PROJECT AGREEMENT

between

THE UNITED STATES DEPARTMENT OF ENERGY

and

THE MAX PLANCK INSTITUTE FOR PLASMA PHYSICS

on

A COLLABORATIVE PROGRAM TO DESIGN, FABRICATE, AND TEST A TRIM COIL SYSTEM FOR WENDELSTEIN 7-X (W7-X) in the framework of the Wendelstein 7-X Project

CONSIDERING THAT:

1) THE UNITED STATES DEPARTMENT OF ENERGY (USDOE) and the EUROPEAN ATOMIC ENERGY COMMUNITY (EURATOM) represented by the European Commission entered into an "Agreement for Cooperation between the Department of Energy of the United States of America and the European Atomic Energy Community represented by the Commission of the European Communities in the Field of Fusion Energy Research and Development" on May 14, 2001, as extended, (hereinafter referred to as the "Agreement");

2) The bilateral cooperation in the field of fusion energy research is performed also under the framework of the U.S.-EU Energy Council Working Group-II on Technology, Research, Development and Demonstration, subgroup 'Fusion Energy and Science';

3) For the purposes of this Project Agreement, the USDOE acts through the Princeton Plasma Physics Laboratory (PPPL) and in coordination with Oak Ridge National Laboratory (ORNL); and the Max Planck Institute for Plasma Physics (IPP) as a signatory of the European Fusion Development Agreement (EFDA) and of a Contract of Association with EURATOM is responsible for the implementation of this Project Agreement; USDOE and IPP being hereinafter referred to as the Parties;

4) The Parties have an interest in the control of 3D, high-beta, diverted plasmas for next-step fusion devices;

5) A Trim Coil system for control of divertor heat load balance is needed to optimize the performance of the Wendelstein 7-X (W7-X) stellarator, under the coordination of the Wendelstein 7-X Project Director;

6) Calculations performed by the IPP have shown that low-order field errors due to fabrication and construction tolerances can cause non-uniform distribution of heat loads among the ten divertor targets in the Wendelstein 7-X stellarator. For optimum performance, the heat loads should be distributed as uniformly as possible, so a system of "Trim Coils" was designed by IPP to provide additional control over low-order field perturbations during operation. A conceptual design study for a Trim Coil system was completed by IPP, and space was allocated on the W7-X device and in the facility to accommodate it. The involvement of third parties is considered to be important to complete the implementation of the Trim Coil system in a timely manner; and

7) The USDOE Fusion Energy Sciences (FES) program has a strong interest in understanding the control of three-dimensional, diverted toroidal plasmas due to its relevance to future next-step fusion devices, and has initiated a collaborative program with IPP using the W7-X facility centered on this topic. The Trim Coils are of high importance for the W7-X research program and the U.S. fusion program, in particular, from the initial phase of operations. As part of this collaboration, the U.S., starting from requirements and conceptual design data provided by IPP, will complete the design, fabrication, and testing of the W7-X trim coil system, and delivery to the W7-X site. The IPP will install the equipment.

THEREFORE the Parties agree to carry out a Collaborative Program to design, fabricate, and test a trim coil system for Wendelstein 7-X in the framework of the Wendelstein 7-X project, under the terms and conditions set forth below.

ARTICLE 1. OBJECTIVE

The W7-X trim coil system consists of three sub-systems: coils, coil supports, and power supplies. The scope and deliverables for the project are as follows:

Coils Five water-cooled copper coils of two different shapes (four of Type A and one of Type B), approximately 3.2m x 3.2m in overall dimensions, 11cm x 15cm in cross section for Type A, Type B slightly different. Starting from requirements and conceptual design data provided by IPP, PPPL will complete the design, fabrication, and testing of the coils, and deliver them to the W7-X site. Instrumentation and coil services interface hardware will be included. Basic handling fixtures needed to receive the coils at IPP will be provided.

Coil supports (steel brackets that attach the coils to the exterior of the W7-X cryostat): ORNL and PPPL collaborated in developing an initial concept for the supports, and transferred the information to IPP in February 2011. IPP will be responsible for completing the design and fabrication of the coil supports; PPPL will provide a modest level of ongoing support in the areas of design and analysis.

Quality documentation: Design, manufacturing, inspection, and test documentation associated with U.S.-fabricated equipment items will be provided to IPP as deliverables.

Power supplies for the coils (such as five controlled AC-to-DC convertors, controls, cabling, switchgear): Starting from requirements and conceptual design data provided by IPP, PPPL provided a cost estimate for U.S. fabrication of the power supplies, and transferred the information to IPP in February 2011.

ARTICLE 2. SCHEDULE AND DELIVERABLES

The preliminary milestone schedule is as follows:

Table: Coils Milestone Schedule

No.	Event	Preliminary Baseline	Status
C-1.	Project kickoff meeting (U.S.-IPP)	16 Nov. 2010	Complete
C-2.	Transfer coil & support requirements and conceptual design data to U.S. Team.	30 Nov. 2010	Complete
C-3.	PPPL review of project work plan and estimate completed. Work authorized.	22 Dec. 2010	Complete
C-4.	Commence project execution	10 Jan. 2011	Complete
C-5.	Complete transfer of U.S. support concept design data to IPP	22 Feb. 2011	Complete
C-6.	Complete preliminary design review	30 Apr. 2011	Complete
C-7.	Complete final design review	15 June 2011	Complete
C-8.	Order conductor	1 Aug. 2011	Complete
C-9.	Order windings	28 Sept. 2011	Complete
C-10.	Complete coil acceptance tests. [Included in supplier's contract.]		
C-11.	Deliver coils to IPP [Notation: M5(A) = Module 5, Type A]	M5(A): 29 June 2012 M1(A): 29 June 2012 M4(A): 28 Sept. 2012 M3(A): 13 Dec. 2012 M2(B): 28 Feb. 2013	

ARTICLE 3. RESPONSIBILITIES

3.1. All activities regarding the implementation of this Project Agreement shall be carried out by PPPL and IPP directly. All decisions regarding the implementation of this Project Agreement shall be taken by PPPL and IPP through their responsible representatives or bodies by mutual consent. All technical and administrative communication shall be made directly between PPPL and IPP.

3.2. PPPL shall be responsible for performing the project work scope:

- PPPL will be responsible for overall project management, for maintaining an effective technical and management interface with IPP, and reporting as required to both IPP and USDOE/FES. PPPL will be the primary point of contact for IPP and USDOE/FES. PPPL will be responsible for fabrication and acceptance testing, and delivery of the coils. PPPL will procure the coils from an industrial supplier. PPPL will be responsible for power supply design and estimating. If power supply fabrication is added to the project, PPPL will be responsible.
- PPPL will support the project as needed in the areas of procurement and quality assurance and will provide senior laboratory management attention.

3.3. IPP shall be responsible for:

- Delivering valid requirements and conceptual design data to the U.S. team;
- Participating in joint project meetings and reviews and, at its discretion, participating in the oversight of manufacturing, inspection, and testing activities; and
- Installation of the equipment in the W7-X facility at IPP.

ARTICLE 4. MANAGEMENT

4.1. Each Party shall appoint one Project Technical Coordinator who shall jointly be responsible for management of the W7-X Trim Coil Project, and for proposing and recommending a Project Management Plan to their respective authorities. If the technical context of the Project Management Plan undergoes significant change affecting the purpose, direction, priority and/or scope of the W7-X Trim Coil Project, the Project Technical Coordinators shall inform the Coordinating Committee of the Agreement and seek appropriate guidance.

4.2. For IPP, the Project Technical Coordinator shall be Dr. Thomas Rummel.

4.3. For PPPL, the Project Technical Coordinator shall be Dr. Hutch Neilson.

ARTICLE 5. EXCHANGES OF PERSONNEL AND EQUIPMENT

5.1. The exchange of equipment for this Project Agreement shall be the subject of separate property transfer agreements between the Parties or their designated implementing agents. These agreements shall refer to this Project Agreement and comply with Article IX of the Agreement.

5.2. In the case of extended visits, the exchanges of personnel shall be the object of separate arrangements between the Parties. These arrangements shall refer to this Project Agreement and comply with Article VIII of the Agreement.

ARTICLE 6. PUBLICATIONS AND INTELLECTUAL PROPERTY

6.1. Both Parties must approve technical papers based on physics or engineering investigations developed in the framework of this Project Agreement before being sent to a publisher. Such publications shall normally be issued in the form of joint reports by the individuals who contributed to the investigations and shall be handled in accordance with Article VII of the Agreement.

6.2. Each Party shall have equal and full access to data developed from the W7-X trim coil project, except for information that is proprietary to industrial suppliers. Publications are to be clearly marked with the following caption: "This work has been performed under a Project Agreement between IPP in the framework of the Wendelstein 7-X project and the Princeton Plasma Physics Laboratory for the U.S. Department of Energy's Fusion Energy Sciences Program." Other publications that make use of the unpublished results of this Collaborative Program should make reference to this Collaborative Program in an acknowledgment.

6.3. The Parties shall notify each other within a reasonable time of any intellectual property rights arising under this Project Agreement and shall seek protection and allocation of intellectual property for activities conducted under this Project Agreement in accordance with Annex A to the Agreement.

ARTICLE 7. GENERAL PROVISIONS

7.1. This Project Agreement is subject to and governed by the Agreement.

7.2. Unless otherwise specifically agreed in writing by the Parties, all costs and expenses of each Party resulting from or connected with this Project Agreement shall be borne by the Party that incurs them.

ARTICLE 8. DURATION, AMENDMENT AND TERMINATION

8.1. This Project Agreement shall begin upon the latter date of signature, and remain in force through installation and the useful life of U.S.-supplied equipment at W7-X. This Project Agreement may be amended or extended by written agreement of the Parties as long as the Agreement and EFDA are in force.

8.2. The Parties may terminate this Project Agreement at any time by mutual consent in writing. Alternatively, a Party that wishes to terminate its participation in this Project Agreement should provide at least six months advance notification in writing to the other Party.

8.3. In the event that, during the period of this Project Agreement, the nature of either Party's magnetic fusion program should change substantially, whether by substantial expansion, reduction or transformation, or by amalgamation of major elements with the magnetic fusion program of a third party, that Party shall immediately inform the other Party with a view to making any necessary revisions in the scope of this Project Agreement.

IN WITNESS WHEREOF, the Parties have executed this Project Agreement in duplicate.

FOR THE UNITED STATES DEPARTMENT OF ENERGY:

Edmund Synakowski
Associate Director of the Office of Science
for Fusion Energy Sciences
Office of Science

Date: March 27, 2012

Place: Washington, DC

FOR THE MAX PLANCK INSTITUTE FOR PLASMA PHYSICS:

Sibylle Guenter
Scientific Director

Christina Wenninger-Mrozek
Managing Director

Max-Planck Institut für Plasmaphysik (IPP)
Garching, Germany

Associated with the European Fusion Programme

Date: April 2, 2012

Place: Garching