NCSX Work Approval Form (WAF)

WBS Number: 22
WBS Title: Vacuum Pumping System
Job Number: 2201
Job Title: Vacuum Pumping System
Job Manager: Bill Blanchard

Description:

The MIE project scope is limited to one TMP backed by an existing mechanical/booster pump system. Design, fabrication, installation, and system testing of equipment needed to implement the vacuum pumping system. In the future, NCSX Vacuum Pumping System will use as much as possible of the existing PBX-M vacuum pumping system hardware where it is cost effective to implement.

Schedule:

See Attached

Approvals:

_____	_____
Job Manager	Date
_____	_____
Responsible Line Manager	Date
_____	_____
Project Manager	Date
_____	_____
Engineering Department Head	Date

NCSX June 2007 ETC
TABLE I - DESIGN LABOR

WBS Number: 22
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Description:
The proposed design consists of a high vacuum system which is manually operated and includes an isolation valve, a vertical pumpduct on a lower P12 port cover and one 1500 l/s TMP. The TMP will be backed by an existing booster mechanical pump system. The system will also contain one unshielded RGA and one ion gauge with and a valved access port for initially roughing down the vacuum vessel.

Task ID	KS	Hours										
	M&S	EMEM	EMSM	EMSB	EMTB	EAEM	EASB	EEEM	EESM	EESB	EETB	
Title I and II Design												This is a relatively simple vacuum pumping system that will utilize major components (TMP, isolation valves, booster and mechnical pump) already at PPPL. Estimate based on prior experience on similar systems (e.g., NSTX), adjusted for the simplicity of this system. Input from experienced engineers/personnel familar with specific parts of this scope was used for estimates. Includes design activities, some P&ID drawings, weld drawings, fab drawings, calculations, two reviews (PDR & FDR), oversight and purchasing of components. The system should have an approximate pumping speed of 700 l/s for attaining 4e-7 Torr or less after the vacuum vessel has been baked out and the surfaces well conditioned.
Preliminary Design												
AC Power / Instrumentation												
Backing System							16	16				
Instrumentation Rack							20	16				
Rack to Instrumentation							16		16			
VPS (Mechanical)							24					
Design / Management / Admin		64		24								
Drafting												
Final Design												
AC Power / Instrumentation												
Backing System							32					
Instrumentation Rack							36					
Rack to Instrumentation							24		32			
VPS (Mechanical)												
Design / Management / Admin		88		32								
Drafting							40					
Subtotal Title I & II Design		***152***	***0***	***56***	***0***	***0***	***208***	***32***	***48***	***0***	***0***	
Title III												This effort includes procurement, fabrication/welding/assembly, installation, oversight, leak checking of the subsystems, installation procedures, refurbishment of legacy equipment as required and initial operation and testing.
AC Power / Instrumentation												
Backing System / Procurement	$3.0K						8					
Instrumentation Rack / Procurement	$3.0K						8					Includes standard cabling, raceways, conduits and miscellaneous items
Rack to Instrumentation / Procurement	$1.5K						8		8			
Backing System / Procedure / Installation							16				96	
Instrumentation Rack / Procedure / Installation							16				128	
Rack to Instrumentation / Procedure / Installation							16		40		96	
VPS (Mechanical)												
Oversight / Admin		16										
Procurement	$10.0K	4		8								Includes piping and other miscellaneous items. Major components available from legacy equipment.
Fabrication					144							
Procedure and Installation		16		40	80							
Procedure and Testing		12		8								
Subtotal Title III	***$17.5K***	***48***	***0***	***56***	***224***	***0***	***72***	***0***	***48***	***0***	***320***	

NCSX June 2007 ETC
TABLE II - Materials and Subcontracts

WBS Number: 22
WBS Title: Torus Vacuum Pumping Systems
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Materials and Subcontracts (M&S)	Basis of Estimate

Description:

Included in Table I

NCSX June 2007 ETC
TABLE III - Fabrication and Installation

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In-house Fabrication and Assembly and Installation

Included in Table I

NCSX June 2007 ETC
TABLE IV - Uncertainty of Estimate and Residual Risk Assessment

WBS Number: 22
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Uncertainty of the Estimate

	High	Medium	Low	Uncertainty Range (%)	Comments/Other Considerations
Design Maturity			X	-15%/+25%	There have been no design reviews therefore the design is not fixed.
Design Complexity			X		Anticipated to only require standard components
Other Comments:					

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 Low	Cost Impact High	Schedule Impact Low	Schedule Impact High
NONE								

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 reponsible 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 Unlikely (P<10%), NC=Non-credible (P<1%)