NCSX Work Approval Form (WAF)

WBS Number: 186
WBS Title: Tooling Design & Fabrication
Job Numbers: 1803 & 1805
Job Titles: FPA Tooling & Constructibility (1803)
Job Titles: FPA Hardware & Fixture Procurement (1805)
Job Manager: Tom Brown (1803) and Larry Dudek (1805)

Description:

This WBS element includes all of the non-VVSA procurements.

Schedule:

See Attached

Approvals:

Tom Brown
Digitally signed by Tom Brown
DN: cn=Tom Brown, c=US, o=PPPL
Reason: I have reviewed this document
Date: 2007.07.18 08:35:57 -04'00'

Job Manager — Date

Lawrence E. Dudek
Digitally signed by Lawrence E. Dudek
DN: cn=Lawrence E. Dudek, c=US
Date: 2007.07.18 13:23:08 -04'00'

Job Manager — Date

Wayne Reiersen
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Date: 2007.07.19 08:19:44 -04'00'

Responsible Line Manager — Date

James L Anderson
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Reason: I am approving this document
Date: 2007.07.19 10:55:41 -04'00'

Project Manager — Date

Mike Williams
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Date: 2007.07.19 13:50:59 -04'00'

Engineering Department Head — Date

NCSX June 2007 ETC
TABLE I - DESIGN LABOR

	TASK DESCRIPTION	41MS	48MS	EAEM (Fan)	EAEM (Brown)	EADM (Morris)	Basis of Estimate
WBS Number: 186							
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Job Manager: Tom Brown							
Description:							
Design (Job 1803)							
Stage 3							
	Details of remaining Manhour needs						
	Complete SISSCO/support frame interface					0	**Work Completed**
	Revise drawings as needed per FDR input					48	**Based on previous experience on Station 1 earlier work on original fixture**
	Flange bolt/VV support access platform					120	**Based on previous experience on Station 1 earlier work on original fixture**
	Transportation study (move between test cells)					40	**Based on previous experience on Station 1 earlier work on original fixture**
	VV/MC clearance report (for VVSA1, 2 and 3)				72		**Based on previous experience on Station 1 earlier work on original fixture**
	Generate laser trace drawing for each screen					80	**Based on previous experience on Station 1 earlier work on original fixture**
	Assembly sequence plan and Installation procedure				40		**Based on previous experience on Station 1 earlier work on original fixture**
	Analyze single point lift			40	16		**Based on previous experience on Station 1 earlier work on original fixture**
	Subtotal Stage 3			***40***	***128***	***288***	
Stage 5							
	Details of remaining Manhour needs						
	Complete FP support and platform models					240	**Based on previous experience on Station 1 earlier work on original fixture**
	Complete platform models					80	**Based on previous experience on Station 1 earlier work on original fixture**
	Complete dwg package & release for fabrication					120	**Based on previous experience on Station 1 earlier work on original fixture**
	Complete models and dwgs for test cell metrology layout					160	**Based on previous experience on Station 1 earlier work on original fixture**
	Design follow-up and preliminary analysis				60		**Based on previous experience on Station 1 earlier work on original fixture**
	Perform structural analysis			60			**Based on previous experience on Station 1 earlier work on original fixture**
							Based on previous experience on Station 1 earlier work on original fixture
	Subtotal Stage 5			***60***	***60***	***600***	
Final Machne Assembly Fixture Design							
	Details of remaining Manhour needs						
	Complete Stage 6 support					240	**Based on previous experience on Station 1 earlier work on original fixture**
	Complete platform models					80	**Based on previous experience on Station 1 earlier work on original fixture**
	Complete dwg package & release drawings					160	**Based on previous experience on Station 1 earlier work on original fixture**
	Design follow-up and preliminary analysis				120		**Based on previous experience on Station 1 earlier work on original fixture**
	Perform structural analysis			120			**Based on previous experience on Station 1 earlier work on original fixture**
							Based on previous experience on Station 1 earlier work on original fixture
	Subtotal Final Machine Assembly Fixtures Design			***120***	***120***	***480***	**Based on previous experience on Station 1 earlier work on original fixture**
	TOTAL REMAINING HOURS (Job 1803)			**220**	**308**	**1368**	
Design (Job 1805) - NONE		**1896**					
		1896					

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Job Manager: Tom Brown

Materials and Subcontracts (M&S)

Job 1803 - NONE

Job 1805

PPPL Shop Rate for EMTB ($/hr) = 81 — NEED TO HAVE BAIS OF ESTIMATE FOR BELOW ITEMS

	Description	Unit Weight (lbs)	$ per Lb	Unit Cost ($)	Qnty	Total Cost ($)	Comments	Equiv Shop hrs			Basis of Estimate
Stage 2 - Assy Fixture Cost (Existing Design)							**Estimate is for two Stage 2 units**				
	20 Degree Wedge Fixture	11,600	4	46,400	2	**$92,800**	Weldment plus some machinings	1,146	29	wks	Based on actual weight of existing fixtures and previous experience on similar tasks
Stage 3 - MC Assembly Fixture Cost							**Estimate is for one Stage 3 unit**				
	Rt side laser screen weldment (new parts)	300	4	1,200	2	$2,400		30			Based on current status of CADD Models - previous input from vendors on similar tasks - dwgs completed.
	Reworked left side laser screen weldment				2	$1,944	Assumes 3 days of shop time	24			Based on previous experience on similar tasks
	Test cell hook adaptor plate	300	7	2,100	1	$2,100		26			Based on previous experience on similar tasks - HOWEVER, interface has changes => need new estimate.
	SISSCO 3 Actuator Lift System					$0	Cost included in Mike Viola's WBS				
	MC I-beam upper support at Type-A	579	4	2,316	1	$2,316	weldment plus some machined structure				Based on CADD model data and previous experience on similar tasks
	MC upper support at Type-C - inboard	160	4	640	1	$640	weldment plus some machined structure				Based on CADD model data and previous experience on similar tasks
	MC upper support at Type-C - outbd	60	7	420	3	$1,260	weldment plus some machining				Based on CADD model data and previous experience on similar tasks
	MC base support system (left / rt side)	2,938	4	11,752	1	$11,752	weldment plus some machined structure	145			Based on CADD model data and previous experience on similar tasks
	VV support system	1,411	4	5,644	1	$5,644	weldment plus some machined structure	70			Based on CADD model data and previous experience on similar tasks
	Hilman roller - 8-0T plus R & U guides			950	8	$7,600	Based on Hilman phone quote				Phone quote from Vendor - in 2006
	AirLoc Wedgmount Precision Levelers			315	6	$1,890	Based on phone quote				Phone quote from Vendor - start of 2007
	Bushnell Laser Boresighter			34.97	7	$245	Internet price (one spare included)				
	Flange bolt access platform					$0	Shop supplied (included in Viola's estimeate)	0			
	Hardware & Misc items					$1,000					Rough estimate based on previous experience on similar tasks,
	Misc assembly Cost					$8,100	Assumes 2.5 wk shop hours	100			Based on previous experience on similar task
						$46,891		394	9.9	wks	
Stage 5 - Final FP Assembly Fixture Cost							**Estimate is for one Stage 5 units**				
1	FPA base support system	1,500	4	6,000	1	$6,000	This will be similar to Stage 3, without rollers	74			Based on CADD model data and previous experience on similar tasks
2	AirLoc Wedgmount Precision Levelers			315	4	$1,260	Based on phone quote				Phone vendor prices off Internet - March 2007
3	TF support structure	2,200	4	8,800	2	$17,600	Structure weldment (estimated weight)	217			Based on CADD model data and previous experience on similar tasks
4	Port 4 handling structure	500	4	2,000	1	$2,000	Structure weldment (estimated weight)	25			Based on CADD model data and previous experience on similar tasks
5	Hardware & Masc. items					$1,000					Rough estimate based on previous experience on similar tasks,
6	Misc. assembly Cost					$8,100	Assumes 2.5 wk shop hours	100.0			Based on previous experience on similar task
						$35,960	each	416	10.4	wks	
						$71,920	need two				
Final Machine Assembly Fixture Costs							**Estimate for 3 FP's and 3 Spool Fixtures**				
1	FPA base support system	4,000	4	16,000	3	$48,000	Structure weldment (estimated weight)	593			Based on CADD model data and previous experience on similar tasks
2	AirLoc Wedgmount Precision Levelers			315	12	$3,780	Based on phone quote (assume 4 pt supt)				Phone quote from Vendor - start of 2007
3	Spool piece support system	1,000	4	4,000	3	$12,000	Structure weldment (estimated weight)				Based on CADD model data and previous experience on similar tasks
4	Thomson linear motion components			1000	12	$12,000	Estimate				Rough estimate based on conceptual design
5	FPA base motor driven linear screw system				3	-	Existing system already available				
6	Spool piece support linear screw system			1500	3	$4,500	Nook screw system (no motor needed)				Rough estimate based on previous experience - 2006
7	Hardware & Masc. items					$3,000					Rough estimate based on previous experience on similar tasks,
8	Misc. assembly Cost					$16,200	Assumes 5 wk shop hours	200			Based on previous experience on similar task
						$99,480		793	19.8	wks	
	TOTAL M&S					**$311,091**	with add'l wedges				
						$218,291	without add'l wedge				

NCSX June 2007 ETC
TABLE III - Fabrication and Assembly

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Job Manager: Tom Brown	
Fabrication and Assembly	
M&S/Fab in Job 1805	

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

WBS Number: 186
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Job Manager: Tom Brown

Uncertainty of the Estimate

	High	Medium	Low	Uncertainty Range (%)	Comments/Other Cionsiderations
Job 1803 - Tom Brown					
Station 3				-10%/+15%	
Design Maturity		X			Simulation run identified several additional issues to be resolved (expect resolution by July)
Design Complexity			X		Standardized components.
Station 5				-10%/+15%	
Design Maturity		X			Only preliminary design completed, but relatively straightforward steps
Design Complexity			X		Standardized components.
Station 6				-20%/+40%	
Design Maturity			X		Only at conceptual stage - incomplete simulations
Design Complexity		X			More complex systems
Job 1805 - Larry Dudek					
Station 3				-10%/+15%	
Design Maturity		X			Simulation run identified several additional issues to be resolved (expect resolution by July)
Design Complexity			X		Standardized components, but some complexity.
Comment:					Design still evolving so amount of material/components could change - expect to resolve by July (SISSCO Inteface_)
Station 5				-10%/+15%	
Design Maturity		X			Only preliminary design completed, but relatively straightforward steps
Design Complexity			X		Standardized components.
Comment:					Design still evolving - expect design to be finalized in July.
Station 6				-20%/+40%	
Design Maturity			X		Only at conceptual stage - incomplete simulations
Design Complexity		X			More complex systems
Comment:					Design still evolving - expect design to be finalized in July.

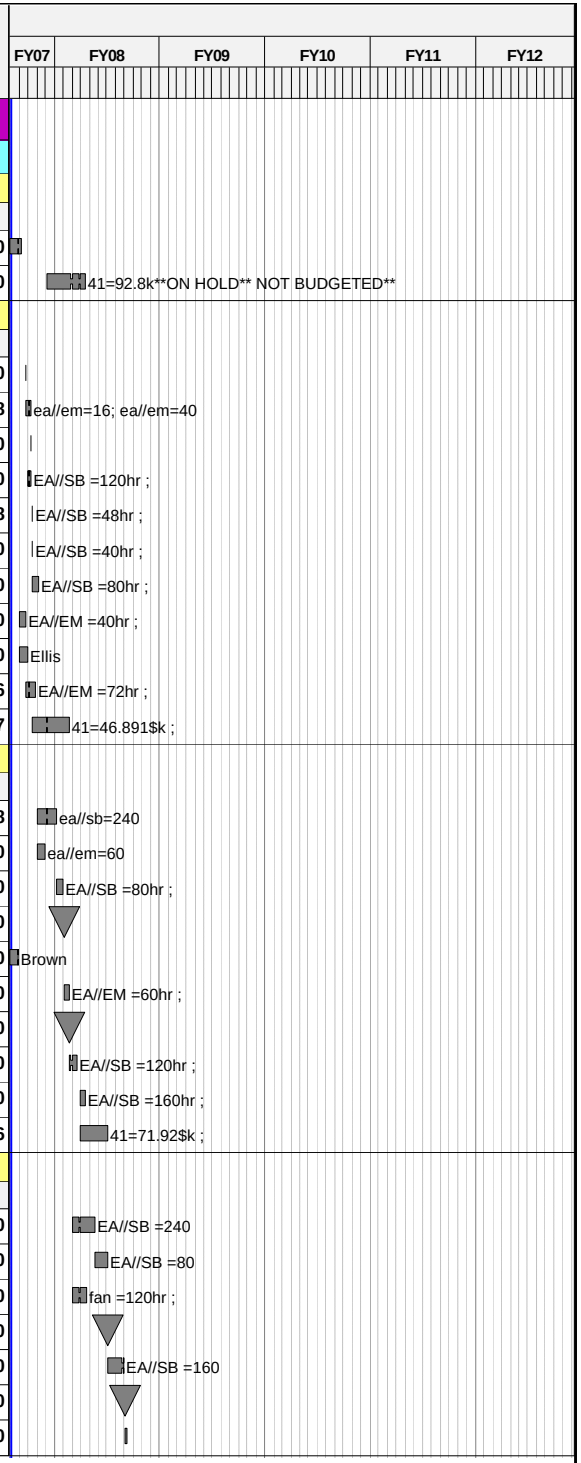
Note: High/Medium/Low uncertainty assessment from Job Manager. Uncertainty range based on AACEI recommended practice 18R-97 as amended for NCSX.

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
1803	Assembly sled for final assembly is not adequately stiff or does not provide repeatable motion	U	Functionality of sled will be determined first with concrete blocks and later with first FP. Ample time to make design modifications between arrival of the first and third FPs.	Nominal cost impact is 1 man-month of engineering design and up to half the fabrication cost of the sled	+ $25	+ $75	+ 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 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%)

Activity ID	MILE-stones (level 2 & 3)	Activity Description	Duration (work days	Baseline Start	Baseline Finish	Shifts	Total Float	% cmplt	Proposed Budgeted
18 - Field Period Assembly									
Job: 1803/1805- FPA Tooling/Constr-BROWN/DUDEK									
Station 2-Modular Coil Sub- Assembly									
1803-2.1		Assembly sequence plan drafted	28	01MAY07	08JUN07		65	LOE	0.00
1803-2.2		Procure 2 20degree wedge fixt (for total of 6)	90	04SEP07*	18JAN08		80		0.00
Station 3-Modular Coil to VVSA Assembly									
1803-3.2		Finalize drawings for internal review and outsid	3	25JUN07	27JUN07		111		0.00
1803-3.3		Analyze single point lift	10	28JUN07	12JUL07		111		9,756.88
1803-3.4	3	Stage 3 support FDR	1	13JUL07*	13JUL07		111		0.00
1803-3.5		Flange bolt/VV support access platform	8	02JUL07*	12JUL07		112		13,495.20
1803-3.6		Revise drawings per FDR input and release for Fa	2	16JUL07	17JUL07		111		5,398.08
1803-3.7		Transportation study (move between test cells)	2	18JUL07	19JUL07		173		4,498.40
1803-3.8		Generate laser trace drawing for each screen	20	16JUL07	10AUG07		157		8,996.80
1803-3.9		Assembly sequence plan and Installation procedur	18	01JUN07*	26JUN07		168		6,969.20
R1802-305		Metrology plan	20	01JUN07*	28JUN07		187		0.00
1803-3.10		VV/MC clearance report (for VVSA1, 2 and 3)	21	27JUN07	26JUL07		168		12,544.56
1803-3.11		Procure materials and fixture	88	18JUL07*	19NOV07		111		60,445.47
Station 5-Final Field Period Assembly									
1803-5.1		Complete FP support models	50	01AUG07*	10OCT07		127		27,276.48
1803-5.5		Design followup & prelim analysis	20	01AUG07*	28AUG07		187		10,453.80
1803-5.2		Complete platform models	15	11OCT07	31OCT07		127		9,592.80
1803-5.3		PDR	0		07NOV07		127		0.00
R1802-503		Sequence plan	20	02MAY07*	30MAY07		240		0.00
1803-5.4		Structural Analysis	10	08NOV07*	21NOV07		127		11,145.60
1803-5.6	3	Station 5 FDR	0		21NOV07		127		0.00
1803-5.7		Complete dwg package and release for Fa	20	22NOV07	21DEC07		127		14,389.20
1803-5.8		Complete models and dwgs for test cell metrology	9	02JAN08	14JAN08		163		19,185.60
1803-5.9		Procure materials and fixture (2 stations)	65	02JAN08	01APR08		127		94,071.36
6.00-Final Machine Assembly									
1803-6.1		Complete Stage 6 support models	50	03DEC07*	19FEB08		69		28,778.40
1803-6.2		Complete platform models	30	20FEB08	01APR08		69		9,592.80
1803-6.3		Structural Analysis	30	03DEC07*	22JAN08		119		22,291.20
1803-6.4		PDR	0		01APR08		69		0.00
1803-6.5		Complete drawing package	40	02APR08	28MAY08		69		19,185.60
1803-6.6	3	Station 6 FDR	0		04JUN08		69		0.00
1803-6.7		Revise drawings per FDR input and release for Fa	5	05JUN08	11JUN08		69		0.00



Activity ID	MILE-stones (level 2 & 3)	Activity Description	Duration (work days	Baseline Start	Baseline Finish	Shifts	Total Float	% cmplt	Proposed Budgeted
1803-6.9		Design followup and prelim analysis	82	03DEC07*	03APR08		112		22,291.20
1803-6.8		Procure materials and fixture	65	02SEP08*	03DEC08		13		111,484.70
Subtotal			400	01MAY07	03DEC08		13		521,843.33