

NCSX June 2007 ETC
 TABLE III - Fabrication and Installation

WBS Number: 185													
WBS Title: Assembly of Field Periods													
Job Numbers: 1802, 1810, and 1815													
Job Title: FPA Oversight & Support (1802)													
Job Title: FPA Operations - Stations 1, 2, & 3 (1810)													
Job Title: FPA Operations - Station 5 (1815)													
Job Manager: Mike Viola													
Fabrication and Assembly													
Assumptions:													
Assumes 5 day workweek 1 shift no overtime													
Parallel ops for sta 5 (2 fixtures available)													
Parallel ops for sta 5 (2 fixtures available)													
Only 1 fixture for station 3 only													
Parallel ops for sta 2													
Station 5-Final Field Period Assembly													
Sequence Plan (Brown) - Covered in Job 1803													checked with primavera
Systems Analysis (Brooks) - covered in Job 8204													checked with primavera
Metrology Plan (Ellis) - Covered in Job 8205													checked with primavera
Procedures approved													checked with primavera
JHA completed													checked with primavera
Training needs identified & released													checked with primavera
ACC review completed													checked with primavera
Pre-job brief completed													checked with primavera
Station 5 operational													checked with primavera
Job: 1802 - FP Assy Oversight&Support-VIOLA Total													checked with primavera
													checked with primavera

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Job Manager: Mike Viola												
Fabrication and Assembly Assumptions:												
Assumes 5 day workweek 1 shift no overtime												
Parallel ops for sta 5 (2 fixtures available)												
Parallel ops for sta 5 (2 fixtures available)												
Only 1 fixture for station 3 only												
Parallel ops for sta 2												
Station 1- FP #3 VV Prep (hrd surf cmpnts)												
Misc Hardware												
\$ 2.0K												
Layout diagnostic&coolant paths on vessel - Completed												
12.0												
240 2.5												
15% complete												
Serial tasks alternating between FPA constant 2.5 men. Not started yet due to coil alignment tests												
checked with primavera												
Install heater tape on vertical ports												
7.0												
140 2.5												
Serial tasks alternating between FPA constant 2.5 men. Not started yet due to coil alignment tests												
checked with primavera												
Verify installation of heater tapes												
1.0												
20 2.5												
Serial tasks alternating between FPA constant 2.5 men. Not started yet due to coil alignment tests												
checked with primavera												
Attach studs for coolant lines												
3.0												
60 2.5												
Serial tasks alternating between FPA constant 2.5 men. Not started yet due to coil alignment tests												
checked with primavera												
Install Templates												
3.0												
60 2.5												
Serial tasks alternating between FPA constant 2.5 men. Not started yet due to coil alignment tests												
checked with primavera												
Wind magnetic diagnostic sensors												
14.0												
280 2.5												
Serial tasks alternating between FPA constant 2.5 men.												
checked with primavera												
Install precision magnetic diagnostic sensors - Completed												
3.0												
60 2.5												
Serial tasks alternating between FPA constant 2.5 men.												
checked with primavera												
Verify installation magnetic diagnostic sensors - Completed												
4.0												
80 2.5												
Serial tasks alternating between FPA constant 2.5 men.												
checked with primavera												
Install local I&C (incl thermocouples)												
5.0												
100 2.5												
Serial tasks alternating between FPA constant 2.5 men.												
checked with primavera												
Verify installation of local I&C												
2.0												
40 2.5												
Serial tasks alternating between FPA constant 2.5 men.												
checked with primavera												
Install cooling/htg lines to vac vs1												
15.0												
300 2.5												
Serial tasks alternating between FPA constant 2.5 men.												
checked with primavera												
Weld cooling/htg risers												
16.0												
320 2.5												
Serial tasks alternating between FPA constant 2.5 men Experience is 8 tubes per day 128 tubes per VVSA												
checked with primavera												
Verify Instl of H/C lines,headers,manifolds												
5.0												
100 2.5												
Serial tasks alternating between FPA constant 2.5 men.												
checked with primavera												
Perform final acceptance testing (H/C flow test)												
5.0												
100 2.5												
Serial tasks alternating between FPA constant 2.5 men												
checked with primavera												
Trim seal plates												
2.0												
40 2.5												
Serial tasks alternating between FPA constant 2.5 men												
checked with primavera												
Loop termination & verification												
18.0												
360 2.5												
Serial tasks alternating between FPA constant 2.5 men.												
checked with primavera												
Install Final Internal and External monuments and measure												
4.0												
80 2.5												
Serial tasks alternating between FPA constant 2.5 men.												
checked with primavera												
Final Scan												
4.0												
80 2.5												
Serial tasks alternating between FPA constant 2.5 men.												
checked with primavera												
Install heater tape and insulation on removeable ports												
10.0												
200 2.5												
Serial tasks alternating between FPA constant 2.5 men												
checked with primavera												
Prepare and transfer completed VV to holding area												
2.0												
40 2.5												
Serial tasks alternating between FPA constant 2.5 men.												
checked with primavera												
Station 1-Spool pieces (3) (spacers)												
2702												
checked with primavera												
Attach diagnostics, studs and coolant lines												
17.0												
340 2.5												
checked with primavera												
install Final Internal and External monuments and measure												
2.0												
40 2.5												
checked with primavera												

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

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Fabrication and Assembly Assumptions:															
Assumes 5 day workweek 1 shift no overtime															
Parallel ops for sta 5 (2 fixtures available)															
Parallel ops for sta 5 (2 fixtures available)															
Only 1 fixture for station 3 only															
Parallel ops for sta 2															
Assemble A1B1C1															
5.00	Pre-assemble A1-A2												Sequence Plan R5	checked with primavera	
5.01	Position the Type-A modular coil on the fixture. "B" flange down. Obtain a set of "realigned" fiducial positions.	2.0								40			Metrology Staff Budgeted as LOE - COMPLETED	checked with primavera	
5.02	Align the laser tracker to the conical seats locking into a minimum of 8 of them.	1.0										20	Metrology Staff Budgeted as LOE	checked with primavera	
5.03	Establish a global coordinate system based on the modular coil geometry. Measure the monuments on the fixture and on the walls.	2.0										40	Metrology Staff Budgeted as LOE	checked with primavera	
5.04	Place the an initial set of metal shims on the coil in the designated locations, identical to those in the A1-A2 fit up test.	0.5									10	2.5		checked with primavera	
5.05	Install dial indicators on the modular coil in areas where we expect to see deflection.	2.0									40	2.5		checked with primavera	
5.06	Lower the mating type A modular coil into position.	1.0									20	2.5		checked with primavera	
5.07	Measure the monuments on the bottom coil. Jack areas of the coil as necessary to bring displaced monuments back to within .002" of their original position.	1.0									20	2.5		checked with primavera	
5.08	Using three target points, perform the positioning as was done in the A1-A2 fit up test.	1.0									20	2.5		checked with primavera	
5.09	Install the remaining metal shims with Fuji paper, install studs, supernuts, and torque to 50% of final value.	2.0									40	2.5		checked with primavera	
5.10	Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that they are tight. If a loose shim is found back off on sufficient adjacent bolts to allow a replacement shim to be inserted. Tighten bolt and recheck.	1.0									20	2.5		checked with primavera	
5.11	Measure the tooling balls on both coils. The maximum deviation from the "realigned" points should be .007" or less.	5.0										100	Metrology Staff Budgeted as LOE	checked with primavera	
5.12	If the above step does not fall within .007" or less then loosen all studs, adjust shims locally. Re-torque all studs to 50%.	3.0									60	2.5		checked with primavera	
5.13	Loosen studs to extract Fuji paper. Evaluate shim pressure distribution and make shim adjustments if shim pressure is unacceptable. Re-torque all studs to 50% and recheck alignment.													checked with primavera	
5.14	Install the A-A locator bushings at two stud locations for use in re-positioning MCHP in Stage 3.	2.0									40	2.5		checked with primavera	
5.15	Remove all studs, nuts, shims etc. Identify shim locations.	1.0									20	2.5		checked with primavera	
6.00	A-B modular coil assembly												Sequence Plan R5	checked with primavera	
6.01	Place the Type-A coil, "A" flange down, on the 20deg fixture. Obtain a set of "realigned" fiducial positions for the "A" and "B" coils.	2.0									40	2.5		checked with primavera	
6.02	Using the laser tracker, align to the conical seats locking into a minimum of 8 of them.	1.0										20	Metrology Staff Budgeted as LOE	checked with primavera	
6.03	Establish a global coordinate system based on the modular coil geometry. Measure the monuments on the fixture and on the walls.	2.0										40	Metrology Staff Budgeted as LOE	checked with primavera	
6.04	Place the an initial set of metal shims on the coil in the designated locations.	2.0									40	2.5		checked with primavera	
6.04.1	Stuff Shim Bag with Fiberglass, Reseal, Place Shim Bag on Wing	0.3										5	2.5	LED: Must place bag before coil assembly	checked with primavera
6.05	Lower the Type-B coil onto the Type-A coil.	1.0									20	2.5		checked with primavera	
6.06	Measure the monuments on the A coil. Jack areas of the coil as necessary to bring displaced monuments back to within .002" of their original position.	1.0									20	2.5		checked with primavera	
6.06.1	Install Dial indicators for X-Y Positioning	1.0									20	2.5	LED: Missing from sequence	checked with primavera	
6.07	Using three target points on the B coil, perform the X-Y positioning of the B coil.	1.0									20	2.5		checked with primavera	
6.08	Install the remaining metal shims with Fuji paper, install studs, supernuts, and torque to 50% of final value.	2.0									40	2.5		checked with primavera	
6.09	Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that they are tight. If a loose shim is found back off on sufficient adjacent bolts to allow a replacement shim to be inserted. Tighten bolt and recheck.	1.0									20	2.5		checked with primavera	
6.10	Measure the tooling balls on both coils. The maximum deviation from the "realigned" points should be .007" or less.	5.0										100	Metrology Staff Budgeted as LOE	checked with primavera	
6.11	If the above step does not fall within .007" or less then loosen all studs, adjust shims locally. Re-torque all studs to 50%.	3.0									60	2.5		checked with primavera	
6.12	Loosen all studs, reduce load on flanges and install an equivalent set of alumina coated metal shims. Re-torque all studs to 50%.	1.0									20	2.5		checked with primavera	
6.13	Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that they are tight. If a loose shim is found back off on sufficient adjacent bolts to allow a replacement shim to be inserted. Tighten bolt and recheck.	1.0									20	2.5		checked with primavera	
6.14	Measure the tooling balls on both coils. The maximum deviation from the "realigned" points should be .007" or less.	5.0										100	Metrology Staff Budgeted as LOE	checked with primavera	

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

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Job Title: FPA Operations - Station 5 (1815)												
Job Manager: Mike Viola												
Fabrication and Assembly												
Assumptions:												
	Assumes 5 day workweek 1 shift no overtime											
	Parallel ops for sta 5 (2 fixtures available)											
	Parallel ops for sta 5 (2 fixtures available)											
	Only 1 fixture for station 3 only											
	Parallel ops for sta 2											
9.01	Install trim coil on the top surface of the Type-C on Period 1 and 2 only on the MCHP - Right Side (See Figure 3 below).	6.0								120	2.5	
10.00	Complete local service and interface details											
10.01	Install all wing support bladders between wing surfaces (A/B, B/C) and on the C wing (MCHP - Right Side only).	2.0								40	2.5	
10.02	Make local service runs/connections on the shell of each MC.	8.0								160	2.5	
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	
11.00	Final measurements / transfer completed MCHP to holding area											
11.02	Make final metrology measurement of all fiducials. Scan the "B" flange of Type-C coil. Record the results.									0	2.5	
11.03	Using tension tester measure bolt length on all tension fasteners and record the results.	0.5								10	2.5	
11.04	Mark part for identification	0.0								0	2.5	
11.05	Install lift support beams	2.0								40	2.5	
11.06	Remove from stand and measure weight of completed assembly	1.0								20	2.5	
11.07	Move to holding area.	0.0								0	2.5	

Sequence Plan R5
checked with primavera
checked with primavera

LED: Bags were placed earlier
4 days for coolant lines 4 days for
mod coils thermocouples and strain
gages terminations
checked with primavera
checked with primavera

Sequence Plan R5
checked with primavera
checked with primavera

Done at 7.18
checked with primavera
checked with primavera
checked with primavera
checked with primavera

246 shifts
checked with primavera

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Job Manager: Mike Viola														
Fabrication and Assembly Assumptions:														
	Assumes 5 day workweek 1 shift no overtime													
	Parallel ops for sta 5 (2 fixtures available)													
	Parallel ops for sta 5 (2 fixtures available)													
	Only 1 fixture for station 3 only													
	Parallel ops for sta 2													
6.07	Using three target points on the B coil, perform the X-Y positioning of the B coil.	1.0								20		Metrology Staff Budgeted as LOE	checked with primavera	
6.08	Install studs, supernuts, and torque to 50% of final value.	2.0								40	2.5		checked with primavera	
6.09	Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that they are tight. If a loose shim is found back off on sufficient adjacent bolts to allow a replacement shim to be inserted. Tighten bolt and recheck.	1.0								20	2.5		checked with primavera	
6.10	Measure the tooling balls on both coils. The maximum deviation from the "realigned" points should be .007" or less.	5.0										100	Metrology Staff Budgeted as LOE	checked with primavera
6.11	If the above step does not fall within .007" or less then loosen all studs, adjust shims locally. Re-torque all studs to 50%.	3.0								60	2.5		checked with primavera	
6.12	One hole at a time, remove the supernut. Using the eccentric gage slid onto the stud define the hole eccentricity. Select bushing and machine to match required eccentricity. Install bushing. Replace nut and tighten back to 50% and recheck alignment. Total 10 days 7 days to pre fit & fab bushings (in parallel with other tasks) and 3 days to install	10.0								200	2.5		LED: See above	checked with primavera
6.13	Complete tightening of flange bolts to 100%.	1.0								20	2.5			checked with primavera
6.14	Measure the tooling balls on both coils. The maximum deviation from the "realigned" points should be .007" or less.	3.0										60	Metrology Staff Budgeted as LOE	checked with primavera
6.15	Scan the "B" flange of Type-B coil	1.0								20	2.5			checked with primavera
6.16	Using the "B" flange measurement of the Type-B coil and the earlier "A" flange measurement of the Type-C coil, define all B/C flange shim thickness.													checked with primavera
7.00	(A-B) to C modular coil assembly (MCHP)													Sequence Plan R5
7.01	Place the "A/B" assembly, "A" coil down, on the 40deg fixture. Obtain a set of "realigned" fiducial positions. For the "A", "B", and "C" coils.	2.0								40	2.5			checked with primavera
7.02	Using the laser tracker, align to the conical seats locking into a minimum of 8 of them.	1.0										20	Metrology Staff Budgeted as LOE	checked with primavera
7.03	Establish a global coordinate system based on the modular coil geometry. Measure the monuments on the fixture and on the walls.	2.0										40	Metrology Staff Budgeted as LOE	checked with primavera
7.04	Place all alumina and grind inboard weld shims on the coil.	2.0								40	2.5			checked with primavera
7.05	Lower the Type-C coil onto the Type-B coil.	1.0								20	2.5			checked with primavera
7.06	Measure the monuments on the A coil to evaluate monument displacements. If movement greater than .002" is observed discuss with back office on how to proceed in bringing displaced monuments back to within .002" of their original position.	1.0										20	Metrology Staff Budgeted as LOE	checked with primavera
7.07	Using three target points on the Type-C coil, perform the X-Y positioning of the coil.	1.0								20	2.5			checked with primavera
7.08	Install studs, supernuts, and torque to 50% of final value.	2.0								40	2.5			checked with primavera
7.09	Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that they are tight. If a loose shim is found back off on sufficient adjacent bolts to allow a replacement shim to be inserted. Tighten bolt and recheck.	1.0								20	2.5			checked with primavera
7.10	Measure the tooling balls on all coils. The maximum deviation from the "realigned" points should be .010" or less.	5.0										100	Metrology Staff Budgeted as LOE	checked with primavera
7.11	One hole at a time, remove the supernut. Using the eccentric gage slid onto the stud define the hole eccentricity. Select bushing and machine to match required eccentricity. Install bushing. Replace nut and tighten back to 50% and recheck alignment. Total 10 days 7 days to pre fit & fab bushings (in parallel with other tasks) and 3 days to install	10.0								200	2.5		LED: See above	checked with primavera
7.12	Complete tightening of flange bolts to 100%.	1.0								20	2.5			checked with primavera
7.13	Measure the tooling balls on both coils. The maximum deviation from the "realigned" points should be .010" or less.	4.0										80	Metrology Staff Budgeted as LOE	checked with primavera
8.00	Tack weld inboard welded shims													Sequence Plan R5
8.01	Partially tack weld all inboard shims to one flange to keep them in place. The final welding of all welded shims to take place in Station 3.	1.0								20	2.5			checked with primavera
9.00	Install trim coil													Sequence Plan R5
9.01	Install trim coil on the top surface of the Type-C on Period 1 and 2 only on the MCHP - Right Side (See Figure 3 below).	6.0								120	2.5			checked with primavera
10.00	Complete local service and interface details													Sequence Plan R5
10.01	Inflate all wing support bladders between wing surfaces (A/B, B/C) and on the C wing (MCHP - Right Side only).	2.0								40	2.5		See above	checked with primavera
10.02	Make local service runs/connections on the shell of each MC.	8.0								160	2.5		4 days for coolant lines 4 days for mod coils thermocouples and strain gages terminations	checked with primavera

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WBS Number: 185												
WBS Title: Assembly of Field Periods												
Job Numbers: 1802, 1810, and 1815												
Job Title: FPA Oversight & Support (1802)												
Job Title: FPA Operations - Stations 1, 2, & 3 (1810)												
Job Title: FPA Operations - Station 5 (1815)												
Job Manager: Mike Viola												
Fabrication and Assembly												
Assumptions:												
	Assumes 5 day workweek 1 shift no overtime											
	Parallel ops for sta 5 (2 fixtures available)											
	Parallel ops for sta 5 (2 fixtures available)											
	Only 1 fixture for station 3 only											
	Parallel ops for sta 2											
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		
11.00	Final measurements / transfer completed MCHP to holding area											Sequence Plan R5
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
11.03	Using tension tester measure bolt length on all tension fasteners and record the results.	0.5							10	2.5		checked with primavera
11.04	Mark part for identification	0.0							0	2.5		checked with primavera
11.05	Install lift support beams	2.0							40	2.5		checked with primavera
11.06	Remove from stand and measure weight of completed assembly and Move to holding area.	2.0							40	2.5		checked with primavera

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Job Title: FPA Operations - Stations 1, 2, & 3 (1810)											
Job Title: FPA Operations - Station 5 (1815)											
Job Manager: Mike Viola											
Fabrication and Assembly Assumptions:											
Assumes 5 day workweek 1 shift no overtime											
Parallel ops for sta 5 (2 fixtures available)											
Parallel ops for sta 5 (2 fixtures available)											
Only 1 fixture for station 3 only											
Parallel ops for sta 2											
A2,B2,C2 Subtotal task 5-11 (total elasp time)			83						1335	620	
Station 2-Modular Coil Subassembly-FP#2											
Assemble/Align Mod-Coils A3/B3/C3			126						2125	740	Sequence Plan R5
Assemble/Align Mod-Coils A4/B4/C4			83						1335	620	Sequence Plan R5
Station 2-Modular Coil Subassembly-FP#3											
Assemble/Align Mod-Coils A5/B5/C5			126						2125	740	Sequence Plan R5
Assemble/Align Mod-Coils A6/B6/C6			83						1335	620	Sequence Plan R5
Station 3-Assemble Mod Coils and VVSA-FP#1											
Misc Hardware											
Procure and load test 3 legged actuator System			4.0	\$ 5.0K							
Procure, Fabricate and load test 3 legged actuator Lift Fixture			8.0	\$ 43.0K					96	3.0	
Begin Assembly of First Field Period Assy			2.0	\$ 6.0K					128	2.0	
Fab new platform legs			4.0						40	2.5	
Install station 3 platforms (8 required)			4.0	\$ 10.0K					64	2.0	
Test out station 3 equipment and procedures				\$ 10.0K					112	3.5	
									0	2.5	
Assembly Step											
1.00	Pre-Installation set-up										
1.01	Install Station 3 site monuments as needed to perform metrology measurements.										
			3.0	\$ 2.0K					60	2.5	
1.02	Install floor mounted tracks and VV base support										
			5.0	\$ 1.0K					100	2.5	
1.03	Use rigging operations to establish the MCHP CG location.										
			2.0						40	2.5	
2.00	Pre-assemble left MCHP										
2.01	Install MCHP support cart assemblies										
			4.0						80	2.5	
2.02	Verify cart motion. Move left cart to final assembly position to accept left MCHP and secure to the floor supports. Move right cart far to the right.										
			2.0						40	2.5	
2.03	Install adjustor bar support weldment on Left Side										
			0.0						0	2.5	checked with primavera
2.04	Using the SISCO crane, position left MCHP on the cart assembly										
			1.0						20	2.5	checked with primavera
2.05	Secure left MCHP at three location to vertical support posts on support cart base.										
			2.0						40	2.5	checked with primavera
2.06	Measure the monuments on the positioned left MCHP and on the walls to establish the machine coordinate for further assembly operations.										
			5.0							100	Metrology Staff Budgeted as LOE
2.07	Set the positioning stop on the cart so it returns to the machine coordinate defined position in further assembly steps.										
			1.0						20	2.5	checked with primavera
3.00	Pre-assemble right MCHP										
3.01	Move the right base support cart to its final position ready to accept the right MCHP. Position the AirLoc Wedgemount in a lowered position.										
			0.5						10	2.5	checked with primavera
3.02	Lift the right side MCHP using the SISCO crane and position it to be ready to engage the preinstalled Type-A flange guide bushings.										
			1.0						20	2.5	checked with primavera
3.03	Temporary fasteners located adjacent to the alignment bushings can be used to help bring the parts together.										
			0.0						0	2.5	checked with primavera
3.04	While held by the crane bring the AirLoc Wedgemount leveler up to take the load.										
			0.0						0	2.5	checked with primavera
3.05	Install temporary scaffolding to install flange hardware										
			1.0						20	2.5	checked with primavera
3.06	Install bolts and shims as needed for assembly tolerances.										
			1.0						20	2.5	checked with primavera
3.07	Tighten flange fasteners to 50%										
			1.0						20	2.5	checked with primavera
3.08	Perform metrology measurements of all alignment fiducials on both MCHPs. The maximum deviation from the reference points should be .020" or less.										
			5.0							100	Metrology Staff Budgeted as LOE
3.09	Perform position adjustments on the right side MCHP if needed. Loosen all studs, adjust AirLock Wedgemounts as needed and install alternate sized shims. Re-torque all studs to 50% and recheck.										
			2.0						40	2.5	checked with primavera
3.10	Verify position of the VV support hanger locations (top and bottom) on the left and right MCHP. May be done as part of 3.08 if 3.09 not needed										
			3.0							60	Metrology Staff Budgeted as LOE
3.11	Remove flange hardware and temporary platforms										
			1.0						20	2.5	checked with primavera

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Job Numbers: 1802, 1810, and 1815														
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Job Title: FPA Operations - Stations 1, 2, & 3 (1810)														
Job Title: FPA Operations - Station 5 (1815)														
Job Manager: Mike Viola														
Fabrication and Assembly Assumptions:														
	Assumes 5 day workweek 1 shift no overtime													
	Parallel ops for sta 5 (2 fixtures available)													
	Parallel ops for sta 5 (2 fixtures available)													
	Only 1 fixture for station 3 only													
	Parallel ops for sta 2													
4.00	Install laser screens													
4.01	Establish a global coordinate system based on the full period geometry. Measure the monuments on the MCHP's and on the walls.	2.0								40		Metrology Staff Budgeted as LOE	checked with primavera	
4.02	Using metrology and the established global coordinate system place all of the laser screens as called out in the Stage 3 drawings.	2.0								40	2.5		checked with primavera	
4.03	Turn each lasers on and with metrology determine their alignment. Record the laser position.	1.0								20	2.5		checked with primavera	
4.04	Based on metrology measurements of the screens and lasers the screens path can be defined by the back office. Print the path on milar paper and using metrology mount the milar on the screens.									0	2.5		checked with primavera	
4.05	Disengage the MCHP's by using the left support and adjustor bar to move the left MCHP.	1.0								20	2.5		checked with primavera	
4.06	Remove both MCHP's.												Can these stay on the carts and be rolled all the way back?	checked with primavera
5.00	Install vacuum vessel									0	2.5		checked with primavera	
5.01	Remove the adjustor bar support from left side.	0.0								0	2.5		checked with primavera	
5.02	Install VV NBI port support stand.	2.0								40	2.5		checked with primavera	
5.03	Install VVSA to base support and make the connection to the NBI port attachment.	1.0								20	2.5		checked with primavera	
5.04	Using metrology take tooling ball readings off the VV shell to properly position the VVSA to the global coordinate system. Secure the VVSA to the base and at the NBI port support stand.	2.0								40	2.5		checked with primavera	
6.00	Install left MCHP over VV									0	2.5		checked with primavera	
6.01	Install any bumper protection components on the VV (left and right side) before manipulating left MCHP over the VV.	0.5								10	2.5		checked with primavera	
6.02	Move the left base support cart to the far left so it will not interfere with the MCHP installation. Position the AirLoc Wedgemount in a lowered position.	0.0								0	2.5		checked with primavera	
6.03	Using the SISSCO actuators with laser guidance move the left MCHP over the VV.	2.0								40	2.5		checked with primavera	
6.04	Re-install the left adjustor bar.	0.0								0	2.5		checked with primavera	
6.05	Once the MCHP has been moved over the VV bring up Wedgemount levelers to stabilize the unit and take metrology measurements. Make position adjustments to properly align the MCHP.	2.0								40	2.5		checked with primavera	
6.06	Transfer the full load to the AirLoc Wedgemount leveler.	0.0								0	2.5		checked with primavera	
6.07	Using the adjustor bar on the left side move the MCHP to the left 1/2".	0.0								0	2.5		checked with primavera	
7.00	Install right MCHP over VV									0	2.5		checked with primavera	
7.01	Move the right base support cart to the far right so it will not interfere with the MCHP installation. Position the AirLoc Wedgemount in a lowered position.	0.0								0	2.5		checked with primavera	
7.02	Using the SISSCO actuators with laser guidance move the right MCHP over the VV TO WITHIN 1/2" OF ITS FINAL POSITION and pause. Go to the next step.	2.0								40	2.5		checked with primavera	
7.03	Using the adjustor bar on the left side move the left MCHP to its final position.	0.5								10	2.5		checked with primavera	
7.04	With the left MCHP in place, move the right side MCHP using the CISSCO crane and position it to be ready to engage the preinstalled Type-A flange guide bushings.	0.5								10	2.5		checked with primavera	
7.05	Temporary fasteners located adjacent to the alignment bushings can be used to help bring the parts together.	0.0								0	2.5		checked with primavera	
7.06	While held by the crane bring the AirLoc Wedgemount leveler up to take the load.	0.5								10	2.5		checked with primavera	
7.07	Remove the laser screens to provide more floor space for scaffolding.	0.0								0	2.5		checked with primavera	
7.08	Install temporary scaffolding to install flange hardware	4.0								80	2.5		checked with primavera	
7.09	Install bolts and all alumina and inboard weld shims.	2.0								40	2.5		checked with primavera	
7.10	Tighten flange fasteners to 50%	1.0								20	2.5		checked with primavera	
7.11	Make a hand "wobble" test (rotate on bolt) on all shims to make sure that they are tight. If a loose shim is found back off on sufficient adjacent bolts to allow a replacement shim to be inserted. Tighten bolt and recheck.	1.0								20	2.5		checked with primavera	
7.12	Perform metrology measurements of all alignment fiducials on both MCHP's. The maximum deviation from the reference points should be .020" or less.	5.0										100	Metrology Staff Budgeted as LOE	checked with primavera
7.13	Perform position adjustments on the right side MCHP if tolerance is not met. Loosen all studs, adjust AirLock Wedgemounts as needed; install alternate sized shims. Re-torque all studs to 50% and recheck.	3.0								60	2.5		checked with primavera	
7.14	Remove SISSCO actuator from right MCHP.	0.0								0	2.5		checked with primavera	
7.15	One hole at a time, remove the supernut. Using the eccentric gage slid onto the stud define the hole eccentricity. Select bushing and machine to match required eccentricity. Install bushing. Replace nut and tighten back to 50% and recheck alignment. Total 10 days 7 days to pre fit & fab bushings (in parallel with other tasks)and 3 days to install	10.0								200	2.5		checked with primavera	

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

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Job Title: FPA Operations - Stations 1, 2, & 3 (1810)												
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Job Manager: Mike Viola												
Fabrication and Assembly Assumptions:												
	Assumes 5 day workweek 1 shift no overtime											
	Parallel ops for sta 5 (2 fixtures available)											
	Parallel ops for sta 5 (2 fixtures available)											
	Only 1 fixture for station 3 only											
	Parallel ops for sta 2											
6.02	Attach the temporary support at the end of the Type-C MC used to unload the a pair of center supports.	1.0						20	2.5			checked with primavera
6.03	Lower leveler pad to disengage base of MC on the right side. Remove right side leveler pad and intermediate support.	0.0						0	2.5			checked with primavera
6.04	Install TF support brackets (top & bottom) to the port 12 side on the Type-A MC (platforms will be needed).	2.0						40	2.5			checked with primavera
6.05	Slide the first TF assembly against the TF support bracket and secure in place with the mating support bracket.	1.0						20	2.5			checked with primavera
6.06	Install TF support brackets (top & bottom) to the port 12 side on the Type-B MC.	2.0						40	2.5			checked with primavera
6.07	Slide the second TF assembly against the support bracket and secure in place with the mating support bracket.	1.0						20	2.5			checked with primavera
6.08	Install machine support plates (inboard and outboard) on the bottom, spanning two TF coil support brackets.	3.0						60	2.5			checked with primavera
6.09	Reinstall leveler pad to engage base of MC on the right side.	0.0						0	2.5			checked with primavera
6.10	Installed one side of the TF support brackets on the Type-C coil (top and bottom) for the TF installation to occur at Station 6.	1.0						20	2.5			checked with primavera
7.00	TF installation - left side											
7.01	The TF installation on the left side will follow the same ten (10) steps that were followed on the right side.	13.0						260	2.5			checked with primavera
8.00	TF fit-up check											
8.01	Perform a fit-up check of the four TF coils to determine if they can be positioned within tolerances.	5.0						100	2.5			checked with primavera
9.00	Install Ports 4											
9.01	Tack weld the left and right port 4's. Use a local laser attached to the port cover to define the port trajectory and to aid positioning in port during welding.	2.0						40	2.5			checked with primavera
9.02	Install boots on both port 4's	4.0						80	2.5			checked with primavera
10.00	Installation of PF structural members and routing of MC coolant and leads.											
10.01	Install the PF coil support structure that surround the TF coils. In doing this the MC leads and coolant lines need to be routed to the outside of the PF structure. PF structure is only partially installed at the Type-C MC's.	8.0						160	2.5			checked with primavera
11.00	MC header installation and coolant connections											
11.01	Install the MC coolant manifold outside of the PF structure in the area of PF6.	3.0						60	2.5			checked with primavera
11.02	Connect all MC coolant lines to the manifold (40 lines top and bottom)	20.0						400	2.5			checked with primavera
12.00	Diagnostic											
12.01	Install Rogowski coils on the end of the VV, left side. Route leads through space between port 8 and spool port opening and coil onto shell of MC for future routing	5.0						100	2.5			checked with primavera
13.00	Final measurements											
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
13.02	Using the laser tracker, align to tooling balls on each MCHP, locking into a minimum of 8 of them.	1.0						20				Metrology Staff Budgeted as LOE
13.03	Using monuments on the VV for alignment, bring the VV into proper alignment. Make final adjust in the VV supports to secure VV in place.	4.0						80	2.5			checked with primavera
13.04	Install or identify three primary fiducials that will be used in positioning the Period in Station 6.	2.0						40	2.5			checked with primavera
13.05	Make a final measurement of all fiducials, the VV end flanges and the Type-C MC end flanges. Record the results.	5.0						100				Metrology Staff Budgeted as LOE
13.10	Final Acceptance tests											
13.11	Check Assembly (bolts, etc)	5.0						100	2.5			checked with primavera
13.12	Check Diagnostics (Loops, thermocouples)	5.0						100	2.5			checked with primavera
13.13	Check manifolds (pressure, flow, etc.)	5.0						100	2.5			checked with primavera
13.14	Check 6 modcoils (voltage etc)	6.0						120	2.5			checked with primavera
13.15	Check trim coils (voltage etc)	3.0						60	2.5			checked with primavera
13.16	Check TF coils (voltage etc)	6.0						120	2.5			checked with primavera
14.00	Transfer Period to final assembly (Station 6).											
14.01	Install crane rigging to completed Period assembly	2.0						40	2.5			checked with primavera
14.02	Remove platforms	1.0						20	2.5			checked with primavera
14.03	Transfer completed Period to Station 6 located in NCSX test cell.	2.0						40	2.5			checked with primavera

