

## NCSX Fabrication Project Cost and Schedule Estimating Form

### WBS 141 Modular Coil Winding forms

#### Labor

Activity Title	Manhours	FY2003 \$\$	Labor Type	Start Date Month/Yr	End Date Month/Yr	Comments
<b>Preliminary Design (Title I)</b>						
( 48% of design schedule)	203		<i>EAEM</i>	Apr-03	Oct-03	PPPL Engineer
	0		<i>EADM</i>	Apr-03	Oct-03	PPPL Designer
	2999		<i>ORNL Eng</i>	Apr-03	Oct-03	Composite of ORNL Engineer / Designer
	0		<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
<b>Final Design (Title II)</b>						
( 52% of design schedule)	217		<i>EAEM</i>	Oct-03	Apr-04	PPPL Engineer
	0		<i>EADM</i>	Oct-03	Apr-04	PPPL Designer
	3203		<i>ORNL Eng</i>	Oct-03	Apr-04	Composite of ORNL Engineer / Designer
	0		<i>ORNL Phys.</i>	Oct-03	Apr-04	Composite of ORNL Physicist
	0		<i>PPPL Phys.</i>	Oct-03	Apr-04	PPPL Physics/scientific
<b>Lab R&amp;D labor</b>						
	228		<i>EAEM</i>	Apr-03	Oct-03	PPPL Engineer
	0		<i>EADM</i>	Apr-03	Oct-03	PPPL Designer
	1250		<i>ORNL Eng</i>	Apr-03	Oct-03	Composite of ORNL Engineer / Designer
	0		<i>EASM</i>	Apr-03	Oct-03	PPPL monthly support
	0		<i>EMTB</i>	Apr-03	Oct-03	PPPL Technician
<b>Lab Fab/Assembly/Installation (Title III)</b>						
	342		<i>EAEM</i>	Apr-04	Oct-06	PPPL Engineer
	0		<i>EADM</i>	Apr-04	Oct-06	PPPL Designer
	1066		<i>ORNL Eng</i>	Apr-04	Oct-06	Composite of ORNL Engineer / Designer
	0		<i>EASM</i>	Apr-04	Oct-06	PPPL monthly support
	0		<i>EMTB</i>	Apr-04	Oct-06	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>	413	294	141	141	0	0	990
PPPL Designer	<i>EADM</i>	0	0	0	0	0	0	0
Composite of ORNL Engineer / Designer	<i>ORNL Eng</i>	4071	3567	440	440	0	0	8519
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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### WBS 141 Modular Coil Winding forms

#### M&S Costs

Activity Title	FY2003 \$\$	Comment
<b>Manufacturing Development (R&amp;D)</b>		
Purchased Design Services	\$0	
Procured Hardware/Material	\$1,175,000	
Profit	\$0	included in hardware estimate
<i>total, manf/dev (R&amp;D)</i>	\$1,175,000	w/o G&A
<b>Procured Hardware/Material</b>		
set of 18 machined coil forms	\$4,839,300	
Profit	\$0	included in hardware estimate
<i>total, procured hdwe/matl.</i>	\$4,839,300	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	\$48,000	at least one trip per month is expected for two years

## NCSX Fabrication Project Cost and Schedule Estimating Form

### WBS 141 Modular Coil Winding forms

#### Summary Costs

Activity Title	Manhours	FY2003 \$\$	Comment
<b>Labor</b>			
PPPL Effort	990	\$151,409	<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	8,519	\$1,107,444	
subtotal, labor	9,508	\$1,258,853	
<b>M&amp;S, Other</b>			
Manufacturing Development (R&D)		\$1,175,000	
Procured Hardware/Material		\$4,839,300	
Purchased Design Services		\$0	
Procured Installation/Assembly Costs		\$0	
Travel		\$48,000	
subtotal, M&S		\$6,062,300	
<b>G&amp;A</b>		\$430,750	25% on all purchased materials, subcontracts, travel \$1,084,825 G&A adjustment on large procurement
<b>Subtotal without contingency</b>		\$7,751,903	
<b>Contingency</b>		\$3,100,761	40% Overall on this WBS
<b>Total cost</b>		\$10,852,664	

# NCSX Fabrication Project Cost and Schedule

## WBS 141 Modular Coil Winding forms

### Materials and Subcontracts (M&S)

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**Description:**

This effort covers procurement of the cast and machined winding forms via fixed price subcontract.  
The R&D is costed separately.

**Purchased parts:**

Coil winding forms	\$4,839,300 see notes below
<i>subtotal, purchased parts</i>	\$4,839,300

**Worksheet:**

**Cast and machined winding forms**

Cost developed as composite input from two vendors

	Estimate (FY-03\$)		vendor 1 (FY-03\$)	vendor 2 (FY-03\$)
Production castings (total for 18)				
Vendor design, tooling, fixtures				
Patterns				
Casting				
Machining				
Inspection				
Shipping				
<b>Production Total</b>	\$4,839,300			\$4,368,600
 Production Schedule			16 months 1-Feb-04 1-Jun-05	

NCSX Fabrication Project Cost and Schedule

WBS 141 Modular Coil Winding forms

R&D

Description:  
This effort covers all R&D necessary for developing the casting and machining processes for the winding forms. This R&D will be performed by at two vendors, after which a fixed price subcontract will be let for the production castings.

Summary

Purchased Design Services	
Vendor surveillance via	\$16,074
subtotal	\$16,070 w/o G&A
Procured Hardware/Material	
Cast and machined winding forms	\$1,175,000 allocations for 2 forms from different vendors
subtotal	\$1,175,000 w/o G&A

Subcontractor labor rates:

design rate:	\$120 per hour
lab rate	\$60 per hour
inspection/technician rate	\$80 per hour

		Labor category													
		unit	no.	hours	total fraction	EAEM fract.	EAEM hrs	EADM fract.	EADM hrs	ORNL Eng fract.	ORNL Eng hrs	EASM fract.	EASM hrs	Vendor fract.	Vendor hrs
<b>R&amp;D design</b>															
<b>Task</b>															
Pro-E models	60	hrs/model	6	360	1.00	0.00	0	0.00	0	1.00	360	0.00	0	0.00	0
assy dwgs	20	hrs/dwg	6	120	1.00	0.00	0	0.00	0	1.00	120	0.00	0	0.00	0
Detail drawings	8	hrs/dwg	24	192	1.00	0.00	0	0.00	0	1.00	192	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/anal	0	0	1.00	0.00	0	0.00	0	1.00	0	0.00	0	0.00	0
procurement specifications	80	hrs/spec	1	80	1.00	0.00	0	0.00	0	1.00	80	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
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
vendor misc engineering	0%	% of tot	0	0	1.00	0.00	0	0.00	0	1.00	40	0.00	0	1.00	0
preliminary and final design reviews	40	hrs/rev	1	40	1.00	0.00	0	0.00	0	1.00	158	0.00	0	0.00	0
meetings/reporting/presentations	20%	% of tot	792	158	1.00	0.00	0	0.00	0	1.00	158	0.00	0	0.00	0
subtotal				950		0		0		950		0		0	0

		unit	no.	hours	total fraction	EAEM fract.	EAEM hrs	EADM fract.	EADM hrs	ORNL Eng fract.	ORNL Eng hrs	EASM fract.	EASM hrs	EMTB fract.	EMTB hrs
<b>R&amp;D Tasks and Title III (see notes)</b>															
Procurement assistance	8	hrs/wk	12	96	1.00	0.50	48	0.00	0	0.50	48	0.00	0	0.00	0
Vendor surveillance, oversight	8	hrs/wk	36	288	1.00	0.50	144	0.00	0	0.50	144	0.00	0	0.00	0
Disposition of deviation requests and non-conformances	4	hrs/wk	36	144	1.00	0.25	36	0.00	0	0.75	108	0.00	0	0.00	0
subtotal				528		228		0		300		0		0	0

Schedule assumptions

start	duration (weeks)	end
Bid and award	12	Oct-02 Jan-03
Winding form manufacture	36	Jan-03 Sep-03

Notes and worksheets

Engineering Design

Pro-E models	6	models required to conceptually define all castings and hardware prior to ordering two types
assy dwgs	6	drawings of shell structure
Detail drawings	24	drawings of winding forms, bolts, shims etc.
installation dwg	0	
cooling schematic	0	
electrical schematic	0	
I&C schematic	0	
special analysis	0	
procurement specifications	1	specification for winding form
vendor shop drawings	0	included in quote for R&D castings
vendor part programming	0	included in quote for R&D castings
vendor misc engineering	0	included in quote for R&D castings
preliminary and final design reviews	1	one review of spec, plan, parts
meetings/reporting/presentations	20%	

Cast and machined winding forms  
Cost developed as composite input from several vendors via manufacturing study subcontracts

Composite Cost Estimate	vendor 1	vendor 2
(FY-02\$)	(FY-02\$)	(FY-02\$)
Total for 2 coil forms, 2 vendors	\$1,175,000	
R&D Schedule	14 months	13 months 14 months
	558000.00	500000

## NCSX Fabrication Project Cost and Schedule

### WBS 141 Modular Coil Winding forms

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

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**Description:**

This effort covers all Title I, II, and III engineering for the modular coil winding forms. The coils will be wound in-house by PPPL under WBS 142. All installation oversight will be performed as part of 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)	200	hrs/model	15	3000	1.00	0.00	0	0.00	0	1.00	3000	0.00	0	0.00	0
assy dwgs	40	hrs/dwg	9	360	1.00	0.00	0	0.00	0	1.00	360	0.00	0	0.00	0
Detail drawings	40	hrs/dwg	36	1440	1.00	0.00	0	0.00	0	1.00	1440	0.00	0	0.00	0
installation dwg	40	hrs/dwg	6	240	1.00	0.00	0	0.00	0	1.00	240	0.00	0	0.00	0
cooling schematic	0	hrs/dwg	3	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	3	60	1.00	0.00	0	0.00	0	1.00	60	0.00	0	0.00	0
stress analysis	80	hrs/calc	6	480	1.00	0.50	240	0.00	0	0.50	240	0.00	0	0.00	0
thermal analysis	40	hrs/calc	3	120	1.00	0.50	60	0.00	0	0.50	60	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	80	hrs/spec	2	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	6020	602	1.00	0.00	0	0.00	0	1.00	602	0.00	0	0.00	0
<i>subtotal</i>				6622			420		0		6202		0		0
<b>Title III</b>															
vendor oversight, inspection	8	hrs/wk	61	488	1.00	0.50	244	0.00	0	0.00	0	0.50	244		
Disposition of deviation requests and non-conformances	8	hrs/wk	61	488	1.00	0.20	98	0.00	0	0.00	0	0.80	390		
As-built drawings	8	hrs/dwg	54	432	1.00	0.00	0	0.00	0	0.00	0	1.00	432		
<i>subtotal</i>				1408			342		0		0		1066		

## NCSX Fabrication Project Cost and Schedule

### WBS 141 Modular Coil Winding forms

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

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Schedule assumptions	start	duration (weeks)	end
Title I Design	Apr-03	27	Oct-03
Title II Design	Oct-03	29	Apr-04
Procurement	Apr-04	61	Jul-05
In-house fab / sub-assy	Jan-05	72	May-06
Installation / final assembly	Sep-05	53	Oct-06

#### Notes and worksheets

#### Coil Form Design

	total	per coil	Casting form	bolts and shim hardware	
Pro-E models	15	5	2	3	
assy dwgs	9	3	1	2	
Detail drawings	36	12	6	6	flanges, TF interfaces, port interfaces, left and right winding cavities
installation dwg	6	2	1	1	
cooling schematic	3	1	1		
electrical schematic	0	0			
I&C schematic	3	1	1		
stress analysis	6	2	1	1	
thermal analysis	3	1	1		
special analysis	0	em analysis covered under WBS 171			
procurement specifications	2	procurement specifications for set of machined castings and for hardware, revise to reflect R&D results			
preliminary and final design reviews	2	reviews			
meetings/reporting/presentations	15%				