

# **US CONTRIBUTIONS TO ITER PROJECT**

## **STATEMENT OF WORK**

**SOW-843-20090112-SIMMONS-1**

**(USITER-PD0003-R00)**

**FOR**

***Industrial Manufacturing and Cost and Schedule Estimates  
for the ITER In-Vessel Coils (IVC)***

**Prepared: January 12, 2009**

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***Statement of Work for:  
Industrial Manufacturing and Cost and Schedule Estimates for the ITER  
In-Vessel Coils (IVC)***

**Tasks:** PPPL will award two or more subcontracts for independent development of Industrial Manufacturing and Cost and Schedule Estimates for the ITER In-Vessel Coils. These IVCs are being designed for ITER to provide control of Edge Localized Modes (ELMs), moderately unstable resistive wall modes (RWMs), and vertical stability of the plasma.

The purpose of these studies will be to provide the ITER International Organization (IO) with industrial-based feedback on the design, reliability issues, manufacturability, and cost and schedule for production.

**Background:** The Princeton Plasma Physics Laboratory has been engaged in fusion research for more than five decades. It is managed by Princeton University under the sponsorship of the U.S. Department of Energy and currently employs a permanent staff of approximately 450. Additional information about PPPL can be found at <http://www.pppl.gov/>.

PPPL is supporting the design of the ITER Project in Cadarache, France. The ITER Project is an international undertaking involving seven participate domestic agencies. These are the European Union, Japan, the Russian Federation, South Korea, China, India, and the United States. The US ITER Project Office is located in Oak Ridge, Tennessee. PPPL is assigned specific design responsibilities, including design of the power supplies, selected diagnostics, port plug modules, and the in-vessel coils (IVC)

**Description:** The IVCs consist of (27) 3-turn picture frame type coils which serve the dual function of ELM and RWM control, and (2) 3-turn toroidal ring coils which provide vertical stabilization. All are mounted on the vacuum vessel wall behind the shield modules. Each of the ELM/RWM coils are supplied by an individual power supply at currents up to 20 kA; the two VS coils are connected in an anti-series and are interleaved with two power supplies which provide currents up to 80 kA. To provide the necessary radiation resistance, all of the coils utilize ceramic insulated copper conductor. The conductors are enclosed in stainless steel jackets for strength and to provide compatibility with ITER's vacuum requirements. Water is circulated between the conductors and the case to cool the conductors and to remove nuclear heat generated in the case. The coils are configured in sections joined by demountable jumpers to provided compatibility with ITER's remote handling requirements.

**Tasks:**

1. A review of the manufacturability of the current design. Areas of technical and manufacturing risk are to be highlighted.
2. Recommendations to improve the design, manufacturability and reduce technical risk.
3. Development of detailed cost and schedule estimates for the "baseline" and, after mutual agreement to the details, the recommended improved design.

**Appendices:**

1. Brief outline of IVC design concepts - dated July 15, 2008.
2. Draft Systems Requirements Document (SRD) – dated December 5, 2008
3. Basic set of drawings which describe the design (expected to be posted by January 31, 2009). These drawing shall serve as the basis of this Scope of Work.

## **ITER Quality Assurance Requirements**

Fabrication of the coils will likely be in accordance with the requirements of the ITER QA Program and the French nuclear law, **ESPN** (Équipement Sous Pression Nucléaire). As such quality requirements are likely to include:

1. Design reviews and independent verifications
2. Thorough documentation
3. Established Manufacturing, Inspection, Test, and Quality Plans
4. Documented vendor qualification and surveillance
5. Formal procedures
6. Complete oversight and assessment activities
7. Controlled measuring and test equipment (M&TE)
8. Documented worker qualifications
9. Formal inspection and testing
10. PPPL QA representative approvals
11. ITER approval of significant NCRs
12. ITER review of plans
13. Approved Notified Body (specific third party) acceptance of some activities and items

### **Schedule and Deliverables:**

1. A draft report shall be provided by March 15, 2009 which details all of the findings. The report shall be in electronic format. Cost and schedule information shall be broken down to the component level and detailed on spreadsheets. Backup vendor quotes, etc. shall be provided as .pdf documents.
2. The final report shall be provided by March 30, 2009.

**Proposed Principal Investigator:** Philip J. Heitzenroeder (PPPL)