

NCSX Fabrication Project Cost and Schedule Estimating Form

WBS 162 Coil Leads

Labor

Activity Title	Manhours	FY2003 \$\$	Labor Type	Start Date Month/Yr	End Date Month/Yr	Comments
Preliminary Design (Title I)						
(50% of design schedule)	0		<i>EAEM</i>	Mar-06	May-06	PPPL Engineer
	0		<i>EADM</i>	Mar-06	May-06	PPPL Designer
	869		<i>ORNL Eng</i>	Mar-06	May-06	Composite of ORNL Engineer / Designer
	20		<i>ORNL Phys.</i>	Mar-06	May-06	Composite of ORNL Physics / scientific
	0		<i>PPPL Phys.</i>	Mar-06	May-06	PPPL Physics/scientific
Final Design (Title II)						
(50% of design schedule)	0		<i>EAEM</i>	May-06	Jun-06	PPPL Engineer
	0		<i>EADM</i>	May-06	Jun-06	PPPL Designer
	869		<i>ORNL Eng</i>	May-06	Jun-06	Composite of ORNL Engineer / Designer
	20		<i>ORNL Phys.</i>	May-06	Jun-06	Composite of ORNL Physicist
	0		<i>PPPL Phys.</i>	May-06	Jun-06	PPPL Physics/scientific
Lab R&D labor						
	0		<i>EAEM</i>	Mar-06	May-06	PPPL Engineer
	0		<i>EADM</i>	Mar-06	May-06	PPPL Designer
	0		<i>ORNL Eng</i>	Mar-06	May-06	Composite of ORNL Engineer / Designer
	0		<i>EASM</i>	Mar-06	May-06	PPPL monthly support
	0		<i>EMTB</i>	Mar-06	May-06	PPPL Technician
Lab Fab/Assembly/Installation (Title III)						
	0		<i>EAEM</i>	Jun-06	Nov-06	PPPL Engineer
	8		<i>EADM</i>	Jun-06	Nov-06	PPPL Designer
	98		<i>ORNL Eng</i>	Jun-06	Nov-06	Composite of ORNL Engineer / Designer
	8		<i>EASM</i>	Jun-06	Nov-06	PPPL monthly support
	0		<i>EMTB</i>	Jun-06	Nov-06	PPPL Technician

NCSX Fabrication Project Cost and Schedule Estimating Form

WBS 162 Coil Leads

Labor

Manhours per fiscal year by labor category

Level of Effort		FY2003	FY2004	FY2005	FY2006	FY2007	FY2008	TOTAL
PPPL Engineer	<i>EAEM</i>	0	0	0	0	0	0	0
PPPL Designer	<i>EADM</i>	0	0	0	6	2	0	8
Composite of ORNL Engineer / Designer	<i>ORNL Eng</i>	0	0	0	1814	22	0	1836
PPPL monthly support	<i>EASM</i>	0	0	0	6	2	0	8
PPPL Technician	<i>EMTB</i>	0	0	0	0	0	0	0
Composite of ORNL Physics / scientific	<i>ORNL Phy</i>	0	0	0	40	0	0	40
PPPL Physics/scientific	<i>PPPL Phy</i>	0	0	0	0	0	0	0

NCSX Fabrication Project Cost and Schedule Estimating Form

WBS 162 Coil Leads

M&S Costs

Activity Title	FY2003 \$\$	Comment
Manufacturing Development (R&D)		
Purchased Design Services	\$0	
Procured Hardware/Material	\$0	
Profit at 10%	\$0	
<i>total, manf/dev (R&D)</i>	\$0	w/o G&A
Procured Hardware/Material		
set of cables	\$191,049	
misc attachment hardware	\$13,467	
0	\$0	
materials for in-house fab	\$0	
subtotal, purchased parts	\$204,516	
Profit at 10%	\$19,105	
<i>total, procured hdwe/matl.</i>	\$223,621	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	\$0	No travel is anticipated for this WBS

Summary Costs

Activity Title	Manhours	FY2003 \$\$	Comment
----------------	----------	-------------	---------

NCSX Fabrication Project Cost and Schedule Estimating Form

WBS 162 Coil Leads

Labor

PPPL Effort	16	\$1,600
ORNL effort	1,876	\$245,028
subtotal, labor	1,892	\$246,628

<i>Assumed rates:</i>		<i>EASM</i> 100 \$/hr
<i>EAEM</i>	153 \$/hr	<i>EMTB</i> 73 \$/hr
<i>EADM</i>	100 \$/hr	PPPL Phys 141 \$/hr
<i>ORNL Eng</i>	130 \$/hr	ORNL Phys 160 \$/hr

M&S, Other

Manufacturing Development (R&D)		\$0
Procured Hardware/Material		\$223,621
Purchased Design Services		\$0
Procured Installation/Assembly Costs		\$0
Travel		\$0
subtotal, M&S		\$223,621

G&A \$55,905

25% on all purchased materials, subcontracts, travel

Subtotal without contingency \$526,154

Contingency \$115,754

22% Overall on this WBS

Total cost \$641,908

WBS 162 Coil Leads

Materials and Subcontracts (M&S)

Description:
 This effort covers all coil leads that connect the coil terminals to the buswork at the boundary of the crystalat. The lead cables are all the same except for length, and will be procured from a qualified vendor. All installation will be performed as part of WBS 7.

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

Purchased parts:
 set of cables \$191,040
 misc attachment hardware \$13,467 @10\$/ft
 subtotal, purchased parts \$204,516

Leads consist of "kickless" cable with factory split terminations and gas bleed cooling
 Leads connect from coil terminals to buswork at bottom of machine.
 Each coil is connected separately except PF1 and PF2, which are connected in series within the central solenoid assembly

Purchased materials for in-house fabrication and sub-assembly

None required \$0
 subtotal purchased materials 0

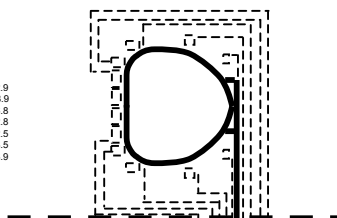
Worksheet, TF Coils:

vendor estimate based on 20 ft cables

Lead cost, TF Coils
 Terminations assembly \$1,500 ea 2709 \$ per 20 ft cable
 Cable with teflon insulation, reinforced teflon
 outer jacket \$50 per foot 106 length adjustment factor, \$/ft
 Total number of cables 18 360
 Total length of cables 277 -83
 Total cable cost **\$40,852** **\$39,969**

Geometry
 radius of vertical runs 12 ft
 height of upper terminals 11 ft
 height of lower terminals 7 ft
Lengths

terminal radius (m)	height from floor (ft)	cable length (ft)
coils at 10, 130, 250 degrees 3.00	11.00	12.9
coils at 70, 190, 310 degrees 3.00	7.00	8.9
coils at 30, 150, 270 degrees 3.00	11.00	16.8
coils at 90, 210, 330 degrees 3.00	7.00	12.8
coils at 50, 170, 290 degrees 3.00	11.00	22.5
coils at 110, 230, 350 degrees 3.00	7.00	18.5
Subtotals		73.9
Total length	222 ft	
25% extra for bends, offsets	55	
Total procured length	277 ft	
Avg length per cable	15 ft	



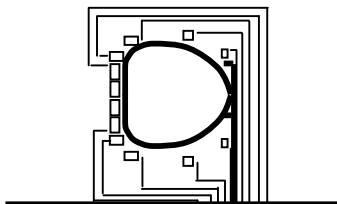
Worksheet, PF Coils:

vendor estimate based on 20 ft cables

Lead cost, PF Coils
 Terminations assembly \$1,500 ea 2709 \$ per 20 ft cable
 Cable with teflon insulation, reinforced teflon
 outer jacket \$50 per foot 106 length adjustment factor, \$/ft
 Total number of cables 10 200
 Total length of cables 226 -26
 Total cable cost **\$26,304** **\$29,855**

Geometry
 radius of vertical runs 10 ft
 height of upper runs 12 ft
 height of connection to buswork 0 ft
Lengths

terminal radius (m)	height from midplane (m)	top length (ft)	bottom length (ft)
TF Coils			
PF1, PF2, connected in series as assy 0.00	1.30	29.7	14.3
PF3 0.00	1.30	29.7	14.3
PF4 0.69	1.60	28.8	15.2
PF5 2.23	1.50	14.9	14.9
PF6 2.80	1.00	13.3	13.3
External Trim Coils			
Mod Coils		116.4	72.0
Subtotals			
Total length	188 ft		
20% extra for bends, toroidal offsets	38		
Total procured length	226 ft		
Avg length per cable	23 ft		



NCSX Fabrication Project Cost and Schedule

WBS 162 Coil Leads

R&D

Description:
No R&D is anticipated for this WBS element, but vendor will have non-recurring engineering costs to ensure low temperature capability

Summary
Purchased Design Services \$0 w/o G&A
design rate \$120 per hour
Procured Hardware/Material \$0 w/o G&A
fab rate \$60 per hour
inspection/technician rate \$80 per hour

R&D design	unit	no.	hours	Labor category										
				total fraction	EAEM		EADM		ORNL Eng		EASM		Vendor	
Task				fraction	fract.	hrs	fract.	hrs	fract.	hrs	fract.	hrs	fract.	hrs
Pro-E models	0 hrs/model	0	0	1.00	0.00	0	0.00	0	1.00	0	0.00	0	0.00	0
assy dwgs	0 hrs/dwg	0	0	1.00	0.00	0	0.00	0	1.00	0	0.00	0	0.00	0
Detail drawings	0 hrs/dwg	0	0	1.00	0.00	0	0.00	0	1.00	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
cooling schematic	0 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	0 hrs/dwg	0	0	1.00	0.00	0	0.00	0	1.00	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
procurement specifications	8 hrs/spec	0	0	1.00	0.00	0	0.00	0	1.00	0	0.00	0	0.00	0
vendor shop drawings	0 hrs/dwg	0	0	1.00									1.00	0
vendor part programming	0 hrs/model	0	0	1.00									1.00	0
vendor misc engineering	20% % of tot	0	0	1.00									1.00	0
preliminary and final design reviews	0 hrs/rev	0	0	1.00	0.00	0	0.00	0	1.00	0	0.00	0	0.00	0
meetings/reporting/presentations	10% % of tot	0	0	1.00	0.00	0	0.00	0	1.00	0	0.00	0	0.00	0
<i>subtotal</i>			0			0		0		0		0		0

R&D Title III	unit	no.	hours	Labor category										
				total fraction	EAEM		EADM		ORNL Eng		EASM		EMTB	
Task				fraction	fract.	hrs	fract.	hrs	fract.	hrs	fract.	hrs	fract.	hrs
vendor oversight, inspection	0 hrs/wk	4	0	1.00	0.00	0	0.00	0	0.00	0	1.00	0	0.00	0
in-house fab/assy, oversight, and inspection	0 hrs/wk	4	0	1.00	0.00	0	0.00	0	0.00	0	1.00	0	0.00	0
Testing and experiments	0 hrs/wk	1	0	1.00	0.00	0	0.00	0	0.00	0	1.00	0	0.00	0
<i>subtotal</i>			0			0		0		0		0		0

Schedule assumptions	start	duration (weeks)	end
R&D planning	Mar-06	4	Apr-06
Bid and award	Apr-06	2	Apr-06
R&D procurement / in-house fab.	Apr-06	4	Apr-06
R&D testing	Apr-06	1	May-06

Notes and worksheets

NCSX Fabrication Project Cost and Schedule

WBS 162 Coil Leads

Engineering, Title I, II and III

Description:

This effort covers all Title I, II, and III engineering for the Coil leads. The leads will be procured from a qualified vendor in the correct length for each coil. All installation oversight will be performed as part of WBS 7.

	multiplier	unit	no.	hours	Labor category										
					fraction	EAEM		EADM		ORNL Eng		ORNL Physics		PPPL Physics	
					frac.	hrs	frac.	hrs	frac.	hrs	frac.	hrs	frac.	hrs	
Title I, II design															
Pro-E models	8	hrs/model	49	392	1.00	0.00	0	0.00	0	1.00	392	0.00	0	0.00	0
assy dwgs	16	hrs/dwg	14	224	1.00	0.00	0	0.00	0	1.00	224	0.00	0	0.00	0
Detail drawings	8	hrs/dwg	37	296	1.00	0.00	0	0.00	0	1.00	296	0.00	0	0.00	0
installation dwg	16	hrs/dwg	28	448	1.00	0.00	0	0.00	0	1.00	448	0.00	0	0.00	0
cooling schematic	0	hrs/dwg	1	0	1.00	0.00	0	0.00	0	1.00	0	0.00	0	0.00	0
electrical schematic	8	hrs/dwg	14	112	1.00	0.00	0	0.00	0	1.00	112	0.00	0	0.00	0
I&C schematic	8	hrs/dwg	0	0	1.00	0.00	0	0.00	0	1.00	0	0.00	0	0.00	0
stress analysis	0	hrs/calc	0	0	1.00	0.00	0	0.00	0	1.00	0	0.00	0	0.00	0
thermal analysis	24	hrs/calc	1	24	1.00	0.00	0	0.00	0	1.00	24	0.00	0	0.00	0
special analysis	40	hrs/calc	1	40	1.00	0.00	0	0.00	0	0.00	0	1.00	40	0.00	0
procurement specifications	40	hrs/spec	1	40	1.00	0.00	0	0.00	0	1.00	40	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	1616	162	1.00	0.00	0	0.00	0	1.00	162	0.00	0	0.00	0
<i>subtotal</i>				1778			0		0		1738		40		0
Title III															
vendor oversight, inspection	8	hrs/lot	1	8	1.00	0.00	0	0.00	0	0.00	0	1.00	8		
in-house fab/assy oversight and inspection	2	hrs/wk	4	8	1.00	0.00	0	1.00	8	0.00	0	0.00	0		
Disposition of deviation requests and non-conformances	0.5	hrs/wk	20	10	1.00	0.00	0	0.00	0	0.00	0	1.00	10		
As-built drawings	1	hrs/dwg	80	80	1.00	0.00	0	0.00	0	0.00	0	1.00	80		
Installation oversight and inspection	0	hrs/wk	4	0	1.00	0.25	0	0.75	0	0.00	0	0.00	0		
<i>subtotal</i>				106			0		8		0		98		

NCSX Fabrication Project Cost and Schedule

WBS 162 Coil Leads

Engineering, Title I, II and III

Schedule assumptions	start	duration (weeks)	end
Title I Design, R&D	Mar-06	6	May-06
Title II Design	May-06	6	Jun-06
Procurement	Jun-06	12	Sep-06
In-house fab / sub-assy	Sep-06	4	Oct-06
Installation / final assembly	Oct-06	4	Nov-06

Notes and worksheets

PF Coil leads

	total	coils at 10, 70, 130, 190, 250, 310 degrees	coils at 30, 90, 150, 210, 270, 330 degrees	coils at 50, 110, 170, 230, 290, 350 degrees	PF1-2	PF3	PF4	PF5	PF6	coils at 0, 120, 240, degrees, top and bottom	coils at 60, 180, 300 degrees Top and bottom	Outer perimeter coils	coil 1 at 10, 70, 130, 190, 250, 310 degrees	coil 2 at 30, 90, 150, 210, 270, 330 degrees	coil 3 at 50, 110, 170, 230, 290, 350 degrees
Pro-E models	49	6	6	6	1	1	1	1	1	3	3	2	6	6	6
assy dwgs	14	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Detail drawings	37	3	3	3	2	2	2	2	2	3	3	3	3	3	3
installation dwg	28	2	2	2	2	2	2	2	2	2	2	2	2	2	2
cooling schematic	1														
electrical schematic	14	1	1	1	1	1	1	1	1	1	1	1	1	1	1
I&C schematic															
stress analysis															
thermal analysis	1														
special analysis	1														
procurement specifications	1														
preliminary and final design reviews	1														
meetings/reporting/presentations	15%														