

NCSX Fabrication Project Cost and Schedule Estimating Form

WBS 121 Vacuum Vessel Assembly

Labor

Activity Title	Manhours	FY2003 \$\$	Labor Type	Start Date Month/Yr	End Date Month/Yr	Comments
Preliminary Design (Title I)						
(57% of design schedule)	68		<i>EAEM</i>	Apr-03	Oct-03	PPPL Engineer
	0		<i>EADM</i>	Apr-03	Oct-03	PPPL Designer
	2344		<i>ORNL Eng</i>	Apr-03	Oct-03	Composite of ORNL Engineer / Designer
	91		<i>ORNL Phys.</i>	Apr-03	Oct-03	Composite of ORNL Physics / scientific
	0		<i>PPPL Phys.</i>	Apr-03	Oct-03	PPPL Physics/scientific
Final Design (Title II)						
(43% of design schedule)	52		<i>EAEM</i>	Oct-03	Mar-04	PPPL Engineer
	0		<i>EADM</i>	Oct-03	Mar-04	PPPL Designer
	1767		<i>ORNL Eng</i>	Oct-03	Mar-04	Composite of ORNL Engineer / Designer
	69		<i>ORNL Phys.</i>	Oct-03	Mar-04	Composite of ORNL Physicist
	0		<i>PPPL Phys.</i>	Oct-03	Mar-04	PPPL Physics/scientific
Lab R&D labor						
	488		<i>EAEM</i>	Apr-03	Oct-03	PPPL Engineer
	0		<i>EADM</i>	Apr-03	Oct-03	PPPL Designer
	1271		<i>ORNL Eng</i>	Apr-03	Oct-03	Composite of ORNL Engineer / Designer
	408		<i>EASM</i>	Apr-03	Oct-03	PPPL monthly support
	0		<i>EMTB</i>	Apr-03	Oct-03	PPPL Technician
Lab Fab/Assembly/Installation (Title III)						
	348		<i>EAEM</i>	May-04	Oct-06	PPPL Engineer
	0		<i>EADM</i>	May-04	Oct-06	PPPL Designer
	939		<i>ORNL Eng</i>	May-04	Oct-06	Composite of ORNL Engineer / Designer
	0		<i>EASM</i>	May-04	Oct-06	PPPL monthly support
	0		<i>EMTB</i>	May-04	Oct-06	PPPL Technician

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Labor

		<i>Manhours per fiscal year by labor category</i>						
Level of Effort		FY2003	FY2004	FY2005	FY2006	FY2007	FY2008	TOTAL
PPPL Engineer	<i>EAEM</i>	533	135	144	144	0	0	956
PPPL Designer	<i>EADM</i>	0	0	0	0	0	0	0
Composite of ORNL Engineer / Designer	<i>ORNL Eng</i>	3464	2081	388	388	0	0	6321
PPPL monthly support	<i>EASM</i>	391	17	0	0	0	0	408
PPPL Technician	<i>EMTB</i>	0	0	0	0	0	0	0
Composite of ORNL Physics / scientific	<i>ORNL Phy</i>	87	73	0	0	0	0	160
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	\$755,450	
Profit	\$0	included in hardware estimate
<i>total, manf/dev (R&D)</i>	\$755,450	w/o G&A
Procured Hardware/Material		
vacuum vessel assembly	\$2,729,355	
NBI port duct assemblies	\$144,360	
Profit	\$0	included in hardware estimate
<i>total, procured hdwe/matl.</i>	\$2,873,715	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	\$24,000	at least one trip per month is expected for two years

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Summary Costs

Activity Title	Manhours	FY2003 \$\$	Comment
Labor			
PPPL Effort	1,364	\$187,120	<i>Assumed rates:</i> <i>EAEM</i> 153 \$/hr <i>EADM</i> 100 \$/hr <i>ORNL Eng</i> 130 \$/hr <i>EASM</i> 100 \$/hr <i>EMTB</i> 73 \$/hr PPPL Phys 141 \$/hr ORNL Phys 160 \$/hr
ORNL effort	6,481	\$847,319	
subtotal, labor	7,845	\$1,034,439	
M&S, Other			
Manufacturing Development (R&D)		\$755,450	
Procured Hardware/Material		\$2,873,715	
Purchased Design Services		\$0	
Procured Installation/Assembly Costs		\$0	
Travel		\$24,000	
subtotal, M&S		\$3,653,165	
G&A		\$355,953	25% on all purchased materials, subcontracts, travel \$557,339 G&A adjustment on large procurement
Subtotal without contingency		\$5,043,556	
Contingency		\$2,017,423	40% Overall on this WBS
Total cost		\$7,060,979	

NCSX Fabrication Project Cost and Schedule

WBS 121 Vacuum Vessel Assembly

Engineering, Title I, II and III

Description:

This effort covers all Title I, II, and III engineering for the vacuum vessel assembly, which includes the vessel shell, port extensions, spacer flange and seals. Two R&D subcontracts will be awarded for fabrication demonstration and development, followed by procurement of the final vessel 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)	24	hrs/model	48	1152	1.00	0.00	0	0.00	0	1.00	1152	0.00	0	0.00	0
assy dwgs	40	hrs/dwg	20	800	1.00	0.00	0	0.00	0	1.00	800	0.00	0	0.00	0
Detail drawings	20	hrs/dwg	54	1080	1.00	0.00	0	0.00	0	1.00	1080	0.00	0	0.00	0
installation dwg	8	hrs/dwg	30	240	1.00	0.00	0	0.00	0	1.00	240	0.00	0	0.00	0
cooling schematic	20	hrs/dwg	0	0	1.00	0.00	0	0.00	0	1.00	0	0.00	0	0.00	0
electrical schematic	0	hrs/dwg	0	0	1.00	0.00	0	0.00	0	1.00	0	0.00	0	0.00	0
I&C schematic	20	hrs/dwg	0	0	1.00	0.00	0	0.00	0	1.00	0	0.00	0	0.00	0
stress analysis	40	hrs/calc	4	160	1.00	0.00	0	0.00	0	1.00	160	0.00	0	0.00	0
thermal analysis	40	hrs/calc	2	80	1.00	0.00	0	0.00	0	1.00	80	0.00	0	0.00	0
special analysis (electromagnetics)	160	hrs/calc	1	160	1.00	0.00	0	0.00	0	0.00	0	1.00	160	0.00	0
procurement/fab specifications	160	hrs/spec	1	160	1.00	0.75	120	0.00	0	0.25	40	0.00	0	0.00	0
preliminary and final design reviews	80	hrs/rev	2	160	1.00	0.00	0	0.00	0	1.00	160	0.00	0	0.00	0
meetings/reporting/presentations	10%	% of tot	3992	399	1.00	0.00	0	0.00	0	1.00	399	0.00	0	0.00	0
<i>subtotal</i>				4391			120		0		4111		160		0
Title III															
vendor oversight, inspection	8	hrs/wk	73	581	1.00	0.50	290	0.00	0	0.00	0	0.50	290		
Disposition of deviation requests and non-conformances	4	hrs/wk	73	290	1.00	0.20	58	0.00	0	0.00	0	0.80	232		
As-built drawings	4	hrs/dwg	104	416	1.00	0.00	0	0.00	0	0.00	0	1.00	416		
<i>subtotal</i>				1287			348		0		0		939		

NCSX Fabrication Project Cost and Schedule

WBS 121 Vacuum Vessel Assembly

Engineering, Title I, II and III

Schedule assumptions	start	duration (weeks)	end		
Title I Design	Apr-03	27	Oct-03		
Title II Design	Oct-03	21	Mar-04	FDR	Jan-04
Procurement	May-04	73	Sep-05		
In-house fab / sub-assy	Oct-05	22	Mar-06		
Installation / final assembly	Mar-06	31	Oct-06		

Notes and worksheets

vacuum vessel design

	total	vessel torus, flanges, and port reinforcements	port extensions	joint spacer flange	bolts, seals, and other hardware	
Pro-E models	48	5	37	3	3	
assy dwgs	20	3	13	2	2	13 port extension/flange assemblies
Detail drawings	54	6	36	6	6	half period vessel shell, flanges, ports x 13 types, seals, spacer, etc.
installation dwg	30	15	13	1	1	
cooling schematic	0	0	0			Included in WBS 123
electrical schematic	0	0				included in WBS 125
I&C schematic	0	0	0			
stress analysis	4	1	1	1	1	Analyses include stress and buckling from normal and disruption loads
thermal analysis	2	1	1			
special analysis	1	1				em disruption analysis
procurement specifications	1					one procurement specification for vessel assembly
preliminary and final design reviews	2					two standard reviews
meetings/reporting/presentations	15%					

WBS 121 Vacuum Vessel Assembly

R&D

Description:
This effort covers all R&D necessary for developing and demonstrating the fabrication process for the vacuum vessel. This R&D will be performed by two vendors, preferably proposing different fabrication approaches. After which a final price subcontract will be let for the production vessel assembly. In addition, PVPV will perform in-house R&D to verify the field joint welding joint design and process.

Summary

Purchased Design Services	
None expected	EAEEM
subtotal	
	\$0 W/O G&A
Procured Hardware/Material	
vacuum vessel R&D contracts	\$751,245 allocations for 2 forms from different vendors
weld test materials	\$4,200
subtotal	
	\$755,445 w/o G&A
Subcontractor labor rates:	
design rate:	\$122 per hour
fab rate:	\$50 per hour
inspection/technician rate:	\$80 per hour

		Labor category												
		total			EAEEM		EACM		ORNL Eng		EASM		Vendor	
		fraction	hrs	fraction	hrs	fraction	hrs	fraction	hrs	fraction	hrs	fraction	hrs	
R&D design	unit	no.	hours											
Task														
Proc-E models	hrs/model	11	264	1.00	0.00	0.00	0.00	1.00	264	0.00	0.00	0.00	0.00	
assy dwgs	hrs/dwg	5	100	1.00	0.00	0.00	0.00	1.00	100	0.00	0.00	0.00	0.00	
Detail drawings	tracking	12	192	1.00	0.00	0.00	0.00	1.00	192	0.00	0.00	0.00	0.00	
installation dwg	hrs/dwg	0	0	1.00	0.00	0.00	0.00	1.00	0	0.00	0.00	0.00	0.00	
cooling schematic	hrs/dwg	0	0	1.00	0.00	0.00	0.00	1.00	0	0.00	0.00	0.00	0.00	
electrical schematic	hrs/dwg	0	0	1.00	0.00	0.00	0.00	1.00	0	0.00	0.00	0.00	0.00	
I&C schematic	hrs/dwg	0	0	1.00	0.00	0.00	0.00	1.00	0	0.00	0.00	0.00	0.00	
special analysis	hrs/spec	1	80	1.00	0.00	0.00	0.00	1.00	80	0.00	0.00	0.00	0.00	
procurement specifications	tracking	0	0	1.00	0.00	0.00	0.00	1.00	0	0.00	0.00	0.00	0.00	
vendor shop drawings	hrs/model	0	0	1.00	0.00	0.00	0.00	1.00	0	0.00	0.00	0.00	0.00	
vendor part programming	% of tot	0	0	1.00	0.00	0.00	0.00	1.00	0	0.00	0.00	0.00	0.00	
vendor misc engineering	% of tot	0	0	1.00	0.00	0.00	0.00	1.00	0	0.00	0.00	0.00	0.00	
preliminary and final design reviews	hrs/rev	1	80	1.00	0.00	0.00	0.00	1.00	80	0.00	0.00	0.00	0.00	
meetings/reporting/presentations	% of tot	716	143	1.00	0.00	0.00	0.00	1.00	143	0.00	0.00	0.00	0.00	
subtotal			899		0		0		899		0		0	

		Labor category												
		total			EAEEM		EACM		ORNL Eng		EASM		EMTB	
		fraction	hrs	fraction	hrs	fraction	hrs	fraction	hrs	fraction	hrs	fraction	hrs	
R&D Tasks and Title III (see notes)	unit	no.	hours											
Procurement assistance	hrs/wk	12	96	1.00	0.50	48	0.00	0.50	48	0.00	0.00	0.00	0.00	
Vendor surveillance, oversight	hrs/wk	52	416	1.00	0.50	208	0.00	0.50	208	0.00	0.00	0.00	0.00	
Disposition of deviation requests and non-conformances	hrs/wk	52	208	1.00	0.25	52	0.00	0.75	156	0.00	0.00	0.00	0.00	
subtotal			720		308		0		412		0		0	

Schedule assumptions	start	duration (weeks)	end
Bid and award	Jul-03	12	Oct-03
Vessel R&D	Oct-03	52	Sep-04

Notes and worksheets

Vessel R&D Engineering Design

	11	12	1	2	3	4	5	6	7	8	9	10	11	12
	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Proc-E models	11	0	0	0	0	0	0	0	0	0	0	0	0	0
assy dwgs	5	3	4	1										
Detail drawings	12	6	2	4										
installation dwg	0	0	0	0										
cooling schematic	0	0	0	0										
electrical schematic	0	0	0	0										
I&C schematic	0	0	0	0										
special analysis	0	0	0	0										
procurement specifications	1	1												
vendor shop drawings	0													
vendor part programming	0													
vendor misc engineering	0													
preliminary and final design reviews	0													
meetings/reporting/presentations	20%													

Vacuum vessel fabrication R&D

Cost derived from subcontracts with two vendors		vendor 1	vendor 2
Composite Cost Estimate	(FY-03B)	(FY-03B)	(FY-03B)
R&D studies by vendors			
PVVS			
R&D budget allocated, 2 vendors	\$751,245		
R&D Schedule	12 months	10 months	12 months
		123635	
		178378	
		75299	127205
		27931	128545
PVVS		\$400,343	\$265,600
PVVS total		\$665,943	
total contract		\$400,343	\$360,600
		\$761,746	

Notes:
Desired results include demonstration of forming the torus shell, oort stub reinforcements, and oort extension to torus welds.

WBS 121 Vacuum Vessel Assembly

Materials and Subcontracts (M&S)

Description:

This effort covers procurement of the vacuum vessel assembly by fixed price subcontract. The vessel assembly includes the torus, port extensions, spacers, and miscellaneous hardware. The R&D is costed separately.

Purchased parts:

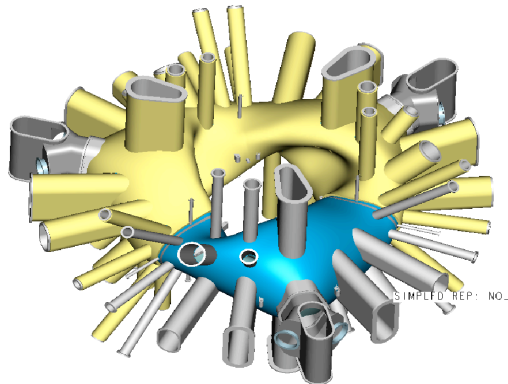
Vacuum vessel assembly	\$2,729,355	see notes below
NBI port duct extensions	\$144,360	
<i>subtotal, purchased parts</i>	<i>\$2,873,715</i>	

Worksheet:

Vacuum Vessel Assembly

Cost derived from budgetary estimates by two vendors as part of R&D subcontracts

	Estimate (FY-02\$)		vendor 1 (FY-02\$)	vendor 2 (FY-02\$)
Vessel assembly, 3 field periods				
Vendor design, tooling, fixtures			\$875,000	\$1,203,483
Forming or casting vessel, extensions			\$1,673,000	\$1,677,673
Welding			incl above	incl above
Machining / polishing			incl above	incl above
Assy. Inspection, leak check, seals			incl above	incl above
shipping				\$29,553
Production Total	\$2,729,355		\$2,548,000	\$2,910,709
Production Schedule			12 months	
			01-Apr-04	
			25-Mar-05	



NCSX Fabrication Project Cost and Schedule

WBS 121 Vacuum Vessel Assembly

In-house Fabrication and Assembly

Description:

No fabrication and assembly is associated with this WBS

Labor category

	multiplier	unit	no.	hours	total fraction	EAEM		EASM, EMSM		EMTB		EADM	
						fract.	hrs	fract.	hrs	fract.	hrs	fract.	hrs
Fab operations summary													
	0	hrs/lot	1	0	1.00	0.00	0	0.00	0	0.00	0	1.00	0
	0	hrs/line	1	0	0.00	0.00	0	0.00	0	0.00	0	0.00	0
	0	hrs / coil	1	0	0.00	0.00	0	0.00	0	0.00	0	0.00	0
<i>subtotal</i>				0			0		0		0		0
Assembly operations summary													
	0	hr/lot	1	0	1.00	0.00	0	1.00	0	0.00	0	0.00	0
	0	hr/lot	1	0	0.00	0.00	0	0.00	0	0.00	0	0.00	0
	0	hr/coil	1	0	0.00	0.00	0	0.00	0	0.00	0	0.00	0
	0	hours	1	0	0.00	0.00	0	0.00	0	0.00	0	0.00	0
<i>subtotal</i>				0			0		0		0		0