

## NCSX Work Approval Form (WAF)

**WBS Number: 45**

**WBS Title: Power Systems Design Integration**

**Job Number: 4501**

**Job Title: Power Systems Design Integration**

**Job Manager: Raki Ramkrishnan**

**Description:**

This WBS element consists of the electrical system engineering and design/drafting, which includes the design and analysis of the overall electrical system, its documentation, and the conduct of design reviews. It also includes the T effort to ensure overall project coordination of electrical systems by providing electrical systems support to other systems, including diagnostics, which provides the engineering, design/drafting, and installation of diagnostic cabling. It also includes the the effort to conduct all systems-related preoperational testing.

**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: 45</b>  |           |       |      |      |   |      |     |      |  |
| <b>WBS Title: Power Systems Design Integration</b>   |           |       |      |      |   |      |     |      |  |
| <b>Job Number: 4501</b>  |           |       |      |      |   |      |     |      |  |
| <b>Job Title: Power Systems Design Integration</b>   |           |       |      |      |   |      |     |      |  |
| <b>Job Manager: Raki Ramkrishnan</b>   |           |       |      |      |   |      |     |      |  |
|  |           |       |      |      |   |      |     |      |  |
| Develop SRD  | 451-0-2   |       |      |      |   | 40   |     |      | Needed before FDR on WBS4              |
| Calculations-Dsn   | 451-1-2   |       |      | 8    |   | 40   |     |      | Needed before FDR on WBS4              |
| PDR Prep Power system -Dsn   | 451-2-2   |       |      | 128  |   | 96   |     |      | Needed before power Cable installation |
| FDR C-Site   | 451-2-2.1 |       |      | 120  |   | 80   |     |      | Needed before power Cable installation |
| PDR Power system -Dsn  | 451-2-3   |       |      |      |   |      |     |      | Needed before power Cable installation |
| Dwgs,asbuilts -Elect Dsn   | 451-3-2   |       |      | 320  |   | 320  |     |      | Needed before coil energization        |
| FDR AC auxiliaries & grounding-Dsn   | 451-4-2   |       |      | 40   |   | 40   |     |      | Needed before coil energization        |
| FDR C-Site -Cabling  | 451-6-2   |       |      | 120  |   | 80   |     |      | Needed before power Cable installation |
| <b>WBS 452 - Electrical Systems Support</b>  |           |       |      |      |   |      |     |      |  |
| Diagnostics AC Power Distr-Dsn   | 452-1-2   |       |      | 160  |   | 80   |     |      |  |
| Diagnostics AC Power Distr-Procure   | 452-1-4   | \$1K  |      | 8    |   |      |     |      |  |
| Diagnostics AC Power Distr-Install   | 452-1-6   |       |      | 80   |   | 24   | 80  | 640  |  |
| Diagnostics AC Power Distr-Commission  | 452-1-8   |       |      |      |   | 24   | 80  | 160  | Needed before first plasma             |
| Diagnostics sensor cabling-Dsn   | 452-2-2   |       |      | 160  |   | 24   |     |      |  |
| Diagnostics sensor cabling-Procure   | 452-2-4   | \$2K  |      |      |   |      |     |      |  |
| Diagnostics sensor cabling-Install   | 452-2-6   |       |      |      |   | 16   | 32  | 160  |  |
| Diagnostics sensor cabling-Commission  | 452-2-8   |       |      |      |   | 8    | 16  | 32   | Needed before first plasma             |
| <b>WBS 453 - System Testing (PTP's)</b>  |           |       |      |      |   |      |     |      |  |
| New Procedures   | 453-1-2   |       |      | 160  |   | 24   |     |      | Needed before FDR on WBS4              |
| Preop Testing-Procure test equipt  | 453-1-3   | \$20K |      |      |   |      |     |      | Needed before coil energization        |
| TF Coil Test   | 453-1-4   | \$1K  |      | 8    |   | 32   | 40  | 54   | Needed before first plasma             |
| PF5 Coil Test  | 453-1-5   | \$1K  |      | 8    |   | 32   | 40  | 54   | Needed before first plasma             |
| Trim Coil Test (per coil)  | 453-1-6   | \$1K  |      | 8    |   | 32   | 40  | 54   | Needed before first plasma             |
| Testing PTPs, ISTPs  | 453-1-7   | \$10K |      | 160  |   | 240  | 320 | 376  | Needed before first plasma             |
|  |           |       |      |      |   |      |     |      |  |
| <b>Totals</b>  |           | \$36K | \$0K | 1488 | 0 | 1232 | 648 | 1530 |  |
| <b>Notes on the Basis of Estimate</b>  |           |       |      |      |   |      |     |      |  |
| <b>(1) Design and Fabrication/Installation</b>   |           |       |      |      |   |      |     |      |  |
| Estimate based on estensive 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 assesments 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 tor those activities within the Test Cell.   |           |       |      |      |   |      |     |      |  |



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**TABLE III - Fabrication/Assembly Installation**

|   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|---|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
|   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <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**

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**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           |               |            |                                    | Do not anticipate major changes in the design |
| Design Complexity |             |               | X          | -5%/+10%                           | Known technologies                            |

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

**Residual Impacts**

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

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 Unlikley (P<10%), NC=Non-credible (P<1%)