12.91	33101222	13.78
Black-Painted Steel	33101203	2.89	33101622	13.73	33101232	15.61
Aluminum	3220195	2.98	3220195	14.16	3220196	16.08
Type 304 SS	33081511	10.80	3308124	51.30	33081521	58.22
Type 316 SS	33081581	13.40	33081774	68.45	33081591	72.36

Humidity Sensor Quote

Part Number	Availability	Price	Description	Qty
Server MicroServer™, Two Channel *				
ITHC-W	In Stock	\$295.00	Server MicroServer™ for Temp and Humidity, with 8" Wand Probe, Cable 6" (152 mm) with DB9 Connector, Two Channel Capability, 110 or 240 Vac power	0
ITHC-W-2	In Stock	\$310.00	Server MicroServer™ for Temp and Humidity, with Industrial 2" (51mm) Wand Probe, Cable 3 ft (0.9 m) with DB9 Connector, Two Channel Capability, 110 or 240 Vac power	0
ITHC-W-5	In Stock	\$320.00	Server MicroServer™ for Temp and Humidity, with Industrial 5" (127mm) Wand Probe, Cable 20 ft (6.1 m) with DB9 Connector, Two Channel Capability, 110 or 240 Vac power	0
Server MicroServer™, LCD Display, 2Mbyte Flash Memory Card, 2 Relay Alarm, and Battery Back-up, Single Channel only				
ITHC-M	In Stock	\$395.00	Server MicroServer™ for Temp and Humidity with 8" (203mm) Wand Probe, Cable 6" (152mm) with DB9 Connector, LCD Display, 2Mbyte Flash Memory Card, 2 Relay Alarm, and Battery Back-up, Single Channel only, 110 or 240 Vac power	0
ITHC-M-2	In Stock	\$410.00	Server MicroServer™ for Temp and Humidity with Industrial 2" (51mm) Probe, Cable 3 ft (0.9 m) with DB9 Connector, LCD Display, 2Mbyte Flash Memory Card, 2 Relay Alarm, and Battery Back-up, Single Channel only, 110 or 240 Vac power	0
ITHC-M-5	In Stock	\$420.00	Server MicroServer™ for Temp and Humidity with Industrial 5" (127mm) Probe, Cable 20 ft (6.1 m) with DB9 Connector, LCD Display, 2Mbyte Flash Memory Card, 2 Relay Alarm, and Battery Back-up, Single Channel only, 110 or 240 Vac power	0
Server MicroServer™ in Industrial Enclosure, Two Channel**				

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