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, o=PPPL, ou, email=tbrown@pppl.gov, c=US
Date: 2008.02.19 08:00:18 -05'00'

_____
Job Manager

_____
Job Manager

_____
Responsible Line Manager

_____
Project Manager

_____
Engineering Department Head

NCSX June 2007 ETC
TABLE I - DESIGN LABOR

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

Description:

	TASK DESCRIPTION	41MS	48MS	EAEM (Fan, equiv)	EAEM (Brown)	EAEM (Smith)	EAEM (Avasarala)	EADM (Morris)	EADM (Upcavage)	Basis of Estimate
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							0		**Work Completed**
	Transportation study (move between test cells)							0		**Work Completed**
1	MCHP rotation fixture			40				40		**Work Completed**
2	Flange bolt/VV support access platform							80		**Based on previous experience on Station 1 earlier work on original fixture**
3	Updated Stations 3 and 5 sequence plan				32					**Work 95% Completed**
4	Station 3 alignment FDR and clean-up activities				40	40		40		**Based on previous experience on Station 1 earlier work on original fixture**
5	Generate laser screen trace drawings (3 periods)					40		40		**Based on previous experience on Station 1 earlier work on original fixture**
6	Analyze single point lift (proof test of support frame)			40		40	40			**Based on previous experience on Station 1 earlier work on original fixture**
7	Station 3 simulation detail model				24	120				**Based on previous experience on Station 1 earlier work on original fixture**
8	VV/MC clearance study (for VVSA1, 2 and 3)					120				**Based on previous experience on Station 1 earlier work on original fixture**
9	Station 3 deflection FEA study			120	24		80			**Based on previous experience on Station 1 earlier work on original fixture**
10	Oversite, cost and schedules, reviews				40					**Based on previous experience on Station 1 earlier work on original fixture**
	Subtotal Stage 3			***200***	***160***	***360***	***120***	***200***	***0***	***1040***
Stage 5										
	Details of remaining Manhour needs									
1	FP support models and drawings					40		0		**Based on previous experience on Station 1 earlier work on original fixture**
2	Circular ports assembly tooling models and dwgs							100		**Based on previous experience on Station 1 earlier work on original fixture**
3	VV port alignment tooling				80			80		**Based on previous experience on Station 1 earlier work on original fixture**
4	Station 5 (and 3) lift fixture structures and lift test			40		40			80	**Based on previous experience on Station 1 earlier work on original fixture**
5	Port 4 assembly tooling, models and dwgs								80	**Based on previous experience on Station 1 earlier work on original fixture**
6	Complete external platform models							80		**Based on previous experience on Station 1 earlier work on original fixture**
7	VV work platforms							120		**Based on previous experience on Station 1 earlier work on original fixture**
8	Station 5 support structural analysis			80			80			**Based on previous experience on Station 1 earlier work on original fixture**
9	Station 5 PDR activities				40					**Based on previous experience on Station 1 earlier work on original fixture**
10	Station 5 FDR - Base support				40					**Based on previous experience on Station 1 earlier work on original fixture**
11	Base support release for fabrication								40	**Based on previous experience on Station 1 earlier work on original fixture**
12	Station 5 FDR - Lift fixtures, port tooling and platforms				40					**Based on previous experience on Station 1 earlier work on original fixture**
13	Complete dwgs package & release for fabrication							40		**Based on previous experience on Station 1 earlier work on original fixture**
14	Oversite, cost and schedules, reviews				80					**Based on previous experience on Station 1 earlier work on original fixture**
	Subtotal Stage 5			***120***	***280***	***80***	***80***	***420***	***200***	***1180***

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Job Manager: Tom Brown

Description:

	TASK DESCRIPTION	41MS	48MS	EAEM (Fan, equiv)	EAEM (Brown)	EAEM (Smith)	EAEM (Avasarala)	EADM (Morris)	EADM (Upcavage)	Basis of Estimate
	Station 6: Final Machne Assembly Fixture Design									
	Details of remaining Manhour needs									
1	Stage 6 FP support and roller system				160		120	240		**Based on previous experience on Station 1 earlier work on original fixture**
2	Spool piece support and roller system				160		120	240		**Based on previous experience on Station 1 earlier work on original fixture**
3	Update Station 6 sequence plan				40					**Based on previous experience on Station 1 earlier work on original fixture**
4	External tooling/man access platforms							120		**Based on previous experience on Station 1 earlier work on original fixture**
5	Metrology support stands							40		**Based on previous experience on Station 1 earlier work on original fixture**
6	Station 6 stress and deflection FEA study			160			160			**Based on previous experience on Station 1 earlier work on original fixture**
7	Station 6 simulation model and clearance study				80	80				**Based on previous experience on Station 1 earlier work on original fixture**
8	Station 6 PDR - all systems				40					**Based on previous experience on Station 1 earlier work on original fixture**
9	Station 6 FDR - FP support and roller system				40					**Based on previous experience on Station 1 earlier work on original fixture**
10	FP support system release for fabrication								40	**Based on previous experience on Station 1 earlier work on original fixture**
11	Station 6 FDR - Spool piece support system				40					**Based on previous experience on Station 1 earlier work on original fixture**
12	Spool piece system release for fabrication							40		**Based on previous experience on Station 1 earlier work on original fixture**
13	Models/dwgs for test cell metrology layout							160		**Based on previous experience on Station 1 earlier work on original fixture**
	Oversite, cost and schedules, reviews				80					**Based on previous experience on Station 1 earlier work on original fixture**
	Subtotal Final Machine Assembly Fixtures Design			***160***	***640***	***80***	***400***	***840***	***40***	***2160***
	TITLE III eingineering support									**FTE**
1	FY08 - Station 2 and 3				***0.0***	***0.7***	***0.3***	***0.0***		**1.0**
2	FY09 - Station 3 and 5				***0.2***	***0.6***	***0.5***	***0.2***		**1.5**
3	FY10 - Station 5 and 6				***0.1***	***0.6***	***0.6***	***0.2***		**1.5**
3	FY11 - Station 6 and test cell				***0.1***	***0.6***	***0.6***	***0.2***		**1.5**
	Subtotal TITLE III Design (assume 1750 hrs per year)				***700***	***4375***	***3500***	***1050***		**9625**
	TOTAL REMAINING HOURS (Job 1805)			**480**	**1780**	**4895**	**4100**	**2510**	**240**	
	Design (Job 1805) - NONE	**14005**								

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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**				
1	Laser mounting brackets (includes a set of 3)	59	4.25	251	2	$502		6			Based on CADD model data and previous experience on similar tasks
2	Left side base grout plates	496	4.25	2,108	1	$2,108		26			Based on CADD model data and previous experience on similar tasks
3	MCHP lift fixture frame weldment	1330	5.5	7,315	1	$7,315		90			Based on CADD model data and previous experience on similar tasks
4	Lift fixture mounting bracket weldments	359	5.5	1,975	6	$11,847					Based on CADD model data and previous experience on similar tasks
5	Reworked laser frame structure	105.5	4.25	448	2	$897	weldment				Based on CADD model data and previous experience on similar tasks
6	Right inboard laser frame structure	200	4.25	850	1	$850	weldment				Based on CADD model data and previous experience on similar tasks
7	Left inboard laser frame structure	161	4.25	684	1	$684	weldment				Based on CADD model data and previous experience on similar tasks
8	Laser screen lexan sheet (1/8 x 48" x 96")			145	3	$435					Web data cost basis
9	Estimate for Station 2 type alignment system					3,240	Assumes 5 days of shop time				Based on previous experience on similar tasks
10	Hardware & Misc items					$1,000					
11	Misc assembly Cost					$8,100	Assumes 2.5 wk shop hours				
						$36,978	To complete Station 3	123	3.1	wks	
	Partially assembled 2nd unit										
1	MC base support system (left / rt side)	2,938	4.25	12,487	1	$12,487					Based on earlier purchas with allowance for cost upgrade
2	Hilman roller - 8-0T plus R & U guides			950	5	$4,750	Based on Hilman phone quote				
3	AirLoc Wedgmount Precision Levelers			315	6	$1,890	Based on phone quote				
4	Lift fixture mounting bracket weldments	359	5.5	1,975	6	$11,847					
5	Estimate for Station 2 type alignment system					3,240	Assumes 5 days of shop time				
6	Hardware & Misc items					$1,000					4.0
7	Misc assembly Cost					$8,100	Assumes 2.5 wk shop hours				
						$43,314	To purchas a scaled down Station 3 assembly				
						$80,291	Remaining total cost for Station 3 tooling				
Stage 5 - Final FP Assembly Fixture Cost							**Estimate is for one Stage 5 units**				
1	FPA base support system	930	5.5	5,115	1	5,115	Weight based on CAD model	63			
2	Type-C side support structure	340	4.25	1,445	2	2,890	Weight based on CAD model	36			
3	NB side stabalizing support structure	440	4.25	1,870	1	1,870	Weight based on CAD model	23			
4	TF local temporary supports	50	5.5	275	2	550	Weight estimate	7			
5	20 ton screw jacks			164	4	656	McMaster-Carr price				
6	AirLoc Wedgmount Precision Levelers			500	2	1,000	Estimate based on earlier purchas of lighter un				
7	Port 4 handling structure	800	5.5	4,400	1	4,400	Weight based on CAD model	54			
8	Small port handling structure	50	5.5	275	4	1,100	Weight estimate	14			
9	Station 5 (and 3) lift fixture structures	1,366	5.5	7,513	1	7,513	Weight based on CAD model	93			
10	VV work platforms						Cost covered in Viola's WBS				
11	Stage 5 assembly platform						Cost covered in Viola's WBS				
12	Hardware & Masc. items					1,000					
13	Misc. assembly Cost					8,100	Assumes additional 2.5 wk shop hours	100			
						34,194		389	9.7	wks	
						22,281	2nd Station fixture less items 7 and 9				
						$44,562	need two				
Final Machine Assembly Fixture Costs							**Estimate for 3 FP's and 3 Spool Fixtures**				
1	FPA base support system	4,000	5.5	22,000	3	$66,000	Structure weldment (estimated weight)	815			Based on CADD model data and previous experience on similar tasks
2	AirLoc Wedgmount Precision Levelers			500	12	$6,000	Estimate cost of higher capacity of purchased unit				Estimate cost of higher capacity of purchased unit
3	Spool piece support system	2,000	5.5	11,000	3	$33,000	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, 2007
7	Metrology support stands				3	24,000	Estimate for concrete fill steel structure				Rough estimate based on previous experience - 2006, 2007
8	Hardware & Masc. items					$3,000					Rough estimate based on previous experience on similar tasks,
9	Misc. assembly Cost					$16,200	Assumes 5 wk shop hours	200			Based on previous experience on similar tasks
						$164,700		1,015	25.4	wks	
	TOTAL M&S					**$382,353**	with add'l wedges				
						$289,553	without add'l wedge				

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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

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Uncertainty of the Estimate

	High	Medium	Low	Uncertainty Range (%)	Comments/Other Cionsiderations
Job 1803 - Tom Brown					
Station 3				-10%/+10%	
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%)