

NCSX June 2007 ETC
TABLE I - DESIGN LABOR

| | | | | | | | | | | | | | |
|--|-----------|------|------|-------|------------|------|-----------|---------|------|------|------|------|------|
| WBS Number: 185 | | | | | | | | | | | | | |
| WBS Title: Assembly of Field Periods | | | | | | | | | | | | | |
| Job Numbers: 1802, 1810, and 1815 | | | | | | | | | | | | | |
| Job Title: FPA Oversight & support (1802) | | | | | | | | | | | | | |
| Job Title: FPA Operations - Stations 1, 2, & 3 (1810) | | | | | | | | | | | | | |
| Job Title: FPA Operations - Station 5 (1815) | | | | | | | | | | | | | |
| Job Manager: Mike Viola | | | | | | | | | | | | | |
| Description: | | | | | | | | | | | | | |
| TASK DESCRIPTION | Work days | 41MS | 48MS | 37STK | 35TRV L | 31OT | ORNL M | ORNLDSN | EMEM | EMSM | EMSB | EMTB | CREW |
| | | | | | | | | | | | | | |
| Design | | | | | | | | | | | | | |
| This is a Fabrication Job - All labor in Table III | | | | | | | | | | | | | |
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NCSX June 2007 ETC
TABLE II - Materials and Subcontracts

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

NCSX June 2007 ETC
 TABLE III - Fabrication and Installation

| | | | | | | | | | | | | |
|--|--|--|--|--|--|--|--|--|--|--|--|--|
| WBS Number: 185 | | | | | | | | | | | | |
| WBS Title: Assembly of Field Periods | | | | | | | | | | | | |
| Job Numbers: 1802, 1810, and 1815 | | | | | | | | | | | | |
| Job Title: FPA Oversight & Support (1802) | | | | | | | | | | | | |
| Job Title: FPA Operations - Stations 1, 2, & 3 (1810) | | | | | | | | | | | | |
| Job Title: FPA Operations - Station 5 (1815) | | | | | | | | | | | | |
| Job Manager: Mike Viola | | | | | | | | | | | | |
| Fabrication and Assembly | | | | | | | | | | | | |
| Assumptions: | | | | | | | | | | | | |
| Assumes 5 day workweek 1 shift no overtime | | | | | | | | | | | | |
| Parallel ops for sta 5 (2 fixtures available) | | | | | | | | | | | | |
| Parallel ops for sta 5 (2 fixtures available) | | | | | | | | | | | | |
| Only 1 fixture for station 3 only | | | | | | | | | | | | |
| Parallel ops for sta 2 | | | | | | | | | | | | |
| Station 5-Final Field Period Assembly | | | | | | | | | | | | |
| Sequence Plan (Brown) - Covered in Job 1803 | | | | | | | | | | | | |
| Systems Analysis (Brooks) - covered in Job 8204 | | | | | | | | | | | | |
| Metrology Plan (Ellis) - Covered in Job 8205 | | | | | | | | | | | | |
| Procedures approved 14.0 | | | | | | | | | | | | |
| JHA completed 6.0 | | | | | | | | | | | | |
| Training needs identified & released 6.0 | | | | | | | | | | | | |
| ACC review completed 7.0 | | | | | | | | | | | | |
| Pre-job brief completed 7.0 | | | | | | | | | | | | |
| Station 5 operational 1.0 | | | | | | | | | | | | |
| Job: 1802 - FP Assy Oversight&Support-VIOLA Total | | | | | | | | | | | | |
| \$ - ## ## # 0 1 2 0 0 0 | | | | | | | | | | | | |
| checked with primavera | | | | | | | | | | | | |
| checked with primavera | | | | | | | | | | | | |
| checked with primavera | | | | | | | | | | | | |
| checked with primavera | | | | | | | | | | | | |
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TABLE III - Fabrication and Installation

| WBS Number: 185 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|--|--|--|--|--|--|--|--|--|--|--|--|--|--|------|-------|--------|------|------|--------|------|------|------|------|------|------|----------|--|------------------------|---|--|------------------------|--|------------------------|--|------------------------|--|--|--|
| WBS Title: Assembly of Field Periods | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Job Numbers: 1802, 1810, and 1815 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Job Title: FPA Oversight & Support (1802) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Job Title: FPA Operations - Stations 1, 2, & 3 (1810) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Job Title: FPA Operations - Station 5 (1815) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Job Manager: Mike Viola | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fabrication and Assembly Assumptions: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Assumes 5 day workweek 1 shift no overtime | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Parallel ops for sta 5 (2 fixtures available) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Parallel ops for sta 5 (2 fixtures available) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Only 1 fixture for station 3 only | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Parallel ops for sta 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | K\$ | FTE | | | | | | | | | | | | | | | | | | | | | | | |
| TASK DESCRIPTION | | | | | | | | | | | | | | | 4IMS | 3STFK | 3STRVL | 3HOT | ORNL | EM/DSN | SHTB | EMEM | BMSM | BMSB | BMTB | CREW | Met Crew | Basis of Estimate | | | | | | | | | | | |
| Work days | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Job: 1810 - Field Period Assembly-VIOLA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | Station 1: Based on actual VV #1 costs - almost completed. | checked with primavera | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | Station 2: Based on actual VV #1 costs - almost completed. | checked with primavera | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | Based on experience to accomplish similar tasks (e.g., metrology scans/lock-ins, coil trial fitups, gross checks). Also, it appears that your single shift activity is running parallel resources that are not available. i.e. the trials development crew are the same as the FP crew. | checked with primavera | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | Nose/Bushing related items based on conceptual designs and rough estimates | checked with primavera | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | Assumed nose concept based on application of epoxy & set-up times | checked with primavera | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | estimates based on conceptual designs tempered with experience in alignment of multiple components | checked with primavera | | | | | | | |
| General F.P. Assy support | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | checked with primavera | | | | | | | |
| LOE Crane support, fixture setupfor . Station 1 through station 5 1.2fte | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 men 3 day a week .LOE adjust consistent with schedule thru Station 5 | checked with primavera | | | | | |
| LOE Field Supervision for station 1 through station 5 edwards 1.0fte | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | This is LOE adjust consistent with overall schedule thru Station 5. | checked with primavera | | | | | |
| LOE Metrology support Station 1 tthrough station 5 1.5 fte engr plus ducco 100% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1.50 | 1.00 | this is LOE adjust consistent with overall schedule. Hours distributed per task based resource profile | checked with primavera | | | |
| Misc M&S station 1 through station 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 3K/month | checked with primavera | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 3K/month | checked with primavera | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

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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 | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| TASK DESCRIPTION | | Work days | | 4IMS | 3S7HK | 3STRVL | 3HOT | ORNL EMD5N | SHTB | EMEM | EM5M | EM5B | EMTB | CREW | Met Crew | Basis of Estimate | | | | |
| Station 1-FP #1 VV Prep (hard surface components) | | | | | | | | | | | | | | | | | | | | |
| Layout diagnostic&coolant paths on vessel - Completed | | 35.0 | | | | | | | | | | | | | | | | | checked with primavera | |
| Install heater tape on vertical ports - Completed | | 7.0 | | | | | | | | | | | | | | | | | checked with primavera | |
| Verify installation of heater tapes - Completed | | 1.0 | | | | | | | | | | | | | | | | | checked with primavera | |
| Attach studs for coolant lines - Completed | | 3.0 | | | | | | | | | | | | | | | | | checked with primavera | |
| Wind magnetic diagnostic sensors - Completed | | 14.0 | | | | | | | | | | | | | | | | | checked with primavera | |
| Install precision magnetic diagnostic sensors - Completed | | 3.0 | | | | | | | | | | | | | | | | | checked with primavera | |
| Verify installation magnetic diagnostic sensors - Completed | | 4.0 | | | | | | | | | | | | | | | | | checked with primavera | |
| Install local I&C (incl thermocouples) - Completed | | 5.0 | | | | | | | | | | | | | | | | | checked with primavera | |
| Verify installation of local I&C | | 2.0 | | | | | | | | | | | | | | | | | checked with primavera | |
| Install cooling/htg lines to vac vsl | | 15.0 | | | | | | | | | | | 300 | 2.5 | | | | | checked with primavera | |
| Weld cooling/htg risers | | 16.0 | \$ 2.0K | | | | | | | | | | 320 | 2.5 | | | | | serial tasks alternating between FPA constant 2.5 men | checked with primavera |
| Verify Instl of H/C lines,headers,manifolds | | 5.0 | | | | | | | | | | | 100 | 2.5 | | | | | serial tasks alternating between FPA constant 2.5 men | checked with primavera |
| Perform final acceptance testing (H/C flow test) | | 5.0 | \$ 4.0K | | | | | | | | | | 100 | 2.5 | | | | | serial tasks alternating between FPA constant 2.5 men | checked with primavera |
| Trim seal plates | | 2.0 | | | | | | | | | | | 40 | 2.5 | | | | | serial tasks alternating between FPA constant 2.5 men | checked with primavera |
| Loop termination & verification | | 18.0 | | | | | | | | | | | 360 | 2.5 | | | | | serial tasks alternating between FPA constant 2.5 men | checked with primavera |
| Install Final Internal and External monuments and measure | | 4.0 | | | | | | | | | | | 80 | 2.5 | | | | | checked with primavera | checked with primavera |
| Final Scan | | 4.0 | | | | | | | | | | | 80 | 2.5 | | | | | serial tasks alternating between FPA constant 2.5 men | checked with primavera |
| Install heater tape on removeable ports | | 10.0 | | | | | | | | | | | 200 | 2.5 | | | | | serial tasks alternating between FPA constant 2.5 men | checked with primavera |
| Prepare and transfer completed VV to holding are | | 2.0 | | | | | | | | | | | 40 | 2.5 | | | | | serial tasks alternating between FPA constant 2.5 men | checked with primavera |

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

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| Job Title: FPA Operations - Station 5 (1815) | | | | | | | | | | |
| Job Manager: Mike Viola | | | | | | | | | | |
| Fabrication and Assembly Assumptions: | | | | | | | | | | |
| Assumes 5 day workweek 1 shift no overtime | | | | | | | | | | |
| Parallel ops for sta 5 (2 fixtures available) | | | | | | | | | | |
| Parallel ops for sta 5 (2 fixtures available) | | | | | | | | | | |
| Only 1 fixture for station 3 only | | | | | | | | | | |
| Parallel ops for sta 2 | | | | | | | | | | |
| Station 1- FP #3 VV Prep (hrd surf cmpnts) | | | | | | | | | | |
| Misc Hardware \$ 2.0K | | | | | | | | | | |
| Layout diagnostic&coolant paths on vessel - Completed 12.0 240 2.5 | | | | | | | | | | |
| Install heater tape on vertical ports 7.0 140 2.5 | | | | | | | | | | |
| Verify installation of heater tapes 1.0 20 2.5 | | | | | | | | | | |
| Attach studs for coolant lines 3.0 60 2.5 | | | | | | | | | | |
| Install Templates 3.0 60 2.5 | | | | | | | | | | |
| Wind magnetic diagnostic sensors 14.0 280 2.5 | | | | | | | | | | |
| Install precision magnetic diagnostic sensors - Completed 3.0 60 2.5 | | | | | | | | | | |
| Verify installation magnetic diagnostic sensors - Completed 4.0 80 2.5 | | | | | | | | | | |
| Install local I&C (incl thermocouples) 5.0 100 2.5 | | | | | | | | | | |
| Verify installation of local I&C 2.0 40 2.5 | | | | | | | | | | |
| Install cooling/htg lines to vac vsl 15.0 300 2.5 | | | | | | | | | | |
| Weld cooling/htg risers 16.0 320 2.5 | | | | | | | | | | |
| Verify Instl of H/C lines,headers,manifolds 5.0 100 2.5 | | | | | | | | | | |
| Perform final acceptance testing (H/C flow test) 5.0 100 2.5 | | | | | | | | | | |
| Trim seal plates 2.0 40 2.5 | | | | | | | | | | |
| Loop termination & verification 18.0 360 2.5 | | | | | | | | | | |
| Install Final Internal and External monuments and measure 4.0 80 2.5 | | | | | | | | | | |
| Final Scan 4.0 80 2.5 | | | | | | | | | | |
| Install heater tape and insulation on removeable ports 10.0 200 2.5 | | | | | | | | | | |
| Prepare and transfer completed VV to holding area 2.0 40 2.5 | | | | | | | | | | |
| Station 1-Spool pieces (3) (spacers) 2702 | | | | | | | | | | |
| Attach diagnostics, studs and coolant lines 17.0 340 2.5 | | | | | | | | | | |
| Install Final Internal and External monuments and measure 2.0 40 2.5 | | | | | | | | | | |

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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 2 Trials | | | | | | | | | | | | |
| Trial tensioning test on prototype | | | | | | | | | | | | |
| Trial bushing and shim test on prototype | | | | | | | | | | | | |
| Bushing test B-C | | | | | | | | | | | | |
| Alignment mechanisms, metro equip & positioning | | | | | | | | | | | | |
| Procure alignment mechanisms, fiducials, lifting | | | | | | | | | | | | |
| Consulting support for NOSE WELDING | | | | | | | | | | | | |
| Determine fiducial types&locations | | | | | | | | | | | | |
| Procure monuments&related metrology equipment | | | | | | | | | | | | |
| INTRF-001 PPPL buy SS plate for weld trials | | | | | | | | | | | | |
| INTRF-035 PPPL Determine shim material | | | | | | | | | | | | |
| PHIL-04 water jet cut shims for A/B flange weld test | | | | | | | | | | | | |
| PHIL-05 solution anneal shims (note: shims not ground) | | | | | | | | | | | | |
| PHIL-06 assemble shims&flanges;grind relief in flanges | | | | | | | | | | | | |
| PHIL-07 weld & monitor distortion; improvise clamping | | | | | | | | | | | | |
| PHIL-11 Mount A6 on angle plate | | | | | | | | | | | | |
| PHIL-12 Weld fiducials on A6 & B6 | | | | | | | | | | | | |
| PHIL-13 Measure A6 casting | | | | | | | | | | | | |
| PHIL-15 Remove A6 & lower & grout wedge | | | | | | | | | | | | |
| PHIL-16 Re-mount A6 on wedge | | | | | | | | | | | | |
| PHIL-17 Re-measure A6 | | | | | | | | | | | | |
| PHIL-18 Measure B6 on wedge | | | | | | | | | | | | |
| PHIL-19 Place B6 on A6; Meas B6 casting use A6 as base | | | | | | | | | | | | |
| PHIL-21 Prepare angle plate dogs & chocks | | | | | | | | | | | | |
| PHIL-22 Water jet cut outboard 0.5" stk 316 SS shims | | | | | | | | | | | | |
| PHIL-23 Water jet cut inboard 0.625 316 SS | | | | | | | | | | | | |
| PHIL-24 Assemble castings,align torque&meas inbd. shims | | | | | | | | | | | | |
| PHIL-27 Solution anneal shims | | | | | | | | | | | | |
| PHIL-32 Align castings | | | | | | | | | | | | |
| PHIL-33 Fit&install bushings 25% stock, 25% eccentric | | | | | | | | | | | | |
| PHIL-34 Weld procedure/weld qual. | | | | | | | | | | | | |
| PHIL-36 Install strain gauges | | | | | | | | | | | | |
| PHIL-37 Set up dial ind., CMM, transit system | | | | | | | | | | | | |
| PHIL-38 Install all shims and adjust bushings | | | | | | | | | | | | |
| PHIL-39 Final align and baseline measurements | | | | | | | | | | | | |
| PHIL-40 Perform 25% of welding & measure | | | | | | | | | | | | |
| PHIL-41 Perform 50% of welding & measure | | | | | | | | | | | | |
| PHIL-42 Perform 75% of welding & measure | | | | | | | | | | | | |
| PHIL-43 finish welding & measure | | | | | | | | | | | | |
| PHIL-25 Purchase (2) grinding machines | | | | | | | | | | | | |
| PHIL-26 Grind inbd. Shims to thickness (outside shop) | | | | | | | | | | | | |
| PHIL-30 Zenex - fabricate eccentric bushings | | | | | | | | | | | | |
| Hardware rework (1/2 FTE) | | | | | | | | | | | | |
| Station 2 Setup | | | | | | | | | | | | |
| Misc Hardware | | | | | | | | | | | | |
| Test out equip & procedures | | | | | | | | | | | | |
| Receive drawings and hardware (shims and bolts) | | | | | | | | | | | | |
| 3.00 Shim sizing / preparations | | | | | | | | | | | | |
| 3.01 Using flange measurement of the coils, define the A/A and A/B shim thickness. | | | | | | | | | | | | |
| Perform welding trials and procure EWI and Bob Parcels support. | | | | | | | | | | | | |
| MISC LOE SUPPORT | | | | | | | | | | | | |
| Back Office | | | | | | | | | | | | |

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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 | | | | | | | | | | | | | | | | | | |
| 3.02 | Surface grind a set of metal shims that will be used on the first MCHP article for assembly process qualifications. | | | | | | | | | | | | | | | Actual experience (LED: actual Experience Was 4 days per JOINT) | checked with primavera | |
| | | | | | | | | | | | | | | | | | | |
| 3.03 | Compress alumina coated shims and sort by thickness the shim set that will be installed on the MCHP. | | | | | | | | | | | | | | | | 800 shims - not critical path | checked with primavera |
| 4.00 | Pre-Installation Station 2 set-up | | | | | | | | | | | | | | | | | |
| 4.01 | Install MCHP fixtures and metrology equipment. | | | | | | | | | | | | | | | | Metrology plan covering Station 2: not critical path - separate crew in parallel | checked with primavera |
| 4.02 | Perform metrology set-up and checks | | | | | | | | | | | | | | | | not critical path - separate crew in parallel | checked with primavera |
| | Install FIRST Holding 20 deg fixture | 4.0 | \$ 2.0K | | | | | | | | | | | | | | checked with primavera | checked with primavera |
| | Install SECOND Holding 20 deg fixture | 3.0 | \$ 2.0K | | | | | | | | | | | | | | Just received - Not done yet | checked with primavera |
| | Install THIRD Holding 20 deg fixture | 6.0 | \$ 2.0K | | | | | | | | | | | | | | Just received - Not done yet | checked with primavera |
| | Install LAST Holding 20 deg fixture | 3.0 | \$ 2.0K | | | | | | | | | | | | | | Just received - Not done yet | checked with primavera |
| | Tools&tooling available for FPA operations | 2.0 | | | | | | | | | | | | | | | checked with primavera | checked with primavera |

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TABLE III - Fabrication and Installation

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

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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 | | | | | | | | | | | | | | |
| 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 | | checked with primavera | |
| 5.05 | Install dial indicators on the modular coil in areas where we expect to see deflection. | 2.0 | | | | | | | | | 40 | | checked with primavera | |
| 5.06 | Lower the mating type A modular coil into position. | 1.0 | | | | | | | | | 20 | | 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 | | 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 | | 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 | | 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 | | 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 | | 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 | | checked with primavera | |
| 5.15 | Remove all studs, nuts, shims etc. Identify shim locations. | 1.0 | | | | | | | | | 20 | | checked with primavera | |
| 6.00 | A-B modular coil assembly | | | | | | | | | | | | Sequence Plan R5 | |
| 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 | | 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 | | checked with primavera | |
| 6.04.1 | Stuff Shim Bag with Fiberglass. Reseal, Place Shim Bag on Wing | 0.3 | | | | | | | | | 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 | | 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 | | checked with primavera | |
| 6.06.1 | Install Dial indicators for X-Y Positioning | 1.0 | | | | | | | | | 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 | | | | | | | | | 20 | | 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 | | 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 | | 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 | | 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 | | 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 | | 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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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 | | | | | | | | | | |
| 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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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 | | | | | | | | | | | | | | |
| 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 | | | | | | | | | | | | Sequence Plan R5 | checked with primavera |
| 10.01 | Install all wing support bladders between wing surfaces (A/B, B/C) and on the C wing (MCHP - Right Side only). | 2.0 | | | | | | | | 40 | 2.5 | | LED: Bags were placed earlier 4 days for coolant lines 4 days for mod coils thermocouples and strain gages terminations | checked with primavera |
| 10.02 | Make local service runs/connections on the shell of each MC. | 8.0 | | | | | | | | 160 | 2.5 | | | checked with primavera |
| 10.03 | Inject stycast or some compound to fill in all shim spaces in order to prevent VV/MC insulation from falling out. | 1.0 | | | | | | | | 20 | 2.5 | | | checked with primavera |
| 11.00 | Final measurements / transfer completed MCHP to holding area | | | | | | | | | | | | Sequence Plan R5 | checked with primavera |
| 11.02 | Make final metrology measurement of all fiducials. Scan the "B" flange of Type-C coil. Record the results. | | | | | | | | | 0 | 2.5 | | | checked with primavera |
| 11.03 | Using tension tester measure bolt length on all tension fasteners and record the results. | 0.5 | | | | | | | | 10 | 2.5 | | | checked with primavera |
| 11.04 | Mark part for identification | 0.0 | | | | | | | | 0 | 2.5 | | | checked with primavera |
| 11.05 | Install lift support beams | 2.0 | | | | | | | | 40 | 2.5 | | | checked with primavera |
| 11.06 | Remove from stand and measure weight of completed assembly | 1.0 | | | | | | | | 20 | 2.5 | | | checked with primavera |
| 11.07 | Move to holding area. | 0.0 | | | | | | | | 0 | 2.5 | | | checked with primavera |
| | | | | | | | | | | | 246 shifts | | | |

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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 | | | | | | | | | | | | | | | | | | | | | | | | |
| A1,B1,C1 subtotal task 5-11 (total elapsed time) | | | | | | | | | | 126 | | | | | | | | | 2125 | 740 | | | | |
| Station 2 - Production Articles (HPA) and second half of FP #1 A2,B2,C2 | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.00 | MC fit-up pre-check and surface insulation | | | | | | | | | | | | | | | | | | | | Sequence Plan R5 | checked with primavera | | |
| 1.01 | Verify that mating MC's of a MCHP will come together without interferences by pre-fitting mating coils. This will include the Type-C coil with its interfacing Period Type-C coil. | | | | | | | | | 4.0 | | | | | | 80 | 2.5 | | | | Sequence Plan R5 | 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 | | |
| 2.08 | Measure Type B "A" flanges | | | | | | | | | 14.0 | | | | | | 40 | 2.5 | 220 | | | Sequence Plan R5 | checked with primavera | | |
| 2.11 | Measure Type C "A" flanges | | | | | | | | | 13.0 | | | | | | 40 | 2.5 | 220 | | | Repeats 2.01-2.07 | checked with primavera | | |
| 2.14 | Measure Type A-A "A" flange | | | | | | | | | 13.0 | | | | | | 40 | 2.5 | 220 | | | Repeats 2.01-2.07 | checked with primavera | | |
| 3.00 | Shim sizing / preparations | | | | | | | | | | | | | | | | | | | | Sequence Plan R5 | checked with primavera | | |
| 3.01 | Using flange measurement of the coils, define the A/A and A/B shim thickness. | | | | | | | | | | | | | | | | | | | | | checked with primavera | | |
| 3.02 | Compress alumina coated shims and sort by thickness the shim set that will be installed on the MCHP. | | | | | | | | | 4.0 | | | | | | 80 | 2.5 | | | May need more shims | checked with primavera | | | |
| 4.00 | Pre-Installation Station 2 set-up recalibration | | | | | | | | | | | | | | | | | | | | Sequence Plan R5 | checked with primavera | | |
| 4.01 | Install MCHP fixtures and metrology equipment. | | | | | | | | | | | | | | | 0 | 2.5 | | | | | checked with primavera | | |
| 4.02 | Perform metrology set-up and checks | | | | | | | | | 53.0 | 2.0 | | | | | | | | 40 | | Metrology Staff Budgeted as LOE | checked with primavera | | |
| 5.00 | Pre-assemble A-A (Needs to be done total of 3 times A1-A2, A3-A4, A5-A6) | | | | | | | | | | | | | | | | | | | | | checked with primavera | | |
| 5.01 | Position the Type-A modular coil on the fixture, "B" flange down. Obtain a set of "realigned" fiducial positions. | | | | | | | | | | | | | | | | | | | | | checked with primavera | | |
| 5.02 | Align the laser tracker to the conical seats locking into a minimum of 8 of them. | | | | | | | | | | | | | | | | | | | | | checked with primavera | | |
| 5.03 | Establish a global coordinate system based on the modular coil geometry. Measure the monuments on the fixture and on the walls. | | | | | | | | | | | | | | | | | | | | | checked with primavera | | |
| 5.04 | Place all alumina and grind inboard weld shims on the coil. | | | | | | | | | | | | | | | | | | | | | | checked with primavera | |
| 5.05 | Install dial indicators on the modular coil in areas where we expect to see deflection. | | | | | | | | | | | | | | | | | | | | | | checked with primavera | |
| 5.06 | Lower the mating type A modular coil into position. | | | | | | | | | | | | | | | | | | | | | | checked with primavera | |
| 5.07 | Measure the monuments on the bottom coil. Jack areas of the coil as necessary to bring displaced monuments back to within .002" of their original position. | | | | | | | | | | | | | | | | | | | | | checked with primavera | | |
| 5.08 | Using three target points, perform the positioning as was done in the A1-A2 task. | | | | | | | | | | | | | | | | | | | | | checked with primavera | | |
| 5.09 | Install studs, supernuts, and torque to 50% of final value. | | | | | | | | | | | | | | | | | | | | | | checked with primavera | |
| 5.10 | Make a hand "wobble" 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 rechecked. | | | | | | | | | | | | | | | | | | | | | | checked with primavera | |
| 5.11 | Measure the tooling balls on both coils. The maximum deviation from the "realigned" fiducial positions shall be .007" or less. | | | | | | | | | | | | | | | | | | | | | | checked with primavera | |
| 5.12 | If the above step does not fall within .007" or less then loosen all studs, adjust shims locally. Re-torque all studs to 50%. | | | | | | | | | | | | | | | | | | | | | | | checked with primavera |
| 5.13 | Install the A-A locator bushings at two stud locations for use in re-positioning MCHP in Stage 3. | | | | | | | | | | | | | | | | | | | | | | checked with primavera | |
| 5.14 | Remove all studs, nuts, shims etc. Identify shim locations. | | | | | | | | | | | | | | | | | | | | | | checked with primavera | |
| 6.00 | A-B modular coil assembly | | | | | | | | | | | | | | | | | | | | | Sequence Plan R5 | checked with primavera | |
| 6.01 | Place the Type-A coil, "A" flange down, on the 20deg fixture. Obtain a set of "realigned" fiducial positions for the "A" and "B" coils. | | | | | | | | | 1.0 | | | | | | 20 | 2.5 | | | | | | | checked with primavera |
| 6.02 | Using the laser tracker, align to the conical seats locking into a minimum of 8 of them. | | | | | | | | | 1.0 | | | | | | | | | 20 | | | Metrology Staff Budgeted as LOE | checked with primavera | |
| 6.03 | Establish a global coordinate system based on the modular coil geometry. Measure the monuments on the fixture and on the walls. | | | | | | | | | 2.0 | | | | | | | | | 40 | | | Metrology Staff Budgeted as LOE | checked with primavera | |
| 6.04 | Place all alumina and grind inboard weld shims on the coil. | | | | | | | | | 2.0 | | | | | | 40 | 2.5 | | | | | | checked with primavera | |
| 6.04.1 | Stuff Shim Bag with Fiberglass, Reseal, Place Shim Bag on Wing | | | | | | | | | | | | | | | | | | | | | | LED: Must place bag before coil assembly | checked with primavera |
| 6.05 | Lower the Type-B coil onto the Type-A coil. | | | | | | | | | 1.0 | | | | | | 20 | 2.5 | | | | | | | checked with primavera |
| 6.06 | Measure the monuments on the A coil. Jack areas of the coil as necessary to bring displaced monuments back to within .002" of their original position. | | | | | | | | | 1.0 | | | | | | | | | 20 | | | Metrology Staff Budgeted as LOE | checked with primavera | |
| 6.06.1 | Install Dial Indicators for X-Y Positioning | | | | | | | | | 1.0 | | | | | | 20 | 2.5 | | | | | | LED: Missing from sequence | checked with primavera |

A-A done above

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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: | | | | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | | | | |
| 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. | | | | | | | | | | | | | 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. | 1.0 | | | | | | | | | | | | | | | |
| 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%. | 5.0 | | | | | | | | | | | | | | | |
| 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 | 3.0 | | | | | | | | | | | | | | | |
| 6.13 | Complete tightening of flange bolts to 100%. | 10.0 | | | | | | | | | | | | 200 | 2.5 | LED: See above | checked with primavera |
| 6.14 | Measure the tooling balls on both coils. The maximum deviation from the "realigned" points should be .007" or less. | 1.0 | | | | | | | | | | | | 20 | 2.5 | | checked with primavera |
| 6.15 | Measure the tooling balls on both coils. The maximum deviation from the "realigned" points should be .007" or less. | 3.0 | | | | | | | | | | | | | | | |
| 6.16 | Scan the "B" flange of Type-B coil | | | | | | | | | | | | | 20 | 2.5 | | checked with primavera |
| 7.00 | 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. | 1.0 | | | | | | | | | | | | | | | |
| 7.01 | (A-B) to C modular coil assembly (MCHP) | | | | | | | | | | | | | | | | |
| 7.02 | 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 |
| 7.03 | Using the laser tracker, align to the conical seats locking into a minimum of 8 of them. | 1.0 | | | | | | | | | | | | | | | |
| 7.04 | Establish a global coordinate system based on the modular coil geometry. Measure the monuments on the fixture and on the walls. | 2.0 | | | | | | | | | | | | | | | |
| 7.05 | Place all alumina and grind inboard weld shims on the coil. | 2.0 | | | | | | | | | | | | 40 | 2.5 | | checked with primavera |
| 7.06 | Lower the Type-C coil onto the Type-B coil. | 1.0 | | | | | | | | | | | | 20 | 2.5 | | checked with primavera |
| 7.07 | 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 | | | | | | | | | | | | | | | |
| 7.08 | 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 |
| 7.09 | Install studs, supernuts, and torque to 50% of final value. | 2.0 | | | | | | | | | | | | 40 | 2.5 | | checked with primavera |
| 7.10 | 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 |
| 7.11 | Measure the tooling balls on all coils. The maximum deviation from the "realigned" points should be .010" or less. | 5.0 | | | | | | | | | | | | | | | |
| 7.12 | 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 | | | | | | | | | | | | | | | |
| 7.13 | Complete tightening of flange bolts to 100%. | 1.0 | | | | | | | | | | | | 20 | 2.5 | | checked with primavera |
| 8.00 | Measure the tooling balls on both coils. The maximum deviation from the "realigned" points should be .010" or less. | 4.0 | | | | | | | | | | | | | | | |
| 8.01 | Tack weld inboard welded shims | | | | | | | | | | | | | | | | |
| 8.02 | 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 | | | | | | | | | | | | | | | | |
| 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 | | | | | | | | | | | | | | | | |
| 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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 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 | | | | | | | | | | | | | | |
| 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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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 | | | | | | | | | | |
| 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 | | | | \$ 5.0K | | | | | | |
| Procure and load test 3 legged actuator System | | | 4.0 | \$ 43.0K | | | | 96 | 3.0 | |
| Procure, Fabricate and load test 3 legged actuator Lift Fixture | | | 8.0 | \$ 6.0K | | | | 128 | 2.0 | |
| Begin Assembly of First Field Period Assy | | | 2.0 | | | | | 40 | 2.5 | |
| Fab new platform legs | | | 4.0 | | | | | 64 | 2.0 | |
| Install station 3 platforms (8 required) | | | 4.0 | \$ 10.0K | | | | 112 | 3.5 | |
| Test out station 3 equipment and procedures | | | | \$ 10.0K | | | | 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 | | | | | | | 0 | 2.5 | |
| 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 SISSCO crane, position left MCHP on the cart assembly | | 1.0 | | | | | 20 | 2.5 | checked with primavera |
| 2.05 | Secure left MCHP at three location to vertical support posts on support cart base. | | 2.0 | | | | | 40 | 2.5 | checked with primavera |
| 2.06 | Measure the monuments on the positioned left MCHP and on the walls to establish the machine coordinate for further assembly operations. | | 5.0 | | | | | | 100 | Metrology Staff Budgeted as LOE |
| 2.07 | Set the positioning stop on the cart so it returns to the machine coordinate defined position in further assembly steps. | | 1.0 | | | | | 20 | 2.5 | checked with primavera |
| 3.00 | Pre-assemble right MCHP | | | | | | | 0 | 2.5 | checked with primavera |
| 3.01 | Move the right base support cart to its final position ready to accept the right MCHP. Position the AirLoc Wedgemount in a lowered position. | | 0.5 | | | | | 10 | 2.5 | checked with primavera |
| 3.02 | Lift the right side MCHP using the SISSCO crane and position it to be ready to engage the preinstalled Type-A flange guide bushings. | | 1.0 | | | | | 20 | 2.5 | checked with primavera |
| 3.03 | Temporary fasteners located adjacent to the alignment bushings can be used to help bring the parts together. | | 0.0 | | | | | 0 | 2.5 | checked with primavera |
| 3.04 | While held by the crane bring the AirLoc Wedgemount leveler up to take the load. | | 0.0 | | | | | 0 | 2.5 | checked with primavera |
| 3.05 | Install temporary scaffolding to install flange hardware | | 1.0 | | | | | 20 | 2.5 | checked with primavera |
| 3.06 | Install bolts and shims as needed for assembly tolerances. | | 1.0 | | | | | 20 | 2.5 | checked with primavera |
| 3.07 | Tighten flange fasteners to 50% | | 1.0 | | | | | 20 | 2.5 | checked with primavera |
| 3.08 | Perform metrology measurements of all alignment fiducials on both 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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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 | | | | | | | | | | | | | | | |
| 4.00 | Install laser screens | | | | | | | | | | | \$ 2.0K | | | |
| 4.01 | Establish a global coordinate system based on the full period geometry. Measure the monuments on the MCHP's and on the walls. | | | | | | | | | | | 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. | | | | | | | | | | | 40 | 2.5 | checked with primavera | |
| 4.03 | Turn each lasers on and with metrology determine their alignment. Record the laser position. | | | | | | | | | | | 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. | | | | | | | | | | | 20 | 2.5 | checked with primavera | |
| 4.06 | Remove both MCHP's. | | | | | | | | | | | 40 | 2.5 | Can these stay on the carts and be rolled all the way back? | checked with primavera |
| 5.00 | Install vacuum vessel | | | | | | | | | | | 0 | 2.5 | checked with primavera | |
| 5.01 | Remove the adjustor bar support from left side. | | | | | | | | | | | 0 | 2.5 | checked with primavera | |
| 5.02 | Install VV NBI port support stand. | | | | | | | | | | | 40 | 2.5 | checked with primavera | |
| 5.03 | Install VVSA to base support and make the connection to the NBI port attachment. | | | | | | | | | | | 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. | | | | | | | | | | | 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. | | | | | | | | | | | 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 | 2.5 | checked with primavera | |
| 6.03 | Using the SISSCO actuators with laser guidance move the left MCHP over the VV. | | | | | | | | | | | 40 | 2.5 | checked with primavera | |
| 6.04 | Re-install the left adjustor bar. | | | | | | | | | | | 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. | | | | | | | | | | | 40 | 2.5 | checked with primavera | |
| 6.06 | Transfer the full load to the AirLoc Wedgemount leveler. | | | | | | | | | | | 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 | 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 | 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. | | | | | | | | | | | 40 | 2.5 | checked with primavera | |
| 7.03 | Using the adjustor bar on the left side move the left MCHP to its final position. | | | | | | | | | | | 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. | | | | | | | | | | | 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 | 2.5 | checked with primavera | |
| 7.06 | While held by the crane bring the AirLoc Wedgemount leveler up to take the load. | | | | | | | | | | | 10 | 2.5 | checked with primavera | |
| 7.07 | Remove the laser screens to provide more floor space for scaffolding. | | | | | | | | | | | 0 | 2.5 | checked with primavera | |
| 7.08 | Install temporary scaffolding to install flange hardware | | | | | | | | | | | 80 | 2.5 | checked with primavera | |
| 7.09 | Install bolts and all alumina and inboard weld shims. | | | | | | | | | | | 40 | 2.5 | checked with primavera | |
| 7.10 | Tighten flange fasteners to 50% | | | | | | | | | | | 20 | 2.5 | checked with primavera | |
| 7.11 | Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that they are tight. If a loose shim is found back off on sufficient adjacent bolts to allow a replacement shim to be inserted. Tighten bolt and recheck. | | | | | | | | | | | 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 | 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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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 | | | | | | | | | | | |
| 7.16 | Tighten nuts 100%. Measure before welding adequate coil alignment and fit-up of shims | 1.0 | | | | | | | | 20 | 2.5 | |
| 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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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 | | | | | | | | | | | | | | | | |
| TASK DESCRIPTION | Work days | 4HMS | 37STK | 35TRVL | 310T | ORNL EM/DSN | SHTB | EMEM | EMSM | EMSB | EMTB | CREW | Met Crew | Basis of Estimate | checked with primavera | |
| | | | | | | | | | | | | | | Shop based on similar tasks, 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 | | | | | | | | | | | | | | | | |
| Station 5- Final FP Assy -FP#1 (in NCSX TC) | | | | | | | | | | | | | | | | |
| 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 supplies | | \$ 15.0K | | | | | | | | | | | | | checked with primavera | |
| Testout Sta 5 equipt & procedures | 5.0 | | | | | | | | | | | 160 | 4.0 | | checked with primavera | |
| Check 3 sled interfaces adjust holes | 12.0 | | | | | | | | | | | 384 | 4.0 | | checked with primavera | |
| Fixtures installed - final metrology | 6.0 | | | | | | | | | | | 192 | 4.0 | | checked with primavera | |
| Miscellaneous for tooling | | | | | | | | | | | | | | \$ 1,027.8K | checked with primavera | |
| Station 5 preinstallation in parallel | | | | | | | | | | | | | | | | |
| 1.00 Component preparations | | | | | | | | | | | | | | | | |
| 1.01 The short dome port (the one on the top of the dome) needs to cut off near the dome. The longest port can remain. | 2.0 | | | | | | | | | | | 40 | 2.5 | | checked with primavera | |
| 1.02 Install heat tape and thermocouples on all ports. | 0.0 | | | | | | | | | | | 0 | 2.5 | Covered in Station 2 LED: Reversed order of 1.02 & 1.03 | checked with primavera | |
| 1.03 Install insulation system around all ports. | 0.0 | | | | | | | | | | | 0 | 2.5 | Covered in Station 2 | checked with primavera | |
| Install insulation system around all ports. | 0.0 | | | | | | | | | | | 0 | 2.5 | | checked with primavera | |
| Install heat tape and thermocouples on all ports. | 0.0 | | | | | | | | | | | 0 | 2.5 | | checked with primavera | |
| 2.00 Pre-Installation set-up | | | | | | | | | | | | | | | | |
| 2.01 Install period support fixture | 2.0 | | | | | | | | | | | 40 | 2.5 | | checked with primavera | |
| 2.02 Install FPA on support stand. Use leveler pad to engage base of MC. Add bolts to secure in place. | 2.0 | | | | | | | | | | | 40 | 2.5 | | checked with primavera | |
| 2.03 Install external working platforms | 4.0 | | | | | | | | | | | 80 | 2.5 | | checked with primavera | |
| 2.04 Install internal VV working platforms | 3.0 | | | | | | | | | | | 60 | 2.5 | | checked with primavera | |
| 3.00 VV port installation | | | | | | | | | | | | | | | | |
| 3.01 Install the domes (left and right side), inserting the long dome port through the MC opening, and weld the dome shell to the VV. | 2.0 | | | | | | | | | | | 40 | 2.5 | | 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 them. | 30.0 | | | | | | | | | | | 600 | 2.5 | | checked with primavera | |
| 3.03 Leak check each port immediately after it is welded. | 30.0 | | | | | | | | | | | 600 | 2.5 | | checked with primavera | |
| 4.00 Install port boot seal assembly | | | | | | | | | | | | | | | | |
| 4.01 Install boots on all ports except for the two port 4's. | 16.0 | | | | | | | | | | | 320 | 2.5 | | checked with primavera | |
| 5.00 MC lead and coolant connections | | | | | | | | | | | | | | | | |
| 5.01 Install MC lead connections on each of the MC's and temporarily position the leads so they will not interfere with the TF coil installation and for routing through the PF structure. | 6.0 | | | | | | | | | | | 72 | 1.5 | in parallel with 5.02 | checked with primavera | |
| 5.02 Install MC coolant lines on each MC and position them for the TF installation and routing through PF structure. | 12.0 | | | | | | | | | | | 240 | 2.5 | | checked with primavera | |
| 5.03 Platforms may need to be altered or moved for the installation of the TF coils. | 3.0 | | | | | | | | | | | 60 | 2.5 | | checked with primavera | |
| 6.00 TF installation - right side | | | | | | | | | | | | | | | | |
| 6.01 Rotate two individual TF coils over the MC on the right side and temporarily support them off the Type-B and C MC's. | 2.0 | | | | | | | | | | | 40 | 2.5 | | checked with primavera | |

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 | | | | | | | | | |
| 6.02 | Attach the temporary support at the end of the Type-C MC used to unload the a pair of center supports. | 1.0 | | | | | | 20 | 2.5 | checked with primavera |
| 6.03 | Lower leveler pad to disengage base of MC on the right side. Remove right side leveler pad and intermediate support. | 0.0 | | | | | | 0 | 2.5 | checked with primavera |
| 6.04 | Install TF support brackets (top & bottom) to the port 12 side on the Type-A MC (platforms will be needed). | 2.0 | | | | | | 40 | 2.5 | checked with primavera |
| 6.05 | Slide the first TF assembly against the TF support bracket and secure in place with the mating support bracket. | 1.0 | | | | | | 20 | 2.5 | checked with primavera |
| 6.06 | Install TF support brackets (top & bottom) to the port 12 side on the Type-B MC. | 2.0 | | | | | | 40 | 2.5 | checked with primavera |
| 6.07 | Slide the second TF assembly against the support bracket and secure in place with the mating support bracket. | 1.0 | | | | | | 20 | 2.5 | checked with primavera |
| 6.08 | Install machine support plates (inboard and outboard) on the bottom, spanning two TF coil support brackets. | 3.0 | | | | | | 60 | 2.5 | checked with primavera |
| 6.09 | Reinstall leveler pad to engage base of MC on the right side. | 0.0 | | | | | | 0 | 2.5 | checked with primavera |
| 6.10 | Installed one side of the TF support brackets on the Type-C coil (top and bottom) for the TF installation to occur at Station 6. | 1.0 | | | | | | 20 | 2.5 | checked with primavera |
| 7.00 | TF installation - left side | | | | | | | | | checked with primavera |
| 7.01 | The TF installation on the left side will follow the same ten (10) steps that were followed on the right side. | 13.0 | | | | | | 260 | 2.5 | checked with primavera |
| 8.00 | TF fit-up check | | | | | | | | | checked with primavera |
| 8.01 | Perform a fit-up check of the four TF coils to determine if they can be positioned within tolerances. | 5.0 | | | | | | 100 | 2.5 | checked with primavera |
| 9.00 | Install Ports 4 | | | | | | | | | checked with primavera |
| 9.01 | Tack weld the left and right port 4's. Use a local laser attached to the port cover to define the port trajectory and to aid positioning in port during welding. | 2.0 | | | | | | 40 | 2.5 | checked with primavera |
| 9.02 | Install boots on both port 4's. | 4.0 | | | | | | 80 | 2.5 | checked with primavera |
| 10.00 | Installation of PF structural members and routing of MC coolant and leads. | | | | | | | | | checked with primavera |
| 10.01 | Install the PF coil support structure that surround the TF coils. In doing this the MC leads and coolant lines need to be routed to the outside of the PF structure. PF structure is only partially installed at the Type-C MC's. | 8.0 | | | | | | 160 | 2.5 | checked with primavera |
| 11.00 | MC header installation and coolant connections | | | | | | | | | checked with primavera |
| 11.01 | Install the MC coolant manifold outside of the PF structure in the area of PF6. | 3.0 | | | | | | 60 | 2.5 | checked with primavera |
| 11.02 | Connect all MC coolant lines to the manifold (40 lines top and bottom) | 20.0 | | | | | | 400 | 2.5 | checked with primavera |
| 12.00 | Diagnostic | | | | | | | | | checked with primavera |
| 12.01 | Install Rogowski coils on the end of the VV, left side. Route leads through space between port 8 and spool port opening and coil onto shell of MC for future routing | 5.0 | | | | | | 100 | 2.5 | checked with primavera |
| 13.00 | Final measurements | | | | | | | | | checked with primavera |
| 13.01 | Obtain a set of Period 1 alignment fiducial positions to use in locating the VV within the MC. | 5.0 | | | | | | 100 | | Metrology Staff Budgeted as LOE |
| 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 | | | | | | | | | checked with primavera |
| 13.11 | Check Assembly (bolts, etc) | 5.0 | | | | | | 100 | 2.5 | checked with primavera |
| 13.12 | Check Diagnostics (Loops, thermocouples) | 5.0 | | | | | | 100 | 2.5 | checked with primavera |
| 13.13 | Check manifolds (pressure, flow, etc.) | 5.0 | | | | | | 100 | 2.5 | checked with primavera |
| 13.14 | Check 6 modcoils (voltage etc) | 6.0 | | | | | | 120 | 2.5 | checked with primavera |
| 13.15 | Check trim coils (voltage etc) | 3.0 | | | | | | 60 | 2.5 | checked with primavera |
| 13.16 | Check TF coils (voltage etc) | 6.0 | | | | | | 120 | 2.5 | checked with primavera |
| 14.00 | Transfer Period to final assembly (Station 6). | | | | | | | | | checked with primavera |
| 14.01 | Install crane rigging to completed Period assembly | 2.0 | | | | | | 40 | 2.5 | checked with primavera |
| 14.02 | Remove platforms | 1.0 | | | | | | 20 | 2.5 | checked with primavera |
| 14.03 | Transfer completed Period to Station 6 located in NCSX test cell. | 2.0 | | | | | | 40 | 2.5 | checked with primavera |

Flex lines but need field supports installed

Metrology Staff Budgeted as LOE

Metrology Staff Budgeted as LOE

Metrology Staff Budgeted as LOE

Metrology Staff Budgeted as LOE

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 | | | | | | | | | | | | | | |
| Install on support platform (incl in job 7503) | | | | | | | | | | | | | | |
| subtotal | | | 196 | 0 | | | | | 4472 | 220 | \$ | 4,692.0K | checked with primavera | |
| Station 5- Final FP Assy -FP#2 (in NCSX TC) | | | | | | | | | | | | | checked with primavera | |
| Repeat steps for FP #1 | | | 196 | \$ - | | | | | 4472 | 220 | | | checked with primavera | |
| Station 5- Final FP Assy -FP#3 (in NCSX TC) | | | | | | | | | | | | | checked with primavera | |
| Repeat steps for FP #1 | | | 196 | \$ - | | | | | 4472 | 220 | | | checked with primavera | |
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NCSX June 2007 ETC

TABLE IV - Uncertainty of Estimate and Residual Risk Assessment

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 Estimate

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

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

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Job Manager: Mike Viola

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

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TABLE IV - Uncertainty of Estimate and Residual Risk Assessment

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

| | | | | | | | |
|--|----|---|--|--------|---------|--------|--------|
| 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. | <i>Crisis event not covered by contingency</i> | | | | |
| Metrology equipment and general purpose tooling/ lifting equipment (e.g.cranes) not available to support the schedule | U | Maintenance contract mitigates impact of metrology equipment. Additional \$200K budgeted for a 3rd laser tracker and/or spare metrology equipment. Should result in improved efficiency. | Up to 2 week impact on FPA and critical path. FPA cost impact assumed to be \$300k/mo. | + \$0 | + \$150 | + 0.00 | + 0.50 |
| 1815 Metrology equipment and general purpose tooling/ lifting equipment (e.g.cranes) not available to support the schedule | U | Maintenance contract mitigates impact of metrology equipment. Additional \$200K budgeted for a 3rd laser tracker and/or spare metrology equipment. Should result in improved efficiency. | Up to 2 week impact on FPA and critical path. FPA cost impact assumed to be \$300k/mo. | + \$0 | + \$150 | + 0.00 | + 0.50 |

NCSX June 2007 ETC

TABLE IV - Uncertainty of Estimate and Residual Risk Assessment

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 Job Manager: Mike Viola

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

- Notes:
- [1] Low cost and schedule impacts are considered the minimum (0-percentile) impacts should the event occur. High cost and schedule impacts are considered the maximum (100-percentile) impacts should the event occur
 - [2] Cost impacts should be entered as man-hours (by demographic) and M&S direct cost under basis of estimate. Cost impacts should NOT include standing army costs which are separately calculated from the schedule impact. Project control is responsible 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=Unlikely (40%>P>10%), VU=Very Unlikely (P<10%), NC=Non-credible (P<1%)

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

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

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

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

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

| Station 2 | Coverage | Title III Support Travel | |
|------------------|------------------|--------------------------|----------------|
| 1st period | 60% 60% Engr/Dsn | Job 1802 | Job 7503 |
| 2nd period | 40% 40% Engr/Dsn | \$4,500 | FY2007 |
| 3thd period | 20% 20% Engr/Dsn | \$9,000 | FY2008 |
| ENGR | 50% Average | \$4,500 | \$1,500 FY2009 |
| Designer | 50% Average | | \$6,000 FY2010 |
| | | | \$4,500 FY2011 |
| Station 3 | | | |
| 0 | 50% 50% Engr/Dsn | | |
| 0 | 30% 30% Engr/Dsn | | |
| 0 | 10% 10% Engr/Dsn | | |
| ENGR | 50% Average | | |
| Designer | 50% Average | | |
| Station 5 | | | |
| 0 | 50% 50% Engr/Dsn | | |
| 0 | 30% 30% Engr/Dsn | | |
| 0 | 10% 10% Engr/Dsn | | |
| ENGR | 50% Average | | |
| Designer | 50% Average | | |
| Station 6 | | | |
| 0 | 80% 80% Engr/Dsn | | |
| 0 | 60% 60% Engr/Dsn | | |
| 0 | 40% 40% Engr/Dsn | | |
| ENGR | 100% Average | | |
| Designer | 50% Average | | |