

NCSX Fabrication Project Cost and Schedule Estimating Form

WBS 187 Measurement Systems

Labor

Activity Title	Manhours	FY2003 \$\$	Labor Type	Start Date Month/Yr	End Date Month/Yr	Comments
Preliminary Design (Title I)						
(50% of design schedule)	45		<i>EAEM</i>	Apr-03	Nov-03	PPPL Engineer
	0		<i>EADM</i>	Apr-03	Nov-03	PPPL Designer
	142		<i>ORNL Eng</i>	Apr-03	Nov-03	Composite of ORNL Engineer / Designer
	0		<i>ORNL Phys.</i>	Apr-03	Nov-03	Composite of ORNL Physics / scientific
	0		<i>PPPL Phys.</i>	Apr-03	Nov-03	PPPL Physics/scientific
Final Design (Title II)						
(50% of design schedule)	45		<i>EAEM</i>	Nov-03	Jun-04	PPPL Engineer
	0		<i>EADM</i>	Nov-03	Jun-04	PPPL Designer
	142		<i>ORNL Eng</i>	Nov-03	Jun-04	Composite of ORNL Engineer / Designer
	0		<i>ORNL Phys.</i>	Nov-03	Jun-04	Composite of ORNL Physicist
	0		<i>PPPL Phys.</i>	Nov-03	Jun-04	PPPL Physics/scientific
Lab R&D labor						
	0		<i>EAEM</i>	Apr-03	Nov-03	PPPL Engineer
	0		<i>EADM</i>	Apr-03	Nov-03	PPPL Designer
	0		<i>ORNL Eng</i>	Apr-03	Nov-03	Composite of ORNL Engineer / Designer
	0		<i>EASM</i>	Apr-03	Nov-03	PPPL monthly support
	0		<i>EMTB</i>	Apr-03	Nov-03	PPPL Technician
Lab Fab/Assembly/Installation (Title III)						
	0		<i>EAEM</i>	Jul-04	Oct-06	PPPL Engineer
	0		<i>EADM</i>	Jul-04	Oct-06	PPPL Designer
	0		<i>ORNL Eng</i>	Jul-04	Oct-06	Composite of ORNL Engineer / Designer
	168		<i>EASM</i>	Jul-04	Oct-06	PPPL monthly support
	392		<i>EMTB</i>	Jul-04	Oct-06	PPPL Technician

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Labor

Manhours per fiscal year by labor category

Level of Effort		FY2003	FY2004	FY2005	FY2006	FY2007	FY2008	TOTAL
PPPL Engineer	<i>EAEM</i>	39	51	0	0	0	0	90
PPPL Designer	<i>EADM</i>	0	0	0	0	0	0	0
Composite of ORNL Engineer / Designer	<i>ORNL Eng</i>	122	162	0	0	0	0	284
PPPL monthly support	<i>EASM</i>	0	19	75	75	0	0	168
PPPL Technician	<i>EMTB</i>	0	44	174	174	0	0	392
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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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		
Measurement systems	\$290,000	
Targets, etc.	\$25,000	
0	\$0	
0	\$25,000	
Profit at 10%	\$0	included in hardware
<i>total, procured hdwe/matl.</i>	\$340,000	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	\$6,000	travel for training

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Summary Costs

Activity Title	Manhours	FY2003 \$\$	Comment	
Labor				
PPPL Effort	650	\$59,186	<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	284	\$36,920		
subtotal, labor	934	\$96,106		
M&S, Other				
Manufacturing Development (R&D)		\$0		
Procured Hardware/Material		\$340,000		
Purchased Design Services		\$0		
Procured Installation/Assembly Costs		\$0		
Travel		\$6,000		
subtotal, M&S		\$346,000		
G&A		\$86,500	25% on all purchased materials, subcontracts, travel	
Subtotal without contingency		\$528,606		
Contingency		\$126,865	24% Overall on this WBS	
Total cost		\$655,471		

NCSX Fabrication Project Cost and Schedule

WBS 187 Measurement Systems

In-house Fabrication and Assembly

Description:

This effort covers all PPPL effort involved with preparing the facility space for field period assembly. There is very little area prep to do after the test cell is made ready for coil winding.

Labor category

Sub-assembly	multiplier	unit	no.	hours	total fraction		EAEM		EASM, EMSM		EMTB		EADM	
					fract.	hrs	fract.	hrs	fract.	hrs	fract.	hrs		
Lab misc assembly/installation/training	560	ea	1	560	1.00	0.00	0	0.30	168	0.70	392	0.00	0	
				0	1.00	0.00	0	0.20	0	0.80	0	0.00	0	
				0	1.00	0.00	0	0.20	0	0.80	0	0.00	0	
				0	1.00	0.00	0	0.20	0	0.80	0	0.00	0	
				0	1.00	0.00	0	1.00	0	0.00	0	0.00	0	
				0	1.00	0.00	0	0.00	0	1.00	0	0.00	0	
<i>subtotal</i>				560			0		168		392	0		

	total fraction	EAEM		EASM, EMSM		EMTB		EADM	
		fract.	hrs	fract.	hrs	fract.	hrs	fract.	hrs
0	1.00	0.00	0	0.00	0	1.00	0	0.00	0
0	1.00	0.00	0	1.00	0	0.00	0	0.00	0
0	1.00	0.00	0	0.00	0	1.00	0	0.00	0
<i>subtotal</i>	0		0		0		0		0

Schedule assumptions

	start	duration (weeks)	end
Title I Design, R&D	Aug-03	10	Sep-03
Title II Design	Oct-03	26	Apr-04
Procurement	Apr-04	22	Oct-04
In-house fab / sub-assy	Oct-04	48	Sep-05
Installation / final assembly	Feb-05	67	Jun-06

Notes and worksheets

Field Period Assembly Area Preparation

Ref J. Chrzanowski spreadsheet, April 2003

This proposal includes the costs associated with the fabrication of (18) Modular coils for the NCSX Machine. This includes inspection of the conductor and castings, coil winding, VPI and Testing activities.

Activity	Duration	Start	End	HP	Safety	IH	QC	EAEM	EADM	EMSM	EMSM	EMTB	M&S	M&S
ID	Days			hours	hours	hours	hours	Engr	Designer	Sr. Lab	machinis	Tech	w/o G&A	w/G&A
<p>Notes: A number of activities can be performed in parallel and are not series activities during the field period assemblies.</p> <p>a) The TF coil sub-assembly</p> <p>b) The sub-assembly of the modular coils</p> <p>c) Preparation of the vacuum vessel for assembly</p>														
187	Measurement Systems													
	Final design of measurement systems	165	1-Oct-03	1-Jun-04	incl in engr			224	432					
	Lab fabrication/assy./installation	192	2-Jan-04	30-Sep-04						160	400		50000	
	Procured hardware and materials	192	2-Jan-04	30-Sep-04	incl in M&S									
					0	0	0	224	432	0	160	400	50000	

NCSX Fabrication Project Cost and Schedule

WBS 187 Measurement Systems

Materials and Subcontracts (M&S)

Description:

This effort covers all M&S required for Field Period Assembly Planning and Oversight

Assumptions:

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

Purchased parts:

subtotal, purchased parts **\$0**

Purchased materials for in-house fabrication and sub-assembly

Measurement systems \$290,000
Targets, etc. \$25,000

subtotal purchased materials **\$315,000**

Worksheet:**Measurement systems**

	unit cost	unit	no.	total	remarks
3-D Scanner system	\$80,000	ea	1	\$80,000	incl 5k for training
GPS system	\$100,000	ea	1	\$100,000	incl 5k for training
FARO arm	\$55,000	ea	2	\$110,000	incl 5k for training
subtotal				\$290,000	

Targets

tooling balls, retroreflectors, etc.	\$25,000	lot	1	\$25,000	
subtotal				\$25,000	

WBS 187 Measurement Systems

R&D

Description:
No R&D is anticipated for this element

Summary

Purchased Design Services

subtotal \$0 w/o G&A

Procured Hardware/Material

subtotal \$0 w/o G&A

Subcontractor labor rates:

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

R&D design	unit	no.	hours	Labor category													
				total fraction		EAEM		EADM		ORNL Enq		EASM		Vendor			
				frac.	hrs	frac.	hrs	frac.	hrs	frac.	hrs	frac.	hrs	frac.	hrs		
Task																	
Pro-E models	12	hrs/model	0	0	1.00	0.00	0	0.00	0	1.00	0	0.00	0	0.00	0	0.00	0
assy 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	8	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	40	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	0.00	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	0.00	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	0.00	0	0.00	0
preliminary and final design reviews	40	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/reporting/presentations	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
subtotal			0	0			0		0			0		0			0

R&D Tasks and Title III (see notes)	unit	no.	hours	Labor category													
				total fraction		EAEM		EADM		ORNL Enq		EASM, EISM		EMTB			
				frac.	hrs	frac.	hrs	frac.	hrs	frac.	hrs	frac.	hrs	frac.	hrs		
0	hrs	1	0	0.00	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0
0	hrs/setup	1	0	0.00	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0
0	hrs/setup	1	0	0.00	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0
0	hrs / coil	1	0	0.00	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0
0	hrs	1	0	0.00	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0
subtotal			0	0			0		0			0		0			0

Schedule assumptions	start	duration (weeks)	end
R&D planning	Nov-02	4	Dec-02
Bid and award	Dec-02	2	Dec-02
R&D procurement / in-house fab.	Dec-02	4	Jan-03
R&D testing	Jan-03	52	Jan-04

Notes and worksheets

Engineering Design

Pro-E models	0
assy dwgs	0
Detail drawings	0
installation dwg	0
cooling schematic	0
electrical schematic	0
I&C schematic	0
special analysis	0
procurement specifications	0
Epoxy R&D contract	0
Tooling and fixtures	0
Clean room	0
Cable conductor	0
vendor shop drawings	0
vendor part programming	0
vendor misc engineering	0
preliminary and final design reviews	0
meetings/reporting/presentations	10%

NCSX Fabrication Project Cost and Schedule

WBS 187 Measurement Systems

Engineering, Title I, II and III

Description:

This effort covers all Title I, II, and III engineering for the field period subassembly tooling and fixtures

	multiplier	unit	no.	hours	Labor category											
					total		EAEM		EADM		ORNL Eng		ORNL Physics		PPPL Physics	
					fraction	hrs	fract.	hrs	fract.	hrs	fract.	hrs	fract.	hrs	fract.	hrs
Title I, II design																
Pro-E models (avg)	16	hrs/model	0	0	1.00	0.00	0	0.00	0	1.00	0	0.00	0	0.00	0	
assy dwgs	20	hrs/dwg	0	0	1.00	0.00	0	0.00	0	1.00	0	0.00	0	0.00	0	
Detail drawings	20	hrs/dwg	0	0	1.00	0.00	0	0.00	0	1.00	0	0.00	0	0.00	0	
installation dwg	20	hrs/dwg	9	180	1.00	0.00	0	0.00	0	1.00	180	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	20	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	24	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	0	0	1.00	0.00	0	0.00	0	1.00	0	0.00	0	0.00	0	
special analysis (electromagnetics)	40	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	0.75	90	0.00	0	0.25	30	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	340	34	1.00	0.00	0	0.00	0	1.00	34	0.00	0	0.00	0	
<i>subtotal</i>				374			90		0		284		0		0	

	multiplier	unit	no.	hours	Labor category										
					total		EAEM		EASM		EADM		ORNL Eng		
					fraction	hrs	fract.	hrs	fract.	hrs	fract.	hrs	fract.	hrs	
Title III															
vendor oversight, inspection	0	hrs/wk	22	0	1.00	0.50	0	0.00	0	0.00	0	0.50	0		
Disposition of deviation requests and non-conformances	0	hrs/wk	147	0	1.00	0.20	0	0.00	0	0.00	0	0.80	0		
As-built drawings	0	hrs/dwg	9	0	1.00	0.00	0	0.00	0	0.00	0	1.00	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>				0			0		0		0		0		

Schedule assumptions	start	duration (weeks)	end
Title I Design	Apr-03	31	Nov-03
Title II Design	Nov-03	30	Jun-04
Procurement	Jul-04	22	Dec-04

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Engineering, Title I, II and III

In-house fab / sub-assy	Jan-05	72	May-06
Installation / final assembly	Sep-05	53	Oct-06

Notes and worksheets

	total	3-D scanner	GPS system	FARO arm	
Pro-E models	0				
assy dwgs	0				
Detail drawings	0				
installation dwg	9	3	3	3	set up views of targets
cooling schematic	0				
electrical schematic	0				
I&C schematic	0				
stress analysis	0				
thermal analysis	0				
special analysis	0				
procurement specifications	3	1	1	1	
preliminary and final design reviews	1				
meetings/reporting/presentations	15%				