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: Job Manager Date Responsible Line Manager Date Project Manager Date **Engineering Department Head** Date

NCSX June 2007 ETC TABLE I - DESIGN LABOR

IMPO N. I. 405		-	1	1	1	1					
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:				1			1	1			
Description.			-	 	-			ļ			
TASK DESCRIPTION Work da	/s 41MS	48MS	35TRV 37STK L		ORNLE M	ORNLDSN	EMEM	EMSM	EMSB	CREW	
Design											
This is a Fabrication Job - All labor in Table III											

NCSX June 2007 ETC TABLE II - Materials and Subcontracts

WBS	Number: 185						
	Title: Assembly of Field Periods						
	Numbers: 1802, 1810, and 1815						
Job '	Title: FPA Oversight & Support (1802)						
Job.	Title: FPA Operations - Stations 1, 2, &	3 (1810)					
	Fitle: FPA Operations - Station 5 (1815)						
		,					
Job	Manager: Mike Viola						
Mate	rials and Supplies						
Metrolo	gy Consumables - Input by Steve Raftopoulos						Basis of Estimate
СС	Item	Quantity	Cost	Annual cost	Years	FY'07-FY'09 Cost Comment	
		-, ,					
5323	Generic replacement or consumables			0.45		045,000,0	
-	Surface probe kits Replacement Leica Workstation Computer	2	\$7,500 \$3,000	\$15,000 \$3,000	1	\$15,000 Consumable \$3,000	Recent procurements Recent procurements
	Replacement Leica Workstation Computer Replacement Laptops for Romer Arms	3	\$3,000	\$3,000	1	\$9,000	Recent procurements 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 Replacement/additional 1.5" CCR drift nest pucks	15 30	\$300 \$30	\$4,500 \$900	3	\$13,500 Consumable \$2,700 Consumable	Recent procurements Recent procurements
	Replacement Probe Tips for Romer Arms	6	\$600	\$3,600	3	\$10,800 Consumable	Recent procurements Recent procurements
	Replacement Flobe Tips for Romer Arms	Ů	ΨΟΟΟ	ψ3,000	<u> </u>	\$10,000 Consumable	Necent productions
			Subtotal	\$54,200		\$107,100	
5323	Generic one-time needs		00.000	* 4.000		Od one Ore time word	
	2 - Prortable Brunson Stands Dial indicators for Coil Winding Turning fixture	6	\$2,000 \$200	\$4,000 \$1,200	1 1	\$4,000 One-time need \$1,200 One-time need	Recent procurements 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 181							
9450	NCSX specific needs Monuments/nests for floor grid in NCSX test cell	75	\$75	\$5,625	2	\$11.250 NCSV specific and time peed	Pocent producements
	Reflector holders for wall - NCSX test cell	75 50	\$150	\$5,625	1	\$11,250 NCSX specific one-time need \$7,500 NCSX specific one-time need	Recent procurements 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 fli	
						positioning	
			0	640.405		654.750	
			Subtotal	\$46,125		\$51,750	
5323	Annual software and hardware maintenance costs						
3020	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 of	uicker
						turnaround.	
		1	Subtotal	\$39,750		\$440.250	
-			Suptotal	\$39,750		\$119,250	
	Total			\$150,275		\$288,300	
				,0			
	Total Cost to NCSX			\$46,125		\$51,750	

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															
oob manager. mike viola															
Fabrication and Assembly								1 1		l					
Assumptions:															
A				- 1				1							
Assumes 5 day workweek 1 shift no overtime				- 1	- 1	1	1	1 1							
Parallel ops for sta 5 (2 fixtures available)															
Parallel ops for sta 5 (2 fixtures available)		<u> </u>										L	_		
Only 1 fixture for station 3 only															-
Parallel ops for sta 2															
			K	\$					FTE						
				.	M.	2	<u> </u>	_					ew		
		Work	1MS	118	STR	RNL	ál m	E	4SM	(SB	ATB	REW	Ö		
TASK DESCRIPTION		days	41	378	35	S S	E E	N. W.	E	EM	\equiv	8	Me	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
														this is LOE adjust consistent with overall	
Metrology Engineering Supervision Station 1 through station 5 raftopolous 50%								0.50						schedule	checked with primavera
														this is LOE adjust consistent with overall	
PPPL EM LOE Station 1 through station 5 Viola 100%								1.00						schedule	checked with primavera
														this is LOE adjust consistent with overall schedule. See table V for detail from	
Title III field period assembly Station 1 through station 5 ORNL support														Mike Cole	checked with primavera
Thie in held period assembly Station 1 through station 3 Orthe support	_	1	1 1	- 1		1	1	1				1		this is LOE adjust consistent with overall	checked with philiavera
HP Coverage in the TFTR TC LOE Station 1 through station 3 @.75 fte							0.75	5						schedule	checked with primavera
Station 2-Modular Coil Sub- Assembly				,	- 1	1	00	-							checked with primavera
Sequence Plan (Brown) - Covered in Job 1803			1 1	- 1											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								1							checked with primavera
Station 3-Modular Coil to VVSA Assembly			1	-				1							checked with primavera
Sequence Plan (Brown) - Covered in Job 1803 Systems Analysis (Brooks) - covered in Job 8204	-	1					1	+				\vdash			checked with primavera
Metrology Plan (Elllis) - Covered in Job 8205		1		-		-		1							checked with primavera 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 checked with primavera
ACC review completed Pre-job brief completed	+	6.0		-		-		1							checked with primavera
Station 3 operational	+	1.0		-		-	1	+							checked with primavera
Fixtures installed		6.0		-+		1		+							checked with primavera
		0.0								1		1			checked with billiavera

WBS Number: 185														
VBS Title: Assembly of Field Periods														
ob Numbers: 1802, 1810, and 1815														
ob Title: FPA Oversight & Support (1802)														
ob Title: FPA Operations - Stations 1, 2, & 3 (1810)														
ob Title: FPA Operations - Station 5 (1815)														
ob Manager: Mike Viola														
abrication and Assembly		-						1			I			
ssumptions:														
·								1						
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														
tation 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
ob: 1802 - FP Assy Oversight&Support-VIOLA Total	•		\$ - #	## ##	#	0	1	2	0	0	()	•	checked with primavera
														checked with primavera

WBS Number: 185													I	
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:				1			1 1	1						
·														
Assumes 5 day workweek 1 shift no overtime														
Parallel ops for sta 5 (2 fixtures available)														
Parallel ops for sta 5 (2 fixtures available)											ΙŢ			
Only 1 fixture for station 3 only														
Parallel ops for sta 2														
		 '	(\$	1 1		1	F	TE				_		checked with primavera
			7 Z		RNL M/DSN		7	4	_	~	>	rew		
	Work	W.	SI	OT	Z Q	H	MEM	MSM	MSB	MTB	3EW	ot O		
TASK DESCRIPTION	days	4	35	31	Ö	S	Ξ	ñ	ā	ñ	Ö	Ž	Basis of Estimate	
ob: 1810 - Field Period Assembly-VIOLA														
													Station 1: Based on actual VV #1	ale a disease of the design of the second
													costs - almost completed. Station 2: Based on actual VV #1	checked with primavera
													costs - almost completed.	checked with primavera
													and a minor completion.	oncokea 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 primavers
													Assumed nose concept based on	onoonod mar primavore
													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
eneral F.P. Assy support														checked with primavera
													2 men 3 day a week .LOE adjust	
LOE Crane support, fixture setupfor . Station 1 through station 5 1.2 fte										1.20			consistent with schedule thru Station 5	checked with primayor
ESE State Support, include Setupior . Station 1 tillough station 5 1.2 lie		1		1						1.20			This is LOE adjust consistent with	oncoxed with phillavera
LOE Field Supervision for station 1 through station 5 edwards 1.0fte								1.00					overall schedule thru Station 5.	checked with primavera
.,													this is LOE adjust consistent with overall	
													schedule. Hours distributed per task	
LOE Metrology support Station 1 tthrough station 5 1.5 fte engr plus ducco 100%							1.50			1.00			based resource profile	checked with primavera
Nr. 1100 - 11 - 1 - 1 - 1 - 1		01//									ΙŢ		01//th	
Misc M&S station 1 through station 5		3K/month	/e										3K/month	checked with primavera
		,	(\$				Ho	ours						checked with primavera

VBS Number: 185														
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lob Manager: Mike Viola														
abrication and Assembly														
ssumptions:														
Assumes 5 day workweek 1 shift no overtime														
Parallel ops for sta 5 (2 fixtures available)														
Parallel ops for sta 5 (2 fixtures available)						1								
Only 1 fixture for station 3 only	1											-		-
Parallel ops for sta 2	+						1 1							
	1			4	-		1 1					3		
	XX7l	2	×	ے الا	RNL MDSN	ω	×	M	В	д	≥	į.		
TASK DESCRIPTION	Work days	<u> </u>	STK	<u> </u>	A M	HTB	MEM	MSM	MSB	MTB	REW	ĕ	Basis of Estimate	checked with primaver
	uays	4	6	9 8	ОШ	S	Щ	Щ	ш	Щ	O	2	Dasis of Estimate	
ation 1-FP #1 VV Prep (hard surface components)										-	- 1			checked with primaver
Layout diagnostic&coolant paths on vessel - Completed	35.0													checked with primaver
Install heater tape on vertical ports - Completed Verify installation of heater tapes - Completed	7.0													checked with primaver checked with primaver
Attach studs for coolant lines - Completed	3.0													checked with primave
Wind magnetic diagnostic sensors - Completed	14.0			_										checked with primave
Install precision magnetic diagnostic sensors - Completed	 3.0		-											checked with primave
Verify installation magnetic diagnostic sensors - Completed	 4.0													checked with primave
Install local I&C (incl thermocouples) - Completed	5.0													checked with primave
Verify installation of local I&C	2.0													checked with primave
Install cooling/htg lines to vac vsl	15.0)								300	2.5			checked with primave
													serial tasks alternating between FPA	
Weld cooling/htg risers	16.0	\$ 2.0K								320	2.5		constant 2.5 men	checked with primaver
													serial tasks alternating between FPA	
Verify InstI of H/C lines,headers,manifolds	5.0)								100	2.5		constant 2.5 men	checked with primaver
										400			serial tasks alternating between FPA	and the second
Perform final acceptance testing (H/C flow test)	5.0	\$ 4.0K								100	2.5		constant 2.5 men serial tasks alternating between FPA	checked with primaver
Trim coal plates	2.0									40	2.5		constant 2.5 men	checked with primaver
Trim seal plates	2.0		_	_						40	2.3		serial tasks alternating between FPA	checked with primaver
Loop termination & verification	18.0	,								360	2.5		constant 2.5 men	checked with primaver
install Final Internal and External monuments and measure	4.0					-	1			80	2.5		outleast 2.0 mon	checked with primaver
	7.0	1								30	2.0		serial tasks alternating between FPA	zz.nod mar pinnavoi
Final Scan	4.0									80	2.5		constant 2.5 men	checked with primaver
													serial tasks alternating between FPA	
Install heater tape on removeable ports	10.0									200	2.5		constant 2.5 men	checked with primaver
													serial tasks alternating between FPA	
Prepare and transfer completed VV to holding are	2.0	d l	- 1		l	1	1 1			40	2.5		constant 2.5 men	checked with primaver

WBS Number: 185												
WBS Title: Assembly of Field Periods												
Job Numbers: 1802, 1810, and 1815												
Job Title: FPA Oversight & Support (1802)												
Leb Title: FDA Overstiene Ctetiene 4 0 8 2 (4040)						-						
Job Title: FPA Operations - Stations 1, 2, & 3 (1810)												
Job Title: FPA Operations - Station 5 (1815)												
Job Manager: Mike Viola												
Fabrication and Assembly Assumptions:					T	1	т т	ı ı				
•												
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 Layout diagnostic&coolant paths on vessel - Completed		107	\$ 2.0K									checked with primavera
Install heater tape on vertical ports - Completed		12.0										checked with primavera
Verify installation of heater tapes - Completed		1.0										checked with primavera
Attach studs forcoolant lines - Completed		3.0	5			1						checked with primavera
Wind magnetic diagnostic sensors - Completed		14.0)									checked with primavera
Install precision magnetic diagnostic sensors - Completed		3.0	D .									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	D									checked with primavera
											Serial tasks alternating between FPA	
Install cooling/htg lines to vac vsl		15.0	o						300	2.5	constant 2.5 men.	checked with primavera
											Serial tasks alternating between FPA	
											constant 2.5 men. Delayed due to coil	
Weld cooling/htg risers		16.0	\$ 2.0K						320	2.5	tests	checked with primavera
Verify InstI 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
											Serial tasks alternating between FPA	
Perform final acceptance testing (H/C flow test)		5.0	\$ 4.0K						100	2.5	constant 2.5 men	checked with primavera
Trim seal plates		2.0	5						40	2.5	Serial tasks alternating between FPA	
, , , , , , , , , , , , , , , , , , ,											constant 2.5 men. Need to buy high	
											strength nibbler.	checked with primavera
		+	1	+	+	-	+ + +				Serial tasks alternating between FPA	oncoked with primavera
Loop termination & verification		18.0							360	2.5	constant 2.5 men	checked with primavera
install Final Internal and External monuments and measure		4.0		+-	+	 	+		80	2.5	CONSIGNIC Z.O MICH	checked with primavera
		4.0	1		1	 	1 1		00	2.0	Serial tasks alternating between FPA	onconou with primavera
Final Scan		4.0							80	2.5	constant 2.5 men	checked with primavera
i mai Souli		4.0	1	+	1	 	1 +		30	2.0	Serial tasks alternating between FPA	Shooked with primavera
Install heater tape on removeable ports		10.0							200	2.5	constant 2.5 men	checked with primavera
		.0.0		 +	+		+ +		200	2.0	Serial tasks alternating between FPA	Shooked with primavera
Prepare and transfer completed VV to holding are		2.0							40	2.5	constant 2.5 men	checked with primavera
ropare and transfer completed vivio nothing are		2.0	4	 +	+		+ +		40	۷.٥	CONSTANT 2.3 MON	checked with primavera
L L	1		1			1		-				checked with primavera

WBS Number: 185											
WBS Title: Assembly of Field Periods			1								
Job Numbers: 1802, 1810, and 1815			1								
Job Title: FPA Oversight & Support (1802)											
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Job Title: FPA Operations - Stations 1, 2, & 3 (1816)			+								
Job Manager: Mike Viola											
			-								
Fabrication and Assembly			1								
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)			Ċ		•						
Only 1 fixture for station 3 only											
Parallel ops for sta 2											
Station 1- FP #3 VV Prep (hrd surf cmpnts) Misc Hardware		\$ 2.0K	1	1			1				checked with primavera checked with primavera
Layout diagnostic&coolant paths on vessel - Completed	12.0	Ψ 2.01	+					240 2	5	15% complete	checked with primavera
										Serial tasks alternating between FPA	
									_	constant 2.5 men. Not started yet due to	
Install heater tape on vertical ports	7.0		+					140 2	5	coil alignment tests Serial tasks alternating between FPA	checked with primavera
										constant 2.5 men. Not started yet due to	
Verify installation of heater tapes	1.0							20 2	5	coil alignment tests	checked with primavera
										Serial tasks alternating between FPA	
Attach studs for coolant lines	3.0							60 2	5	constant 2.5 men. Not started yet due to coil alignment tests	checked with primavera
This is the second in the seco	0.0							00 2		Serial tasks alternating between FPA	onconoa mar primarora
.									_	constant 2.5 men. Not started yet due to	
Install Templates	3.0		-					60 2.	5	coil alignment tests Serial tasks alternating between FPA	
										constant 2.5 men. Not started yet due to	
Wind magnetic diagnostic sensors	14.0							280 2	5	coil alignment tests	checked with primavera
										Serial tasks alternating between FPA	
Install precision magnetic diagnostic sensors - Completed	3.0							60 2	5	constant 2.5 men. Serial tasks alternating between FPA	checked with primavera
Verify installation magnetic diagnostic sensors - Completed	4.0							80 2	5	constant 2.5 men.	checked with primavera
, , , , , , , , , , , , , , , , , , , ,										Serial tasks alternating between FPA	onconoa mar piimarora
Install local I&C (incl thermocouples)	5.0							100 2	5	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
Verify installation of local fac	2.0							40 2	3	Serial tasks alternating between FPA	checked with philiavera
Install cooling/htg lines to vac vsl	15.0							300 2		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
										Serial tasks alternating between FPA	
Verify Instl of H/C lines,headers,manifolds	5.0							100 2	5	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	chacked with primayers
Perform final acceptance testing (n/c now test)	5.0							100 2	.5	Serial tasks alternating between FPA	checked with primavera
Trim seal plates	2.0							40 2	5	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	E	Serial tasks alternating between FPA constant 2.5 men.	checked with primavera
instali r'inai internai and externai monuments and measure	4.0		+					0U Z	J	Serial tasks alternating between FPA	checked with primavera
Final Scan	4.0		\perp	<u></u>				80 2	5	constant 2.5 men.	checked with primavera
										Serial tasks alternating between FPA	
Install heater tape and insulation on removeable ports	 10.0		 1-					200 2	5	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)	2.0		-		1	1 1	 1	2702	J ₁	constant 2.5 men.	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

14/50 ::	1 405									-		T	T
	mber: 185												
WBS Titl	e: Assembly of Field Periods												
Job Num	bers: 1802, 1810, and 1815												
Job Title	: FPA Oversight & Support (1802)												
	: FPA Operations - Stations 1, 2, & 3 (1810)												
	: FPA Operations - Station 5 (1815)												
Job Man	ager: Mike Viola												
F-1ii													
Assumption	and Assembly												
Assumption													
	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 Tr				_									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	<u> </u>		\$ 2.0K	+				240	2.5			checked with primavera
	Bushing test B-C Alignment mechanisms, metro equipt &positioning		7.0) ¢ 40 0V	+ + + -		 		112 120	2.0			checked with primavera
	Procure alignment mechanisms, fiducials, lifting	 	20.0	\$ 40.0K \$ 25.0K					400	2.5			checked with primavera
		-	20.0						+00	2.0		Perform welding trials and procure	oncoked with primavera
<u></u>	Consulting support for NOSE WELDING		loe	\$ 70.0K								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
INTRF-001	PPPL buy SS plate for weld trials		10						31				
INTRF-035	PPPL Determine shim material		23				40		0.4				
PHIL-04	water jet cut shims for A/B flange weld test solution anneal shims (note: shims not ground).		3					8	24				
PHIL-05 PHIL-06	assemble shims&flangesgrind relief in flanges		3					0	48				
PHIL-07	weld & monitor distortion; improvise clamping		3						48				
PHIL-11	Mount A6 on angle plate		1						16				
PHIL-12	Weld fiducials on A6 & B6		2						32				
PHIL-13	Measure A6 casting		2						0				
PHIL-15	Remove A6 & lower & grout wedge		4						64				
PHIL-16	Re-mount A6 on wedge		2						32				
PHIL-17	Re-measure A6		2						0				
PHIL-18	Measure B6 on wedge		2						32				
PHIL-19	Place B6 on A6; Meas B6 casting use A6 as base		2						0				
PHIL-21	Prepare angle plate dogs & chocks Water jet cut outboard 0,5" stk 316 SS shims		4						64 32				
PHIL-22 PHIL-23	Water jet cut inboard 0,625 316 SS		3						24				
PHIL-24	Assemble castings, align torque&meas inbd. shims		4						64				
PHIL-27	Solution anneal shims		2					16	Ŭ.				
PHIL-32	Align castings		2						32				
PHIL-33	Fit&install bushings 25% stock, 25% eccentric		5						80				
PHIL-34	Weld procedure/weld qual.		7						56				
PHIL-36	Install strain gauges		5		+			40					
PHIL-37	Set up dial ind., CMM, transit system		5		+				40				
PHIL-38	Install all shims and adjust bushings Final align and baseline measurements		3		+++-		 		32 72				
PHIL-39 PHIL-40	Perform 25% of welding & measure		2		+ + + -				32	+			
PHIL-40 PHIL-41	Perform 50% of welding & measure Perform 50% of welding & measure		2		+ + + -				32				
PHIL-41	Perform 75% of welding & measure		2						32				
PHIL-43	finish welding & measure		2						32				
PHIL-25	Purchase (2) grinding machines		45										
PHIL-26	Grind inbd. Shims to thickness (outside shop)		4										
PHIL-30	Zenex - fabricate eccentric bushings		5										
	Hardware rework (1/2 FTE)		120.0	\$ 10.0K					960	1.0		MISC LOE SUPPORT	checked with primavera
Station 2 Se													checked with primavera
	Misc Hardware			\$ 5.0K									checked with primavera
			7.0	11	1 1 1	1	1		140	2.5			checked with primavera
	Test out equipt & procedures												also also also distributo di contra
3.00	Test out equipt & procedures Receive drawings and hardware (shims and bolts) Shim sizing / preparations		7.0						140	2.5			checked with primavera checked with primavera

WBS Nu	mber: 185										
NBS Tit	le: Assembly of Field Periods										
	nbers: 1802, 1810, and 1815										
	e: FPA Oversight & Support (1802)										
	E: FPA Operations - Stations 1, 2, & 3 (1810)										
	e: FPA Operations - Station 5 (1815)										
JOD Wan	ager: Mike Viola										
abrication	and Assembly										
ssumption											
	Assumes 5 day workweek 1 shift no overtime				- '	 T T	1				
	Parallel ops for sta 5 (2 fixtures available)									+	
										_	
	Parallel ops for sta 5 (2 fixtures available)			_							
	Only 1 fixture for station 3 only										
3.02	Parallel ops for sta 2 Surface grind a set of metal shims that will be used on the first MCHP article for assembly process										
3.02	qualifications.									Actual experience (LED: actual	
		12.0						240	2.5	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.	12.0						240	2.5		
		6.0						120	2.5	800 shims - not critical path	checked with primavera
4.00	Pre-Installation Station 2 set-up										
	L. HARDER C. L.									Metrology plan covering Station 2:	checked with primavera
4.01	Install MCHP fixtures and metrology equipment.									not critical path - separate crew in parallel	all and and are the second
4.02	Perform metrology set-up and checks			_						not critical path - separate crew in	checked with primavera
4.02	r chom metrology see up and checks	5.0						100	2.5	parallel	checked with primavera
	Install FIRST Holding 20 deg fixture		\$ 2.01	ĸ				80	2.5	paraner	checked with primavera
	Install SECOND Holding 20 deg fixture		\$ 2.01					60	2.5	Just received - Not done yet	checked with primavera
	Install THIRD Holding 20 deg fixture	6.0						120	2.5	Just received - Not done yet	checked with primavera
	Install LAST Holding 20 deg fixture		\$ 2.01					60	2.5	Just received - Not done yet	checked with primavera
	Tools&tooling available for FPA operations	2.0		1 1				40	2.5	·	checked with primavera
	-						İ	_			checked with primavera

Job Numbers: 1802, 1810, i Job Title: FPA Oversight & Job Title: FPA Operations of the control o	per: 185											
ob Title: FPA Oversight & ob Title: FPA Operations ob Title: FPA Operations ob Title: FPA Operations ob Manager: Mike Viola abrication and Assembly ssumptions: Assumes 5 day workv Parallel ops for sta 5 (Parallel ops for sta 5 (Only 1 fixture for stati Parallel ops for sta 2 TATION 2 Te-measauring and fitup checks 1.00 MC fit-up pre-check and station of the valis of the pre-check and station of the pre-check an	Assembly of Field Periods											
ob Title: FPA Operations ob Title: FPA Operations ob Title: FPA Operations ob Manager: Mike Viola abrication and Assembly ssumptions: Assumes 5 day workv Parallel ops for sta 5 (Only 1 fixture for stati Parallel ops for sta 2 TATION 2 Te-measauring and fitup checks 1.00 MC fit-up pre-check and state of the sta	ers: 1802, 1810, and 1815											
bb Title: FPA Operations ob Title: FPA Operations ob Title: FPA Operations ob Manager: Mike Viola bbrication and Assembly ssumptions: Assumes 5 day workv Parallel ops for sta 5 (Parallel ops for sta 5 (Only 1 fixture for stati Parallel ops for sta 2 e-measauring and fitup checks 1.00 Mc fit-up pre-check and station of the pre-	PA Oversight & Support (1802)											
britale: FPA Operations ob Manager: Mike Viola brication and Assembly sumptions: Assumes 5 day workv Parallel ops for sta 5 (Only 1 fixture for stati Parallel ops for sta 5 (Only 1 fixture for stati Parallel ops for sta 2 (Only 1 fixture for stati Parallel ops for sta 2 (TATION 2 e-measauring and fitup checks 1.00 MC fit-up pre-check and si 1.01 Verify that mating MC's of a This will include the Type-C 1.02 Epoxy paint all close fitting in 2.00 Pre-measurement of MCH 2.01 Set the Type-A coil on the parallel ops for static parallel ops for sta 2 (Dising the laser tracker, align 2.00 using the laser tracker, align 2.00 the fixture and on the walls. 2.01 Measure and of the tooling be 2.02 Scan the 'B' flange of the T 2.07 Remove Type-A coil from the coil for the coil f	PA Operations - Stations 1, 2, & 3 (1810)											
Assumes 5 day worky Parallel ops for sta 5 (Parallel ops for sta 5 (Only 1 fixture for statile parallel ops for sta 5 (Only 1 fixture for statile parallel ops for sta 5 (Only 1 fixture for statile parallel ops for sta 2 (FATION 2 TOTALION 2 TOTALION 2 TOTALION 2 TOTALION 2 TOTALION 2 TOTALION 3 TOTALION 4												
brication and Assembly sumptions: Assumes 5 day worky Parallel ops for sta 5 (Parallel ops for sta 5 (Only 1 fixture for statil Parallel ops for sta 2 (Parallel ops for sta												
Assumes 5 day worky Parallel ops for sta 5 (Parallel ops for sta 5 (Only 1 fixture for stati Parallel ops for sta 2 (Only 1 fixture for stati Parallel ops for sta 2 ATION 2 ——measauring and fitup checks 1.00 Mc fit-up pre-check and si 1.01 Verify that mating Mc's of a 1 his will include the Type-C 1.02 Epoxy paint all close fitting ii 2.00 Pre-measurement of McHi 2.01 Set the Type-A coil on the p 2.02 Using the laser tracker, algr 2.03 Set the Type-A coil on the p 2.04 Measure all of the toloring be 2.05 Scan the "B" flange of the Type-B "A" ff 2.11 Measure Type A. "A 3.00 Shim sizing / preparations 3.01 Using flange measurement of 3.02 Surface grind a set of metal qualifications.	er. Wirke Viola											
Assumes 5 day worky Parallel ops for sta 5 (Parallel ops for sta 5 (Only 1 fixture for statil Parallel ops for sta 2 (Only 1 fixture for statil Parallel ops for sta 2 (ATION 2 (Emeasuring and fitup checks 1.00 MC fit-up pre-check and si 1.01 Verify that mating MC's of a 1 fix sill include the Type-C 1.02 Epoxy paint all close fitting ii 2.00 Pre-measurement of MCHI 2.01 Set the Type-A coil on the p 2.02 Using the laser tracker, algrent in the two pre-check and si 2.03 Establish a global coordinate in the fixture and on the walls. 2.04 Measure all of the toling be 2.05 Scan the "B" llange of the Type-A coil from st 2.08 Measure Type A coil from st 2.09 Measure Type A "A" (Measure Type B "A" T 2.11 Measure Type C "A" fill 2.14 Measure Type C "A" fill 3.00 Shim sizing / preparations 3.01 Using flange measurement of 3.02 Surface grind a set of metal qualifications.												
Assumes 5 day worky Parallel ops for sta 5 (Parallel ops for sta 5 (Only 1 fixture for stati Parallel ops for sta 5 (Only 1 fixture for stati Parallel ops for sta 2 ATION 2	d Assembly						•					
Parallel ops for sta 5 (Parallel ops for sta 5 (Only 1 fixture for statit Parallel ops for sta 2 ATION 2												
Parallel ops for sta 5 (Only 1 fixture for stati Parallel ops for sta 2 Par	Assumes 5 day workweek 1 shift no overtime											
Parallel ops for sta 5 (Only 1 fixture for stati Parallel ops for sta 2 ATION 2	Parallel ops for sta 5 (2 fixtures available)											
Only 1 fixture for stati Parallel ops for sta 2 ATION 2 measauring and fitup checks 1.00 MC fit-up pre-check and si 1.01 Verify that mating MC's of a This will include the Type-C 1.02 Epoxy paint all close fitting in 2.00 Pre-measurement of MCHI 2.01 Set the Type-A coil on the p 2.02 Using the laser tracker, align 2.03 Estacush a gloost coordinate the fixture and on the walls. 2.04 Measure all of the tooling be 2.05 Scan the 18" flange of the T 2.07 Remove Type-A coil form st Measure Type A coil from st Measure Type B "A" fl 2.11 Measure Type C "A" fl 2.11 Measure Type A-A " A 3.00 Shim sizing / preparations 3.01 Using flange measurement of 3.02 Surface grind a set of metal qualifications.	Parallel ops for sta 5 (2 fixtures available)											
Parallel ops for sta 2 ATION 2 measauring and fitup checks 1.00	Only 1 fixture for station 3 only											
e-measauring and fitup checks 1.00 MC fit-up pre-check and st 1.01 Verify that mating MC's of a 1.01 Verify that mating MC's of a 1.02 Epoxy paint all close fitting it 2.00 Pre-measurement of MCH 2.01 Set the Type-A coil on the p 2.02 Using the laser tracker, align 2.03 Establish a global coordinate 4.04 Measure all of the tooling ba 2.05 Scan the "B" flange of the Ty 2.07 Remove Type-A coil from st 2.08 Measure Type B "A" f 2.11 Measure Type A- "A 3.00 Shim sizing / preparations 3.01 Using flange measurement of 3.02 Surface grind a set of metal qualifications.												
e-measauring and fitup checks 1.00 MC fit-up pre-check and st 1.01 Verify that mating MC's of a This will include the Type-C. 1.02 Epoxy paint all close fitting is 2.00 Pre-measurement of MCHI 2.01 Set the Type-A coil on the p 2.02 Using the laser tracker, align 2.03 testablish a global coordinate 2.04 Measure all of the tooling be 2.05 Scan the "B" flange of the Ty 2.07 Remove Type-A coil from st 2.08 Measure Type B "A" fl 2.11 Measure Type C "A" fl 3.00 Shim sizing / preparations 3.01 Using flange measurement of 3.02 Surface grind a set of metal qualifications.	·											checked with primave
1.01 Verify that mating MC's of a This will include the Type-C 1.02 Epoxy paint all close fitting in 2.00 Pre-measurement of MCHI 2.01 Set the Type-A coil on the p 2.02 Using the laser tracker, alignous the statement of the total paint of th	g and fitup checks											checked with primave
This will include the Type-C 1.02 Epoxy paint all close fitting in 2.00 Pre-measurement of MCHI 2.01 Set the Type-A coil on the p 2.02 Using the laser tracker, align 2.03 Establish a global coordinate the fixture and on the walls. 2.04 Measure all of the tooling be 2.05 Scan the "B" flange of the Ti 2.07 Remove Type-A coil from st 2.08 Measure Type B "A" f Measure Type C "A" I Measure Type S "A" f Measure Type B "A" f Measure	IC fit-up pre-check and surface insulation										Sequence Plan R5	checked with primave
1.02 Epoxy paint all close fitting is 2.00 Pre-measurement of MCHI 2.01 Set the Type-A coil on the p 2.02 Using the laser tracker, aligned a state of the total content of the tributer and on the walls. 2.03 Estate and on the walls. 2.04 Measure all of the tooling be 2.05 Scan the "B" flange of the Ty 2.07 Remove Type-A coil from st 2.08 Measure Type B "A" f 2.11 Measure Type C "A"fl. 2.14 Measure Type A-A" A 3.00 Shim sizing / preparations 3.01 Using flange measurement of Surface grind a set of metal qualifications.	erify that mating MC's of a MCHP will come together without interferences by pre-fitting mating coils.		4.0					00	٥.			ale and and order and as a con-
2.00 Pre-measurement of MCHI 2.01 Set the Type-A coil on the p 2.02 Using the laser tracker, align 2.03 Establish a global coordinate the fixture and on the walls. 2.04 Measure all of the tooling be 2.05 Scan the "B" flange of the Ti 2.07 Remove Type-A coil from st 2.08 Measure Type B "A" f 2.11 Measure Type C "A" fl 2.14 Measure Type A-A "A 3.00 Shim sizing / preparations 3.01 Using flange measurement of 3.02 Surface grind a set of metal qualifications.	his will include the Type-C coil with its interfacing Period Type-C coil. poxy paint all close fitting interfacing surfaces.		4.0 3.0					80 60				checked with primave
2.01 Set the Type-A coil on the p 2.02 Using the laser tracker, align 2.03 Establish a global coordinate the fixture and on the walls. 2.04 Measure all of the tooling be 2.05 Scan the 'B' flange of the T) 2.07 Remove Type-A coil from st. 2.08 Measure Type B "A" fl 2.11 Measure Type B "A" fl 2.11 Measure Type C "A" fl 2.14 Measure Type Toparations 3.00 Shim sizing / preparations 3.01 Using flange measurement of 3.02 Surface grind a set of metal qualifications.	re-measurement of MCHP Type A, B and C coils flanges plus interfacing Type-A coil flange		3.0		1 1			60	2.5		2 at a time on the two 20 degree	checked with primaver
2.02 Using the laser tracker, alignost to the fixture and on the walls. 2.04 Measure all of the tooling be considered to the tracker alignost to the tooling be considered to the tracker and the tooling be considered to the tracker and tracker	, , , , , , , , , , , , , , , , , , ,										wedges	checked with primaver
2.03 Establish a global coordinate the fixture and on the walls. 2.04 Measure all of the tooling be 2.05 Scan the IB* flange of the Ty 2.07 Remove Type-A coil from st. Measure Type B "A" fl. 2.11 Measure Type C "A" fl. 2.11 Measure Type C "A" fl. 2.14 Measure Type A-A" A Shim sizing / preparations 3.00 Shim sizing / preparations 3.01 Using flange measurement of Surface grind a set of metal qualifications.	et the Type-A coil on the pre-measurement fixture, "A" side flange down.		1.0					20	2.5		May be done early	checked with primaver
the fixture and on the walls. 2.04 Measure all of the tooling be 2.05 Scan the 'B' flange of the Ti 2.07 Remove Type-A coil from st 2.08 Measure Type B "A" fl 2.11 Measure Type C "A" fl 3.00 Shim sizing / preparations 3.01 Using flange measurement 3.02 Surface grind a set of metal qualifications.	sing 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 primave
2.04 Measure all of the tooling be 2.05 Scan the "B" flange of the 1y 2.07 Remove Type-A coil from st 2.08 Measure Type B "A" f 2.11 Measure Type C "A" fl 2.14 Measure Type A- "A 3.00 Shim sizing / preparations 3.01 Using flange measurement of 3.02 Surface grind a set of metal qualifications.	stablish a global coordinate system based on the modular coil geometry. Measure the monuments on		7.0							4.40	Metrology Staff Budgeted as LOE	ale and and additional account
2.05 Scan the "B" flange of the Ty 2.07 Remove Type-A coil from st 2.08 Measure Type B "A" fl 2.11 Measure Type C "A"fl 2.14 Measure Type A-A "A 3.00 Shim sizing / preparations 3.01 Using flange measurement of 3.02 Surface grind a set of metal qualifications.	leasure all of the tooling ball monuments on the winding form.		7.0							140	Metrology Staff Budgeted as LOE	checked with primave
2.07 Remove Type-A coil from st 2.08 Measure Type B "A" if 2.11 Measure Type C "A" ifi. 2.14 Measure Type A-A "A 3.00 Shim sizing / preparations 3.01 Using flange measurement 3.02 Surface grind a set of metal qualifications.			1.0							20	Metrology Staff Budgeted as LOE	checked with primave
2.08 Measure Type B "A" f 2.11 Measure Type C "A"ft 2.14 Measure Type A-A "A 3.00 Shim sizing / preparations 3.01 Using flange measurement of 3.02 Surface grind a set of metal qualifications.	temove Type-A coil from stand and move to holding area.		1.0					20	2.5	20	Metrology Stall Budgeted as LOL	checked with primaver
2.11 Measure Type C "A"fl. 2.14 Measure Type A-A "A 3.00 Shim sizing / preparations 3.01 Using flange measurement of 3.02 Surface grind a set of metal qualifications.	Measure Type B "A" flanges		14.0					40	2.5	220	Repeats 2.01-2.07	checked with primave
Shim sizing / preparations Using flange measurement of Surface grind a set of metal qualifications.	Measure Type C "A"flanges		13.0	ľ				40	2.5	220		checked with primave
3.01 Using flange measurement of 3.02 Surface grind a set of metal qualifications.	Measure Type A-A "A" flange		13.0					40	2.5	220	Repeats 2.01-2.07	checked with primave
3.02 Surface grind a set of metal qualifications.	him sizing / preparations										Sequence Plan R5	checked with primaver
qualifications.	sing flange measurement of the coils, define the A/A and A/B shim thickness.										Back Office	checked with primaver
	urface grind a set of metal shims that will be used on the first MCHP article for assembly process		4.0					00	2.5		Actual experience	ah a alva d with pri
4.00 Pre-Installation Station 2 s	ualifications. re-Installation Station 2 set-up recalibration		4.0	-				80	2.5		Sequence Plan R5	checked with primaver checked with primaver
	nstall MCHP fixtures and metrology equipment.		 	-				0	2.5		Sequence i ian its	checked with primaver
	erform metrology set-up and checks	66	2.0					U	2.5	40	Metrology Staff Budgeted as LOE	checked with primaver

WBS Nur	nber: 185														
	e: Assembly of Field Periods														
	pers: 1802, 1810, and 1815														
	FPA Oversight & Support (1802)														
	FPA Operations - Stations 1, 2, & 3 (1810)														
	FPA Operations - Station 5 (1815)														
Job Mana	ger: Mike Viola														
Fabrication :	and Assembly						1	-1	1	1					
Assumption															
	Assumes 5 day workweek 1 shift no overtime				• •	1	1	-	1						
	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	1			+			1		1					
Assemble															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	_		<u> </u>					·					Metrology Staff Budgeted as LOE -	
	positions.	2.0	0								40			COMPLETED	checked with primavera
5.02	Align the laser tracker to the conical seats locking into a minimum of 8 of them.	1.0	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	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-													-9,	
	A2 fit up test.	0.5			\perp		1	1		1	10				checked with primavera
5.05 5.06	Install dial indicators on the modular coil in areas where we expect to see deflection. Lower the mating type A modular coil into position.	2.0			\vdash		1	-		1	40				checked with primavers
5.06	Lower the mating type A modular coil into position. Measure the monuments on the bottom coil. Jack areas of the coil as necessary to bring displaced	1.0	U		+	-	1	1		1	20	2.5			checked with primavera
	monuments back to within .002" of their original position.	 1.0	~							<u></u>	20				checked with primavera
5.08	Using three target points, perform the positioning as was done in the A1-A2 fit up test.	1.0	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	2.0	n								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											2.0			oncoxed with primavere
	found back off on sufficient adjacent bolts to allow a replacement shim to be inserted. Tighten bolt and	1.0									20	2.5			ah a ak a di with in rimay are
5.11	recheck. Measure the tooling balls on both coils. The maximum deviation from the "realigned" points should be	1.0	U								20	2.5			checked with primavera
	.007" or less.	5.0	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	0								60	2.5			checked with primavera
5.13	Loosen studs to extract Fuji paper. Evaluate shim pressure distribution and make shim adjustments if	3.0	U								00	2.5			checked with primavera
	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				checked with primavera
5.15 6.00	Remove all studs, nuts, shims etc. Identify shim locations. A-B modular coil assembly	1.0	U								20	2.5		Sequence Plan R5	checked with primavera checked with primavera
6.01	Place the Type-A coil, "A" flange down, on the 20deg fixture. Obtain a set of "realigned" fiducial positions													ocquence i lan No	Checked with primavera
	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	0										20	Metrology Staff Budgeted as LOE	checked with primavera
6.03	the fixture and on the walls.	2.0	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	0								40	2.5			checked with primavera
6.04.1	Stuff Shim Bag with Fiberglas, Reseal, Place Shim Bag on Wing													LED: Must place bag before coil	
		0.3									5			assembly	checked with primavera
6.05	Lower the Type-B coil onto the Type-A coil.	1.0	0		\sqcup		1			1	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	ol								20	2.5			checked with primavera
6.06.1	Install Dial indicators for X-Y Positioning	1.0	0							•	20			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	0					\perp			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	2.0									40	2.5			checked with primavera
6.09	value. Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that they are tight. If a loose shim is	2.0		+ - -	+			+			40	2.5			checked with primavera
	found back off on sufficient adjacent bolts to allow a replacement shim to be inserted. Tighten bolt and	,	ا												ale and a service of
6.10	recheck. Measure the tooling balls on both coils. The maximum deviation from the "realigned" points should be	1.0	U		Щ					1	20	2.5			checked with primavera
0.10	.007" or less.	5.0	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														ale and a service of
6.12	studs to 50%. Loosen all studs, reduce load on flanges and install an equivalent set of alumina coated metal shims. Re-	3.0	U	+	+	-	1	1	1	1	60	2.5			checked with primavera
	torque all studs to 50%.	1.0	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	ol								20	2.5			checked with primavera
6.14	Measure the tooling balls on both coils. The maximum deviation from the "realigned" points should be											0	_		e de la companya de
	.007" or less.	5.0	0										100	Metrology Staff Budgeted as LOE	checked with primavera

WBS Nur	nber: 185															
	e: Assembly of Field Periods															
	bers: 1802, 1810, and 1815															
	FPA Oversight & Support (1802)															
	FPA Operations - Stations 1, 2, & 3 (1810)															
	FPA Operations - Station 5 (1815)															
Job Mana	ager: Mike Viola															
	and Assembly															
Assumption	S:															
	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															
6.15	Parallel ops for sta 2 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	
6.17	Complete tightening of flange bolts to 100%.		1.0									20	2.5			checked with primavera checked with primavera
6.18	Measure the tooling balls on both coils. The maximum deviation from the "realigned" points should be		1.0										2.5			<mark>-</mark>
	.007" or less.		2.0											40	Metrology Staff Budgeted as LOE	checked with primavera
6.19 6.20	Scan the "B" flange of Type-B coil Using the "B" flange measurement of the Type-B coil and the earlier "A" flange measurement of the Type-		1.0									20	2.5	1		checked with primavera
	C coil, define all B/C flange shim thickness.														Back office	checked with primavera
7.00	(A-B) to C modular coil assembly (MCHP) Place the "A/B" assembly, "A" coil down, on the 40deg fixture. Obtain a set of "realigned" fiducial positions.														Sequence Plan R5	checked with primavera
7.01	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	40 :l	Metrology Stall Budgeted as LOL	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		checked with primavera
6.06.1	Install Dial indicators for X-Y Positioning		1.0				,					20			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"		F 0						<u> </u>			_		100	Metrology Staff Budgeted as LOE	ah a aka d with prior
7.11	or less. If the above step does not fall within .010" or less then loosen all studs, adjust shims locally. Re-torque all		5.0											100	metrology stall budgeted as LOE	checked with primavera
	studs to 50%.		3.0									60	2.5	i		checked with primavera
7.12	Loosen all studs, reduce load on flanges and install an equivalent set of alumina coated metal shims. Retorque all studs to 50%.	l	1.0									20	2.5			checked with primavera
7.13	Make a hand viggle' 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				checked with primavera
7.14	Measure the tooling balls on all coils. The maximum deviation from the "realigned" points should be .010"			1		-	1									
7.15	or less. If the above step does not fall within .010* or less then loosen all studs, adjust shims locally. Re-torque all		5.0		\vdash			-			1	100	2.5	-		checked with primavera
7.15	studs to 50%.		3.0									60	2.5			checked with primavera
****	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		10.0									200			LED: Increase duraction to 1.5	chocked with primer
7.17	other tasks)and 3 days to install Complete tightening of flange bolts to 100%.		1.0									200			LED. Increase duraction to 1.5	checked with primavera 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				checked with primavera
7.18	Measure the tooling balls on both coils. The maximum deviation from the "realigned" points should be									1			0			
	.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
	Tack weld inboard welded shims														Sequence Plan R5	checked with primavera
8.00										+			1	1		
8.00 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

WBS Number	r: 185									
WBS Title: As	ssembly of Field Periods									
	s: 1802, 1810, and 1815									
	A Oversight & Support (1802)									
	A Operations - Stations 1, 2, & 3 (1810)									
	A Operations - Station 5 (1815)									
Job Manager:										
JOD Wanager	. Mike viola									
abrication and A	ssembly			-		1				
Assumptions:										
Ass	umes 5 day workweek 1 shift no overtime									
Para	allel ops for sta 5 (2 fixtures available)									
Para	allel ops for sta 5 (2 fixtures available)									
Only	y 1 fixture for station 3 only									
	allel ops for sta 2									
	Il trim coil on the top surface of the Type-C on Period 1 and 2 only on the MCHP - Right Side (See	6.0					120	2.5		checked with primavera
	re 3 below). plete local service and interface details	6.0					120	2.5	Sequence Plan R5	checked with primavera
	Il all wing support bladders between wing surfaces (A/B, B/C) and on the C wing (MCHP - Right Side								Sequence Fian No	checked with primavera
only)		2.0					40	2.5	LED: Bags were placed earlier	checked with primavera
10.02 Make	e local service runs/connections on the shell of each MC.								4 days for coolant lines 4 days for	
									mod coils thermocouples and strain	
		8.0					160	2.5	gages terminations	checked with primavera
	t stycast or some compound to fill in all shim spaces in order to prevent VV/MC insulation from falling	1.0					20	2.5		checked with primavera
out. 11.00 Final	I measurements / transfer completed MCHP to holding area	1.0					20	2.5	Seguence Plan R5	checked with primavera
	e 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
	g tension tester measure bolt length on all tension fasteners and record the results.	0.5					10	2.5		checked with primavera
	part for identification	0.0					0	2.5		checked with primavera
	Il lift support beams	2.0					40	2.5		checked with primavera
	ove from stand and measure weight of completed assembly	1.0					20	2.5		checked with primavera
11.07 Move	e to holding area.	0.0					0	2.5	246 shifts	checked with primavera

IM/DC NI	phore 19E															
WBS Num						+										
	: Assembly of Field Periods					\perp										
Job Numb	pers: 1802, 1810, and 1815															
Job Title:	FPA Oversight & Support (1802)															
Job Title:	FPA Operations - Stations 1, 2, & 3 (1810)															
	FPA Operations - Station 5 (1815)															
	ger: Mike Viola															
JOD Walla	ger. Wirke viola					+										
Fabrication a	nd Assembly															
Assumptions																
	Assumes 5 day workweek 1 shift no overtime				-			1	'							
	Parallel ops for sta 5 (2 fixtures available)				1											
	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						l l			2125		740		also also disciplination assessment
Station 2 De	roduction Articles (HPA) and second half of FP #1 A2,B2,C2		120									2123		740	Sequence Plan R5	checked with primavera checked with primavera
1.00	MC fit-up pre-check and surface insulation			1					1						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.					+										checked with primavera
	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								T			·	Ţ		Sequence Plan R5	checked with primavera
2.08	Measure Type B "A" flanges		14.0			1						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.				,	•							'		M	and the second second
4.00	Pre-Installation Station 2 set-up recalibration		4.0									80	2.5		May need more shims Sequence Plan R5	checked with primavera
4.00	Install MCHP fixtures and metrology equipment.											0	2.5		Sequence Flan KS	checked with primavera
4.02	Perform metrology set-up and checks	53 N	2.0									U	2.5	40	Metrology Staff Budgeted as LOE	checked with primavera checked with primavera
5.00	Pre-assemble A-A (Needs to be done total of 3 timee A1-A2, A3-A4, A5-A6)	33.0	2.0											40	metrology oftan Budgeted as LOL	checked with primavera
5.01	Position the Type-A modular coil on the fixture, "B" flange down. Obtain a set of "realigned" fiducial															checked with philiavera
	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 the fixture and on the walls.															checked with primavera
5.04	Place all alumina and grind inboard weld shims on the coil.			_	-							_				onconca with primavera
5.05						7	\		1 1/ V							checked with primavera
5.05	Install dial indicators on the modular coil in areas where we expect to see defi		/ Y		/ \	/	\	/ \	, r	· / \						checked with primavera
5.05 5.06	Install dial indicators on the modular coil in areas where we expect to see defliction. Lower the mating type A modular coil into position.		'		/ \	/ _		1 _ \		\bigvee	M V					checked with primavera checked with primavera checked with primavera
5.155	Lower the mating type A modular coil into position. Measure the monuments on the bottom coil. Jack areas of the coil as necessing displace									V_{Δ}	$\setminus \setminus$					checked with primavera checked with primavera
5.06 5.07	Lower the mating type A modular coil into position. Measure the monuments on the bottom coil. Jack areas of the coil as necess and g displace monuments back to within .02° of their original position.							5			$\setminus \setminus$					checked with primavera checked with primavera checked with primavera
5.06 5.07 5.08	Lower the mating type A modular coil into position. Measure the monuments on the bottom coil. Jack areas of the coil as necess to go displace monuments back to within .002" of their original position. Using three target points, perform the positioning as was done in the A1-A2 1							2			$\setminus \setminus$					checked with primavera checked with primavera checked with primavera checked with primavera
5.06 5.07 5.08 5.09	Lower the mating type A modular coil into position. Measure the monuments on the bottom coil. Jack areas of the coil as necess of monuments back to within .002" of their original position. Using three target points, perform the positioning as was done in the A1-A21 install studs, supernuts, and torque to 50% of final value.										\mathbb{N}					checked with primavera checked with primavera checked with primavera
5.06 5.07 5.08	Lower the mating type A modular coil into position. Measure the monuments on the bottom coil. Jack areas of the coil as necess to go displace monuments back to within .002" of their original position. Using three target points, perform the positioning as was done in the A1-A2 1															checked with primavera checked with primavera checked with primavera checked with primavera checked with primavera
5.06 5.07 5.08 5.09 5.10	Lower the mating type A modular coil into position. Measure the monuments on the bottom coil. Jack areas of the coil as necess for monuments back to within .02° of their original position. Using three target points, perform the positioning as was done in the A1-A2 I and I mistall studs, supernuts, and torque to 50% of final value. Make a hand 'wiggle' test (rotate on bott) on all shims to make sure that the found back off on sufficient adjacent botts to allow a replacement shim to be righten if															checked with primavera checked with primavera checked with primavera checked with primavera
5.06 5.07 5.08 5.09	Lower the mating type A modular coil into position. Measure the monuments on the bottom coil. Jack areas of the coil as necess to monuments back to within. 2002' of their original position. Using three target points, perform the positioning as was done in the A1-A2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1))									checked with primavera checked with primavera checked with primavera checked with primavera checked with primavera checked with primavera
5.06 5.07 5.08 5.09 5.10	Lower the mating type A modular coil into position. Measure the monuments on the bottom coil. Jack areas of the coil as necess to the monuments back to within .002" of their original position. Using three target points, perform the positioning as was done in the A1-A2 install studs, supernuts, and torque to 50% of final value. Make a hand "wiggle" test (rotate on bott) on all shims to make sure that the found back off on sufficient adjacent botts to allow a replacement shim to be techeck. Measure the tooling balls on both coils. The maximum deviation from the ingreed its short poor of the second of the seco)) 									checked with primavera checked with primavera checked with primavera checked with primavera checked with primavera checked with primavera checked with primavera
5.06 5.07 5.08 5.09 5.10 5.11	Lower the mating type A modular coil into position. Measure the monuments on the bottom coil. Jack areas of the coil as necess in monuments back to within .002" of their original position. Using three larget points, perform the positioning as was done in the A1-A2 I linstall studs, supernuts, and torque to 50% of final value. Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that the found back off on sufficient adjacent bolts to allow a replacement shim to be recheck. Measure the tooling balls on both coils. The maximum deviation from the "I med" tits sho on the same than the tooling balls on both coils. The maximum deviation from the "I med" tits sho on the same than t)									checked with primavera checked with primavera
5.06 5.07 5.08 5.09 5.10 5.11 5.12 5.13	Lower the mating type A modular coil into position. Measure the monuments on the bottom coil. Jack areas of the coil as necess from the monuments back to within .02° of their original position. Using three target points, perform the positioning as was done in the A1-A2 that is the positioning as was done in the A1-A2 that is the positioning as was done in the A1-A2 that is the positioning as was done in the A1-A2 that is the positioning as was done in the A1-A2 that is the positioning as was done in the A1-A2 that is the positioning as was done in the A1-A2 that is the positioning as was done in the A1-A2 that is the positioning as was done in the A1-A2 that is the positioning MCHP in the A1-A2 that is the positioning MCHP in the A1-A2 that is the positioning MCHP in Stage 3.						7									checked with primavera checked with primavera
5.06 5.07 5.08 5.09 5.10 5.11 5.12 5.13 5.14	Lower the mating type A modular coil into position. Measure the monuments on the bottom coil. Jack areas of the coil as necess to morniments be act to within. 2002" of their original position. Using three target points, perform the positioning as was done in the A1-A2 I still install studs, supernuts, and torque to 50% of final value. Make a hand "wiggle" test fortate on bolt) on all shims to make sure that the found back off on sufficient adjacent bolts to allow a replacement shim to be techeck. Measure the tooling balls on both coils. The maximum deviation from the "incomplete the tool of the student of the						7								Security Disc DE	checked with primavera checked with primavera
5.06 5.07 5.08 5.09 5.10 5.11 5.12 5.13 5.14 6.00	Lower the mating type A modular coil into position. Measure the monuments on the bottom coil. Jack areas of the coil as necess to monuments back to within. 2002" of their original position. Using three target points, perform the positioning as was done in the A1-A2 to linstall studs, supernuts, and torque to 50% of final value. Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that the found back off on sufficient adjacent bolts to allow a replacement shim to be recheck. Measure the tooling balls on both coils. The maximum deviation from the "found" of ress. If a loos gitten it recheck. Measure the tooling balls on both coils. The maximum deviation from the "found" of ress. If a loos gitten it recheck. It is shown that the shown is the shown in the shown is shown in the						7								Sequence Plan R5	checked with primavera checked with primavera
5.06 5.07 5.08 5.09 5.10 5.11 5.12 5.13 5.14	Lower the mating type A modular coil into position. Measure the monuments on the bottom coil. Jack areas of the coil as necess monuments back to within .02° of their original position. Using three target points, perform the positioning as was done in the A1-A2 in the state of the coil as necess was a state of the coil as the		1.0				<u> </u>					20	2.5		Sequence Plan R5	checked with primavera checked with primavera
5.06 5.07 5.08 5.09 5.10 5.11 5.12 5.13 5.14 6.00	Lower the mating type A modular coil into position. Measure the monuments on the bottom coil. Jack areas of the coil as necess to monuments back to within. 2002" of their original position. Using three target points, perform the positioning as was done in the A1-A2 to linstall studs, supernuts, and torque to 50% of final value. Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that the found back off on sufficient adjacent bolts to allow a replacement shim to be recheck. Measure the tooling balls on both coils. The maximum deviation from the "found" of ress. If a loos gitten it recheck. Measure the tooling balls on both coils. The maximum deviation from the "found" of ress. If a loos gitten it recheck. It is shown that the shown is the shown in the shown is shown in the						7						2.5	20	Sequence Plan R5 Metrology Staff Budgeted as LOE	checked with primavera
5.06 5.07 5.08 5.09 5.10 5.11 5.12 5.13 5.14 6.00 6.01	Lower the mating type A modular coil into position. Measure the monuments on the bottom coil. Jack areas of the coil as necess from monuments back to within. 2002" of their original position. Using three target points, perform the positioning as was done in the A1-A2 I list all studs, supernuts, and torque to 50% of final value. Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that the found back off on sufficient adjacent bolts to allow a replacement shim to be recheck. Measure the tooling balls on both coils. The maximum deviation from the "incomplete the tooling balls on both coils. The maximum deviation from the "incomplete the tooling balls on both coils. The maximum deviation from the "incomplete the tooling balls on both coils. The maximum deviation from the "incomplete the tooling balls on both coils. The maximum deviation from the "incomplete the tooling balls on both coils. The maximum deviation from the "incomplete the tooling balls on both coils. The maximum deviation from the "incomplete the tooling balls on both coils. The maximum deviation from the "incomplete the tooling balls on both coils. The maximum deviation from the "incomplete the tooling balls on both coils. The maximum deviation from the "incomplete the tooling balls on both coils. The maximum deviation from the "incomplete the tooling balls on both coils. The maximum deviation from the "incomplete the tooling balls on both coils. The maximum deviation from the "incomplete the balls on both coils. The maximum deviation from the "incomplete the balls on both coils. The maximum deviation from the "incomplete the balls on both coils." It is loss to discuss the deviation from the "incomplete the the tooling discuss th		1.0				7						2.5	20	Metrology Staff Budgeted as LOE	checked with primavera
5.06 5.07 5.08 5.09 5.10 5.11 5.12 5.13 5.14 6.00 6.01 6.02 6.03	Lower the mating type A modular coil into position. Measure the monuments on the bottom coil. Jack areas of the coil as necess monuments back to within .02° of their original position. Using three target points, perform the positioning as was done in the A1-A2 land install studs, supernuts, and torque to 50% of final value. Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that the found back off on sufficient adjacent bolts to allow a replacement shim to be recheck. Measure the tooling balls on both coils. The maximum deviation from the "found back off on sufficient adjacent bolts to allow a replacement shim to be recheck. Measure the tooling balls on both coils. The maximum deviation from the "found back off on sufficient adjacent bottom of the summary of the summa		1.0 1.0 2.0)) 					20		20 40	•	checked with primavera
5.06 5.07 5.08 5.09 5.10 5.11 5.12 5.13 5.14 6.00 6.01 6.02 6.03	Lower the mating type A modular coil into position. Measure the monuments on the bottom coil. Jack areas of the coil as necess monuments back to within .02° of their original position. Using three target points, perform the positioning as was done in the A1-A2 land material translations, and torque to 50% of final value. Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that the found back off on sufficient adjacent bolts to allow a replacement shim to be recheck. Measure the tooling balls on both coils. The maximum deviation from the "I land off off on sufficient adjacent bolts to allow a replacement shim to be recheck. Measure the tooling balls on both coils. The maximum deviation from the "I land off off on sufficient adjacent bolts to allow a replacement shim to be recheck. Measure the tooling balls on both coils. The maximum deviation from the "I land off on sufficient adjacent bolts to allow a replacement shim to be recheck. Measure the tooling balls on both coils. The maximum deviation from the "I land off on sufficient adjacent bolts to sufficient and sufficient shims locally. Re-torque all studs to 50%. Install the A-A locator bushings at two stud locations for use in re-positioning MCHP in Stage 3. Remove all studs, nuts, shims etc. Identify shim locations. A-B modular coil assembly 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. Using the laser tracker, align to the conical seats locking into a minimum of 8 of them. establish a global coordinate system based on the modular coil geometry. Measure the monuments on the future and on the walls. Place all allumina and grind inboard weld shims on the coil.		1.0				7					20	2.5	20 40	Metrology Staff Budgeted as LOE	checked with primavera
5.06 5.07 5.08 5.09 5.10 5.11 5.12 5.13 5.14 6.00 6.01 6.02	Lower the mating type A modular coil into position. Measure the monuments on the bottom coil. Jack areas of the coil as necess monuments back to within .02° of their original position. Using three target points, perform the positioning as was done in the A1-A2 land install studs, supernuts, and torque to 50% of final value. Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that the found back off on sufficient adjacent bolts to allow a replacement shim to be recheck. Measure the tooling balls on both coils. The maximum deviation from the "found back off on sufficient adjacent bolts to allow a replacement shim to be recheck. Measure the tooling balls on both coils. The maximum deviation from the "found back off on sufficient adjacent bottom of the summary of the summa		1.0 1.0 2.0 2.0				7					20	2.5	20 40	Metrology Staff Budgeted as LOE Metrology Staff Budgeted as LOE LED: Must place bag before coil	checked with primavera
5.06 5.07 5.08 5.09 5.10 5.11 5.12 5.13 5.14 6.00 6.01 6.02 6.03 6.04 6.04.1	Lower the mating type A modular coil into position. Measure the monuments on the bottom coil. Jack areas of the coil as necess from monuments back to within. 2002" of their original position. Using three target points, perform the positioning as was done in the A1-A2 I list of the positioning as was done in the A1-A2 I list of the positioning as was done in the A1-A2 I list of the positioning as was done in the A1-A2 I list of the positioning as was done in the A1-A2 I list of the positioning as was done in the A1-A2 I list of the positioning as was done in the A1-A2 I list of the positioning as was done in the A1-A2 I list of the positioning as was done in the A1-A2 I list of the positioning as was done in the A1-A2 I list of the positioning as was done in the A1-A2 I list of the positioning as was done in the A1-A2 I list of the positioning balls on both coils. The maximum deviation from the modular coil as seembly as the positioning model. The positioning model is the positioning model in the A1-A1 locator bushings at two stud locations for use in re-positioning MCHP in Stage 3. Remove all studs, nuts, shims etc. Identify shim locations. A-B modular coil assembly Place the Type-A coil, "A1 fiange down, on the 20deg fixture. Obtain a set of "realigned" fiducial positions for the "A1-A2 I list of the A1-A2 I li		1.0 1.0 2.0 2.0)					20 40 5	2.5	20 40	Metrology Staff Budgeted as LOE	checked with primavera
5.06 5.07 5.08 5.09 5.10 5.11 5.12 5.13 5.14 6.00 6.01 6.02 6.03 6.04 6.04.1	Lower the mating type A modular coil into position. Measure the monuments on the bottom coil. Jack areas of the coil as necess monuments back to within .02" of their original position. Using three target points, perform the positioning as was done in the A1-A2 and the state of the coil as necess monuments back to within .02" of their original position. Using three target points, perform the positioning as was done in the A1-A2 and the state of the coil as the c		1.0 1.0 2.0 2.0				7	2				20	2.5	20 40	Metrology Staff Budgeted as LOE Metrology Staff Budgeted as LOE LED: Must place bag before coil assembly	checked with primavera
5.06 5.07 5.08 5.09 5.10 5.11 5.12 5.13 5.14 6.00 6.01 6.02 6.03 6.04	Lower the mating type A modular coil into position. Measure the monuments on the bottom coil. Jack areas of the coil as necess from monuments back to within. 2002" of their original position. Using three target points, perform the positioning as was done in the A1-A2 I list of the positioning as was done in the A1-A2 I list of the positioning as was done in the A1-A2 I list of the positioning as was done in the A1-A2 I list of the positioning as was done in the A1-A2 I list of the positioning as was done in the A1-A2 I list of the positioning as was done in the A1-A2 I list of the positioning as was done in the A1-A2 I list of the positioning as was done in the A1-A2 I list of the positioning as was done in the A1-A2 I list of the positioning as was done in the A1-A2 I list of the positioning as was done in the A1-A2 I list of the positioning balls on both coils. The maximum deviation from the modular coil as seembly as the positioning model. The positioning model is the positioning model in the A1-A1 locator bushings at two stud locations for use in re-positioning MCHP in Stage 3. Remove all studs, nuts, shims etc. Identify shim locations. A-B modular coil assembly Place the Type-A coil, "A1 fiange down, on the 20deg fixture. Obtain a set of "realigned" fiducial positions for the "A1-A2 I list of the A1-A2 I li		1.0 1.0 2.0 2.0				7					20 40 5 20	2.5	20 40	Metrology Staff Budgeted as LOE Metrology Staff Budgeted as LOE LED: Must place bag before coil	checked with primavera

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WBS Nun	nber: 185											
	: Assembly of Field Periods											
	pers: 1802, 1810, and 1815											
	FPA Oversight & Support (1802)											
	FPA Operations - Stations 1, 2, & 3 (1810)					1						
	FPA Operations - Station 5 (1815)											
	ger: Mike Viola											
JOD Walla	ger. Wirke viola											
	nd Assembly											
Assumptions	8											
	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. Install studs, supernuts, and torque to 50% of final value.	1.0 2.0						40	2.5	20	Metrology Staff Budgeted as LOE	checked with primavera 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	2.0	1	\vdash			1	40	2.5			checked with primavera
	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											
6.12	studs to 50%. One hole at a time, remove the supernut. Using the eccentric gage slid onto the stud define the hole	3.0						60	2.5			checked with primavera
0.12	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							000	0.5		LED: See above	
6.13	other tasks) and 3 days to install Complete tightening of flange bolts to 100%.	10.0 1.0			ĺ	1	1	200			LED: See above	checked with primavera
6.14	Measure the tooling balls on both coils. The maximum deviation from the "realigned" points should be	1.0						20	2.5			checked with primavera
	.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						40	2.0	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				checked with primavera
7.05 7.06	Lower the Type-C coil onto the Type-B coil. Measure the monuments on the A coil to evaluate monument displacements. If movement greater than	1.0						20	2.5			checked with primavera
	.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				checked with primavera
7.08 7.09	Install studs, supernuts, and torque to 50% of final value. Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that they are tight. If a loose shim is	2.0		\vdash				40	2.5			checked with primavera
	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			<u> </u>		,	200			LED: See above	checked with primavera
7.12 7.13	Complete tightening of flange bolts to 100%.	1.0						20	2.5			checked with primavera
1.13	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	1.0				1		20	2.0		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					1					-	
10.00	Figure 3 below).	6.0		\vdash		1		120	2.5		Seguence Plan PF	checked with primavera
10.00	Complete local service and interface details Inflate all wing support bladders between wing surfaces (A/B, B/C) and on the C wing (MCHP - Right Side										Sequence Plan R5	checked with primavera
	only).	2.0						40	2.5		See above	checked with primavera
10.02	Make local service runs/connections on the shell of each MC.										4 days for coolant lines 4 days for mod coils thermocouples and strain	
		8.0		Ш				160	2.5		gages terminations	checked with primavera

WBS Num	nber: 185									
WBS Title	: Assembly of Field Periods									
Job Numb	pers: 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 Mana	ger: Mike Viola									
Enhrication a	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					2.5			checked with primavera
11.05	Install lift support beams	2.0					2.5			checked with primavera
11.06	Remove from stand and measure weight of completed assembly and Move to holding area.	2.0					2.5			checked with primavera

WBS Number:	185															
	sembly of Field Periods															
	: 1802, 1810, and 1815															
	Oversight & Support (1802)															
	A Operations - Stations 1, 2, & 3 (1810)															
	1 , , , ,															
	Operations - Station 5 (1815)															
Job Manager:	MIKE VIOIA															
Fabrication and Ass	ssembly					-				1						
Assumptions:																
Assu	umes 5 day workweek 1 shift no overtime															
	llel ops for sta 5 (2 fixtures available)															
Paral	llel ops for sta 5 (2 fixtures available)					•										
	1 fixture for station 3 only															
	llel ops for sta 2															
	B2,C2 Subtotal task 5-11 (total elasp time)		83									1335		620		checked with primavera
	Coil Subassembly-FP#2		- 10-			1	<u> </u>		1	<u> </u>	<u> </u>	0.46-				checked with primavera
	mble/Align Mod-Coils A3/B3/C3		126									2125		740	Sequence Plan R5	checked with primavera
Asser	mble/Align Mod-Coils A4/B4/C4		83									1335		620	Sequence Plan R5	checked with primavera
Station 2-Modular C	Coil Subassembly-FP#3	「														checked with primavera
Asser	mble/Align Mod-Coils A5/B5/C5		126									2125		740	Sequence Plan R5	checked with primavera
Asser	mble/Align Mod-Coils A6/B6/C6		83									1335		620	Sequence Plan R5	checked with primavera
	-														-	checked with primavera
	e Mod Coils and VVSA-FP#1															checked with primavera
	Hardware			\$ 5.0												checked with primavera
	ure and load test 3 legged actuator System		4.0									96	3.0			checked with primavera
	ure, Fabricate and load test 3 legged actuator Lift Fixture n Assembly of First Field Period Assy		8.0 2.0	\$ 6.0k								128 40	2.0			checked with primavera
	new platform legs		4.0									64	2.0			checked with primavera
Install	Il station 3 platforms (8 required)		4.0	\$ 10.0k								112	3.5			checked with primavera
Test o	out station 3 equipment and procedures			\$ 10.0								0	2.5			checked with primavera
	Assembly Step															checked with primavera
1.00 Pre-Ins	Assembly Step															checked with primavera
	Station 3 site monuments as needed to perform metrology measurements.		3.0	\$ 2.01								60	2.5			checked with primavera
	floor mounted tracks and VV base support			\$ 1.0k								100	2.5			checked with primavera
	gging operations to establish the MCHP CG location.		2.0									40	2.5			checked with primavera
	ssemble left MCHP MCHP support cart assemblies		4.0									0 80	2.5 2.5			checked with primavera checked with primavera
	cart motion. Move left cart to final assembly position to accept left MCHP and secure to the floor	-														checked with philiavera
suppor	rts. Move right cart far to the right.		2.0		$\perp \perp$							40	2.5			checked with primavera
	adjustor bar support weldment on Left Side the SISSCO crane, position left MCHP on the cart assembly		0.0 1.0		\perp	-			1			20	2.5			checked with primavera
	e left MCHP at three location to vertical support posts on support cart base.	-+	2.0		+	1		1	1			40				checked with primavera
2.06 Measu	ure the monuments on the positioned left MCHP and on the walls to establish the machine						·				'			100	Motrology Stoff Budgeted of LOT	ta di Para di
2.07 Set the	inate for further assembly operations. e positioning stop on the cart so it returns to the machine coordinate defined position in further		5.0											100	Metrology Staff Budgeted as LOE	checked with primavera
asseml	nbly steps.		1.0									20	2.5			checked with primavera
	ssemble right MCHP											0	2.5		·	checked with primavera
	the right base support cart to its final position ready to accept the right MCHP. Position the AirLoc emount in a lowered position.		0.5									10	2.5			checked with primavera
3.02 Lift the	e right side MCHP using the SISSCO crane and position it to be ready to engage the preinstalled								1							
Type-A 3.03 Tempo	A flange guide bushings. orary fasteners located adjacent to the alignment bushings can be used to help bring the parts		1.0		+							20	2.5			checked with primavera
togethe	ner.		0.0									0	2.5			checked with primavera
	held by the crane bring the AirLoc Wedgemount leveler up to take the load.		0.0									0	2.5			checked with primavera
	temporary scaffolding to install flange hardware bolts and shims as needed for assembly tolerances.	-+	1.0		+			-	1		-	20 20				checked with primavera
	en flange fasteners to 50%	- 	1.0						1			20				checked with primavera
3.08 Perform	m metrology measurements of all alignment fiducials on both MCHP's. The maximum deviation		1.0			4				<u> </u>		20	2.0		Matalana 01-# Budantada 1 05	ta di Para di
from th	he reference points should be .020" or less.		5.0											100	Metrology Staff Budgeted as LOE	checked with primavera
	m position adjustments on the right side MCHP if needed. Loosen all studs, adjust AirLock emounts as needed and install alternate sized shims. Re-torque all studs to 50% and recheck.															
	·		2.0			1			1		<u> </u>	40	2.5			checked with primavera
	position of the VV support hanger locations (top and bottom) on the left and right MCHP. May be		3.0											60	Metrology Staff Budgeted as LOE	checked with primavera
done a	as part of 3.08 if 3.09 not needed		5.0	_												

WBS Nur	nber: 185													
	e: Assembly of Field Periods													
	bers: 1802, 1810, and 1815													
	FPA Oversight & Support (1802)													
	FPA Operations - Stations 1, 2, & 3 (1810)													
	FPA Operations - Station 5 (1815)													
Job Mana	ager: Mike Viola													
ahrication	and Assembly													
Assumption														
	Assumes 5 day workweek 1 shift no overtime							l.						
	,					ı		1						
	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	 	Ψ 2.0IC			 			·			·		<mark>-</mark>
	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	0												
4.05	back office. Print the path on milar paper and using metrology mount the milar on the screens.						ļ			0	2.5			checked with primavera
4.05 4.06	Disengage the MCHP's by using the left support and adjustor bar to move the left MCHP. Remove both MCHP's.	1.0			\vdash				-	20	2.5	1	Can these stay on the carts and be	checked with primavera
4.00	Inciliate bout mortil. 3.	2.0								40	2.5	;	rolled all the way back?	checked with primavera
5.00	Install vacuum vessel	2.0								0	2.5		Tolica all the way back.	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				checked with primavera
5.03	Install VVSA to base support and make the connection to the NBI port attachment.	1.0								20	2.5	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			ah a alva d with primayara
6.00	Install left MCHP over VV	2.0								0	2.5			checked with primavera checked with primavera
6.01	Install any bumper protection components on the VV (left and right side) before manipulating left MCHP													checked with primavera
	over the VV.	0.5								10	2.5	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				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									40				
6.06	metrology measurements. Make position adjustments to properly align the MCHP. Transfer the full load to the AirLoc Wedgemount leveler.	2.0								40	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	0.0								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													
7.02	the AirLoc Wedgemount in a lowered position. Using the SISSCO actuators with laser guidance move the right MCHP over the VV TO WITHIN 1/2" OF	0.0			\vdash				-	0	2.5	1		checked with primavera
1.02	ITS FINAL POSITION and pause. Go to the next step.	2.0								40	2.5	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	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	ready to engage the preinstalled Type-A flange guide bushings. Temporary fasteners located adjacent to the alignment bushings can be used to help bring the parts	0.5								10	2.5	1		checked with primavera
	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				checked with primavera
7.07 7.08	Remove the laser screens to provide more floor space for scaffolding. Install temporary scaffolding to install flange hardware	0.0 4.0					-			0	2.5			checked with primavera
7.08	Install temporary scarfolding to install flange hardware Install bolts and all alumina and inboard weld shims.	4.0 2.0		_	\vdash					80 40	2.5			checked with primavera
7.10	Tighten flange fasteners to 50%	1.0		_	\vdash					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	1.0								20	2.0	1		
	found back off on sufficient adjacent bolts to allow a replacement shim to be inserted. Tighten bolt and	4.0									٠,			about adjusts print
7.12	recheck. Perform metrology measurements of all alignment fiducials on both MCHP's. The maximum deviation	1.0								20	2.5	2		checked with primavera
1.12	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	2.0								Ť		1		
	eccentricity. Select bushing and machine to match required eccentricity. Install bushing. Replace nut and			1	1 1	l	1	1	1	1	i .	1		
	tighten back to 50% and recheck alignment. Total 10 days 7 days to pre fit & fab bushings (in parallel with													

WBS Nu	mber: 185										
VBS Titl	le: Assembly of Field Periods										
ob Num	nbers: 1802, 1810, and 1815										
ob Title	: FPA Oversight & Support (1802)										
	e: FPA Operations - Stations 1, 2, & 3 (1810)										
	: FPA Operations - Station 5 (1815)										
	ager: Mike Viola										
OD Man	agori mino viola										
	and Assembly				 	1	T				
ssumption	ns:										
	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	5		checked with primaver
8.00	Weld all inboard shims							0 2.5	5		checked with primaver
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					2	00 2.5			checked with primaver
8.02	Final complete MC scan to verify period alignment.	5.0					3	JU 2.0	100	Metrology Staff Budgeted as LO	
9.00	VVSA attachment to MC.	5.0						0 2.5		menology of an Daugetea as Lot	checked with primaver
9.01	Attach VV permanent vertical supports to the MC at the two outboard connection points at the top and			_				0 2.5	,		checked with primaver
	bottom of the Type-A MC.	2.0						10 2.5	5		checked with primaver
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 primaver
9.03	Disconnect base support and transfer load to VV vertical supports.	1.0						20 2.5			checked with primaver
9.04	Install VV lateral supports and align VVSA to modular coils	4.0						30 2.5			checked with primaver
9.05	Prepare VVSA for transport. Install blocking as required to prevent any motion relative to the modular coils.	2.0						10 2.5			checked with primaver
10.00	Transfer Period to NCSX test cell.	2.0	1	1 1		+		0 2.5			checked with primaver
10.01	Install crane rigging to MCWF and transfer the unit to the transfer support frame. Secure Period /support	2.0						30 5.0			checked with primaver
10.02	frame to the transporter. Transfer completed Period to Station 5 located in NCSX test cell.	1.0	-					10 5.0			checked with primaver
	Subtotal FP#1	115		5			199		500		2495 checked with primaver
	Station 3-Assemble Mod Coils and VVSA-FP#2		i								checked with primaver
	Perform above sequence	115	\$ 5.0k	<			199	0 26	500.0		checked with primaver
	Station 3-Assemble Mod Coils and VVSA-FP#3	110	ψ 5.01	`			1	- 2.0	, 500.0	_	checked with primaver
		 115	¢ 50	,			199	0 0	500.0		
	Perform above sequence	115	\$ 5.0k	\			198	U 2.6	500.0		checked with primaver

WBS Num	nher: 185													
	: Assembly of Field Periods													
	pers: 1802, 1810, and 1815													
	FPA Oversight & Support (1802)													
Job Title:	FPA Operations - Stations 1, 2, & 3 (1810)													
Job Title:	FPA Operations - Station 5 (1815)													
	ger: Mike Viola													
JOD Walla	ger. Mike viola													
Fabrication a	and Assembly					l I								
Assumptions	3:													
	Assumes 5 day workweek 1 shift no overtime						,							
	•						1	Ī						
	Parallel ops for sta 5 (2 fixtures available)													
	Parallel ops for sta 5 (2 fixtures available)													
<u> </u>	Only 1 fixture for station 3 only													
	Parallel ops for sta 2													checked with primavera
														checked with phinavera
	TASK DESCRIPTION	Work days	41MS 37STK	STRVL 10T	ORNL EM/DSN	SH TB	EMEM	EMSM	EMSB	EMTB	SREW	et Crew	Basis of Estimate	ale and a state and a state and a
	TASK DESCRIPTION	uays	4 %	3.	ОШ	S	ш	ш	Ш	Ш	C	Σ	Shop based on similar tasks,	checked with primavera
													tempered (adjusted) for complexity of having to do all welds from inside of	
														checked with primavera
Job: 1815	- Field Period Assembly Station 5 (in NCSX TC)-VIOLA													checked with primavera
	Station 5- Final FP Assy -FP#1 (in NCSX TC)													checked with primavera
	metrology network	10.0	\$ 7.0K							160				checked with primavera
	Bolt on 2 Port Extensions needed for first Plasma diagnostics	1.0								16	2.0		10" ports provided by WBS 38	checked with primavera
	MTM NCR Hardware repurchase (bolt kits & cover plates)		\$ 42.0K											checked with primavera
	Weld Wire & weld supples		\$ 15.0K											checked with primavera
	Testout Sta 5 equipt & procedures	5.0								160				checked with primavera
	Check 3 sled interfaces adjust holes Fixtures installed - final metrology	12.0 6.0								384	4.0			checked with primavera checked with primavera
	Miscellaneous for tooling	6.0								192	4.0		\$ 1.027.8K	checked with primavera
	Station 5 preinstallation in parallel												ψ 1,027.5π	checked with primavera
1.00	Component preparations							1						checked with primavera
1.01	The short dome port (the one on the top of the dome) needs to cut off near the dome. The longest port													checked with primavera
	can remain.	2.0								40	2.5			checked with primavera
1.02	Install heat tape and theomocouples on all ports.												Covered in Station 2 LED: Reversed	
		0.0								0			order of 1.02 & 1.03	checked with primavera
1.03	Install insulation system around all ports.	0.0								0			Covered in Station 2	checked with primavera
<u> </u>	Install insulation system around all ports.	0.0		\square						0				checked with primavera
2.00	Install heat tape and theomocouples on all ports.	0.0								0	2.5			checked with primavera
2.00	Pre-Installation set-up Install period support fixture	2.0	-	+++						40	2.5			checked with primavera checked with primavera
2.02	motali period support intuite	2.0	1	\vdash						40	2.5			checked with primavera
	Install FPA on support stand. Use leveler pad to engage base of MC. Add bolts to secure in place.	2.0								40	2.5			checked with primavera
2.03	Install external working platforms	4.0					-			80				checked with primavera
2.04	Install internal VV working platforms	3.0								60	2.5			checked with primavera
3.00	VV port installation													checked with primavera
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			checked with primavera
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	30.0								600				checked with primavera
	them.									600				checked with primavera
3.03	them. Leak check each port immediately after it is welded.	30.0												
3.03 4.00	them. Leak check each port immediately after it is welded. Install port boot seal assembly	30.0	l				1			000	2.0			checked with primavera
										320	2.5			
4.00 4.01 5.00	Install port boot seal assembly Install boots on all ports except for the two port 4's. MC lead and coolant connections	30.0												checked with primavera
4.00 4.01	Install port boot seal assembly Install boots on all ports except for the two port 4's. MC lead and coolant connections Install MC lead connections on each of the MC's and temporally position the leads so they will not	30.0 16.0								320	2.5		in parallel with 5.02	checked with primavera checked with primavera checked with primavera
4.00 4.01 5.00 5.01	Install port boot seal assembly Install boots on all ports except for the two port 4's. MC lead and coolant connections 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.	30.0									2.5		in parallel with 5.02	checked with primavera checked with primavera
4.00 4.01 5.00 5.01	Install port boot seal assembly Install boots on all ports except for the two port 4's. MC lead and coolant connections Install MC lead connections on each of the MC's and temporally position the leads so they will not	30.0 16.0								320	2.5		in parallel with 5.02	checked with primavera checked with primavera checked with primavera
4.00 4.01 5.00 5.01	Install port boot seal assembly Install boots on all ports except for the two port 4's. MC lead and coolant connections Install MC lead acconnections 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. Install MC coolant lines on each MC and position them for the TF installation and routing through PF	30.0 16.0 6.0								320 72	2.5 1.5 2.5		in parallel with 5.02	checked with primavera checked with primavera checked with primavera checked with primavera
4.00 4.01 5.00 5.01	Install port boot seal assembly Install boots on all ports except for the two port 4's. MC lead and coolant connections 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. Install MC coolant lines on each MC and position them for the TF installation and routing through PF structure. Platforms may need to be altered or moved for the installation of the TF coils. TF installation - right side	30.0 16.0 6.0 12.0								320 72 240	2.5 1.5 2.5		in parallel with 5.02	checked with primavera checked with primavera checked with primavera checked with primavera checked with primavera
4.00 4.01 5.00 5.01 5.02	Install port boot seal assembly Install boots on all ports except for the two port 4's. MC lead and coolant connections Install MC lead and coclant connections Install MC lead connections on each of the MC's and temporally position the leads so they will not satisfare with the TF ce ill installation and for routing through the PF structure Install MC coolant lines on each MC and position them for the TF installation and routing through PF structure. Platforms may need to be altered or moved for the installation of the TF coils.	30.0 16.0 6.0 12.0								320 72 240	2.5 1.5 2.5 2.5		in parallel with 5.02	checked with primavera checked with primavera checked with primavera checked with primavera checked with primavera checked with primavera checked with primavera

WBS Nun	nber: 185				П									
	e: Assembly of Field Periods				+		1							
	bers: 1802, 1810, and 1815			\vdash	++							+		
	FPA Oversight & Support (1802)				\vdash									
					\vdash									
	FPA Operations - Stations 1, 2, & 3 (1810)				-									
	FPA Operations - Station 5 (1815)				-									
Job Mana	ger: Mike Viola													
Fabrication a	and Assembly				ш									
Assumption														
-	Assumes 5 day workweek 1 shift no overtime						1	l						
	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				\vdash									
6.02	Attach the temporary support at the end of the Type-C MC used to unload the a pair of center supports.													
6.02	Lawar lawalar and to discarge a bose of MC on the right side. Domove right side 1997	1.0			+		ļ			20	2.5	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	1 '	'						0	2.5	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	2.0								40	2.5			ah a ak a d with print
6.05	needed). Slide the first TF assembly against the TF support bracket and secure in place with the mating support	2.0	 	+-	++		-			40	2.5)		checked with primavera
	bracket.	1.0	L '							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		$\Box\Box$	LI					40	2.5	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	1 '	'						20	2.5	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 6.10	Reinstall leveler pad to engage base of MC on the right side. Installed one side of the TF support brackets on the Type-C coil (top and bottom) for the TF installation to	0.0	 	+-	+					0	2.5)		checked with primavera
	occur at Station 6.	1.0	<u> </u>	<u> </u>					<u> </u>	20	2.5	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	1							260	2.5	5		checked with primavera
8.00	TF fit-up check	10.0			_					200	2.0			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	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	1							40	2.5	5		checked with primavera
9.02	Install boots on both port 4's.	4.0			_					80				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	1							160	2.5	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	5		checked with primavera
11.02	Connect all MC coolant lines to the manifold (40 lines top and bottom)		1							400	٠.	_	Flex lines but need field supports	and the second
12.00	Diagnostic	20.0	 	+-	+					400	2.5)	installed	checked with primavera checked with primavera
12.00	Install Rogowski coils on the end of the VV, left side. Route leads through space between port 8 and		 	\vdash	+		1					1		
	spool port opening and coil onto shell of MC for future routing	5.0	L							100	2.5	5		checked with primavera
13.00	Final measurements					 							Materia au Ctaff Budertado 105	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 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. Using monuments on the VV for alignment, bring the VV into proper alignment. Make final adjust in the	1.0										20	Metrology Stall Budgeted as LOE	checked with primavera
	VV supports to secure VV in place.	4.0	1 '							80				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	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	5.0										100	Metrology Staff Budgeted as LOE	checked with primavera
13.10	Final Acceptance tests	3.0										1.00	man and state an	checked with primavera
13.11	Check Assembly (bolts, etc)	5.0			_					100	2.5	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	L		\Box					120	2.5			checked with primavera
13.15 13.16	Check trim coils (voltage etc) Check TF coils (voltage etc)	3.0 6.0			+		ļ			60 120	2.5			checked with primavera
	Transfer Period to final assembly (Station 6).	6.0	 	+-	++		-			120	2.5)		checked with primavera
14 00			 		+-+		-			40	2.5	5		checked with primavera
14.00 14.01	Install crane rigging to completed Period assembly	シロ												
14.00 14.01 14.02	Install crane rigging to completed Period assembly Remove platforms	2.0	 		-					20				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		-	_	1	1	1	ı	 		
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	1	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

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

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

WBS Number: 185

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Job Title: FPA Operations - Station 5 (1815)

Job Manager: Mike Viola

		Likelihood of			Cost In	npact	Schedule Im	pact
Job	Risk Description	Occurring	Mitigation Plan	Basis of estimate	Low	High	Low	High
pers	s or prolonged unavailability of certain key onnel (Viola or Perry) from the project could stantially 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
beco	ck office" support for FPA and final assembly omes a chronic bottleneck, stretching out the 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.	of FPA/final assembly.	+ \$0	+ \$600	+ 0.00	+ 2.00
	ular coil damaged during assembly requiring ificant 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
	surface component (coolant tube, flux loop, or damaged during FPA requiring significant ork	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.	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.	and critical path. FPA cost impact assumed to be \$300k/mo.	+ \$0	+ \$150	+ 0.00	+ 0.50

WBS Number: 185

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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

		nwobamua

NC

Welds will be leak checked Impacts of having a few leaks during FPA when leaks can be is covered in estimate addressed without significantly uncertainty with present impacting the critical path.

Likelihood of many leaks appearing during initial pumpdown is considered extremely unlikely with this

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 Title: FPA Oversight & Support (1802)

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Job Title: FPA Operations - Station 5 (1815)

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:

- 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.

 Recommendation for additional work will be made after the design review and test weld

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.



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

Edison Welding Institute Support of Test Welding Program

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

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