

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											
Procuremnt 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	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	0	

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TABLE II- Materials and Subcontracts

WBS Number: 171
WBS Title: Cryostat
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 & 10horiz 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 & 10horiz 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

WBS Number: 171
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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

WBS Number: 171

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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								

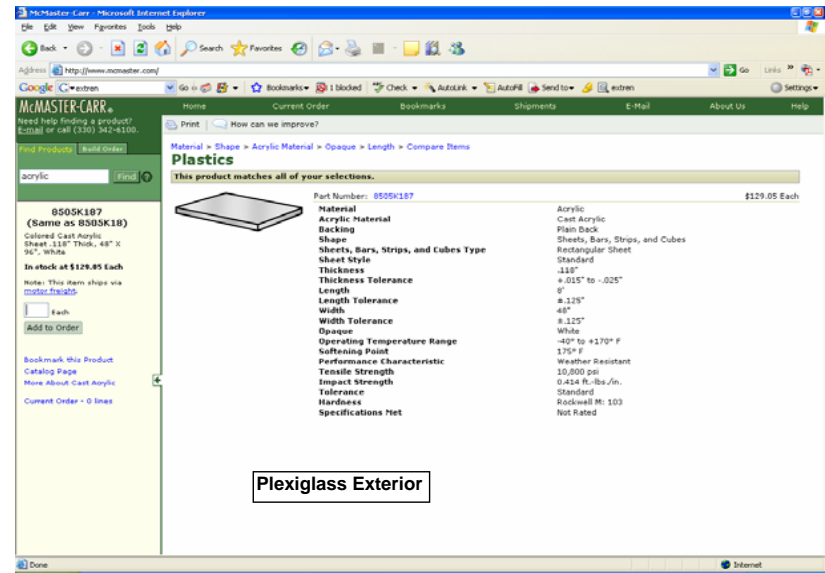
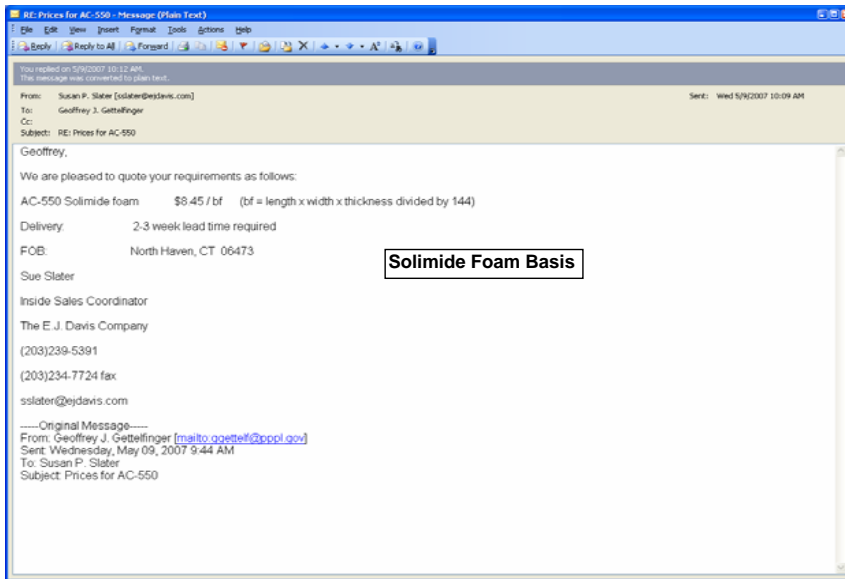
Notes:

- [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

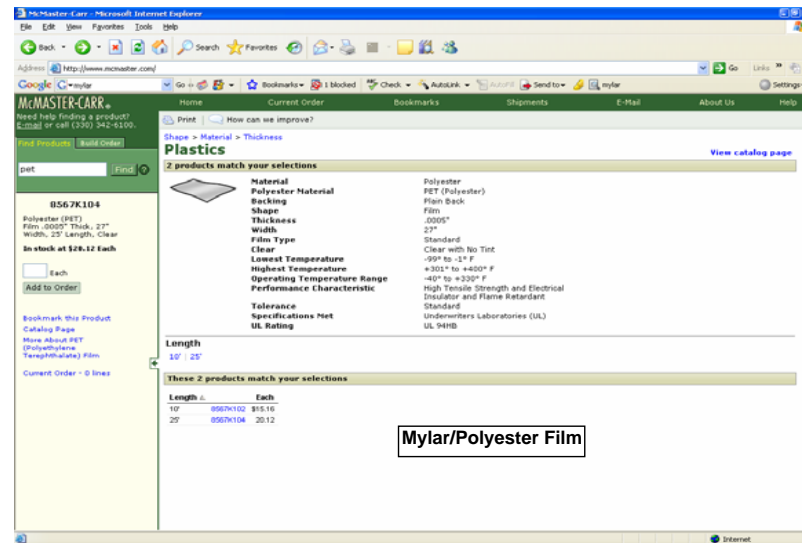
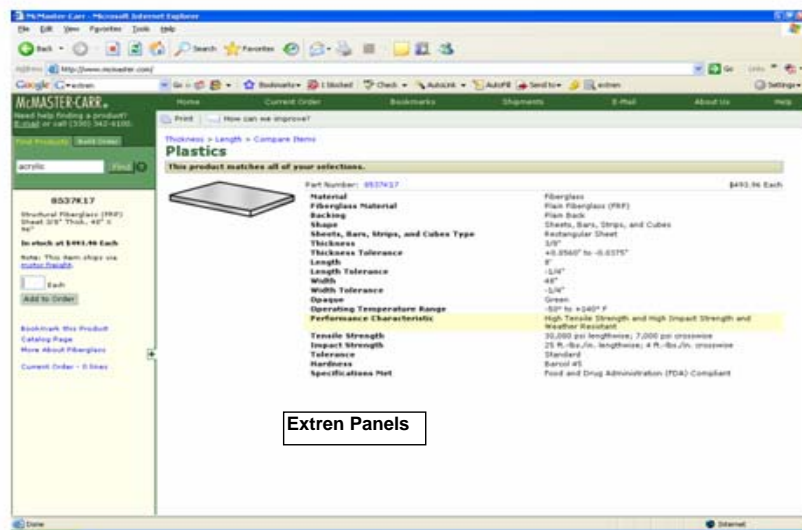
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Job 1751 Backup



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Aluminum Unistrut

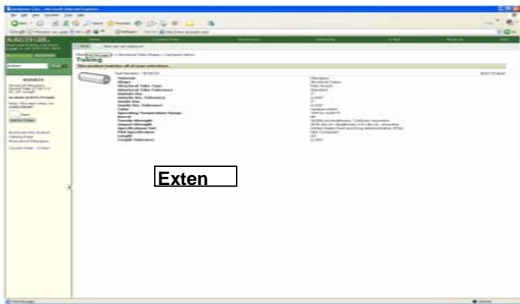
Material	1 to 4 ft. Lengths*	5 ft. Length	6 ft. Length	6'2" Length	8 ft. Length	10 ft. Length
1 1/2" x 1 1/2" Unslotted—12 Gauge	33010103	33010104	33010105	33010106	33010107	33010108
Oxvanized Steel	84.15	33010737	33010132	33010133	33010134	33010135
Black-Painted Steel	4.15	33010441	33010112	33010113	33010114	33010443
Aluminum	4.28	33010442	33010122	33010123	33010124	33010444
Type 304 SS	4.87	33010525	33010122	33010123	33010124	33010526
Type 316 SS	17.80	33085721	33085716	33085717	33085718	33085719
Polyester	21.90	33085729	33085726	33085727	33085728	33085729
1 1/2" x 1 1/2" Slotted Hole—14 Gauge	33010109	33010110	33010111	33010112	33010113	33010114
Oxvanized Steel	3.10	33010747	33010162	33010163	33010164	33010756
Black-Painted Steel	3.09	33010581	33010142	33010143	33010144	33010583
Aluminum	3.09	33010582	33010152	33010153	33010154	33010584
Type 304 SS	3.00	33085735	33085730	33085731	33085732	33085733
Type 316 SS	11.61	33085741	33085736	33085737	33085738	33085739
Polyester	14.41	33085759	33085744	33085745	33085746	33085757
1 1/2" x 1 1/2" Slotted Hole—14 Gauge	33010121	33010122	33010123	33010124	33010125	33010126
Oxvanized Steel	3.74	33010739	33010172	33010173	33010174	33010740
Black-Painted Steel	3.74	33010449	33010172	33010173	33010174	33010450
Aluminum	3.95	33010452	33010182	33010183	33010184	33010454
Type 304 SS	4.41	33010747	33010192	33010193	33010194	33010748
Type 316 SS	16.65	33085751	33085746	33085747	33085748	33085749
Polyester	20.37	33085759	33085754	33085755	33085756	33085757
1 1/2" x 1 1/2" Slotted Hole—14 Gauge	33010127	33010128	33010129	33010130	33010131	33010132
Oxvanized Steel	2.87	33010749	33010742	33010743	33010744	33010745
Black-Painted Steel	2.87	33010521	33010722	33010723	33010724	33010523
Aluminum	2.89	33010522	33010732	33010733	33010734	33010524
Type 304 SS	2.98	33010525	33010742	33010743	33010744	33010526
Type 316 SS	10.80	33085761	33085756	33085757	33085758	33085759
Polyester	13.40	33085774	33085769	33085770	33085771	33085772

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' (1.82 m) 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' (1.82m) 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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Activity ID	MILEstones (level 2 & 3)	Activity Description	Duration (work days)	Baseline Start	Baseline Finish	Shifts	Total Float	% cmlpt	Proposed Budgeted							
										FY07	FY08	FY09	FY10	FY11	FY12	
Job: 1701 - Cryostat Design-GETTLEFINGER																
1701-100		Cryostat- Conceptual Design	65	01OCT08*	12JAN09		55		15,888.00							
1701-101		Cryostat- Preliminary Design	70	21JAN09	28APR09		49		73,446.84							
1701-102		Cryostat- Stress analysis	43	27FEB09*	28APR09		49		38,242.00							
1701-103		Cryostat- Joint R&D	10	15APR09*	28APR09		49		3,298.40							
1701-121		Cryostat- PDR	1	29APR09	29APR09		49		1,324.00							
1701-131		Cryostat- Final Design	70	30APR09	07AUG09		49		73,446.84							
1701-141		Cryostat- FDR	1	10AUG09	10AUG09		49		1,324.00							
Subtotal			213	01OCT08	10AUG09		49		206,970.08							

EM//EM =96
EM//EM =144hr ; EA//SB =402hr ;
EA//EM=200
EM//TB=40
EM//EM =08hr ;
EM//EM =144hr ; EA//SB =402hr ;
EM//EM =08hr ;

Activity ID	MILE-stones (level 2 & 3)	Activity Description	Duration (work days)	Baseline Start	Baseline Finish	Shifts	Total Float	% cmlpt	Proposed Budgeted						
										FY07	FY08	FY09	FY10	FY11	FY12
Job: 1751 - Cryostat Procurement-GETTLEFINGER															
1751-151		Cryostat- Procure Materials and Supplies	65	01OCT09*	13JAN10		122		174,575.12						
1751-161		Cryostat- Fabricate Components	65	14JAN10	14APR10		122		88,670.40						
1751-171		Cryostat- Title III	90	01OCT09	17FEB10		660	LOE	61,606.80						
Subtotal			130	01OCT09	14APR10		620		324,852.32						

■ 41=121.908\$K ;
 ■ EM/TB =800hr ; EMT/TB =240 ;
 ■ EM//EM =360hr ;
 ■