

NCSX Fabrication Project Cost and Schedule Estimating Form

WBS 144 Modular Coil Winding Facility and Fixtures

Labor

Activity Title	Manhours	FY2003 \$\$	Labor Type	Start Date Month/Yr	End Date Month/Yr	Comments
Preliminary Design (Title I)						
(59% of design schedule)	437		<i>EAEM</i>	Apr-03	Sep-03	PPPL Engineer
	1188		<i>EADM</i>	Apr-03	Sep-03	PPPL Designer
	0		<i>ORNL Eng</i>	Apr-03	Sep-03	Composite of ORNL Engineer / Designer
	0		<i>ORNL Phys.</i>	Apr-03	Sep-03	Composite of ORNL Physics / scientific
	0		<i>PPPL Phys.</i>	Apr-03	Sep-03	PPPL Physics/scientific
Final Design (Title II)						
(41% of design schedule)	298		<i>EAEM</i>	Sep-03	Feb-04	PPPL Engineer
	810		<i>EADM</i>	Sep-03	Feb-04	PPPL Designer
	0		<i>ORNL Eng</i>	Sep-03	Feb-04	Composite of ORNL Engineer / Designer
	0		<i>ORNL Phys.</i>	Sep-03	Feb-04	Composite of ORNL Physicist
	0		<i>PPPL Phys.</i>	Sep-03	Feb-04	PPPL Physics/scientific
Lab R&D labor						
	0		<i>EAEM</i>	Apr-03	Sep-03	PPPL Engineer
	0		<i>EADM</i>	Apr-03	Sep-03	PPPL Designer
	0		<i>ORNL Eng</i>	Apr-03	Sep-03	Composite of ORNL Engineer / Designer
	0		<i>EASM</i>	Apr-03	Sep-03	PPPL monthly support
	0		<i>EMTB</i>	Apr-03	Sep-03	PPPL Technician
Lab Fab/Assembly/Installation (Title III)						
	241		<i>EAEM</i>	Jul-04	Oct-06	PPPL Engineer
	368		<i>EADM</i>	Jul-04	Oct-06	PPPL Designer
	0		<i>ORNL Eng</i>	Jul-04	Oct-06	Composite of ORNL Engineer / Designer
	1840		<i>EASM</i>	Jul-04	Oct-06	PPPL monthly support
	8732		<i>EMTB</i>	Jul-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>	439	322	107	107	0	0	975
PPPL Designer	<i>EADM</i>	1195	844	163	163	0	0	2366
Composite of ORNL Engineer / Designer	<i>ORNL Eng</i>	0	0	0	0	0	0	0
PPPL monthly support	<i>EASM</i>	0	206	817	817	0	0	1840
PPPL Technician	<i>EMTB</i>	0	977	3877	3877	0	0	8732
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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WBS 144 Modular Coil Winding Facility and Fixtures

M&S Costs

Activity Title	FY2003 \$\$	Comment
Manufacturing Development (R&D)		
Purchased Design Services	\$0	
Procured Hardware/Material	\$0	
Profit	\$0	profit already included in these items
<i>total, manf/dev (R&D)</i>	\$0	w/o G&A
Procured Hardware/Material		
0	\$0	
0	\$0	
tooling and fixtures	\$217,000	
area prep supplies	\$25,000	
cryo-station testing facility	\$69,500	
subtotal, purchased parts	\$311,500	
Profit at 10%	<u>\$31,150</u>	
<i>total, procured hdwe/matl.</i>	\$342,650	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

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WBS 144 Modular Coil Winding Facility and Fixtures Summary Costs

Activity Title	Manhours	FY2003 \$\$	Comment
Labor			
PPPL Effort	13,913	\$1,207,229	<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	0	\$0	
subtotal, labor	13,913	\$1,207,229	
M&S, Other			
Manufacturing Development (R&D)		\$0	
Procured Hardware/Material		\$342,650	
Purchased Design Services		\$0	
Procured Installation/Assembly Costs		\$0	
Travel		\$0	
subtotal, M&S		\$342,650	
G&A		\$85,663	25% on all purchased materials, subcontracts, travel
Subtotal without contingency		\$1,635,542	
Contingency		\$654,217	40% Overall on this WBS
Total cost		\$2,289,759	

NCSX Fabrication Project Cost and Schedule

WBS 144 Modular Coil Winding Facility and Fixtures

In-house Fabrication and Assembly

Description:

This effort covers all Title I, II, and III engineering for the modular coil winding facilities and fixtures.

Labor category

	multiplier	unit	no.	hours	total fraction		EAEM		EASM, EMSM		EMTB		EADM	
					fract.	hrs	fract.	hrs	fract.	hrs	fract.	hrs		
Fab operations summary														
Design tooling (incl in engr)	0	hrs/lot	1	0	2.00	0.00	0	0.20	0	0.80	0	1.00	0	0
		hrs/line	1	0	1.00	0.00	0	0.10	0	0.90	0	0.00	0	0
		hrs / coil		0	1.00	0.00	0	1.00	0	0.00	0	0.00	0	0
<i>subtotal</i>				0			0		0		0		0	

	multiplier	unit	no.	hours	total fraction		EAEM		EASM, EMSM		EMTB		EADM	
					fract.	hrs	fract.	hrs	fract.	hrs	fract.	hrs		
Assembly operations summary														
tooling	7504	hr/lot	1	7504	1.00	0.00	0	0.18	1332	0.82	6172	0.00	0	0
area prep	2668	hr/lot	1	2668	1.00	0.00	0	0.09	228	0.91	2440	0.00	0	0
set up cryofacility	560	hr/lot	1	560	1.00	0.29	160	0.50	280	0.21	120	0.00	0	0
		hours	1	0	1.00	0.55	0	0.45	0	0.00	0	0.00	0	0
<i>subtotal</i>				10732			160		1840		8732		0	

Schedule assumptions	start	duration (weeks)	end
Title I Design, R&D	Feb-03	26	Aug-03
Title II Design	Aug-03	18	Dec-03
Procurement	Dec-03	22	May-04
In-house fab / sub-assy	May-04	72	Sep-05
Installation / final assembly	Sep-05	53	Oct-06

Notes and worksheets

Modular coil fabrication

ref J. Chrzanowski, April, 2003

NCSX Fabrication Project Cost and Schedule

WBS 144 Modular Coil Winding Facility and Fixtures

In-house Fabrication and Assembly

TASK DESCRIPTION	Duration	Start	End	EAEM	EEEM	EADM	EESM	EMSM	EMTB	M&S	
				Engr	Engr	Designer	Meighan	machinist	Tech		
				Days	hours	hours	hours	hours	hours	w/o G&A	w/G&A
ENGINEERING and OVERSIGHT (included in WBS 142)											
EQUIPMENT and TOOLING COSTS											
Modular Coil Winding Facility		1-Oct-03	28-Feb-04								
Fabricate Coil Winding Tooling/Fixtures		1-Oct-03	28-Feb-04								
Autoclave								288	1728	\$75,000	
Turning fixtures and coil supports								400	2600	\$30,000	
Winding clamp sets [100]								500	120	\$15,000	
Conductor payout spool system								144	864	\$10,000	
Misc. tools and equipment inc. measurement equipment										\$70,000	
VPI tanks and equipment & components									500	\$17,000	
Miscellaneous tools and equipment										\$5,000	
Coil support structure- (1) in autoclave and (1) in test stand									360	\$3,000	
TOTALS				0			0	1332	6172	\$225,000	\$272,250
				\$0			\$0	\$133,200	\$450,556		
											Total
											\$856,006
TASK DESCRIPTION	Duration	Start	End	EAEM	EEEM	EADM	EESM	EMSM	EMTB	M&S	
				Engr	Engr	Designer		machinist	Tech		
				Days	hours	hours	hours	hours	hours	w/o G&A	w/G&A
AREA PREPARATION											
Setup winding facility in the vacated TFTR Test Cell											
Decon Test Cell crane		6-Oct-03	20-Oct-03						240		

NCSX Fabrication Project Cost and Schedule

WBS 144 Modular Coil Winding Facility and Fixtures

In-house Fabrication and Assembly

Setup facility stations Casting preparation Winding station Mold station VPI station			1-Nov-03	28-Feb-04					228	1200			
Build cleanrooms- (2) locations			1-Nov-03	28-Feb-04						1000	\$25,000	\$30,250	
									228	2440			Total
									\$22,800	\$178,120			\$231,170
Setup Cryo-electrical test station Cryo Electrical										120	\$28,000.00 \$21,500.00 \$20,000.00 \$0.00	Cryostat & lines Cable elect. Subcontractor	
													Total
									160 \$24,480	280 \$28,000	120 \$8,760	\$69,500 \$84,095	\$145,335

MODULAR COILS...

M1, Type A, Banana Shaped coil

M2, Type B, Mid Shaped coil

M3, Type C, Bullet Shaped coil



M1, Type A,



M2, Type B,



M3, Type C,

Rate	per Hr
EM	\$153.00
SM	\$100.00
TB	\$73.00
DM	\$100.00

NCSX Fabrication Project Cost and Schedule

WBS 144 Modular Coil Winding Facility and Fixtures

In-house Fabrication and Assembly

M1, Type A,
se141-011

M2, Type B,
se141-012

M3, Type C,
se141-013

NCSX Fabrication Project Cost and Schedule

WBS 144 Modular Coil Winding Facility and Fixtures

Materials and Subcontracts (M&S)

Description:

This effort covers all Title I, II, and III engineering for the modular coil winding and individual coil assemblies. The coil forms are designed as part of WBS 172. The coils will be wound in-house by PPPL. All installation oversight 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:

<i>subtotal, purchased parts</i>	\$0
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Purchased materials for in-house fabrication and sub-assembly

tooling and fixtures	\$217,000
area prep supplies	\$25,000
cryo-station testing facility	\$69,500
<i>subtotal purchased materials</i>	\$311,500

Worksheet:

NCSX Fabrication Project Cost and Schedule

WBS 144 Modular Coil Winding Facility and Fixtures

Engineering, Title I, II and III

Description:

This effort covers all Title I, II, and III engineering for the modular coil winding facilities.

	multiplier	unit	no.	hours	Labor category											
					total		EAEM		EADM		ORNL Eng		ORNL Physics		PPPL Physics	
					fraction	hrs	fraction	hrs	fraction	hrs	fraction	hrs	fraction	hrs	fraction	hrs
Title I, II design																
Pro-E models (avg)	24	hrs/model	16	384	1.00	0.25	96	0.75	288	0.00	0	0.00	0	0.00	0	
assy dwgs	40	hrs/dwg	16	640	1.00	0.00	0	1.00	640	0.00	0	0.00	0	0.00	0	
Detail drawings	24	hrs/dwg	30	720	1.00	0.00	0	1.00	720	0.00	0	0.00	0	0.00	0	
installation dwg	40	hrs/dwg	8	320	1.00	0.00	0	1.00	320	0.00	0	0.00	0	0.00	0	
cooling schematic	20	hrs/dwg	1	20	1.00	0.50	10	0.50	10	0.00	0	0.00	0	0.00	0	
electrical schematic	20	hrs/dwg	1	20	1.00	0.50	10	0.50	10	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	1.00	40	0.00	0	0.00	0	0.00	0	0.00	0	
thermal analysis	40	hrs/calc	1	40	1.00	1.00	40	0.00	0	0.00	0	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	3	120	1.00	1.00	120	0.00	0	0.00	0	0.00	0	0.00	0	
preliminary and final design reviews	80	hrs/rev	2	160	1.00	1.00	160	0.00	0	0.00	0	0.00	0	0.00	0	
meetings/reporting/presentations	10%	% of tot	2484	248	1.00	1.00	248	0.00	0	0.00	0	0.00	0	0.00	0	
<i>subtotal</i>				2732			734		1998		0		0		0	
Title III																
					total	EAEM		EASM		EADM		ORNL Eng				
					fraction	fraction	hrs	fraction	hrs	fraction	hrs	fraction	hrs			
vendor oversight, inspection	2	hrs/wk	22	44	1.00	0.50	22	0.00	0	0.50	22	0.00	0			
Disposition of deviation requests and non-conformances	2	hrs/wk	147	294	1.00	0.20	59	0.00	0	0.80	235	0.00	0			
As-built drawings	2	hrs/dwg	55	110	1.00	0.00	0	0.00	0	1.00	110	0.00	0			
Installation oversight and inspection	0	hrs/wk	53	0	1.00	0.25	0	0.75	0	0.00	0	0.00	0			
<i>subtotal</i>				449			81		0		368		0			
Schedule assumptions																
	start	duration (weeks)	end													
Title I Design	Apr-03	26	Sep-03													
Title II Design	Sep-03	18	Feb-04													

NCSX Fabrication Project Cost and Schedule

WBS 144 Modular Coil Winding Facility and Fixtures

Engineering, Title I, II and III

Procurement	Jul-04	22	Dec-04
In-house fab / sub-assy	Jan-05	72	May-06
Installation / final assembly	Sep-05	53	Oct-06

Notes and worksheets

Coil Winding / Assembly Design and analysis

	total	tooling	design
Pro-E models	16		16
assy dwgs	16		16
Detail drawings	30		30
installation dwg	8		8
cooling schematic	1		1
electrical schematic	1		1
I&C schematic	1		1
stress analysis	1		1
thermal analysis	1		1
special analysis	0		0
procurement specifications	3		3
preliminary and final design reviews	2		2
meetings/reporting/presentations	10%		