

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	K\$		Hours									
	M&S	EMEM	EMSM	EMSB	EMTB	EAEM	EASB	EEEM	EESM	EESB	EETB	
Title I and II Design												
Preliminary Design												
<u>AC Power / Instrumentation</u>												
Backing System							16	16				
Instrumentation Rack							20	16				
Rack to Instrumentation							16		16			
<u>VPS (Mechanical)</u>												
Design / Management / Admin		64		24								
Drafting							24					
Final Design												
<u>AC Power / Instrumentation</u>												
Backing System							32					
Instrumentation Rack							36					
Rack to Instrumentation							24		32			
<u>VPS (Mechanical)</u>												
Design / Management / Admin		88		32								
Drafting							40					
Subtotal Title I & II Design		152	0	56	0	0	208	32	48	0	0	
Title III												
<u>AC Power / Instrumentation</u>												
Backing System / Procurement	\$3.0K						8					
Instrumentation Rack / Procurement	\$3.0K						8					
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	
<u>VPS (Mechanical)</u>												
Oversight / Admin		16										
Procurement	\$10.0K	4		8								
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	

This is a relatively simple vacuum pumping system that will utilize major components (TMP, isolation valves, booster and mechanical 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 familiar 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.

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.

Includes standard cabling, raceways, conduits and miscellaneous items

Includes piping and other miscellaneous items. Major components available from legacy equipment.

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TABLE II - Materials and Subcontracts

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

Materials and Subcontracts (M&S)	Basis of Estimate
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Description:

Included in Table I

NCSX June 2007 ETC
TABLE III - Fabrication and Installation

WBS Number: 22

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Job Number: 2201

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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
WBS Title: Torus Vacuum Pumping Systems
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<u>Uncertainty of the Estimate</u>					
	<u>High</u>	<u>Medium</u>	<u>Low</u>	<u>Uncertainty Range (%)</u>	<u>Comments/Other Considerations</u>
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 ACEI recommended practice 18R-97 as amended for NCSX.

<u>Residual Impacts</u>								
<u>Job</u>	<u>Risk Description</u>	<u>Likelihood of Occurring</u>	<u>Mitigation Plan</u>	<u>Basis of estimate</u>	<u>Cost Impact</u>		<u>Schedule Impact</u>	
					<u>Low</u>	<u>High</u>	<u>Low</u>	<u>High</u>
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 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=Unlikely (40%>P>10%), VU=Very Unlikely (P<10%), NC=Non-credible (P<1%)

Activity ID	MILEstones (level 2 & 3)	Activity Description	Duration (work days)	Baseline Start	Baseline Finish	Shifts	Total Float	% cmlpt	Proposed Budgeted						
										FY07	FY08	FY09	FY10	FY11	FY12
22 - Torus Vacuum Pumping Systems															
Job: 2201 - Vacuum Pumping Systems-BLANCHARD															
220-101		Preliminary Design	30	02JAN09*	12FEB09		190		30,783.52	■ em//em=64; em//sb=24; ea//sb=76 ee//sm=16; ee//em=32					
220-105		PDR	1	13FEB09	13FEB09		190		0.00						
220-109		Final Design	35	16FEB09	03APR09		190		39,214.80	■ ee//sm=32; ea//sb=132; em//em=88; em//sb=32					
220-113		FDR	1	06APR09	06APR09		190		0.00						
220-117		Procure/Install AC pwr & Instrumentation	95	01DEC09*	22APR10		25		53,724.64	■ 41=7.5k ; ea//sb=72; ee//sm=48; ee//tb=320					
220-133		Procure/Install VPS mechanical	115	30OCT09	22APR10		25		45,270.28	■ em//tb=224; em//sm=48 41=10k; em//em=36					
220-137		Test	20	23APR10*	20MAY10		25		3,002.12	■ em//em=12; em//sb=8					
Subtotal			347	02JAN09	20MAY10		25		171,995.36	■					