

NCSX Work Approval Form (WAF)

WBS Number: 38

WBS Title: Electron Beam Mapping

Job Number: 3801

Job Title: Electron Beam Mapping Systems

Job Manager: Brent Stratton

Description:

This WBS element consists of all EB mapping equipment required to accomplish the NCSX mission as defined in the General Requirements. This equipment will be required in the field-line mapping phase of operations and thus is included in the NCSX Fabrication Project.

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: 38													
WBS Title: Electron Beam Mapping													
Job Number: 3801													
Job Title: Electron Beam Mapping Systems													
Job Manager: Brent Stratton													
Description: E-beam mapping will be done with an electron gun and movable fluorescent wand borrowed from Auburn University. Will use same visible TV camera as in WBS 36. Need two port extensions for 10" diameter ports. Need data acquisition system to record wand position, electron gun bias voltage and emission current. Need control capability for wand, electron gun bias voltage and emission current..													
		\$		Labor Hours							Basis of Estimate		
	Task Description	M&S	Travel	E MEM	E MSM	E MTB	E EEM	E ETB	E ADM	E CEM	RM2		
Design System	Design interface components - adapting flange sizes			120								Engineering judgement - however standard design used before	
	Physics-based modeling, work with Auburn personnel		\$3,000									480	Engineering judgement - however standard design used before
	Prepare drawings (~6 drawings)								80				Based on conceptual design and PPPL design experience
	Design software for control & data acquisition for H/W									300			Engineering judgement - however standard design used before
Fabricate System (Including welding)	Fabricating & Welding Spool Pieces					16		16				Engineering judgement - however standard design used before	
	Fabricating other parts					80						Engineering judgement - however standard design used before	
Install System						240						Engineering judgement - however standard design used before	
Engineering Oversight				40									
Materials	Port Extensions Material/Parts	\$4,000										Based on estimate provided by PPPL Construction Manager - see Table V	
	Data Acquisition Materials/Parts	\$10,000										Based on estimate provided by PPPL Computer Division - see Table V	
	Rack	\$28,600										Based on estimate provided by PPPL Electrical Engineer - see Table V	
	TOTAL	\$42,600	\$3,000	160	0	336	0	16	80	300	480		

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TABLE II - Materials and Subcontracts

WBS Number: 38											
WBS Title: Electron Beam Mapping											
Job Number: 3801											
Job Title: Electron Beam Mapping Systems											
Job Manager: Brent Stratton											
Materials and Subcontracts (M&S)										Basis of Estimate	
		Material					Labor				
Description - included in Table I											

NCSX June 2007 ETC
TABLE III - Fabrication/Assembly Installation

WBS Number: 38															
WBS Title: Electron Beam Mapping															
Job Number: 3801															
Job Title: Electron Beam Mapping Systems															
Job Manager: Brent Stratton															
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: 38
WBS Title: Electron Beam Mapping
Job Number: 3801
Job Title: Electron Beam Mapping Systems
Job Manager: Brent Stratton

Uncertainty of the Estimate

	High	Medium	Low	Uncertainty of Estimate (%)	Comments/Other Considerations
Design Maturity		X		-15%/+25%	Similar designs done elsewhere, but NCSX specific design still conceptual
Design Complexity		X			Standard components, but interfaces could be somewhat complex
Other Comments:					Leak checking not included in this estimate

Note: High/Medium/Low uncertainty assessment from Job Manager. Uncertainty range based on ACEI 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
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%)

NCSX June 2007 ETC TABLE V - Basis of Estimate

Backup Information

Hardware requirements for e-beam mapping

Equipment rack	isolating a-c power ethernet link camac crate, system clock, etc Single point grounding	Sichta? Sichta Sichta
Camera	(borrowed from NSTX) Move camera to port on NCSX Modify port to accept camera Move control hardware to NCSX rack timing module/channel for camera MDS tree for camera data Camera filters Cable runs	Stratton Stratton Stratton Sichta Sichta Stratton
Electron gun	(borrowed from Auburn) Modify NCSX port Modify gun probe to fit NCSX port Duplicate/borrow control hardware from NSTX probes Slow ($\approx 1\text{kHz}$) acquisition system to record filament parameters (908?) Bias supply (100V, e.g., Kepco BOP-100-1M $\approx \$3000$) Digital control for bias supply (D-to-A module?) Cable runs	Stratton/Knowlton Stratton Sichta Fredrickson Sichta
Swept fluorescent rod (borrowed from Auburn)	Modify NCSX port and gun Duplicate/borrow control hardware from NSTX probes Control hardware to remotely sweep rod (stepper motor controller?) Cable runs	Stratton Stratton Stratton/Knowlton

Testing system at Auburn

Data Acquisition Hardware

Sichta M&S: \$10K
[computer, LabVIEW, timer card, d/a, a/d, motor controller, network].
hardware & software labor: 300 hours
[requirements/design/select_parts/fdr/code/test].

Additional:
mechanical stuff, installation, post-acquisition software analysis & visualization.

Activity ID	MILEstones (level 2 & 3)	Activity Description	Duration (work days)	Baseline Start	Baseline Finish	Shifts	Total Float	% cmplt	Proposed Budgeted							
										FY07	FY08	FY09	FY10	FY11	FY12	
38 - Electron Beam (EB) Mapping																
Job: 3801 - Electron Beam Mapping-STRATTON																
380-010		E-beam mapping- Prelim Design	40	02MAR09*	24APR09		114		44,761.80	■ R///RM2 =160hr ; EM//EM =50hr ; EA//SB =40hr ; 35=03\$K ;						
380-015		E-beam mapping-PDR	1	27APR09	27APR09		114		0.00							
380-100		E-beam mapping-Final Design	40	28APR09*	23JUN09		114		56,544.80	■ R///RM2 =160hr ; EM//EM =50hr ; EA//SB =40hr ; EC//EM =100hr ;						
380-110		E-beam mapping-FDR	1	24JUN09	24JUN09		114		0.00							
380-115		E-beam mapping-Procure Rack	65	01OCT09*	13JAN10		46		47,369.60	■ 41=29\$K ; ec//em=40						
380-120		E-beam mapping-Procure Ports	65	01OCT09	13JAN10		46		5,728.00	■ 41=04\$K ;						
380-130		E-beam mapping-Procure Data Acquisition	65	01OCT09*	13JAN10		46		14,320.00	■ 41=10\$K ;						
380-135	2	E-beam mapping- Assemble	65	14JAN10*	14APR10		46		94,239.24	■ R///RM2 =160hr ; EM//EM =20hr ; EMT/TB =336 ; EC//EM =200hr ; ee//tb=16						
Subtotal			280	02MAR09	14APR10		46		262,963.44	■						