

## NCSX Fabrication Project Cost and Schedule Estimating Form

### WBS 122 Vacuum Vessel Thermal Insulation

#### Labor

Activity Title	Manhours	FY2003 \$\$	Labor Type	Start Date Month/Yr	End Date Month/Yr	Comments
<b>Preliminary Design (Title I)</b>						
( 33% of design schedule)	10		<i>EAEM</i>	May-05	Aug-05	PPPL Engineer
	0		<i>EADM</i>	May-05	Aug-05	PPPL Designer
	145		<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
<b>Final Design (Title II)</b>						
( 67% of design schedule)	20		<i>EAEM</i>	Aug-05	Jan-06	PPPL Engineer
	0		<i>EADM</i>	Aug-05	Jan-06	PPPL Designer
	291		<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
<b>Lab R&amp;D labor</b>						
	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
<b>Lab Fab/Assembly/Installation (Title III)</b>						
	22		<i>EAEM</i>	Jan-06	Jan-07	PPPL Engineer
	0		<i>EADM</i>	Jan-06	Jan-07	PPPL Designer
	124		<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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#### Labor

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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	17	29	6	0	52
PPPL Designer	<i>EADM</i>	0	0	0	0	0	0	0
Composite of ORNL Engineer / Designer	<i>ORNL Eng</i>	0	0	251	277	33	0	560
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

## NCSX Fabrication Project Cost and Schedule Estimating Form

### WBS 122 Vacuum Vessel Thermal Insulation

#### M&S Costs

Activity Title	FY2003 \$\$	Comment
<b>Manufacturing Development (R&amp;D)</b>		
Purchased Design Services	\$0	
Procured Hardware/Material	\$0	
Profit	\$0	included in hardware estimate
<i>total, manf/dev (R&amp;D)</i>	\$0	w/o G&A
<b>Procured Hardware/Material</b>		
insulation blankets	\$82,007	
Profit	\$0	included in hardware estimate
<i>total, procured hdwe/matl.</i>	\$82,007	w/o G&A
<b>Purchased Design Services</b>	\$0	no purchased services anticipated
<b>Procured Installation/Assembly Costs</b>	\$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

## NCSX Fabrication Project Cost and Schedule Estimating Form

### WBS 122 Vacuum Vessel Thermal Insulation

#### Summary Costs

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Activity Title	Manhours	FY2003 \$\$	Comment
<b>Labor</b>			
PPPL Effort	52	\$7,956	<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	560	\$72,852	
subtotal, labor	612	\$80,808	
<b>M&amp;S, Other</b>			
Manufacturing Development (R&D)		\$0	
Procured Hardware/Material		\$82,007	
Purchased Design Services		\$0	
Procured Installation/Assembly Costs		\$0	
Travel		\$2,000	
subtotal, M&S		\$84,007	
<b>G&amp;A</b>		\$21,002	25% on all purchased materials, subcontracts, travel
<b>Subtotal without contingency</b>		\$185,817	
<b>Contingency</b>		\$59,461	32% Overall on this WBS
<b>Total cost</b>		\$245,278	

## NCSX Fabrication Project Cost and Schedule

### WBS 122 Vacuum Vessel Thermal Insulation

#### Engineering, Title I, II and III

**Description:**

This effort covers all Title I, II, and III engineering for the vacuum vessel thermal insulation, which includes insulation around the vessel shell, and port extensions. The insulation will consist of pre-manufactured blankets and 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	
<b>Title I, II design</b>															
Pro-E models (avg)	4	hrs/model	32	128	1.00	0.00	0	0.00	0	1.00	128	0.00	0	0.00	0
assy dwgs	8	hrs/dwg	4	32	1.00	0.00	0	0.00	0	1.00	32	0.00	0	0.00	0
Detail drawings	4	hrs/dwg	28	112	1.00	0.00	0	0.00	0	1.00	112	0.00	0	0.00	0
installation dwg	8	hrs/dwg	4	32	1.00	0.00	0	0.00	0	1.00	32	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	0	0	1.00	0.00	0	0.00	0	1.00	0	0.00	0	0.00	0
thermal analysis	40	hrs/calc	1	40	1.00	0.00	0	0.00	0	1.00	40	0.00	0	0.00	0
special analysis (electromagnetics)	160	hrs/calc	0	0	1.00	0.00	0	0.00	0	0.00	0	1.00	0	0.00	0
procurement/fab specifications	40	hrs/spec	1	40	1.00	0.75	30	0.00	0	0.25	10	0.00	0	0.00	0
preliminary and final design reviews	40	hrs/rev	1	40	1.00	0.00	0	0.00	0	1.00	40	0.00	0	0.00	0
meetings/reporting/presentations	10%	% of tot	424	42	1.00	0.00	0	0.00	0	1.00	42	0.00	0	0.00	0
<i>subtotal</i>				466			30		0		436		0		0
<b>Title III</b>															
vendor oversight, inspection	1	hrs/wk	24	24	1.00	0.50	12	0.00	0	0.00	0	0.50	12		
Disposition of deviation requests and non-conformances	1	hrs/wk	50	50	1.00	0.20	10	0.00	0	0.00	0	0.80	40		
As-built drawings	2	hrs/dwg	36	72	1.00	0.00	0	0.00	0	0.00	0	1.00	72		
<i>subtotal</i>				146			22		0		0		124		

## NCSX Fabrication Project Cost and Schedule

### WBS 122 Vacuum Vessel Thermal Insulation

#### Engineering, Title I, II and III

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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

##### vessel thermal insulation blankets

	total	vessel torus,	port extensions	NBI duct	support hangars
Pro-E models	32	7	14	6	5
assy dwgs	4	1	1	1	1
Detail drawings	28	6	13	5	4 flat patterns for each part
installation dwg	4	1	1	1	1 on drawing per type of part
cooling schematic	0				
electrical schematic	0				
I&C schematic	0				
stress analysis	0				
thermal analysis	1				one analysis for all insulation
special analysis	0				
procurement specifications	1				one procurement specification for vessel assembly
preliminary and final design reviews	1				one review for thermal insulation
meetings/reporting/presentations	15%				

WBS 122 Vacuum Vessel Thermal Insulation

R&D

Description:  
No R&D is expected for this WBS element

Summary

Purchased Design Services	\$0
<i>subtotal</i>	\$0 w/o GSA
Procured Hardware/Material	\$0
<i>subtotal</i>	\$0 w/o GSA

Subcontractor labor rates:  
design rate: \$0 per hour  
fab rate: \$0 per hour  
inspection/technician rate: \$0 per hour

R&D design	unit	no.	hours	Labor category												
				total fraction	EAEM fract.	EAEM hrs	EADM fract.	EADM hrs	ORNL Eqg fract.	ORNL Eqg hrs	EASM fract.	EASM hrs	Vendor fract.	Vendor hrs		
<b>Task</b>																
Pro-E models	24 hrs/model	0	0	1.00	0.00	0	0.00	0	1.00	0	0.00	0	0.00	0	0.00	0
assw dwgs	20 hrs/dwg	0	0	1.00	0.00	0	0.00	0	1.00	0	0.00	0	0.00	0	0.00	0
Detail drawings	24 hrs/dwg	0	0	1.00	0.00	0	0.00	0	1.00	0	0.00	0	0.00	0	0.00	0
installation dwg	0 hrs/dwg	0	0	1.00	0.00	0	0.00	0	1.00	0	0.00	0	0.00	0	0.00	0
cooling schematic	0 hrs/dwg	0	0	1.00	0.00	0	0.00	0	1.00	0	0.00	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	0.00	0
I&C schematic	0 hrs/dwg	0	0	1.00	0.00	0	0.00	0	1.00	0	0.00	0	0.00	0	0.00	0
special analysis	0 hrs/calc	0	0	1.00	0.00	0	0.00	0	1.00	0	0.00	0	0.00	0	0.00	0
procurement specifications	80 hrs/spec	0	0	1.00	0.00	0	0.00	0	1.00	0	0.00	0	0.00	0	0.00	0
vendor shop drawings	0 hrs/dwg	0	0	1.00	0.00	0	0.00	0	1.00	0	0.00	0	1.00	0	0.00	0
vendor part programming	0 hrs/model	0	0	1.00	0.00	0	0.00	0	1.00	0	0.00	0	1.00	0	0.00	0
vendor misc engineering	0 % of tot	0	0	1.00	0.00	0	0.00	0	1.00	0	0.00	0	1.00	0	0.00	0
preliminary and final design reviews	80 hrs/rev	0	0	1.00	0.00	0	0.00	0	1.00	0	0.00	0	0.00	0	0.00	0
meetings/visitor/ins/representations	20% % of tot	0	0	1.00	0.00	0	0.00	0	1.00	0	0.00	0	0.00	0	0.00	0
<i>subtotal</i>			0			0		0			0		0		0	0

R&D Tasks and Title III (see notes)	unit	no.	hours	Labor category												
				total fraction	EAEM fract.	EAEM hrs	EADM fract.	EADM hrs	ORNL Eqg fract.	ORNL Eqg hrs	EASM fract.	EASM hrs	EMTB fract.	EMTB hrs		
Procurement assistance	0 hrs/wk	12	0	1.00	0.50	0	0.00	0	0.50	0	0.00	0	0.00	0	0.00	0
Vendor surveillance, oversight	0 hrs/wk	52	0	1.00	0.50	0	0.00	0	0.50	0	0.00	0	0.00	0	0.00	0
Disposition of deviation requests and non-conformances	0 hrs/wk	52	0	1.00	0.25	0	0.00	0	0.75	0	0.00	0	0.00	0	0.00	0
<i>subtotal</i>			0			0		0			0		0		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



**WBS 122 Vacuum Vessel Thermal Insulation**

**Materials and Subcontracts (M&S)**

**Description:**  
This effort covers procurement of the vacuum vessel thermal insulation by fixed price subcontract. The vessel insulation covers the torus, port extensions, and support hangers. The R&D is costed separately.

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

**Purchased parts:**  
Torus blankets \$28,800 see notes below  
Port duct blankets \$37,680  
NBI duct blankets \$11,160  
Support hanger blankets \$4,367  
subtotal purchased parts \$82,007

**Worksheet:**

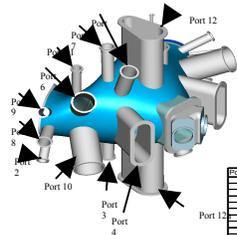
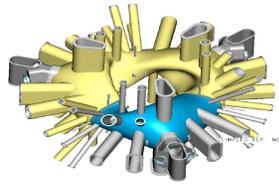
**WV thermal blankets**

**Torus blankets**  
area per half field period 80 ft<sup>2</sup>  
cost of insulation material \$20 per ft<sup>2</sup>  
no. of blankets types per half period 6  
fabrication hours per blanket 8 hrs  
labor cost per blanket \$480  
technical oversight, inspection 1 hrs  
technical oversight, inspection \$120 per blanket  
total cost per blanket \$600  
total cost per half period \$4,800  
total cost for torus \$28,800

**port extension blankets**  
area of extensions per half field period 80 ft<sup>2</sup>  
cost of insulation material \$20 per ft<sup>2</sup>  
no. of part types per half period 13  
fabrication hours per blanket 4  
labor cost per blanket \$240  
technical oversight, inspection 1 hrs  
technical oversight, inspection \$120 per blanket  
total cost per blanket \$360  
total cost per half period \$6,280  
total cost for all extensions \$37,680

**NBI duct blankets**  
area of single NBI duct assembly 36 ft<sup>2</sup>  
cost of insulation material \$20 per ft<sup>2</sup>  
no. of blankets per duct 5  
fabrication hours per blanket 8  
labor cost per blanket \$480  
technical oversight, inspection 1 hrs  
technical oversight, inspection \$120 per blanket  
total cost per blanket \$744  
total cost per NBI duct \$3,720  
total cost for all NBI ducts \$11,160

**Support hanger blankets**  
area of support hanger assemblies for zone 6 0.8 ft<sup>2</sup>  
cost of insulation material \$20 per ft<sup>2</sup>  
no. of hangers per field period 4  
fabrication hours per blanket 4  
labor cost per blanket \$240  
technical oversight, inspection 1 hrs  
technical oversight, inspection \$120 per blanket  
total cost per blanket \$364  
total cost per field period \$1,456  
total cost for all hangers \$4,367



452 ft<sup>2</sup>

Port	Surface area	No. Ports	Total
1	200	1	200
2	200	1	200
3	200	1	200
4	200	1	200
5	200	1	200
6	200	1	200
7	200	1	200
8	200	1	200
9	200	1	200
10	200	1	200
11	200	1	200
12	200	1	200
13	200	1	200
14	200	1	200
15	200	1	200
16	200	1	200
17	200	1	200
18	200	1	200
19	200	1	200
20	200	1	200
21	200	1	200
22	200	1	200
23	200	1	200
24	200	1	200
25	200	1	200
26	200	1	200
27	200	1	200
28	200	1	200
29	200	1	200
30	200	1	200
31	200	1	200
32	200	1	200
33	200	1	200
34	200	1	200
35	200	1	200
36	200	1	200
37	200	1	200
38	200	1	200
39	200	1	200
40	200	1	200
41	200	1	200
42	200	1	200
43	200	1	200
44	200	1	200
45	200	1	200
46	200	1	200
47	200	1	200
48	200	1	200
49	200	1	200
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88	200	1	200
89	200	1	200
90	200	1	200
91	200	1	200
92	200	1	200
93	200	1	200
94	200	1	200
95	200	1	200
96	200	1	200
97	200	1	200
98	200	1	200
99	200	1	200
100	200	1	200

# NCSX Fabrication Project Cost and Schedule

## WBS 122 Vacuum Vessel Thermal Insulation

### In-house Fabrication and Assembly

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**Description:**

No in-house 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
<b>Fab operations summary</b>													
	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
<b>Assembly operations summary</b>													
	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