

NCSX Fabrication Project Cost and Schedule Estimating Form

WBS 171 Cryostat

Labor

Activity Title	Manhours	FY2003 \$\$	Labor Type	Start Date Month/Yr	End Date Month/Yr	Comments
Preliminary Design (Title I)						
(33% of design schedule)	488		<i>EAEM</i>	May-05	Aug-05	PPPL Engineer
	297		<i>EADM</i>	May-05	Aug-05	PPPL Designer
	0		<i>ORNL Eng</i>	May-05	Aug-05	Composite of ORNL Engineer / Designer
	0		<i>ORNL Phys.</i>	May-05	Aug-05	Composite of ORNL Physics / scientific
	0		<i>PPPL Phys.</i>	May-05	Aug-05	PPPL Physics/scientific
Final Design (Title II)						
(67% of design schedule)	976		<i>EAEM</i>	Aug-05	Jan-06	PPPL Engineer
	593		<i>EADM</i>	Aug-05	Jan-06	PPPL Designer
	0		<i>ORNL Eng</i>	Aug-05	Jan-06	Composite of ORNL Engineer / Designer
	0		<i>ORNL Phys.</i>	Aug-05	Jan-06	Composite of ORNL Physicist
	0		<i>PPPL Phys.</i>	Aug-05	Jan-06	PPPL Physics/scientific
Lab R&D labor						
	0		<i>EAEM</i>	May-05	Aug-05	PPPL Engineer
	0		<i>EADM</i>	May-05	Aug-05	PPPL Designer
	0		<i>ORNL Eng</i>	May-05	Aug-05	Composite of ORNL Engineer / Designer
	0		<i>EASM</i>	May-05	Aug-05	PPPL monthly support
	0		<i>EMTB</i>	May-05	Aug-05	PPPL Technician
Lab Fab/Assembly/Installation (Title III)						
	34		<i>EAEM</i>	Jan-06	Jan-07	PPPL Engineer
	220		<i>EADM</i>	Jan-06	Jan-07	PPPL Designer
	0		<i>ORNL Eng</i>	Jan-06	Jan-07	Composite of ORNL Engineer / Designer
	0		<i>EASM</i>	Jan-06	Jan-07	PPPL monthly support
	0		<i>EMTB</i>	Jan-06	Jan-07	PPPL Technician

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Manhours per fiscal year by labor category

Level of Effort		FY2003	FY2004	FY2005	FY2006	FY2007	FY2008	TOTAL
PPPL Engineer	<i>EAEM</i>	0	0	842	647	9	0	1498
PPPL Designer	<i>EADM</i>	0	0	512	540	58	0	1110
Composite of ORNL Engineer / Designer	<i>ORNL Eng</i>	0	0	0	0	0	0	0
PPPL monthly support	<i>EASM</i>	0	0	0	0	0	0	0
PPPL Technician	<i>EMTB</i>	0	0	0	0	0	0	0
Composite of ORNL Physics / scientific	<i>ORNL Phy</i>	0	0	0	0	0	0	0
PPPL Physics/scientific	<i>PPPL Phy</i>	0	0	0	0	0	0	0

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M&S Costs

Activity Title	FY2003 \$\$	Comment
Manufacturing Development (R&D)		
Purchased Design Services	\$0	
Procured Hardware/Material	\$0	
Profit	\$0	included in hardware estimate
<i>total, manf/dev (R&D)</i>	\$0	w/o G&A
Procured Hardware/Material		
cryostat assembly	\$358,465	
Profit	\$0	included in hardware estimate
<i>total, procured hdwe/matl.</i>	\$358,465	w/o G&A
Purchased Design Services	\$0	no purchased services anticipated
Procured Installation/Assembly Costs	\$0	All installation and assembly costs are included in WBS 7

Other Costs

Activity Title	FY2003 \$\$	Comment
Travel	\$2,000	only one trip is anticipated for this WBS

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Summary Costs

Activity Title	Manhours	FY2003 \$\$	Comment
Labor			
PPPL Effort	2,608	\$340,194	<i>Assumed rates:</i> <i>EAEM 153 \$/hr</i> <i>EADM 100 \$/hr</i> <i>ORNL Eng 130 \$/hr</i> <i>EASM 100 \$/hr</i> <i>EMTB 73 \$/hr</i> <i>PPPL Phys 141 \$/hr</i> <i>ORNL Phys 160 \$/hr</i>
ORNL effort	0	\$0	
subtotal, labor	2,608	\$340,194	
M&S, Other			
Manufacturing Development (R&D)		\$0	
Procured Hardware/Material		\$358,465	
Purchased Design Services		\$0	
Procured Installation/Assembly Costs		\$0	
Travel		\$2,000	
subtotal, M&S		\$360,465	
G&A		\$90,116	25% on all purchased materials, subcontracts, travel
Subtotal without contingency		\$790,776	
Contingency		\$221,417	28% Overall on this WBS
Total cost		\$1,012,193	

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Materials and Subcontracts (M&S)

Description:
 This effort covers procurement of the cryostat parts by fixed price subcontract. The parts structure parts will be molded from fiberglass reinforced epoxy using conventional wet layup on molds. The boots are silicon rubber commercial products, as are the heaters. The urethane insulation is sprayed on in-place by a vendor.

Assumptions:
 outside engr rate = 120 \$ per hour
 outside lab rate = 60 \$ per hour
 outside inspection/technician rate = 80 \$ per hour

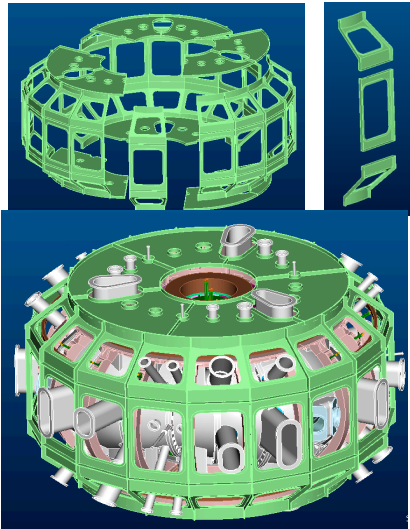
Purchased parts:

Molded fiberglass parts	\$106,248	see notes below
Flat panels	\$18,792	
misc bolts, seals and hardware	\$2,500	
Sprayed on urethane	\$11,928	see notes below
Sprayed on butyl rubber coating fiberglass panels on outside	\$26,627	
Standard boots	\$52,170	
NBI dust boot	\$78,000	
hose clamps, misc. hardware	\$30,000	
Flexible heaters	\$500	
Local I&C	\$27,000	
	\$2,700	
<i>subtotal, purchased parts</i>	\$358,465	

Worksheet:

molded fiberglass shell parts

	totals	top and bottom panels, 2 types	center panel	vertical panels, typical	vertical panels, reduced for joints	angled panels
no. of parts of this type		6	2	15	3	36
area per panel (ft ²)	696	23	6	15.4	13	4.9
material cost, (\$/ft ²)		15	15	15	15	15
material cost (\$)	\$8,946	\$2,070	\$180	\$3,465	\$565	\$2,646
cost of mold, \$/ft ²	\$300	\$300	\$300	\$300	\$300	\$300
mold cost per type	\$25,690	\$13,800	\$1,800	\$4,620	\$3,900	\$1,470
hours to mold parts, ea		8	4	6	6	4
hours to finish parts, incl flange holes, etc.		16	8	16	16	8
total hours per type	\$59,700	144	24	330	66	432
labor cost for shell pieces	\$11,952	\$8,640	\$1,440	\$19,800	\$3,960	\$25,920
technical oversight, insp., (10% of hrs)	\$11,952	\$1,728	\$288	\$3,960	\$792	\$5,184
total cost for molded shell parts	\$106,248					
Flat fiberglass panels for openings						
area per panel (ft ²)	0	0	6	6	3	
material cost, (\$/ft ²)	\$3,240	\$0	\$0	\$1,350	\$270	\$1,620
hours to cut out parts, ea	0	0	4	4	4	
total hours per type	\$12,960	\$0	\$0	\$3,600	\$720	\$8,640
labor cost for panels	\$2,592	\$0	\$0	\$720	\$144	\$1,728
technical oversight, insp., (10% of hrs)						
total cost for flat panel parts	\$18,792					



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Engineering, Title I, II and III

Description:

This effort covers all Title I, II, and III engineering for the complete cryostat, which includes the fiberglass panels and frame, urethane insulation, heaters, boots, and I&C. The panels and fram, boots, urethane insulation, and heaters procurement will be by fixed price subcontract. All Title III engr associated with installation is included in WBS 7.

	multiplier	unit	no.	hours	Labor category										
					total fraction	EAEM		EADM		ORNL Eng		ORNL Physics		PPPL Physics	
					fract.	hrs	fract.	hrs	fract.	hrs	fract.	hrs	fract.	hrs	
Title I, II design															
Pro-E models (avg)	16	hrs/model	40	640	1.00	0.50	320	0.50	320	0.00	0	0.00	0	0.00	0
assy dwgs	16	hrs/dwg	26	416	1.00	0.50	208	0.50	208	0.00	0	0.00	0	0.00	0
Detail drawings	16	hrs/dwg	26	416	1.00	0.50	208	0.50	208	0.00	0	0.00	0	0.00	0
installation dwg	8	hrs/dwg	26	208	1.00	0.50	104	0.50	104	0.00	0	0.00	0	0.00	0
cooling schematic	20	hrs/dwg	0	0	1.00	0.50	0	0.50	0	0.00	0	0.00	0	0.00	0
electrical schematic	0	hrs/dwg	0	0	1.00	0.50	0	0.50	0	0.00	0	0.00	0	0.00	0
I&C schematic	20	hrs/dwg	1	20	1.00	0.50	10	0.50	10	0.00	0	0.00	0	0.00	0
stress analysis	40	hrs/calc	1	40	1.00	0.50	20	0.50	20	0.00	0	0.00	0	0.00	0
thermal analysis	40	hrs/calc	1	40	1.00	0.50	20	0.50	20	0.00	0	0.00	0	0.00	0
special analysis (electromagnetics)	0	hrs/calc	0	0	1.00	0.50	0	0.50	0	0.00	0	0.00	0	0.00	0
procurement/fab specifications	40	hrs/spec	6	240	1.00	1.00	240	0.00	0	0.00	0	0.00	0	0.00	0
preliminary and final design reviews	40	hrs/rev	3	120	1.00	1.00	120	0.00	0	0.00	0	0.00	0	0.00	0
meetings/reporting/presentations	10%	% of tot	2140	214	1.00	1.00	214	0.00	0	0.00	0	0.00	0	0.00	0
<i>subtotal</i>				2354			1464		890		0		0		0
Title III															
vendor oversight, inspection	2	hrs/wk	24	48	1.00	0.50	24	0.00	0	0.50	24	0.00	0		
Disposition of deviation requests and non-conformances	1	hrs/wk	50	50	1.00	0.20	10	0.00	0	0.80	40	0.00	0		
As-built drawings	2	hrs/dwg	78	156	1.00	0.00	0	0.00	0	1.00	156	0.00	0		
<i>subtotal</i>				254			34		0		220		0		

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Engineering, Title I, II and III

Schedule assumptions	start	duration (weeks)	end
Title I Design	May-05	12	Aug-05
Title II Design	Aug-05	24	Jan-06
Procurement	Jan-06	24	Jul-06
In-house fab / sub-assy	Jul-06	0	Jul-06
Installation / final assembly	Jul-06	26	Jan-07

Notes and worksheets

cryostat shell and structure

	total	top and bottom panels	center panel	vertical panels (2 types)	angled panels
Pro-E models	10	2	1	4	3
assy dwgs	7	2	2	2	1
Detail drawings	7	2	2	2	1
installation dwg	5	1	1	2	1 one drawing per type of part
cooling schematic	0				
electrical schematic	0				
I&C schematic	0				
stress analysis	1				all stress analysis of cryostat
thermal analysis	1				all thermal analysis of cryostat
special analysis	0				
procurement specifications	1				one procurement specification for vessel assembly
preliminary and final design reviews	2				two standard reviews for cryostat
meetings/reporting/presentations	10%				