

## NCSX Work Approval Form (WAF)

**WBS Number: 41**

**WBS Title: AC Power**

**Job Number: 4101**

**Job Title: AC Power**

**Job Manager: Raki Ramkrishnan**

**Description:**

This WBS element consists of the effort to design and reconfigure existing auxiliary and experimental AC power systems. The existing AC power infrastructure at C-site will be re-used to the maximum practical extent. A new AC distribution system, up to and including power panels, is provided in the NCSX test cell. Activities associated with the reactivation of AC power systems at C-site are included. Grounding in the NCSX test cell is provided. For initial operation, the C-Site Rectifiers will be used to power the NCSX PF and modular coils.

**Schedule:**

**Approvals:**

\_\_\_\_\_

Job Manager

\_\_\_\_\_

Date

\_\_\_\_\_

Responsible Line Manager

\_\_\_\_\_

Date

\_\_\_\_\_

Project Manager

\_\_\_\_\_

Date

\_\_\_\_\_

Engineering Department Head

\_\_\_\_\_

Date

**NCSX June 2007 ETC  
TABLE I - DESIGN LABOR**

| <b>WBS Number: 41</b>   |                |                |            |            |             |            |           |            |   |
|---|----------------|----------------|------------|------------|-------------|------------|-----------|------------|---|
| <b>WBS Title: AC Power</b>  |                |                |            |            |             |            |           |            |   |
| <b>Job Number: 4101</b>   |                |                |            |            |             |            |           |            |   |
| <b>Job Title: AC Power</b>  |                |                |            |            |             |            |           |            |   |
| <b>Job Manager: Raki Ramkrishnan</b>  |                |                |            |            |             |            |           |            |   |
| <b>Description: This is a LOE effort for design intergration, interface definition, and oversight of diagnostic systems design, fabrication, and installation</b>   |                |                |            |            |             |            |           |            |   |
| Task Description  | Activity       | K\$            |            |            | Labor Hours |            |           |            | Basis of Estimate<br>(See Basis of Estimate Notes Below)                              |
|   |                | M&S            | Travel     | EASM       | ECEM        | EEEM       | EESM      | EETB       |   |
| <b>WBS 411 - Auxiliary AC Power</b>   |                |                |            |            |             |            |           |            |   |
| Prepare Preliminary One line diagram  | 4101-100.1     |                |            | 6          |             | 2          | 2         | 0          |   |
| Ex-Test cell AC pwr-Reactivate& new instl   | 411-1-100      | \$5.0K         |            | 5          |             | 8          | 13        | 21         |   |
| Grounding-Dsn - minimum required for first plasma   | 411-2-2        |                |            | 160        |             | 72         |           |            |   |
| Grounding-Procure   | 411-2-4        | \$10.0K        |            |            |             |            |           |            |   |
| Grounding-Install   | 411-2-6        | \$17.5K        |            | 56         |             | 28         |           | 112        |   |
| Grounding-Commission  | 411-2-8        |                |            | 40         |             | 24         |           | 80         | <b>Needed prior to testing coils</b>  |
| <b>Test Cell AC Power Distr-Dsn</b>   | <b>411-3-2</b> |                |            | <b>16</b>  |             | <b>8</b>   |           |            | <b>Covered by PPPL Facilities as an Infrastructure cost - NOT PART OF MIE PROJECT</b> |
| <b>Test Cell AC Power Distr-Procure(equipment/materials)</b>  | <b>411-3-4</b> | <b>\$10.0K</b> |            |            |             |            |           |            | <b>Covered by PPPL Facilities as an Infrastructure cost - NOT PART OF MIE PROJECT</b> |
| <b>Test Cell AC Power Distr-Install</b>   | <b>411-3-6</b> | <b>\$35.0K</b> |            | <b>64</b>  |             | <b>16</b>  | <b>16</b> | <b>24</b>  | <b>Covered by PPPL Facilities as an Infrastructure cost - NOT PART OF MIE PROJECT</b> |
| <b>Test Cell AC Power Distr-Commission</b>  | <b>411-3-8</b> |                |            |            |             | <b>16</b>  | <b>16</b> | <b>16</b>  | <b>Covered by PPPL Facilities as an Infrastructure cost - NOT PART OF MIE PROJECT</b> |
| <b>Standby Power for Cryo Sys -Dsn</b>  | <b>411-4-2</b> |                |            |            |             |            |           |            | <b>Not Applicable - not funded at this time</b>                                       |
| <b>Standby Power for Cryo Sys -Procure</b>  | <b>411-4-4</b> |                |            |            |             |            |           |            | <b>Not Applicable - not funded at this time</b>                                       |
| <b>Standby Power for Cryo Sys -Install</b>  | <b>411-4-6</b> |                |            |            |             |            |           |            | <b>Not Applicable - not funded at this time</b>                                       |
| <b>WBS 412 - Experimental AC Power</b>  |                |                |            |            |             |            |           |            |   |
| C-site Pulsed AC Power Distr-Dsn  | 412-1-2        |                |            | 16         |             | 16         |           |            |   |
| C-site Pulsed AC Power Distr-Procure  | 412-1-4        | \$5.0K         |            |            |             |            |           |            |   |
| C-site Pulsed AC Power Distr-Install  | 412-1-6        |                |            | 8          |             | 8          | 16        | 80         |   |
| C-site Pulsed AC Power Distr-Commission   | 412-1-8        |                |            |            |             | 24         | 24        | 40         | <b>Needed prior to testing coils</b>  |
| <b>Totals</b>   |                | <b>\$82.5K</b> | <b>\$0</b> | <b>371</b> | <b>0</b>    | <b>222</b> | <b>87</b> | <b>373</b> |   |
| <b>Notes on the Basis of Estimate</b>   |                |                |            |            |             |            |           |            |   |
| <b>(1) Design and Fabrication/Installation</b>  |                |                |            |            |             |            |           |            |   |
| Estimate based on extensive experience of engineer performing similar tasks at PPPL and EBASCO - e.g. recent experience on NSTX. This is basically a job modifying existing PPPL systems and re-installing for NCSX. Design and engineering estimates developed based on assessments of the number of drawings needed (new or modified), the effort to reconfigure existing designs, interfaces with other systems, supervision of on-site contractors, and all necessary re-activation and pre-operational testing needed. |                |                |            |            |             |            |           |            |   |
| <b>(2) M&amp;S</b>  |                |                |            |            |             |            |           |            |   |
| M&S estimated based on similar recent procurements and needed interfaces with installation contractors - this will be Davis-Bacon covered, except for those activities within the Test Cell.  |                |                |            |            |             |            |           |            |   |

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**TABLE II - Materials and Subcontracts**

|   |  |                 |  |  |              |  |  |  |                          |
|---|--|-----------------|--|--|--------------|--|--|--|--------------------------|
| <b>WBS Number: 41</b>                       |  |                 |  |  |              |  |  |  |                          |
| <b>WBS Title: AC Power</b>                  |  |                 |  |  |              |  |  |  |                          |
| <b>Job Number: 4101</b>                     |  |                 |  |  |              |  |  |  |                          |
| <b>Job Title: AC Power</b>                  |  |                 |  |  |              |  |  |  |                          |
| <b>Job Manager: Raki Ramkrishnan</b>        |  |                 |  |  |              |  |  |  |                          |
|   |  |                 |  |  |              |  |  |  |                          |
| <b>Materials and Subcontracts (M&amp;S)</b> |  |                 |  |  |              |  |  |  | <b>Basis of Estimate</b> |
|   |  |                 |  |  |              |  |  |  |                          |
|   |  | <b>Material</b> |  |  | <b>Labor</b> |  |  |  |                          |
| <b>Description - included in Table I</b>    |  |                 |  |  |              |  |  |  |                          |
|   |  |                 |  |  |              |  |  |  |                          |
|   |  |                 |  |  |              |  |  |  |                          |

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**TABLE III - Fabrication/Assembly Installation**

|   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|---|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
|   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| <b>In-house Fabrication and Assembly and Installation</b> |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>Included in Table I</b>                                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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

**WBS Number: 41**  
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**Job Manager: Raki Ramkrishnan**

**Uncertainty of the Estimate**

|                   | <u>High</u> | <u>Medium</u> | <u>Low</u> | <u>Uncertainty of Estimate (%)</u> | <u>Comments/Other Considerations</u>                               |
|-------------------|-------------|---------------|------------|------------------------------------|--|
| Design Maturity   | X           |               |            |                                    | Requirements still evolving, but do not expect major perturbations |
| Design Complexity |             |               | X          | -5%/+10%                           | Standard electrical systems design and fabrication                 |

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

**Residual Impacts**

| Job | Risk Description | Likelihood of Occurring | Mitigation Plan | Basis of estimate | Cost Impact |      | Schedule Impact |      |
|-----|------------------|-------------------------|-----------------|-------------------|-------------|------|-----------------|------|
|     |                  |                         |                 |                   | Low         | High | Low             | High |

NONE

**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=Unlikley (40%>P>10%), VU=Very Unlikely (P<10%), NC=Non-credible (P<1%)