

NCSX Work Approval Form (WAF)

WBS Number: 31

WBS Title: Magnetic Diagnostic Systems

Job Number: 3101

Job Title: Magnetic Diagnostic Systems

Job Manager: Brent Stratton

Description:

This effort covers the design, procurement of materials and parts, and fabrication and installation of the magnetic diagnostics for the NCSX machine. The magnetic sensors include diamagnetic loops, flux loops, saddle loops, Rogowski coils and B-coils that will provide signals to measure the magnetic flux change in the many geometries necessary to determine the magnetic field geometry using an equilibrium reconstruction code.

Schedule:

See Attached

Approvals:

Job Manager	Date
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Responsible Line Manager	Date
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Project Manager	Date
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Engineering Department Head	Date
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**NCSX June 2007 ETC
TABLE II - Materials and Subcontracts**

WBS Number: 31										
WBS Title: Magnetic Diagnostic Systems										
Job Number: 3101										
Job Title: Magnetic Diagnostic Systems										
Job Manager: Brent Stratton										
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Description	Material		Labor							
	Type	Cost \$	EMEM	EMSM	EMTB	EADM	EEEM			
Existing + Added Cost for Co Wound Loops for 18 TF and 6 PF and 2 Solenoid Coils										
Design Protective Boxes			110							TF Complete
Drawings			60							TF Complete.
Purchase SS Sheet		\$870	1							Partial.
Purchase Heat Shrink Tubing, 20 @ 100 ft		\$2,000	6							12 ordered in Dec 06 => 6 of 12 Received.
Purchase additional CoAxial cable 3500 ft		\$4,550	2							Placed order for 1900 ft
Prototype				12						TF Complete.
Formal Issue of Drawings Rev 0							0			Work Completed
Form 26 Protective Boxes				102						6 TF completed.
Weld end plates						18				6 TF completed.
Engineering Support Field/Fab Activities (Title III)			36							
Develop Convective Air Furnace		\$0		0						Work Completed
Fab TF, PF & solenoid co-wound loops				130						9 of 26 completed.
		TOTAL		\$7,420	215	244	18	0	0	
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Description	Material		Labor							
	Type	Cost \$	EMEM	EMSM	EMTB	EADM	EEEM			
Existing + Added Cost for Flux Loop Junction Boxes and 20 Spacer Flux Loops and 6 Protective Boxes										
Purchase Material - 2.75 ConFlat Flanges		\$900	2							Based on previous experience
Purchase Material - AL and SS Plate		\$820				2				Based on previous experience
Purchase Material - 316 SS flat head screws		\$400				2				Based on previous experience
Purchase Material - Circuit Boards RF Filtered w/TB		\$3,200							32	Based on previous experience
Install 24 JB (410 cables) Act #										Included in Job 1810
Terminate 24 JB (410 cables)										Included in Job 1810
Anneal 2.75 Conflat Flanges				12						Based on previous experience
Engineering Support Field/Fab Activities (Title III)			120							Based on previous experience
Purchase 2000 ft 0.059 CoAx-Spacer		\$3,500	2							Based on previous experience
AutoCAD Drawings of Field Runs/Tag#/Port Assignments			112							Based on previous experience
Water Jet Machine Cu Templates		\$240				8				Based on previous experience
Install 20 Templates										Included in Job 1810
Install Spacer Flux Loops										Included in Job 1810
Twist leads										Included in Job 1810
Design Protect Box & Prepare Dwg			22							Based on previous experience
Fab 6 Prot Boxes		\$200		24						Based on previous experience
Install Prot Boxes										Included in Job 1810
Prepare Drawing of Spacer Loops							60			Based on previous experience
NOTE: M&S in Job 1204										
		TOTAL		\$9,260	258	36	12	60	32	

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Description	Material		Labor				
	Type	Cost \$	EMEM	EMSM	EMTB	EADM	EEEM
Existing + Added Cost for High Temperature Rogowski Coil							
CDR + Peer Reviews							
Preliminary Design							
Fabricate Prototype		\$50	60		20		
Test Prototype		\$50		24			
Prepare for and Conduct PDR			20				
Final Design							
Purchase Spec for Winding Mandrel			40				
Trip to Vendor			16	16			
Sub contract Winding 3 Mandrels		\$15,000					
Prepare for and Conduct FDR			10				
Formal Issue of Drawings						4	
Purchase Material - ARI SS Coax Cable 0.032 inch							
Purchase Material - SS Flex and Bendable Smooth Tube							
Purchase Material - Nextel Tape							
Purchase Material - Inconel Bar							
Fabricate coil clamps - 36 (3 Field Periods 12 ea)							
Fabricate ends							
Fixture to Straighten Smooth SS Tube							
Install Wound Coil into Protective SS Flex							
Install 3 Rogowski Coils							
Weld 36 coil clamps							
Engineering Support Field/Fab Activities (Title III)							
			60				
	TOTAL	19,630	281	72	142	4	0

Included in Job 1810
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Description	Material		Labor					
	Type	Cost \$	EMEM	EMSM	EMTB	EADM	EEEM	
Added Cost for Voltage Loops and Protective Boxes								
Drawings- Engineering Sketch of Routing			20					Based on previous experience
Drawings- Layout						16		Based on previous experience
Formal Release of Layout Drawing						4		Based on previous experience
Protective Box Design			6					Based on previous experience
Protective Box Drawing			20					Based on previous experience
Install Voltage 12 Loops on VV								Included in Job 1810
Twisted leads to Prot. Boxes								Included in Job 1810
Fab 3 Protective Boxes	316 SS by 0.048 Thk	\$120				12		Based on previous experience
Install 3 Protect. Boxes								Included in Job 1810
Engineering Support Field/Fab Activities (Title III)			6					Based on previous experience
Purchsae additional 900 ft cable	0.059 OD Inconel CoAx	\$1,600	2					
	TOTAL	\$1,720	54	0	12	20	0	
Total		\$28,770	550	316	172	24	0	

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TABLE IV - Uncertainty of Estimate and Residual Risk Assessment

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Uncertainty of the Estimate

	<u>High</u>	<u>Medium</u>	<u>Low</u>	<u>Uncertainty Range (%)</u>	<u>Comments/Other Considerations</u>
Design Maturity	X			-5%/+10%	Exception is Rogowski => Medium - design not finalized
Design Complexity			X		Exception is Rogowski => Medium - design not finalized

Note: High/Medium/Low uncertainty assessment from Job Manager. Uncertainty range based on AACEI recommended practice 18R-97 as amended for NCSX.

Residual Impacts

Job	Risk Description	Likelihood of Occurring	Mitigation Plan	Basis of estimate	Cost Impact		Schedule Impact	
					Low	High	Low	High
High temperature Rogowski Loop damaged during installation resulting in loss of toroidal current measurement capability		5%	Triple redundancy	3 Installed - only one required.	+\$0K	+\$0K	+0.00	+0.00

Notes:

- [1] Low cost and schedule impacts are considered the minimum (0-percentile) impacts should the event occur. High cost and schedule impacts are considered the maximum (100-percentile) impacts should the event occur.
- [2] Cost impacts should be entered as man-hours (by demographic) and M&S direct cost under basis of estimate. Cost impacts should NOT include standing army costs which are separately calculated from the schedule impact. Project control is responsible for quantifying the low and high cost impacts based on the labor hours and M&S identified.
- [3] The schedule impacts should be entered as the min and max impacts on the critical path. If there is no critical path impact then the schedule entries should be zero.
- [4] Likelihood of occurrence should be entered consistent with our risk classification methodology, i.e. VL= Very Likely (P>80%), L=Likely (80%>P>40%), U=Unlikley (40%>P>10%), VU=Very Unlikley (P<10%), NC=Non-credible (P<1%)