NCSX Work Approval Form (WAF)

WBS Number: 185

WBS Title: Assembly of Field Periods

Job Numbers: 1802, 1810, and 1815

Job Title: FPA Oversight & support (1802)

Job Title: FPA Operations - Stations 1, 2, & 3 (1810)

Job Title: FPA Operations - Station 5 (1815)

Job Manager: Mike Viola

Description:

This WBS element consists of those activities associated with the assembly of the three individual field periods in the TFTR Test Cell.

Schedule:

See Attached

Approvals:

Mike Viola
Digitally signed by Mike Viola
DN: cn=Mike Viola, c=US
Reason: I am approving this document
Date: 2007.07.02 13:11:15 -04'00'

Job Manager — Date

Lawrence E. Dudek
Digitally signed by Lawrence E. Dudek
DN: cn=Lawrence E. Dudek, c=US
Date: 2007.07.05 15:01:22 -04'00'

Responsible Line Manager — Date

Hutch Neilson
Digitally signed by Hutch Neilson
DN: CN = Hutch Neilson, C = US, O = PPPL
Date: 2007.07.05 15:13:32 -04'00'

Project Manager — Date

Mike Williams
Digitally signed by Mike Williams
DN: cn=Mike Williams, o=PPPL, ou=Engineering, email=williams@pppl.gov, c=US
Date: 2007.07.05 15:17:54 -04'00'

Engineering Department Head — Date

NCSX June 2007 ETC
TABLE I - DESIGN LABOR

WBS Number: 185														
WBS Title: Assembly of Field Periods														
Job Numbers: 1802, 1810, and 1815														
Job Title: FPA Oversight & support (1802)														
Job Title: FPA Operations - Stations 1, 2, & 3 (1810)														
Job Title: FPA Operations - Station 5 (1815)														
Job Manager: Mike Viola														
Description:														
TASK DESCRIPTION	Work days	**41MS**	**48MS**	**37STK**	**35TRVL**	**31OT**	ORNLEM	ORNLDSN	EMEM	EMSM	EMSB	EMTB	CREW	
Design														
This is a Fabrication Job - All labor in Table III														

WBS Number: 185
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Job Manager: Mike Viola

Materials and Supplies

Metrology Consumables - Input by Steve Raftopoulos

CC	Item	Quantity	Cost	Annual cost	Years	FY'07-FY'09 Cost	Comment	Basis of Estimate
5323	**Generic replacement or consumables**							
	Surface probe kits	2	$7,500	$15,000	1	$15,000	Consumable	**Recent procurements**
	Replacement Leica Workstation Computer	1	$3,000	$3,000	1	$3,000		**Recent procurements**
	Replacement Laptops for Romer Arms	3	$3,000	$9,000	1	$9,000		**Recent procurements**
	Replace Thommen Sensor for Leica Tracker	1	$1,500	$1,500	2	$3,000		**Recent procurements**
	Replacement tips for Leica and FARO surface probes	4	$300	$1,200	3	$3,600	Consumable	**Recent procurements**
	1.5" CCRs 2 per year, per tracker	4	$2,000	$8,000	3	$24,000	Consumable	**Recent procurements**
	0.5" CCRs 2 per year, per tracker	4	$1,200	$4,800	3	$14,400	Consumable	**Recent procurements**
	Replacement misc. computer parts	1	$700	$700	3	$2,100	Consumable	**Recent procurements**
	Replacement/additional extension bar kits	2	$1,000	$2,000	3	$6,000	Consumable	**Recent procurements**
	Replacement and special nests and adapters	15	$300	$4,500	3	$13,500	Consumable	**Recent procurements**
	Replacement/additional 1.5" CCR drift nest pucks	30	$30	$900	3	$2,700	Consumable	**Recent procurements**
	Replacement Probe Tips for Romer Arms	6	$600	$3,600	3	$10,800	Consumable	**Recent procurements**
			Subtotal	**$54,200**		**$107,100**		
5323	**Generic one-time needs**							
	2 - Prortable Brunson Stands	2	$2,000	$4,000	1	$4,000	One-time need	**Recent procurements**
	Dial indicators for Coil Winding Turning fixture	6	$200	$1,200	1	$1,200	One-time need	**Recent procurements**
	Brunson Adapter plates	6	$500	$3,000	1	$3,000	for mounting of equipment in various configurations	**Recent procurements**
	Recondition/maintenance of K&E stands	4	$500	$2,000	1	$2,000	stands are old and need maintenance	**Recent procurements**
			Subtotal	**$10,200**		**$10,200**		
Job 1810								
9450	**NCSX specific needs**							
	Monuments/nests for floor grid in NCSX test cell	75	$75	$5,625	2	$11,250	NCSX specific one-time need	**Recent procurements**
	Reflector holders for wall - NCSX test cell	50	$150	$7,500	1	$7,500	NCSX specific one-time need	**Recent procurements**
	Leica fixed position reflectors for NCSX test cell walls	50	$300	$15,000	1	$15,000	NCSX specific one-time need	**Recent procurements**
	Leica 0.5" CCRs	15	$1,200	$18,000	1	$18,000	reflectors required to track FPA assembly in mid-air flight and positioning	**Recent procurements**
			Subtotal	**$46,125**		**$51,750**		
5323	**Annual software and hardware maintenance costs**							
	Annual Service Contract for Leica Tracker	1	$17,500	$17,500	3	$52,500	Consumable	**Recent procurements**
	Annual Software maintenance Verisurf	2	$1,750	$3,500	3	$10,500	Annual software renewal to stay current	**Recent procurements**
	Annual Software maintenance Romer	3	$1,750	$5,250	3	$15,750	Annual software renewal to stay current	**Recent procurements**
	Romer Arm Maintenance agreements	3	$4,500	$13,500	3	$40,500	We've been spending $5k/arm ($15K tot) each year for repairs. Maint. agreement provides for loaner and/or quicker turnaround.	**Recent procurements**
			Subtotal	**$39,750**		**$119,250**		
	Total			**$150,275**		**$288,300**		
	Total Cost to NCSX			**$46,125**		**$51,750**		

NCSX June 2007 ETC
TABLE III - Fabrication and Installation

WBS Number: 185
WBS Title: Assembly of Field Periods
Job Numbers: 1802, 1810, and 1815
Job Title: FPA Oversight & Support (1802)
Job Title: FPA Operations - Stations 1, 2, & 3 (1810)
Job Title: FPA Operations - Station 5 (1815)
Job Manager: Mike Viola

Fabrication and Assembly
Assumptions:

- **Assumes 5 day workweek 1 shift no overtime**
- **Parallel ops for sta 5 (2 fixtures available)**
- **Parallel ops for sta 5 (2 fixtures available)**
- **Only 1 fixture for station 3 only**
- **Parallel ops for sta 2**

			K$						FTE								
	TASK DESCRIPTION	Work days	41MS	37STK	35TRVL	31OT	ORNL EM/DSN	SHTB	EMEM	EMSM	EMSB	EMTB	CREW	Met Crew		**Basis of Estimate**	
																Estimate based on recent NCSX FPA activities and the amount of oversight and supervision that is required,	
Job 1802																	
Oversight & Supervision																	checked with primavera
	Metrology Engineering Supervision Station 1 through station 5 raftopolous 50%								0.50							this is LOE adjust consistent with overall schedule	checked with primavera
	PPPL EM LOE Station 1 through station 5 Viola 100%								1.00							this is LOE adjust consistent with overall schedule	checked with primavera
	Title III field period assembly Station 1 through station 5 ORNL support															this is LOE adjust consistent with overall schedule. See table V for detail from Mike Cole	checked with primavera
	HP Coverage in the TFTR TC LOE Station 1 through station 3 @.75 fte							0.75								this is LOE adjust consistent with overall schedule	checked with primavera
Station 2-Modular Coil Sub- Assembly																	checked with primavera
	Sequence Plan (Brown) - Covered in Job 1803																checked with primavera
	Systems Analysis (Brooks) - covered in Job 8204																checked with primavera
	Metrology Plan (Elllis) - Covered in Job 8205																checked with primavera
	Procedures written & approved	14.0															checked with primavera
	JHA completed	6.0															checked with primavera
	Training needs identified & released	6.0															checked with primavera
	ACC review completed	2.0															checked with primavera
	Pre-job brief completed	1.0															checked with primavera
	Station 2 operational																checked with primavera
Station 3-Modular Coil to VVSA Assembly																	checked with primavera
	Sequence Plan (Brown) - Covered in Job 1803																checked with primavera
	Systems Analysis (Brooks) - covered in Job 8204																checked with primavera
	Metrology Plan (Elllis) - Covered in Job 8205																checked with primavera
	Procedures approved	10.0															checked with primavera
	JHA completed	6.0															checked with primavera
	Training needs identified & released	6.0															checked with primavera
	ACC review completed	6.0															checked with primavera
	Pre-job brief completed	6.0															checked with primavera
	Station 3 operational	1.0															checked with primavera
	Fixtures installed	6.0															checked with primavera

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Job Title: FPA Operations - Stations 1, 2, & 3 (1810)																		
Job Title: FPA Operations - Station 5 (1815)																		
Job Manager: Mike Viola																		
Fabrication and Assembly																		
Assumptions:																		
	Assumes 5 day workweek 1 shift no overtime																	
	Parallel ops for sta 5 (2 fixtures available)																	
	Parallel ops for sta 5 (2 fixtures available)																	
	Only 1 fixture for station 3 only																	
	Parallel ops for sta 2																	
Station 5-Final Field Period Assembly																		checked with primavera
	Sequence Plan (Brown) - Covered in Job 1803																	checked with primavera
	Systems Analysis (Brooks) - covered in Job 8204																	checked with primavera
	Metrology Plan (Elllis) - Covered in Job 8205																	checked with primavera
	Procedures approved		14.0															checked with primavera
	JHA completed		6.0															checked with primavera
	Training needs identified & released		6.0															checked with primavera
	ACC review completed		7.0															checked with primavera
	Pre-job brief completed		7.0															checked with primavera
	Station 5 operational		1.0															checked with primavera
Job: 1802 - FP Assy Oversight&Support-VIOLA Total				**$ -**	**$ -**	**$ -**	**-**	**0**	**1**	**2**	**0**	**0**	**0**					checked with primavera
																		checked with primavera

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Job Title: FPA Operations - Station 5 (1815)
Job Manager: Mike Viola

Fabrication and Assembly
Assumptions:

- **Assumes 5 day workweek 1 shift no overtime**
- **Parallel ops for sta 5 (2 fixtures available)**
- **Parallel ops for sta 5 (2 fixtures available)**
- **Only 1 fixture for station 3 only**
- **Parallel ops for sta 2**

	TASK DESCRIPTION	Work days	41MS	37STK	35TRVL	31OT	ORNL EM/DSN	SHTB	EMEM	EMSM	EMSB	EMTB	CREW	Met Crew	Basis of Estimate	
			K$							FTE						checked with primavera
Job: 1810 - Field Period Assembly-VIOLA																
															Station 1: Based on actual VV #1 costs - almost completed.	checked with primavera
															Station 2: Based on actual VV #1 costs - almost completed.	checked with primavera
															Based on experience to accomplish similar tasks (e.g., metrology scans/lock-ins, coil trial fitups, gross checks). Also, it appears that your single shift activity is running parallel resources that are not available. i.e. the trials development crew are the same as the FP crew.	checked with primavera
															Nose/Bushing related items based on conceptual designs and rough estimates	checked with primavera
															Assumed nose concept based on application of epoxy & set-up times	checked with primavera
															estimates based on conceptual designs tempered with experieince in alignment of multiple components	checked with primavera
General F.P. Assy support																checked with primavera
	LOE Crane support, fixture setupfor . Station 1 through station 5 1.2 fte											1.20			2 men 3 day a week .LOE adjust consistent with schedule thru Station 5	checked with primavera
	LOE Field Supervision for station 1 through station 5 edwards 1.0fte									1.00					This is LOE adjust consistent with overall schedule thru Station 5.	checked with primavera
	LOE Metrology support Station 1 tthrough station 5 1.5 fte engr plus ducco 100%								1.50			1.00			this is LOE adjust consistent with overall schedule. Hours distributed per task based resource profile	checked with primavera
	Misc M&S station 1 through station 5		3K/month												3K/month	checked with primavera
			K$							Hours						checked with primavera

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Job Title: FPA Operations - Station 5 (1815)
Job Manager: Mike Viola

Fabrication and Assembly
Assumptions:

- **Assumes 5 day workweek 1 shift no overtime**
- **Parallel ops for sta 5 (2 fixtures available)**
- **Parallel ops for sta 5 (2 fixtures available)**
- **Only 1 fixture for station 3 only**
- **Parallel ops for sta 2**

TASK DESCRIPTION	Work days	41MS	37STK	35TRVL	31OT	ORNL EM/DSN	SHTB	EMEM	EMSM	EMSB	EMTB	CREW	Met Crew	Basis of Estimate	checked with primavera
Station 1-FP #1 VV Prep (hard surface components)															checked with primavera
Layout diagnostic&coolant paths on vessel - **Completed**	35.0														checked with primavera
Install heater tape on vertical ports - **Completed**	7.0														checked with primavera
Verify installation of heater tapes - **Completed**	1.0														checked with primavera
Attach studs for coolant lines - **Completed**	3.0														checked with primavera
Wind magnetic diagnostic sensors - **Completed**	14.0														checked with primavera
Install precision magnetic diagnostic sensors - **Completed**	3.0														checked with primavera
Verify installation magnetic diagnostic sensors - **Completed**	4.0														checked with primavera
Install local I&C (incl thermocouples) - **Completed**	5.0														checked with primavera
Verify installation of local I&C	2.0														checked with primavera
Install cooling/htg lines to vac vsl	15.0										300	2.5			checked with primavera
Weld cooling/htg risers	16.0	$ 2.0K									320	2.5		serial tasks alternating between FPA constant 2.5 men	checked with primavera
Verify Instl of H/C lines,headers,manifolds	5.0										100	2.5		serial tasks alternating between FPA constant 2.5 men	checked with primavera
Perform final acceptance testing (H/C flow test)	**5.0**	**$ 4.0K**									100	**2.5**		**serial tasks alternating between FPA constant 2.5 men**	checked with primavera
Trim seal plates	**2.0**										40	**2.5**		**serial tasks alternating between FPA constant 2.5 men**	checked with primavera
Loop termination & verification	18.0										360	2.5		serial tasks alternating between FPA constant 2.5 men	checked with primavera
install Final Internal and External monuments and measure	4.0										80	2.5			checked with primavera
Final Scan	4.0										80	2.5		serial tasks alternating between FPA constant 2.5 men	checked with primavera
Install heater tape on removeable ports	**10.0**										200	**2.5**		**serial tasks alternating between FPA constant 2.5 men**	checked with primavera
Prepare and transfer completed VV to holding are	2.0										40	2.5		serial tasks alternating between FPA constant 2.5 men	checked with primavera

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Job Title: FPA Operations - Station 5 (1815)																		
Job Manager: Mike Viola																		
Fabrication and Assembly																		
Assumptions:																		
	Assumes 5 day workweek 1 shift no overtime																	
	Parallel ops for sta 5 (2 fixtures available)																	
	Parallel ops for sta 5 (2 fixtures available)																	
	Only 1 fixture for station 3 only																	
	Parallel ops for sta 2																	
Station 1- FP #2 VV Prep (hrd surf cmpnts)																		checked with primavera
	Misc Hardware - **Completed**			$ 2.0K														checked with primavera
	Layout diagnostic&coolant paths on vessel - **Completed**		12.0															checked with primavera
	Install heater tape on vertical ports - **Completed**		7.0															checked with primavera
	Verify installation of heater tapes - **Completed**		1.0															checked with primavera
	Attach studs forcoolant lines - **Completed**		3.0															checked with primavera
	Wind magnetic diagnostic sensors - Completed		14.0															checked with primavera
	Install precision magnetic diagnostic sensors - **Completed**		3.0															checked with primavera
	Verify installation magnetic diagnostic sensors - **Completed**		4.0															checked with primavera
	Install local I&C (incl thermocouples) - **Completed**		5.0															checked with primavera
	Verify installation of local I&C - **Completed**		2.0															checked with primavera
	Install cooling/htg lines to vac vsl		15.0										300	2.5			Serial tasks alternating between FPA constant 2.5 men.	checked with primavera
	Weld cooling/htg risers		16.0	$ 2.0K									320	2.5			Serial tasks alternating between FPA constant 2.5 men. Delayed due to coil tests	checked with primavera
	Verify Instl of H/C lines,headers,manifolds		5.0										100	2.5			Serial tasks alternating between FPA constant 2.5 men. Serial tasks are showing up as parallel on schedule	checked with primavera
	Perform final acceptance testing (H/C flow test)		**5.0**	**$ 4.0K**									**100**	**2.5**			**Serial tasks alternating between FPA constant 2.5 men**	checked with primavera
	Trim seal plates		**2.0**										**40**	**2.5**			**Serial tasks alternating between FPA constant 2.5 men. Need to buy high strength nibbler.**	checked with primavera
	Loop termination & verification		18.0										360	2.5			Serial tasks alternating between FPA constant 2.5 men	checked with primavera
	install Final Internal and External monuments and measure		4.0										80	2.5				checked with primavera
	Final Scan		4.0										80	2.5			Serial tasks alternating between FPA constant 2.5 men	checked with primavera
	Install heater tape on removeable ports		**10.0**										**200**	**2.5**			Serial tasks alternating between FPA constant 2.5 men	checked with primavera
	Prepare and transfer completed VV to holding are		2.0										40	2.5			Serial tasks alternating between FPA constant 2.5 men	checked with primavera
																		checked with primavera

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Job Manager: Mike Viola																		
Fabrication and Assembly																		
Assumptions:																		
	Assumes 5 day workweek 1 shift no overtime																	
	Parallel ops for sta 5 (2 fixtures available)																	
	Parallel ops for sta 5 (2 fixtures available)																	
	Only 1 fixture for station 3 only																	
	Parallel ops for sta 2																	
Station 1- FP #3 VV Prep (hrd surf cmpnts)																		checked with primavera
	Misc Hardware			$ 2.0K														checked with primavera
	Layout diagnostic&coolant paths on vessel - **Completed**		12.0										240	2.5			**15% complete**	checked with primavera
	Install heater tape on vertical ports		7.0										140	2.5			Serial tasks alternating between FPA constant 2.5 men. Not started yet due to coil alignment tests	checked with primavera
	Verify installation of heater tapes		1.0										20	2.5			Serial tasks alternating between FPA constant 2.5 men. Not started yet due to coil alignment tests	checked with primavera
	Attach studs for coolant lines		3.0										60	2.5			Serial tasks alternating between FPA constant 2.5 men. Not started yet due to coil alignment tests	checked with primavera
	Install Templates		**3.0**										**60**	**2.5**			Serial tasks alternating between FPA constant 2.5 men. Not started yet due to coil alignment tests	
	Wind magnetic diagnostic sensors		14.0										280	2.5			Serial tasks alternating between FPA constant 2.5 men. Not started yet due to coil alignment tests	checked with primavera
	Install precision magnetic diagnostic sensors **- Completed**		3.0										60	2.5			Serial tasks alternating between FPA constant 2.5 men.	checked with primavera
	Verify installation magnetic diagnostic sensors **- Completed**		4.0										80	2.5			Serial tasks alternating between FPA constant 2.5 men.	checked with primavera
	Install local I&C (incl thermocouples)		5.0										100	2.5			Serial tasks alternating between FPA constant 2.5 men.	checked with primavera
	Verify installation of local I&C		2.0										40	2.5			Serial tasks alternating between FPA constant 2.5 men.	checked with primavera
	Install cooling/htg lines to vac vsl		15.0										300	2.5			Serial tasks alternating between FPA constant 2.5 men.	checked with primavera
	Weld cooling/htg risers		16.0										320	2.5			Serial tasks alternating between FPA constant 2.5 men Experience is 8 tubes per day 128 tubes per VVSA	checked with primavera
	Verify Instl of H/C lines,headers,manifolds		5.0										100	2.5			Serial tasks alternating between FPA constant 2.5 men.	checked with primavera
	Perform final acceptance testing (H/C flow test)		**5.0**										**100**	**2.5**			**Serial tasks alternating between FPA constant 2.5 men**	checked with primavera
	Trim seal plates		**2.0**										**40**	**2.5**			**Serial tasks alternating between FPA constant 2.5 men**	checked with primavera
	Loop termination & verification		18.0										360	2.5				checked with primavera
	Install Final Internal and External monuments and measure		4.0										80	2.5			Serial tasks alternating between FPA constant 2.5 men.	checked with primavera
	Final Scan		4.0										80	2.5			Serial tasks alternating between FPA constant 2.5 men.	checked with primavera
	Install heater tape and insulation on removeable ports		**10.0**										**200**	**2.5**			**Serial tasks alternating between FPA constant 2.5 men**	checked with primavera
	Prepare and transfer completed VV to holding area		2.0										40	2.5			Serial tasks alternating between FPA constant 2.5 men.	checked with primavera
Station 1-Spool pieces (3) (spacers)													2702					checked with primavera
	Attach diagnostics, studs and coolant lines		17.0										340	2.5				checked with primavera
	install Final Internal and External monuments and measure		2.0										40	2.5				checked with primavera

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Job Manager: Mike Viola																		
Fabrication and Assembly																		
Assumptions:																		
	Assumes 5 day workweek 1 shift no overtime																	
	Parallel ops for sta 5 (2 fixtures available)																	
	Parallel ops for sta 5 (2 fixtures available)																	
	Only 1 fixture for station 3 only																	
	Parallel ops for sta 2																	
																		checked with primavera
Station 2 Trials																		checked with primavera
	Trial tensioning test on prototype		2.0	$ 3.0K									40	2.5				checked with primavera
	Trial bushing and shim test on prototype		12.0	$ 2.0K									240	2.5				checked with primavera
	Perform trial x-y-z alignments on A1-A2.		7.0	$ 2.0K									140	2.5				checked with primavera
	Perform developmental trials on A1-A2.		***30.0***	***$ 2.0K***									***600***	***2.5***			***included in job 1421***	checked with primavera
	Bushing test A-B		7.0										112	2.0				
	Bushing test B-C		7.0										112	2.0				
	Alignment mechanisms, metro equipt &positioning		6.0	$ 40.0K									120	2.5				checked with primavera
	Procure alignment mechanisms, fiducials, lifting		20.0	$ 25.0K									400	2.5				checked with primavera
	Develop procedures for torquing bolts		4.0										80	2.5				checked with primavera
	Develop trails for for NOSE WELDING (RLS addition)		30.0	$ 70.0K									600	2.5			**Perform welding trials and procure EWI and Bob Parcells support**	checked with primavera
	Determine fiducial types&locations		11.0	$ 2.0K									220	2.5				checked with primavera
	Procure monuments&related metrology equipment		15.0	$ 15.0K									300	2.5				checked with primavera
	Hardware rework (1/2 FTE)		120.0	$ 10.0K									960	1.0			**MISC LOE SUPPORT**	checked with primavera
Station 2 Setup																		checked with primavera
	Misc Hardware			$ 5.0K														checked with primavera
	Test out equipt & procedures		7.0										140	2.5				checked with primavera
	Receive drawings and hardware (shims and bolts)		7.0										140	2.5				checked with primavera
3.00	**Shim sizing / preparations**																	checked with primavera
3.01	Using flange measurement of the coils, define the A/A and A/B shim thickness.																**Back Office**	checked with primavera
3.02	Surface grind a set of metal shims that will be used on the first MCHP article for assembly process qualifications.		12.0										240	2.5			**Actual experience (LED: actual Experience Was 4 days per JOINT)**	checked with primavera
3.03	Compress alumina coated shims and sort by thickness the shim set that will be installed on the MCHP.		6.0										120	2.5			**800 shims - not critical path**	checked with primavera
4.00	**Pre-Installation Station 2 set-up**																**Metrology plan covering Station 2:**	checked with primavera
4.01	Install MCHP fixtures and metrology equipment.																**not critical path - separate crew in parallel**	checked with primavera
4.02	Perform metrology set-up and checks		5.0										100	2.5			**not critical path - separate crew in parallel**	checked with primavera
	Install **FIRST** Holding 20 deg fixture		4.0	$ 2.0K									80	2.5				checked with primavera
	Install **SECOND** Holding 20 deg fixture		3.0	$ 2.0K									60	2.5			Just received - Not done yet	checked with primavera
	Install **THIRD** Holding 20 deg fixture		6.0	$ 2.0K									120	2.5			Just received - Not done yet	checked with primavera
	Install **LAST** Holding 20 deg fixture		3.0	$ 2.0K									60	2.5			Just received - Not done yet	checked with primavera
	Tools&tooling available for FPA operations		2.0										40	2.5				checked with primavera
																		checked with primavera

WBS Number: 185																		
WBS Title: Assembly of Field Periods																		
Job Numbers: 1802, 1810, and 1815																		
Job Title: FPA Oversight & Support (1802)																		
Job Title: FPA Operations - Stations 1, 2, & 3 (1810)																		
Job Title: FPA Operations - Station 5 (1815)																		
Job Manager: Mike Viola																		
Fabrication and Assembly																		
Assumptions:																		
	Assumes 5 day workweek 1 shift no overtime																	
	Parallel ops for sta 5 (2 fixtures available)																	
	Parallel ops for sta 5 (2 fixtures available)																	
	Only 1 fixture for station 3 only																	
	Parallel ops for sta 2																	
STATION 2																		checked with primavera
Pre-measauring and fitup checks																		checked with primavera
1.00	**MC fit-up pre-check and surface insulation**																**Sequence Plan R5**	checked with primavera
1.01	Verify that mating MC's of a MCHP will come together without interferences by pre-fitting mating coils. This will include the Type-C coil with its interfacing Period Type-C coil.		4.0										80	2.5				checked with primavera
1.02	Epoxy paint all close fitting interfacing surfaces.		3.0										60	2.5				checked with primavera
2.00	**Pre-measurement of MCHP Type A, B and C coils flanges plus interfacing Type-A coil flange**																**2 at a time on the two 20 degree wedges**	checked with primavera
2.01	Set the **Type-A** coil on the pre-measurement fixture, "A" side flange down.		1.0										20	2.5			**May be done early**	checked with primavera
2.02	Using the laser tracker, align to the conical seats locking into a minimum of 8 of them.		2.0												40		**Metrology Staff Budgeted as LOE**	checked with primavera
2.03	Establish a global coordinate system based on the modular coil geometry. Measure the monuments on the fixture and on the walls.		7.0												140		**Metrology Staff Budgeted as LOE**	checked with primavera
2.04	Measure all of the tooling ball monuments on the winding form.		1.0												20		**Metrology Staff Budgeted as LOE**	checked with primavera
2.05	Scan the "B" flange of the Type-A coil.		1.0												20		**Metrology Staff Budgeted as LOE**	checked with primavera
2.07	Remove Type-A coil from stand and move to holding area.		1.0										20	2.5				checked with primavera
2.08	**Measure Type B "A" flanges**		14.0										40	2.5	220		**Repeats 2.01-2.07**	checked with primavera
2.11	**Measure Type C "A"flanges**		13.0										40	2.5	220		**Repeats 2.01-2.07**	checked with primavera
2.14	**Measure Type A-A "A" flange**		13.0										40	2.5	220		**Repeats 2.01-2.07**	checked with primavera
3.00	**Shim sizing / preparations**																**Sequence Plan R5**	checked with primavera
3.01	Using flange measurement of the coils, define the A/A and A/B shim thickness.																**Back Office**	checked with primavera
3.02	Surface grind a set of metal shims that will be used on the first MCHP article for assembly process qualifications.		4.0										80	2.5			**Actual experience**	checked with primavera
4.00	**Pre-Installation Station 2 set-up recalibration**																**Sequence Plan R5**	checked with primavera
4.01	Install MCHP fixtures and metrology equipment.												0	2.5				checked with primavera
4.02	Perform metrology set-up and checks	66	2.0												40		**Metrology Staff Budgeted as LOE**	checked with primavera

WBS Number: 185
WBS Title: Assembly of Field Periods
Job Numbers: 1802, 1810, and 1815
Job Title: FPA Oversight & Support (1802)
Job Title: FPA Operations - Stations 1, 2, & 3 (1810)
Job Title: FPA Operations - Station 5 (1815)
Job Manager: Mike Viola

Fabrication and Assembly
Assumptions:

- **Assumes 5 day workweek 1 shift no overtime**
- **Parallel ops for sta 5 (2 fixtures available)**
- **Parallel ops for sta 5 (2 fixtures available)**
- **Only 1 fixture for station 3 only**
- **Parallel ops for sta 2**

Assemble A1B1C1																		checked with primavera
5.00	**Pre-assemble A1-A2**																**Sequence Plan R5**	checked with primavera
5.01	Position the Type-A modular coil on the fixture, "B" flange down. Obtain a set of "realigned" fiducial positions.		2.0										40				**Metrology Staff Budgeted as LOE - COMPLETED**	checked with primavera
5.02	Align the laser tracker to the conical seats locking into a minimum of 8 of them.		1.0												20		**Metrology Staff Budgeted as LOE**	checked with primavera
5.03	Establish a global coordinate system based on the modular coil geometry. Measure the monuments on the fixture and on the walls.		2.0												40		**Metrology Staff Budgeted as LOE**	checked with primavera
5.04	Place the an initial set of metal shims on the coil in the designated locations, identical to those in the A1-A2 fit up test.		0.5										10	2.5				checked with primavera
5.05	Install dial indicators on the modular coil in areas where we expect to see deflection.		2.0										40	2.5				checked with primavera
5.06	Lower the mating type A modular coil into position.		1.0										20	2.5				checked with primavera
5.07	Measure the monuments on the bottom coil. Jack areas of the coil as necessary to bring displaced monuments back to within .002" of their original position.		1.0										20	2.5				checked with primavera
5.08	Using three target points, perform the positioning as was done in the A1-A2 fit up test.		1.0										20	2.5				checked with primavera
5.09	Install the remaining metal shims with Fuji paper, install studs, supernuts, and torque to 50% of final value.		2.0										40	2.5				checked with primavera
5.10	Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that they are tight. If a loose shim is found back off on sufficient adjacent bolts to allow a replacement shim to be inserted. Tighten bolt and recheck.		1.0										20	2.5				checked with primavera
5.11	Measure the tooling balls on both coils. The maximum deviation from the "realigned" points should be .007" or less.		5.0												100		**Metrology Staff Budgeted as LOE**	checked with primavera
5.12	If the above step does not fall within .007" or less then loosen all studs, adjust shims locally. Re-torque all studs to 50%.		3.0										60	2.5				checked with primavera
~~5.13~~	~~Loosen studs to extract Fuji paper. Evaluate shim pressure distribution and make shim adjustments if shim pressure is unacceptable. Re-torque all studs to 50% and recheck alignment.~~																	checked with primavera
5.14	Install the A-A locator bushings at two stud locations for use in re-positioning MCHP in Stage 3.		2.0										40	2.5				checked with primavera
5.15	Remove all studs, nuts, shims etc. Identify shim locations.		1.0										20	2.5				checked with primavera
6.00	**A-B modular coil assembly**																**Sequence Plan R5**	checked with primavera
6.01	Place the Type-A coil, "A" flange down, on the 20deg fixture. Obtain a set of "realigned" fiducial positions for the "A" and "B" coils.		2.0										40	2.5				checked with primavera
6.02	Using the laser tracker, align to the conical seats locking into a minimum of 8 of them.		1.0												20		**Metrology Staff Budgeted as LOE**	checked with primavera
6.03	Establish a global coordinate system based on the modular coil geometry. Measure the monuments on the fixture and on the walls.		2.0												40		**Metrology Staff Budgeted as LOE**	checked with primavera
6.04	Place the an initial set of metal shims on the coil in the designated locations.		2.0										40	2.5				checked with primavera
6.04.1	Stuff Shim Bag with Fiberglas, Reseal, Place Shim Bag on Wing		0.3										5	2.5			**LED: Must place bag before coil assembly**	checked with primavera
6.05	Lower the Type-B coil onto the Type-A coil.		1.0										20	2.5				checked with primavera
6.06	Measure the monuments on the A coil. Jack areas of the coil as necessary to bring displaced monuments back to within .002" of their original position.		1.0										20	2.5				checked with primavera
6.06.1	Install Dial indicators for X-Y Positioning		1.0										20	2.5			**LED: Missing from sequence**	checked with primavera
6.07	Using three target points on the B coil, perform the X-Y positioning of the B coil.		1.0										20	2.5				checked with primavera
6.08	Install the remaining metal shims with Fuji paper, install studs, supernuts, and torque to 50% of final value.		2.0										40	2.5				checked with primavera
6.09	Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that they are tight. If a loose shim is found back off on sufficient adjacent bolts to allow a replacement shim to be inserted. Tighten bolt and recheck.		1.0										20	2.5				checked with primavera
6.10	Measure the tooling balls on both coils. The maximum deviation from the "realigned" points should be .007" or less.		5.0												100		**Metrology Staff Budgeted as LOE**	checked with primavera
6.11	If the above step does not fall within .007" or less then loosen all studs, adjust shims locally. Re-torque all studs to 50%.		3.0										60	2.5				checked with primavera
6.12	Loosen all studs, reduce load on flanges and install an equivalent set of alumina coated metal shims. Re-torque all studs to 50%.		1.0										20	2.5				checked with primavera
6.13	Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that they are tight. If a loose shim is found back off on sufficient adjacent bolts to allow a replacement shim to be inserted. Tighten bolt and recheck.		1.0										20	2.5				checked with primavera
6.14	Measure the tooling balls on both coils. The maximum deviation from the "realigned" points should be .007" or less.		5.0												100		**Metrology Staff Budgeted as LOE**	checked with primavera

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Job Numbers: 1802, 1810, and 1815																		
Job Title: FPA Oversight & Support (1802)																		
Job Title: FPA Operations - Stations 1, 2, & 3 (1810)																		
Job Title: FPA Operations - Station 5 (1815)																		
Job Manager: Mike Viola																		
Fabrication and Assembly																		
Assumptions:																		
	Assumes 5 day workweek 1 shift no overtime																	
	Parallel ops for sta 5 (2 fixtures available)																	
	Parallel ops for sta 5 (2 fixtures available)																	
	Only 1 fixture for station 3 only																	
	Parallel ops for sta 2																	
6.15	If the above step does not fall within .007" or less then loosen all studs, adjust shims locally. Re-torque all studs to 50%.		3.0										60	2.5				checked with primavera
6.16	One hole at a time, remove the supernut. Using the eccentric gage slid onto the stud define the hole eccentricity. Select bushing and machine to match required eccentricity. Install bushing. Replace nut and tighten back to 50% and recheck alignment. Total 10 days 7 days to pre fit & fab bushings (in parallel with other tasks)and 3 days to install		**10.0**										200	2.5			**LED: Technical Issue space in some areas is insufficient to remove nuts with flanges in position. If there is space duration should be 1.5 days**	checked with primavera
6.17	Complete tightening of flange bolts to 100%.		1.0										20	2.5				checked with primavera
6.18	Measure the tooling balls on both coils. The maximum deviation from the "realigned" points should be .007" or less.		2.0												40		**Metrology Staff Budgeted as LOE**	checked with primavera
6.19	Scan the "B" flange of Type-B coil		1.0										20	2.5				checked with primavera
6.20	Using the "B" flange measurement of the Type-B coil and the earlier "A" flange measurement of the Type-C coil, define all B/C flange shim thickness.																**Back office**	checked with primavera
7.00	**(A-B) to C modular coil assembly (MCHP)**																**Sequence Plan R5**	checked with primavera
7.01	Place the "A/B" assembly, "A" coil down, on the 40deg fixture. Obtain a set of "realigned" fiducial positions. For the "A", "B", and "C" coils.		3.0										60	2.5				checked with primavera
7.02	Using the laser tracker, align to the conical seats locking into a minimum of 8 of them.		1.0												20		**Metrology Staff Budgeted as LOE**	checked with primavera
7.03	Establish a global coordinate system based on the modular coil geometry. Measure the monuments on the fixture and on the walls.		2.0												40		**Metrology Staff Budgeted as LOE**	checked with primavera
7.04	Place the an initial set of metal shims on the coil in the designated locations.		2.0										40	2.5				checked with primavera
7.05	Lower the Type-C coil onto the Type-B coil.		1.0										20	2.5				checked with primavera
7.06	Measure the monuments on the A coil to evaluate monument displacements. If movement greater than .002" is observed discuss with back office on how to proceed in bringing displaced monuments back to within .002" of their original position.		1.0												20		**Metrology Staff Budgeted as LOE**	checked with primavera
6.06.1	Install Dial indicators for X-Y Positioning		1.0										20	2.5			**LED: Missing from sequence**	checked with primavera
7.07	Using three target points on the Type-C coil, perform the X-Y positioning of the coil.		1.0										20	2.5				checked with primavera
7.08	Install the remaining metal shims with Fuji paper, install studs, supernuts, and torque to 50% of final value.		2.0										40	2.5				checked with primavera
7.09	Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that they are tight. If a loose shim is found back off on sufficient adjacent bolts to allow a replacement shim to be inserted. Tighten bolt and recheck.		1.0										20	2.5				checked with primavera
7.10	Measure the tooling balls on all coils. The maximum deviation from the "realigned" points should be .010" or less.		5.0												100		**Metrology Staff Budgeted as LOE**	checked with primavera
7.11	If the above step does not fall within .010" or less then loosen all studs, adjust shims locally. Re-torque all studs to 50%.		3.0										60	2.5				checked with primavera
7.12	Loosen all studs, reduce load on flanges and install an equivalent set of alumina coated metal shims. Re-torque all studs to 50%.		1.0										20	2.5				checked with primavera
7.13	Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that they are tight. If a loose shim is found back off on sufficient adjacent bolts to allow a replacement shim to be inserted. Tighten bolt and recheck.		1.0										20	2.5				checked with primavera
7.14	Measure the tooling balls on all coils. The maximum deviation from the "realigned" points should be .010" or less.		5.0										100	2.5				checked with primavera
7.15	If the above step does not fall within .010" or less then loosen all studs, adjust shims locally. Re-torque all studs to 50%.		3.0										60	2.5				checked with primavera
7.16	One hole at a time, remove the supernut. Using the eccentric gage slid onto the stud define the hole eccentricity. Select bushing and machine to match required eccentricity. Install bushing. Replace nut and tighten back to 50% and recheck alignment. Total 10 days 7 days to pre fit & fab bushings (in parallel with other tasks)and 3 days to install		**10.0**										200	2.5			**LED: Increase duraction to 1.5**	checked with primavera
7.17	Complete tightening of flange bolts to 100%.		1.0										20	2.5				checked with primavera
11.01	Install or identify three primary fiducials that will be used in positioning the Period in Station 3.		1.0										20	2.5				checked with primavera
7.18	Measure the tooling balls on both coils. The maximum deviation from the "realigned" points should be .010" or less. Make final metrology measurement of all fiducials. Scan the "B" flange of Type-C coil. Record the results.		5.0												100		**Metrology Staff Budgeted as LOE**	checked with primavera
8.00	**Tack weld inboard welded shims**																**Sequence Plan R5**	checked with primavera
8.01	Partially tack weld all inboard shims to one flange to keep them in place. The final welding of all welded shims to take place in Station 3.		2.0										40	2.5			**Perform at A-B also**	checked with primavera
9.00	**Install trim coil**																**Sequence Plan R5**	checked with primavera

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Job Title: FPA Operations - Station 5 (1815)																		
Job Manager: Mike Viola																		
Fabrication and Assembly																		
Assumptions:																		
	Assumes 5 day workweek 1 shift no overtime																	
	Parallel ops for sta 5 (2 fixtures available)																	
	Parallel ops for sta 5 (2 fixtures available)																	
	Only 1 fixture for station 3 only																	
	Parallel ops for sta 2																	
9.01	Install trim coil on the top surface of the Type-C on Period 1 and 2 only on the MCHP - Right Side (See Figure 3 below).		6.0										120	2.5				checked with primavera
10.00	**Complete local service and interface details**																**Sequence Plan R5**	checked with primavera
10.01	Install all wing support bladders between wing surfaces (A/B, B/C) and on the C wing (MCHP - Right Side only).		2.0										40	2.5			**LED: Bags were placed earlier**	checked with primavera
10.02	Make local service runs/connections on the shell of each MC.		8.0										160	2.5			**4 days for coolant lines 4 days for mod coils thermocouples and strain gages terminations**	checked with primavera
10.03	Inject stycast or some compound to fill in all shim spaces in order to prevent VV/MC insulation from falling out.		1.0										20	2.5				checked with primavera
11.00	**Final measurements / transfer completed MCHP to holding area**																**Sequence Plan R5**	checked with primavera
11.02	Make final metrology measurement of all fiducials. Scan the "B" flange of Type-C coil. Record the results.												0	2.5			**Done at 7.18**	checked with primavera
11.03	Using tension tester measure bolt length on all tension fasteners and record the results.		0.5										10	2.5				checked with primavera
11.04	Mark part for identification		0.0										0	2.5				checked with primavera
11.05	Install lift support beams		2.0										40	2.5				checked with primavera
11.06	Remove from stand and measure weight of completed assembly		1.0										20	2.5				checked with primavera
11.07	Move to holding area.		0.0										0	2.5			**246 shifts**	checked with primavera

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Job Title: FPA Operations - Station 5 (1815)																		
Job Manager: Mike Viola																		
Fabrication and Assembly																		
Assumptions:																		
	Assumes 5 day workweek 1 shift no overtime																	
	Parallel ops for sta 5 (2 fixtures available)																	
	Parallel ops for sta 5 (2 fixtures available)																	
	Only 1 fixture for station 3 only																	
	Parallel ops for sta 2																	
	A1,B1,C1 subtotal task 5-11 (total elasp time		**126**										**2125**		**740**			checked with primavera
Station 2 - Production Articles (HPA) and second half of FP #1 A2,B2,C2																	**Sequence Plan R5**	checked with primavera
1.00	**MC fit-up pre-check and surface insulation**																**Sequence Plan R5**	checked with primavera
1.01	Verify that mating MC's of a MCHP will come together without interferences by pre-fitting mating coils. This will include the Type-C coil with its interfacing Period Type-C coil.		4.0										80	2.5				checked with primavera
1.02	Epoxy paint all close fitting interfacing surfaces.		3.0										60	2.5				checked with primavera
2.00	**Pre-measurement of MCHP Type A, B and C coils flanges plus interfacing Type-A coil flange**																**Sequence Plan R5**	checked with primavera
2.08	**Measure Type B "A" flanges**		14.0										40	2.5	220		**Repeats 2.01-2.07**	checked with primavera
2.11	**Measure Type C "A"flanges**		13.0										40	2.5	220		**Repeats 2.01-2.07**	checked with primavera
2.14	**Measure Type A-A "A" flange**		13.0										40	2.5	220		**Repeats 2.01-2.07**	checked with primavera
3.00	**Shim sizing / preparations**																**Sequence Plan R5**	checked with primavera
3.01	Using flange measurement of the coils, define the A/A and A/B shim thickness.																	checked with primavera
3.02	Compress alumina coated shims and sort by thickness the shim set that will be installed on the MCHP.		4.0										80	2.5			**May need more shims**	checked with primavera
4.00	**Pre-Installation Station 2 set-up recalibration**																**Sequence Plan R5**	checked with primavera
4.01	Install MCHP fixtures and metrology equipment.												0	2.5				checked with primavera
4.02	Perform metrology set-up and checks	53.0	2.0												40		**Metrology Staff Budgeted as LOE**	checked with primavera
5.00	**Pre-assemble A-A (Needs to be done total of 3 timee A1-A2, A3-A4, A5-A6)**																	checked with primavera
5.01	Position the Type-A modular coil on the fixture, "B" flange down. Obtain a set of "realigned" fiducial positions.																	checked with primavera
5.02	Align the laser tracker to the conical seats locking into a minimum of 8 of them.																	checked with primavera
5.03	Establish a global coordinate system based on the modular coil geometry. Mea e monuments on the fixture and on the walls.																	checked with primavera
5.04	Place all alumina and grind inboard weld shims on the coil.																	checked with primavera
5.05	Install dial indicators on the modular coil in areas where we expect to see defle																	checked with primavera
5.06	Lower the mating type A modular coil into position.																	checked with primavera
5.07	Measure the monuments on the bottom coil. Jack areas of the coil as necessa displaced monuments back to within .002" of their original position.																	checked with primavera
5.08	Using three target points, perform the positioning as was done in the A1-A2																	checked with primavera
5.09	Install studs, supernuts, and torque to 50% of final value.																	checked with primavera
5.10	Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that the loose sh found back off on sufficient adjacent bolts to allow a replacement shim to be ten bolt recheck.																	checked with primavera
5.11	Measure the tooling balls on both coils. The maximum deviation from the " ned" p should .007" or less.																	checked with primavera
5.12	If the above step does not fall within .007" or less then loosen all studs, adjust shims locally. Re-torque all studs to 50%.																	checked with primavera
5.13	Install the A-A locator bushings at two stud locations for use in re-positioning MCHP in Stage 3.																	checked with primavera
5.14	Remove all studs, nuts, shims etc. Identify shim locations.																	checked with primavera
6.00	**A-B modular coil assembly**																**Sequence Plan R5**	checked with primavera
6.01	Place the Type-A coil, "A" flange down, on the 20deg fixture. Obtain a set of "realigned" fiducial positions for the "A" and "B" coils.		1.0										20	2.5				checked with primavera
6.02	Using the laser tracker, align to the conical seats locking into a minimum of 8 of them.		1.0												20		**Metrology Staff Budgeted as LOE**	checked with primavera
6.03	Establish a global coordinate system based on the modular coil geometry. Measure the monuments on the fixture and on the walls.		2.0												40		**Metrology Staff Budgeted as LOE**	checked with primavera
6.04	Place all alumina and grind inboard weld shims on the coil.		2.0										40	2.5				checked with primavera
6.04.1	Stuff Shim Bag with Fiberglas, Reseal, Place Shim Bag on Wing		0.3										5	2.5			**LED: Must place bag before coil assembly**	checked with primavera
6.05	Lower the Type-B coil onto the Type-A coil.		1.0										20	2.5				checked with primavera
6.06	Measure the monuments on the A coil. Jack areas of the coil as necessary to bring displaced monuments back to within .002" of their original position.		1.0												20		**Metrology Staff Budgeted as LOE**	checked with primavera
6.06.1	Install Dial indicators for X-Y Positioning		1.0										20	2.5			**LED: Missing from sequence**	checked with primavera

WBS Number: 185
WBS Title: Assembly of Field Periods
Job Numbers: 1802, 1810, and 1815
Job Title: FPA Oversight & Support (1802)
Job Title: FPA Operations - Stations 1, 2, & 3 (1810)
Job Title: FPA Operations - Station 5 (1815)
Job Manager: Mike Viola

Fabrication and Assembly
Assumptions:

Assumes 5 day workweek 1 shift no overtime
Parallel ops for sta 5 (2 fixtures available)
Parallel ops for sta 5 (2 fixtures available)
Only 1 fixture for station 3 only
Parallel ops for sta 2

6.07	Using three target points on the B coil, perform the X-Y positioning of the B coil.		1.0												20		**Metrology Staff Budgeted as LOE**	checked with primavera
6.08	Install studs, supernuts, and torque to 50% of final value.		2.0										40	2.5				checked with primavera
6.09	Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that they are tight. If a loose shim is found back off on sufficient adjacent bolts to allow a replacement shim to be inserted. Tighten bolt and recheck.		1.0										20	2.5				checked with primavera
6.10	Measure the tooling balls on both coils. The maximum deviation from the "realigned" points should be .007" or less.		5.0												100		**Metrology Staff Budgeted as LOE**	checked with primavera
6.11	If the above step does not fall within .007" or less then loosen all studs, adjust shims locally. Re-torque all studs to 50%.		3.0										60	2.5				checked with primavera
6.12	One hole at a time, remove the supernut. Using the eccentric gage slid onto the stud define the hole eccentricity. Select bushing and machine to match required eccentricity. Install bushing. Replace nut and tighten back to 50% and recheck alignment. Total 10 days 7 days to pre fit & fab bushings (in parallel with other tasks)and 3 days to install		**10.0**										200	2.5			**LED: See above**	checked with primavera
6.13	Complete tightening of flange bolts to 100%.		1.0										20	2.5				checked with primavera
6.14	Measure the tooling balls on both coils. The maximum deviation from the "realigned" points should be .007" or less.		3.0												60		**Metrology Staff Budgeted as LOE**	checked with primavera
6.15	Scan the "B" flange of Type-B coil		1.0										20	2.5				checked with primavera
6.16	Using the "B" flange measurement of the Type-B coil and the earlier "A" flange measurement of the Type-C coil, define all B/C flange shim thickness.																	checked with primavera
7.00	**(A-B) to C modular coil assembly (MCHP)**																**Sequence Plan R5**	checked with primavera
7.01	Place the "A/B" assembly, "A" coil down, on the 40deg fixture. Obtain a set of "realigned" fiducial positions. For the "A", "B", and "C" coils.		2.0										40	2.5				checked with primavera
7.02	Using the laser tracker, align to the conical seats locking into a minimum of 8 of them.		1.0												20		**Metrology Staff Budgeted as LOE**	checked with primavera
7.03	Establish a global coordinate system based on the modular coil geometry. Measure the monuments on the fixture and on the walls.		2.0												40		**Metrology Staff Budgeted as LOE**	checked with primavera
7.04	Place all alumina and grind inboard weld shims on the coil.		2.0										40	2.5				checked with primavera
7.05	Lower the Type-C coil onto the Type-B coil.		1.0										20	2.5				checked with primavera
7.06	Measure the monuments on the A coil to evaluate monument displacements. If movement greater than .002" is observed discuss with back office on how to proceed in bringing displaced monuments back to within .002" of their original position.		1.0												20		**Metrology Staff Budgeted as LOE**	checked with primavera
7.07	Using three target points on the Type-C coil, perform the X-Y positioning of the coil.		1.0										20	2.5				checked with primavera
7.08	Install studs, supernuts, and torque to 50% of final value.		2.0										40	2.5				checked with primavera
7.09	Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that they are tight. If a loose shim is found back off on sufficient adjacent bolts to allow a replacement shim to be inserted. Tighten bolt and recheck.		1.0										20	2.5				checked with primavera
7.10	Measure the tooling balls on all coils. The maximum deviation from the "realigned" points should be .010" or less.		5.0												100		**Metrology Staff Budgeted as LOE**	checked with primavera
7.11	One hole at a time, remove the supernut. Using the eccentric gage slid onto the stud define the hole eccentricity. Select bushing and machine to match required eccentricity. Install bushing. Replace nut and tighten back to 50% and recheck alignment. Total 10 days 7 days to pre fit & fab bushings (in parallel with other tasks)and 3 days to install		**10.0**										200	2.5			**LED: See above**	checked with primavera
7.12	Complete tightening of flange bolts to 100%.		1.0										20	2.5				checked with primavera
7.13	Measure the tooling balls on both coils. The maximum deviation from the "realigned" points should be .010" or less.		4.0												80		**Metrology Staff Budgeted as LOE**	checked with primavera
8.00	**Tack weld inboard welded shims**																**Sequence Plan R5**	checked with primavera
8.01	Partially tack weld all inboard shims to one flange to keep them in place. The final welding of all welded shims to take place in Station 3.		1.0										20	2.5				checked with primavera
9.00	**Install trim coil**																**Sequence Plan R5**	checked with primavera
9.01	Install trim coil on the top surface of the Type-C on Period 1 and 2 only on the MCHP - Right Side (See Figure 3 below).		6.0										120	2.5				checked with primavera
10.00	**Complete local service and interface details**																**Sequence Plan R5**	checked with primavera
10.01	Inflate all wing support bladders between wing surfaces (A/B, B/C) and on the C wing (MCHP - Right Side only).		2.0										40	2.5			**See above**	checked with primavera
10.02	Make local service runs/connections on the shell of each MC.		8.0										160	2.5			**4 days for coolant lines 4 days for mod coils thermocouples and strain gages terminations**	checked with primavera

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Job Title: FPA Operations - Stations 1, 2, & 3 (1810)																		
Job Title: FPA Operations - Station 5 (1815)																		
Job Manager: Mike Viola																		
Fabrication and Assembly																		
Assumptions:																		
	Assumes 5 day workweek 1 shift no overtime																	
	Parallel ops for sta 5 (2 fixtures available)																	
	Parallel ops for sta 5 (2 fixtures available)																	
	Only 1 fixture for station 3 only																	
	Parallel ops for sta 2																	
10.03	Inject stycast or some compound to fill in all shim spaces in order to prevent VV/MC insulation from falling out.		1.0										20	2.5				checked with primavera
11.00	**Final measurements / transfer completed MCHP to holding area**																**Sequence Plan R5**	checked with primavera
11.01	Install or identify three primary fiducials that will be used in positioning the Period in Station 3.		1.0										20	2.5				checked with primavera
11.02	Make final metrology measurement of all fiducials. Scan the "B" flange of Type-C coil. Record the results.		5.0												100		**Metrology Staff Budgeted as LOE**	checked with primavera
11.03	Using tension tester measure bolt length on all tension fasteners and record the results.		0.5										10	2.5				checked with primavera
11.04	Mark part for identification		0.0										0	2.5				checked with primavera
11.05	Install lift support beams		2.0										40	2.5				checked with primavera
11.06	Remove from stand and measure weight of completed assembly and Move to holding area.		2.0										40	2.5				checked with primavera

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Job Manager: Mike Viola																		
Fabrication and Assembly																		
Assumptions:																		
	Assumes 5 day workweek 1 shift no overtime																	
	Parallel ops for sta 5 (2 fixtures available)																	
	Parallel ops for sta 5 (2 fixtures available)																	
	Only 1 fixture for station 3 only																	
	Parallel ops for sta 2																	
	A2,B2,C2 Subtotal task 5-11 (total elasp time)		**83**										**1335**		**620**			checked with primavera
Station 2-Modular Coil Subassembly-FP#2																		checked with primavera
	Assemble/Align Mod-Coils A3/B3/C3		**126**										**2125**		**740**		**Sequence Plan R5**	checked with primavera
	Assemble/Align Mod-Coils A4/B4/C4		**83**										**1335**		**620**		**Sequence Plan R5**	checked with primavera
Station 2-Modular Coil Subassembly-FP#3																		checked with primavera
	Assemble/Align Mod-Coils A5/B5/C5		**126**										**2125**		**740**		**Sequence Plan R5**	checked with primavera
	Assemble/Align Mod-Coils A6/B6/C6		**83**										**1335**		**620**		**Sequence Plan R5**	checked with primavera
																		checked with primavera
Station 3-Assemble Mod Coils and VVSA-FP#1																		checked with primavera
	Misc Hardware			$ 5.0K														checked with primavera
	Procure and load test 3 legged actuator System		4.0	$ 43.0K									96	3.0				checked with primavera
	Procure, Fabricate and load test 3 legged actuator Lift Fixture		8.0	$ 6.0K									128	2.0				checked with primavera
	Begin Assembly of First Field Period Assy		2.0										40	2.5				checked with primavera
	Fab new platform legs		4.0										64	2.0				checked with primavera
	Install station 3 platforms (8 required)		4.0	$ 10.0K									112	3.5				checked with primavera
	Test out station 3 equipment and procedures			$ 10.0K									0	2.5				checked with primavera
																		checked with primavera
	Assembly Step																	checked with primavera
1.00	**Pre-Installation set-up**																	checked with primavera
1.01	Install Station 3 site monuments as needed to perform metrology measurements.		3.0	$ 2.0K									60	2.5				checked with primavera
1.02	Install floor mounted tracks and VV base support		5.0	$ 1.0K									100	2.5				checked with primavera
1.03	Use rigging operations to establish the MCHP CG location.		2.0										40	2.5				checked with primavera
2.00	**Pre-assemble left MCHP**												0	2.5				checked with primavera
2.01	Install MCHP support cart assemblies		4.0										80	2.5				checked with primavera
2.02	Verify cart motion. Move left cart to final assembly position to accept left MCHP and secure to the floor supports. Move right cart far to the right.		2.0										40	2.5				checked with primavera
2.03	Install adjustor bar support weldment on Left Side		0.0										0	2.5				checked with primavera
2.04	Using the SISSCO crane, position left MCHP on the cart assembly		1.0										20	2.5				checked with primavera
2.05	Secure left MCHP at three location to vertical support posts on support cart base.		2.0										40	2.5				checked with primavera
2.06	Measure the monuments on the positioned left MCHP and on the walls to establish the machine coordinate for further assembly operations.		5.0												100		**Metrology Staff Budgeted as LOE**	checked with primavera
2.07	Set the positioning stop on the cart so it returns to the machine coordinate defined position in further assembly steps.		1.0										20	2.5				checked with primavera
3.00	**Pre-assemble right MCHP**												0	2.5				checked with primavera
3.01	Move the right base support cart to its final position ready to accept the right MCHP. Position the AirLoc Wedgemount in a lowered position.		0.5										10	2.5				checked with primavera
3.02	Lift the right side MCHP using the SISSCO crane and position it to be ready to engage the preinstalled Type-A flange guide bushings.		1.0										20	2.5				checked with primavera
3.03	Temporary fasteners located adjacent to the alignment bushings can be used to help bring the parts together.		0.0										0	2.5				checked with primavera
3.04	While held by the crane bring the AirLoc Wedgemount leveler up to take the load.		0.0										0	2.5				checked with primavera
3.05	Install temporary scaffolding to install flange hardware		1.0										20	2.5				checked with primavera
3.06	Install bolts and shims as needed for assembly tolerances.		1.0										20	2.5				checked with primavera
3.07	Tighten flange fasteners to 50%		1.0										20	2.5				checked with primavera
3.08	Perform metrology measurements of all alignment fiducials on both MCHP's. The maximum deviation from the reference points should be .020" or less.		5.0												100		**Metrology Staff Budgeted as LOE**	checked with primavera
3.09	Perform position adjustments on the right side MCHP if needed. Loosen all studs, adjust AirLock Wedgemounts as needed and install alternate sized shims. Re-torque all studs to 50% and recheck.		2.0										40	2.5				checked with primavera
3.10	Verify position of the VV support hanger locations (top and bottom) on the left and right MCHP. May be done as part of 3.08 if 3.09 not needed		3.0												60		**Metrology Staff Budgeted as LOE**	checked with primavera
3.11	Remove flange hardware and temporary platforms		1.0										20	2.5				checked with primavera

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Job Title: FPA Operations - Stations 1, 2, & 3 (1810)																		
Job Title: FPA Operations - Station 5 (1815)																		
Job Manager: Mike Viola																		
Fabrication and Assembly																		
Assumptions:																		
	Assumes 5 day workweek 1 shift no overtime																	
	Parallel ops for sta 5 (2 fixtures available)																	
	Parallel ops for sta 5 (2 fixtures available)																	
	Only 1 fixture for station 3 only																	
	Parallel ops for sta 2																	
4.00	**Install laser screens**			$ 2.0K														checked with primavera
4.01	Establish a global coordinate system based on the full period geometry. Measure the monuments on the MCHP's and on the walls.		2.0												40		**Metrology Staff Budgeted as LOE**	checked with primavera
4.02	Using metrology and the established global coordinate system place all of the laser screens as called out in the Stage 3 drawings.		2.0										40	2.5				checked with primavera
4.03	Turn each lasers on and with metrology determine their alignment. Record the laser position.		1.0										20	2.5				checked with primavera
4.04	Based on metrology measurements of the screens and lasers the screens path can be defined by the back office. Print the path on milar paper and using metrology mount the milar on the screens.												0	2.5				checked with primavera
4.05	Disengage the MCHP's by using the left support and adjustor bar to move the left MCHP.		1.0										20	2.5				checked with primavera
4.06	Remove both MCHP's.		2.0										40	2.5			**Can these stay on the carts and be rolled all the way back?**	checked with primavera
5.00	**Install vacuum vessel**												0	2.5				checked with primavera
5.01	Remove the adjustor bar support from left side.		0.0										0	2.5				checked with primavera
5.02	Install VV NBI port support stand.		2.0										40	2.5				checked with primavera
5.03	Install VVSA to base support and make the connection to the NBI port attachment.		1.0										20	2.5				checked with primavera
5.04	Using metrology take tooling ball readings off the VV shell to properly position the VVSA to the global coordinate system. Secure the VVSA to the base and at the NBI port support stand.		2.0										40	2.5				checked with primavera
6.00	**Install left MCHP over VV**												0	2.5				checked with primavera
6.01	Install any bumper protection components on the VV (left and right side) before manipulating left MCHP over the VV.		0.5										10	2.5				checked with primavera
6.02	Move the left base support cart to the far left so it will not interfere with the MCHP installation. Position the AirLoc Wedgemount in a lowered position.		0.0										0	2.5				checked with primavera
6.03	Using the SISSCO actuators with laser guidance move the left MCHP over the VV.		2.0										40	2.5				checked with primavera
6.04	Re-install the left adjustor bar.		0.0										0	2.5				checked with primavera
6.05	Once the MCHP has been moved over the VV bring up Wedgemount levelers to stabilize the unit and take metrology measurements. Make position adjustments to properly align the MCHP.		2.0										40	2.5				checked with primavera
6.06	Transfer the full load to the AirLoc Wedgemount leveler.		0.0										0	2.5				checked with primavera
6.07	Using the adjustor bar on the left side move the MCHP to the left 1/2".		0.0										0	2.5				checked with primavera
7.00	**Install right MCHP over VV**												0	2.5				checked with primavera
7.01	Move the right base support cart to the far right so it will not interfere with the MCHP installation. Position the AirLoc Wedgemount in a lowered position.		0.0										0	2.5				checked with primavera
7.02	Using the SISSCO actuators with laser guidance move the right MCHP over the VV TO WITHIN 1/2" OF ITS FINAL POSITION and pause. Go to the next step.		2.0										40	2.5				checked with primavera
7.03	Using the adjustor bar on the left side move the left MCHP to its final position.		0.5										10	2.5				checked with primavera
7.04	With the left MCHP in place, move the right side MCHP using the CISSCO crane and position it to be ready to engage the preinstalled Type-A flange guide bushings.		0.5										10	2.5				checked with primavera
7.05	Temporary fasteners located adjacent to the alignment bushings can be used to help bring the parts together.		0.0										0	2.5				checked with primavera
7.06	While held by the crane bring the AirLoc Wedgemount leveler up to take the load.		0.5										10	2.5				checked with primavera
7.07	Remove the laser screens to provide more floor space for scaffolding.		0.0										0	2.5				checked with primavera
7.08	Install temporary scaffolding to install flange hardware		4.0										80	2.5				checked with primavera
7.09	Install bolts and all alumina and inboard weld shims.		2.0										40	2.5				checked with primavera
7.10	Tighten flange fasteners to 50%		1.0										20	2.5				checked with primavera
7.11	Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that they are tight. If a loose shim is found back off on sufficient adjacent bolts to allow a replacement shim to be inserted. Tighten bolt and recheck.		1.0										20	2.5				checked with primavera
7.12	Perform metrology measurements of all alignment fiducials on both MCHP's. The maximum deviation from the reference points should be .020" or less.		5.0												100		**Metrology Staff Budgeted as LOE**	checked with primavera
7.13	Perform position adjustments on the right side MCHP if tolerance is not met. Loosen all studs, adjust AirLock Wedgemounts as needed; install alternate sized shims. Re-torque all studs to 50% and recheck.		3.0										60	2.5				checked with primavera
7.14	Remove SISSCO actuator from right MCHP.		0.0										0	2.5				checked with primavera
7.15	One hole at a time, remove the supernut. Using the eccentric gage slid onto the stud define the hole eccentricity. Select bushing and machine to match required eccentricity. Install bushing. Replace nut and tighten back to 50% and recheck alignment. Total 10 days 7 days to pre fit & fab bushings (in parallel with other tasks)and 3 days to install		**10.0**										200	2.5				checked with primavera

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Job Title: FPA Oversight & Support (1802)																		
Job Title: FPA Operations - Stations 1, 2, & 3 (1810)																		
Job Title: FPA Operations - Station 5 (1815)																		
Job Manager: Mike Viola																		
Fabrication and Assembly																		
Assumptions:																		
	Assumes 5 day workweek 1 shift no overtime																	
	Parallel ops for sta 5 (2 fixtures available)																	
	Parallel ops for sta 5 (2 fixtures available)																	
	Only 1 fixture for station 3 only																	
	Parallel ops for sta 2																	
7.16	Tighten nuts 100%. Measure before welding adequate coil alignment and fit-up of shims		1.0										20	2.5				checked with primavera
8.00	**Weld all inboard shims**												0	2.5				checked with primavera
8.01	Follow a predefined weld sequence at all MC's and partially weld the inboard shim. Perform weld peening operation. Perform a metrology measurement to re-verify coil alignment.		15.0										300	2.5				checked with primavera
8.02	Final complete MC scan to verify period alignment.		5.0												100		**Metrology Staff Budgeted as LOE**	checked with primavera
9.00	**VVSA attachment to MC.**												0	2.5				checked with primavera
9.01	Attach VV permanent vertical supports to the MC at the two outboard connection points at the top and bottom of the Type-A MC.		2.0										40	2.5				checked with primavera
9.02	Attach temporary VV vertical supports to the MC at the two connection points at the top and bottom of the Type-B MC.		1.0										20	2.5				checked with primavera
9.03	Disconnect base support and transfer load to VV vertical supports.		1.0										20	2.5				checked with primavera
9.04	Install VV lateral supports and align VVSA to modular coils		4.0										80	2.5				checked with primavera
9.05	Prepare VVSA for transport. Install blocking as required to prevent any motion relative to the modular coils.		2.0										40	2.5				checked with primavera
10.00	**Transfer Period to NCSX test cell.**												0	2.5				checked with primavera
10.01	Install crane rigging to MCWF and transfer the unit to the transfer support frame. Secure Period /support frame to the transporter.		2.0										80	5.0				checked with primavera
10.02	Transfer completed Period to Station 5 located in NCSX test cell.		1.0										40	5.0				checked with primavera
	Subtotal FP#1		**115**	**5**									**1990**		**500**		2495	checked with primavera
	Station 3-Assemble Mod Coils and VVSA-FP#2																	checked with primavera
	Perform above sequence		**115**	$ 5.0K									**1990**	2.6	500.0			checked with primavera
	Station 3-Assemble Mod Coils and VVSA-FP#3																	checked with primavera
	Perform above sequence		**115**	$ 5.0K									**1990**	2.6	500.0			checked with primavera

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Job Title: FPA Operations - Stations 1, 2, & 3 (1810)
Job Title: FPA Operations - Station 5 (1815)
Job Manager: Mike Viola

Fabrication and Assembly
Assumptions:

- **Assumes 5 day workweek 1 shift no overtime**
- **Parallel ops for sta 5 (2 fixtures available)**
- **Parallel ops for sta 5 (2 fixtures available)**
- **Only 1 fixture for station 3 only**
- **Parallel ops for sta 2**

	TASK DESCRIPTION	Work days	41MS	37STK	35TRVL	31OT	ORNL EM/DSN	SHTB	EMEM	EMSM	EMSB	EMTB	CREW	Met Crew	Basis of Estimate
															Shop based on similar tasks, tempered (adjusted) for complexity of having to do all welds from inside of
	Job: 1815 - Field Period Assembly Station 5 (in NCSX TC)-VIOLA														
	Station 5- Final FP Assy -FP#1 (in NCSX TC)														
	metrology network	10.0	$ 7.0K									160			
	Bolt on 2 Port Extensions needed for first Plasma diagnostics	1.0										16	2.0		10" ports provided by WBS 38
	MTM NCR Hardware repurchase (bolt kits & cover plates)		$ 42.0K												
	Weld Wire & weld supples		$ 15.0K												
	Testout Sta 5 equipt & procedures	5.0										160	4.0		
	Check 3 sled interfaces adjust holes	12.0										384	4.0		
	Fixtures installed - final metrology	6.0										192	4.0		
	Miscellaneous for tooling														$ 1,027.8K
	Station 5 preinstallation in parallel														
1.00	**Component preparations**														
1.01	The short dome port (the one on the top of the dome) needs to cut off near the dome. The longest port can remain.	2.0										40	2.5		
1.02	Install heat tape and theomocouples on all ports.	0.0										0	2.5		**Covered in Station 2 LED: Reversed order of 1.02 & 1.03**
1.03	Install insulation system around all ports.	0.0										0	2.5		**Covered in Station 2**
	Install insulation system around all ports.	0.0										0	2.5		
	Install heat tape and theomocouples on all ports.	0.0										0	2.5		
2.00	**Pre-Installation set-up**														
2.01	Install period support fixture	2.0										40	2.5		
2.02	Install FPA on support stand. Use leveler pad to engage base of MC. Add bolts to secure in place.	2.0										40	2.5		
2.03	Install external working platforms	4.0										80	2.5		
2.04	Install internal VV working platforms	3.0										60	2.5		
3.00	**VV port installation**														
3.01	Install the domes (left and right side), inserting the long dome port through the MC opening, and weld the dome shell to the VV.	2.0										40	2.5		
3.02	Install small dome ports and remaining circular ports. Use a guide tool located at the MC hole opening to help support and center the port. Ports should already have insulation, heater tape and thermocouples on them.	30.0										600	2.5		
3.03	Leak check each port immediately after it is welded.	30.0										600	2.5		
4.00	**Install port boot seal assembly**														
4.01	Install boots on all ports except for the two port 4's.	16.0										320	2.5		
5.00	**MC lead and coolant connections**														
5.01	Install MC lead connections on each of the MC's and temporally position the leads so they will not interfere with the TF coil installation and for routing through the PF structure.	6.0										72	1.5		in parallel with 5.02
5.02	Install MC coolant lines on each MC and position them for the TF installation and routing through PF structure.	12.0										240	2.5		
5.03	Platforms may need to be altered or moved for the installation of the TF coils.	3.0										60	2.5		
6.00	**TF installation - right side**														
6.01	Rotate two individual TF coils over the MC on the right side and temporarily support them off the Type-B and C MC's.	2.0										40	2.5		

checked with primavera

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Job Title: FPA Operations - Station 5 (1815)																		
Job Manager: Mike Viola																		
Fabrication and Assembly																		
Assumptions:																		
	Assumes 5 day workweek 1 shift no overtime																	
	Parallel ops for sta 5 (2 fixtures available)																	
	Parallel ops for sta 5 (2 fixtures available)																	
	Only 1 fixture for station 3 only																	
	Parallel ops for sta 2																	
6.02	Attach the temporary support at the end of the Type-C MC used to unload the a pair of center supports.		1.0										20	2.5				checked with primavera
6.03	Lower leveler pad to disengage base of MC on the right side. Remove right side leveler pad and intermediate support.		0.0										0	2.5				checked with primavera
6.04	Install TF support brackets (top & bottom) to the port 12 side on the Type-A MC (platforms will be needed).		2.0										40	2.5				checked with primavera
6.05	Slide the first TF assembly against the TF support bracket and secure in place with the mating support bracket.		1.0										20	2.5				checked with primavera
6.06	Install TF support brackets (top & bottom) to the port 12 side on the Type-B MC.		2.0										40	2.5				checked with primavera
6.07	Slide the second TF assembly against the support bracket and secure in place with the mating support bracket.		1.0										20	2.5				checked with primavera
6.08	Install machine support plates (inboard and outboard) on the bottom, spanning two TF coil support brackets.		3.0										60	2.5				checked with primavera
6.09	Reinstall leveler pad to engage base of MC on the right side.		0.0										0	2.5				checked with primavera
6.10	Installed one side of the TF support brackets on the Type-C coil (top and bottom) for the TF installation to occur at Station 6.		1.0										20	2.5				checked with primavera
7.00	**TF installation - left side**																	checked with primavera
7.01	The TF installation on the left side will follow the same ten (10) steps that were followed on the right side.		13.0										260	2.5				checked with primavera
8.00	**TF fit-up check**																	checked with primavera
8.01	Perform a fit-up check of the four TF coils to determine if they can be positioned within tolerances.		5.0										100	2.5				checked with primavera
9.00	**Install Ports 4**																	checked with primavera
9.01	Tack weld the left and right port 4's. Use a local laser attached to the port cover to define the port trajectory and to aid positioning in port during welding.		2.0										40	2.5				checked with primavera
9.02	Install boots on both port 4's.		4.0										80	2.5				checked with primavera
10.00	**Installation of PF structural members and routing of MC coolant and leads.**																	checked with primavera
10.01	Install the PF coil support structure that surround the TF coils. In doing this the MC leads and coolant lines need to be routed to the outside of the PF structure. PF structure is only partially installed at the Type-C MC's.		8.0										160	2.5				checked with primavera
11.00	**MC header installation and coolant connections**																	checked with primavera
11.01	Install the MC coolant manifold outside of the PF structure in the area of PF6.		3.0										60	2.5				checked with primavera
11.02	Connect all MC coolant lines to the manifold (40 lines top and bottom)		20.0										400	2.5			**Flex lines but need field supports installed**	checked with primavera
12.00	**Diagnostic**																	checked with primavera
12.01	Install Rogowski coils on the end of the VV, left side. Route leads through space between port 8 and spool port opening and coil onto shell of MC for future routing		5.0										100	2.5				checked with primavera
13.00	**Final measurements**																	checked with primavera
13.01	Obtain a set of Period 1 alignment fiducial positions to use in locating the VV within the MC.		5.0												100		**Metrology Staff Budgeted as LOE**	checked with primavera
13.02	Using the laser tracker, align to tooling balls on each MCHP, locking into a minimum of 8 of them.		1.0												20		**Metrology Staff Budgeted as LOE**	checked with primavera
13.03	Using monuments on the VV for alignment, bring the VV into proper alignment. Make final adjust in the VV supports to secure VV in place.		4.0										80	2.5				checked with primavera
13.04	Install or identify three primary fiducials that will be used in positioning the Period in Station 6.		2.0										40	2.5				checked with primavera
13.05	Make a final measurement of all fiducials, the VV end flanges and the Type-C MC end flanges. Record the results.		5.0												100		**Metrology Staff Budgeted as LOE**	checked with primavera
13.10	**Final Acceptance tests**																	checked with primavera
13.11	Check Assembly (bolts, etc)		5.0										100	2.5				checked with primavera
13.12	Check Diagnostics (Loops, thermocouples)		5.0										100	2.5				checked with primavera
13.13	Check manifolds (pressure, flow, etc.)		5.0										100	2.5				checked with primavera
13.14	Check 6 modcoils (voltage etc)		6.0										120	2.5				checked with primavera
13.15	Check trim coils (voltage etc)		3.0										60	2.5				checked with primavera
13.16	Check TF coils (voltage etc)		6.0										120	2.5				checked with primavera
14.00	**Transfer Period to final assembly (Station 6).**																	checked with primavera
14.01	Install crane rigging to completed Period assembly		2.0										40	2.5				checked with primavera
14.02	Remove platforms		1.0										20	2.5				checked with primavera
14.03	Transfer completed Period to Station **6** located in NCSX test cell.		2.0										40	2.5				checked with primavera

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Job Manager: Mike Viola																		
Fabrication and Assembly																		
Assumptions:																		
	Assumes 5 day workweek 1 shift no overtime																	
	Parallel ops for sta 5 (2 fixtures available)																	
	Parallel ops for sta 5 (2 fixtures available)																	
	Only 1 fixture for station 3 only																	
	Parallel ops for sta 2																	
	Install on support platform (incl in job 7503)																	checked with primavera
	subtotal		**196**	**0**									**4472**		**220**		$ 4,692.0K	checked with primavera
	Station 5- Final FP Assy -FP#2 (in NCSX TC)																	checked with primavera
	Repeat steps for FP #1		**196**	**$ -**									**4472**		**220**			checked with primavera
	Station 5- Final FP Assy -FP#3 (in NCSX TC)																	checked with primavera
	Repeat steps for FP #1		**196**	**$ -**									**4472**		**220**			checked with primavera

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

WBS Number: 185
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Uncertainty of the Estimate

	High	Medium	Low	Uncertainty Range (%)	Comments/Other Considerations
Job 1802				-10%/+15%	
Design Maturity	X				LOE work based on recent NCSX experience
Design Complexity		X			LOE work based on recent NCSX experience, but complex processes
Job 1810					
Station 1				-10%/+15%	
Maturity	X				VV #1 actual experience - very near completion
Complexity		X			Requires field adjustments & tight metrology requirements which necessitates "back office" support
Station 2				-30%/+60%	
Maturity			X		Still at conceptual design for all aspects of joint
Complexity	X				Challenging all aspects of engineering - W&-X experience also indicates FPA is the most challenging task
Station 3				-30%/+60%	
Maturity			X		Still at conceptual design for all aspects of joint
Complexity	X				Challenging all aspects of engineering - W7-X experience also indicates FPA is the most challenging task
Job 1815				-20%/+40%	
Design Maturity			X		Standard welding techniques adjust for welding in tight confines inside vessel
Design Complexity		X			Welding vessel while using metrology for measuring distortion

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

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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
1802	Loss or prolonged unavailability of certain key personnel (Viola or Perry) from the project could substantially impact the schedule.	VU	Viola and Perry will be cross-trained such that each could od the other's job	Estimated impact is <1 months on the critical path. Cost estimates cover 0-1 months of near term FPA assembly (in addition to the standing army costs addressed under schedule impact).	+ $0	+ $150	+ 0.00	+ 0.50
1810	"Back office" support for FPA and final assembly becomes a chronic bottleneck, stretching out the time required to complete assembly operations	VU	Additional support budgeted for Brown, Brooks, and Ellis providing "2 deep" back office support. Should be available to mitigate peak demands once training in key skills is completed.	Estimated impact is <2 months on the critical path. Cost impact covers up to 2 months of FPA/final assembly.	+ $0	+ $600	+ 0.00	+ 2.00
	Modular coil damaged during assembly requiring significant rework to coil	VU	Equipment will be handled during FPA using carefully constructed procedures to minimize likelihood of damage.	Nominally repaired with a 2-man crew within 2 weeks	+ $10	+ $20	+ 0.00	+ 0.50
	VV surface component (coolant tube, flux loop, or TC) damaged during FPA requiring significant rework	VU	Equipment will be handled during FPA using carefully constructed procedures to minimize likelihood of damage.	Nominally repaired with a 2-man crew within 2 weeks	+ $10	+ $20	+ 0.00	+ 0.50

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	Unacceptable distortion in a field period when welding modular coil shims requiring	VU	Likelihood of occurrence is very unlikely as a result of extensive welding R&D and careful monitoring during welding.	Cut apart and re-weld two coils back together. Nominally a 2.5-man crew in 12 weeks.	+ $25	+ $35	+ 0.75	+ 1.25
	Field period damaged during loading, transport, or unloading from TFTR TC to NCSX TC	NC	Extreme care will be taken when transporting a field period renering this event extremely unlikely.	*Crisis event not covered by contingency*				
	Metrology equipment and general purpose tooling/ lifting equipment (e.g.cranes) not available to support the schedule	U	Maintenance contract mitigates impact of metrology equipment. Additional $200K budgeted for a 3rd laser tracker and/or spare metrology equipment. Should result in improved efficiency.	Up to 2 week impact on FPA and critical path. FPA cost impact assumed to be $300k/mo.	+ $0	+ $150	+ 0.00	+ 0.50
1815	Metrology equipment and general purpose tooling/ lifting equipment (e.g.cranes) not available to support the schedule	U	Maintenance contract mitigates impact of metrology equipment. Additional $200K budgeted for a 3rd laser tracker and/or spare metrology equipment. Should result in improved efficiency.	Up to 2 week impact on FPA and critical path. FPA cost impact assumed to be $300k/mo.	+ $0	+ $150	+ 0.00	+ 0.50

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Multiple vacuum leaks during initial pumpdown	NC	Welds will be leak checked during FPA when leaks can be addressed without significantly impacting the critical path. Likelihood of many leaks appearing during initial pumpdown is considered extremely unlikely with this mitigation plan.	Impacts of having a few leaks is covered in estimate uncertainty with present mitigation plan	

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%)

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Job Manager: Mike Viola

EWI Budgetary Proposal No. 50782GTH **Date: June 5, 2007**

Submitted to: Princeton Plasma Physics Lab

Title: On-Site Design Review and Sample Evaluation

Objectives: Discuss design for welding with minimal distortion meeting minimum fatigue requirements. Perform evaluation of welds on test specimen.

Approach:

1. Design review with Bill Mohr from EWI in Princeton, New Jersey, followed up with a written report. Dr. Mohr has extensive experience in fitness-for-service assessment, design, and fatigue of welded structures. This will be an opportunity to validate your considerations regarding distortion, allowable stresses, and other design concerns.
2. A sample weld to be evaluated at EWI using ultrasonic and radiographic testing. Macros will be generated and evaluated and a report will be sent.
3. Recommendation for additional work will be made after the design review and test weld assessment.

Deliverables:

A report will be written summarizing the results of the design review. Lab results, macros and a summary of explanation will be delivered with recommendations.

Program Budget and Duration:

The above work can be completed with a price of **$18,075**. The work is planned for a period of **20 days** after receipt of purchase order and any required materials. This quotation is firm fixed price for the work scope outlined in the proposal and, once accepted, will not be changed without the concurrence of both parties. It is understood that if the Client requests an expanded work scope, EWI will quote the cost and timing to complete the additional work.

Budget	Hours		Total
Labor	63	$	15,785
Travel plus G&A		$	1,168
Material		$	-
Subcontracts		$	-
Miscellaneous		$	-
Fee on Material, Subcontracts & Misc.		$	-
Lab Services		$	1,122
Total Program		**$**	**18,075**

Notes
1 - Labor rates are fully burdened
2 - EWI indirect rates are ACO approved provisional rates

Labor

Labor Grade	Task	Hr
Principal Eng	1	18
Senior Eng	2	20
	3	20
Program Mgr		5
		63

Lab Services
(6) Material Mounts @ $132 per mount = $792
(6) Micrograph with max field of view size of .280-in. by .370-in. = $192
(3) Macrographs @ $46 per macro = $138

Edison Welding Institute Support of Test Welding Program

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

ORNL Updated Title III Engineering (6/8/2007)

Station No.	start date	end date	days	weeks		1st perio	2nd peri	3thd period		ENGR	Designe	Total hrs
station 2	Oct-07	Mar-09	517.00	74	2954	591	394	197	1182	591	591	1182
station 3	Feb-08	Jul-09	516.00	74	2949	491	295	98	885	442	442	885
station 5	Apr-08	Sep-09	518.00	74	2960	493	296	99	888	444	444	888
station 6	Jun-09	Oct-10	487.00	70	2783	742	557	371	1670	1670	835	2505
			701	100	4006							

	Total Hours
Station 2 to 5 (FPA -	2954
Station 6 (Fnl Mach A	2505

Assume each period is 1/3 of the number of weeks

Station 2	Coverage	
1st period	60%	60% Engr/Dsn
2nd period	40%	40% Engr/Dsn
3thd period	20%	20% Engr/Dsn
ENGR	50%	Average
Designer	50%	Average

Station 3	Coverage	
0	50%	50% Engr/Dsn
0	30%	30% Engr/Dsn
0	10%	10% Engr/Dsn
ENGR	50%	Average
Designer	50%	Average

Station 5	Coverage	
0	50%	50% Engr/Dsn
0	30%	30% Engr/Dsn
0	10%	10% Engr/Dsn
ENGR	50%	Average
Designer	50%	Average

Station 6	Coverage	
0	80%	80% Engr/Dsn
0	60%	60% Engr/Dsn
0	40%	40% Engr/Dsn
ENGR	100%	Average
Designer	50%	Average

Title III Support Travel		
Job 1802	Job 7503	
$4,500		FY2007
$9,000		FY2008
$4,500	$1,500	FY2009
	$6,000	FY2010
	$4,500	FY2011