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### Technical Specification

## Technical Specification for Mechanical Engineering Support

The contract is needed for the specialist mechanical engineering support which is required as part of the ICH antenna project. The work comprises of evaluation, verification and compliance of the mechanical designs of the ICH antenna produced by the ICH antenna design team as well as the writing of technical specifications.

<i>Approval Process</i>			
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## 1 Purpose

This document describes the technical needs for the specialist work relating to the mechanical engineering, design and evaluation and the writing of technical specifications for the design and evaluation work required for the ICH Antenna project.

## 2 Scope

The work comprises of the evaluation, verification and compliance of the mechanical designs of the ICH antenna produced by the ICH Antenna design team as well as the writing of technical specifications. The Ion Cyclotron Heating (ICH) antenna uses radio frequency (RF) in the range of 40 to 55MHz to provide the heating and current drive to the ITER plasmas in order to assist in accessing the H-mode and achieving  $Q=10$  as well as other plasma control functions.

The design of the antenna is being outsourced and work is required at ITER to verify and check that the design conforms to all the necessary ITER requirements.

The work will support the ITER ICH antenna project manager in moving the antenna design from PDR through to FDR and providing all the necessary detailed technical specifications and

drawings for the procurement.

## 3 Definitions

CYCLE (TO 02): CYCLE is a consortium of European laboratories (CCFE, CEA, ERM, IPP & POLITO) who, through a contract called a task order (TO 02), are completing some of the antenna design work.

DA: Domestic Agency

ICH: Ion Cyclotron Heating

IO: ITER Organization

IO-TRO: ITER Organization Technical Responsible Officer

TL: Transmission Line

PDR: Preliminary Design Review

FDR: Final Design Review

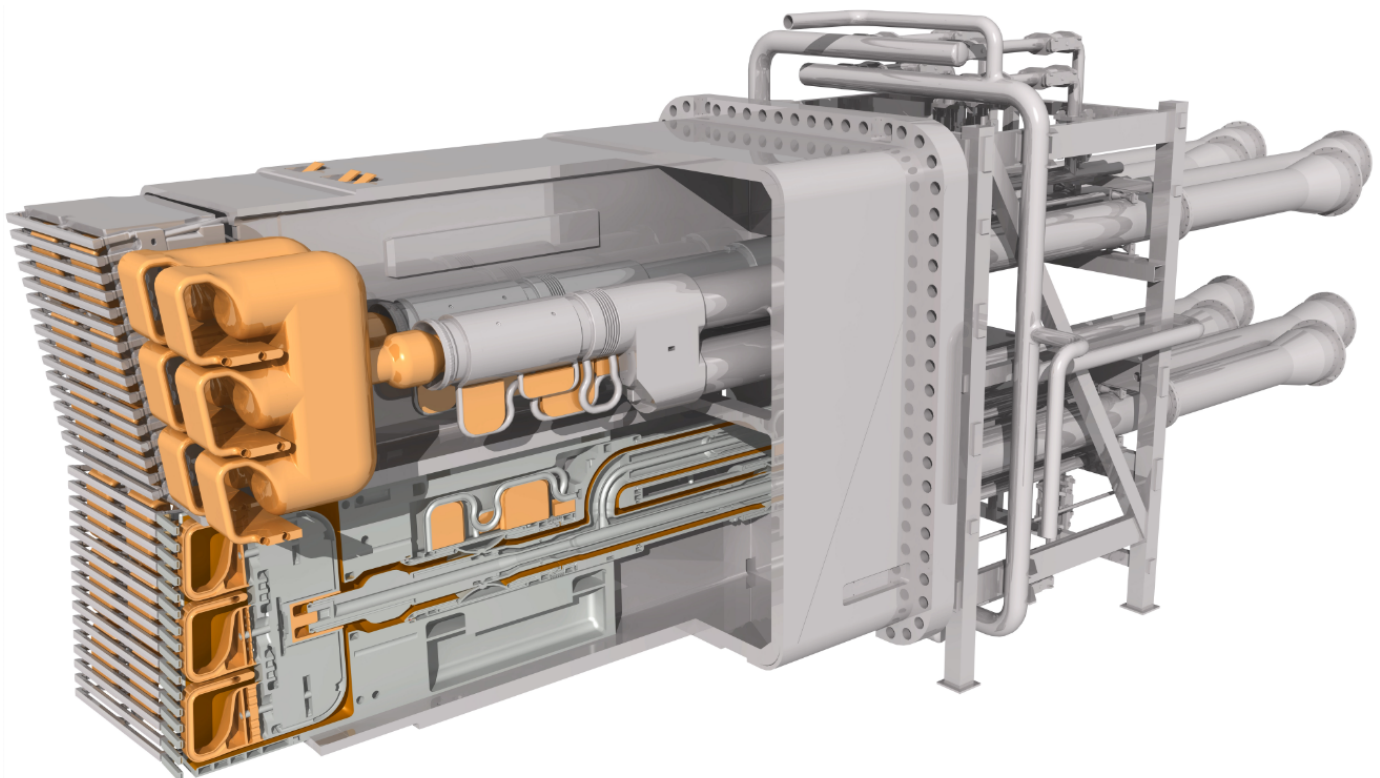
For a complete list of ITER abbreviations see: [ITER Abbreviations \(ITER\\_D\\_2MU6W5\)](#).

## 4 Background and Objectives

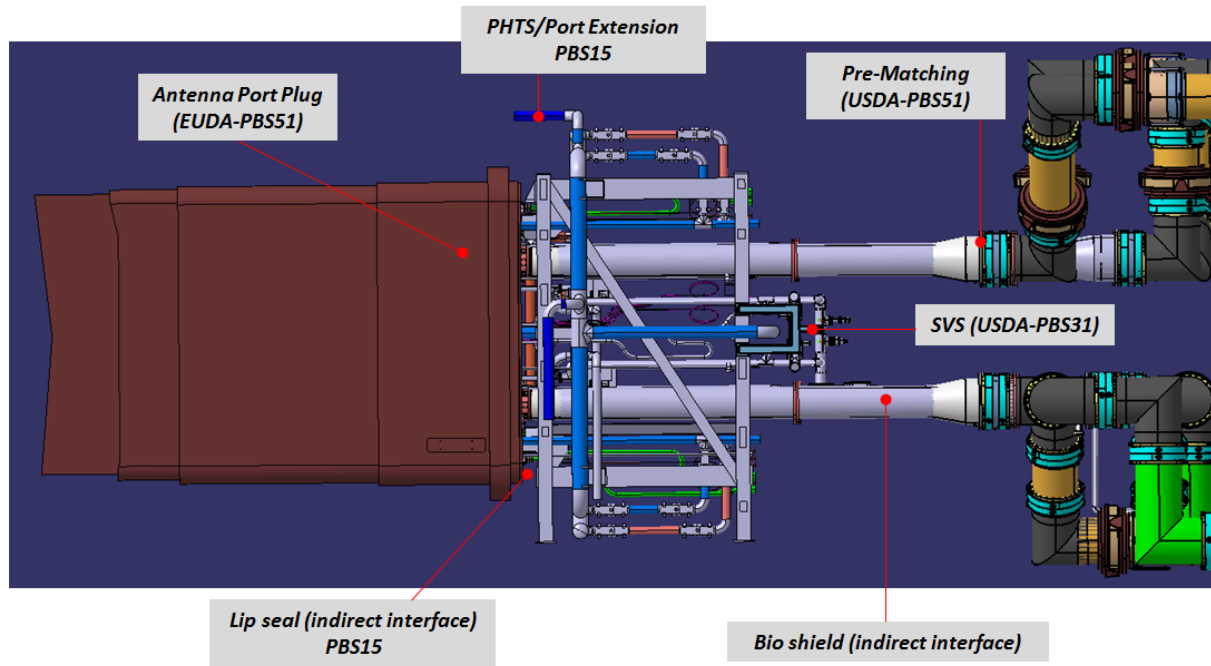
ITER is a major new device that is under construction at Cadarache, near Marseille, France. This device will study the potential of controlled nuclear fusion to provide energy for mankind. To reach the target performances of this device, a set of plasma heating systems are required. These systems will deliver power to the plasma to sustain and control the performance of the device.

The services described below are required for the hardware under development to launch radio-frequency power into the ITER plasmas, and are more specifically focused on the coupling structure, called an Ion Cyclotron Heating and Current Drive (IC H&CD) antenna, illustrated in Figure 1. The scope of work will also cover mechanical aspects of other parts of the whole IC H&CD system, as needed (for instance, the RF transmission lines and the RF matching systems shown Figures 2 and 3).

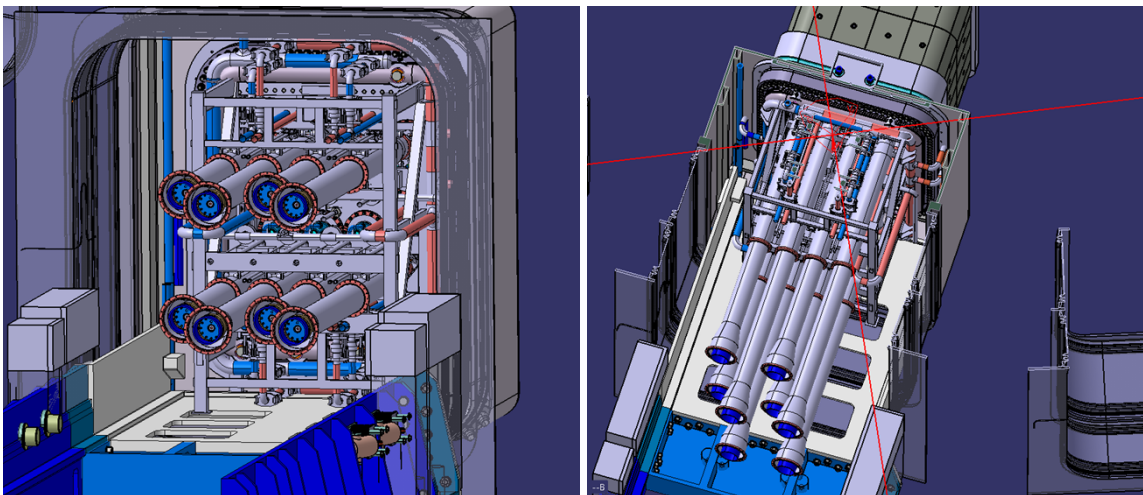
ITER is an Installation Nucléaire de Base under French law, and its components having a nuclear safety function must be designed, qualified, procured, inspected and operated in compliance with the relevant nuclear regulatory framework.



***Fig.1 - Equatorial Port Plug Antenna for IC H&CD power coupling to plasma: 3.5 x 2.5 x 1.9m, 45 tons***



*Fig.2 – Overview of the ICH Antenna & Transition Frame*



*Fig.3 – Overview of the ICH Interface equipped with the Transition Frame.*

## 5 Duration and Location

The duration shall be for 12 months (full time) from the starting date, defined by the kick-off meeting. The services are to be provided at the ITER IO Worksite.

## 6 Work Description

The work involves technical contribution in the following areas:

- The design of the IC antenna and its ancillaries, with emphasis on the mechanical aspects.
- The technical assessment of the progress of the externally contracted design activities.
- The detailed development of the IC antenna subsystems design, with emphasis on the mechanical aspects and fabrication issues.
- Mechanical analysis on the proposed design to verify its compliance with ITER requirements.
- Analyses leading to the definition of technical specifications covering forthcoming design or R&D activities.
- As the final design approaches completion, the work will involve analyses leading to the definition and writing of the technical specifications for a call for tender for the fabrication of the antenna.
- Production of all the documents recording the achievements in these areas.
- Effective management of deliverables and associated work to IO-TRO to meet project schedule in relevant areas of ICH antenna design.
- Preparation of technical reports
- Meeting notes for IO meetings called by interfacing systems and review bodies;
- Technical review notes for ongoing ICH Antenna work. Several technical documents per month may need to be reviewed;
- Preparation of input documents, presentations, meeting notes related to meetings of DA representatives with IO experts;
- Contributions to design workshops on specific topics;

Travel to the DA or other sites (including conferences) may be required to carry out the work.

The related expenses will be reimbursed by the IO in line with the contractual clauses.

## 7 Responsibilities

### 7.1 Contractor's Responsibilities

In order to successfully perform the tasks in these Technical Specifications,

The Contractor shall:

- Strictly implement the IO procedures, instructions and use templates;
- Provide experienced and trained resources to perform the tasks;
- Contractor's personnel shall possess the qualifications, professional competence and experience to carry out services in accordance with IO rules and procedures;
- Contractor's personnel shall be bound by the rules and regulations governing the IO ethics, safety and security IO rules.

### 7.2 IO's Responsibilities

The IO shall:

- Nominate the Technical Responsible Officer to manage the Contract;
- Organise a monthly meeting on work performed;
- Provide offices and the necessary IT equipment at the IO premises.

## 8 List of Deliverables and due dates

The main deliverables are provided in the table below.

D #	Description	Due Dates
D01	Report to prepare the technical specification for the Interspace layout update.	T0 + 02 months*
D02	Report to prepare the update of the ICH Antenna RH aspects (Task definitions form and Remote handling compatibility review), on the basis of the RH equipment available in ENOVIA.	T0 + 04 months*

D03	Report on the CYCLE TO2 deliverables review (CAD + Analyses) about shimming/grounding/straps design updates	T0 + 06 months*
D04	Report on the Interspace layout review report	T0 + 08 months*
D05	Report on the CYCLE TO2 deliverables review (CAD + Analyses) about bulkhead and the back Flange arrangement	T0 + 10 months*
D06	Report on the CYCLE TO2 deliverables review (CAD + Analyses) about the Bi metallic RVTL & RVTL configuration	T0 + 12 months*

(\*Note: the order of the deliverables may change due to the project needs)

## 9 Acceptance Criteria

The following criteria shall be the basis of the acceptance of the successful accomplishment of the Work.

### **Delivery date criteria**

On-time delivery of deliverables according to the dates provisionally defined in Section 8, and confirmed or amended in the relevant Instruction to proceed (I2P).

### **Report and document review criteria**

Reports and design documentation as deliverables shall be stored in the ITER Organization's document management system, IDM, by the Contractor for acceptance. A named ITER Organization's Contract Technical Responsible Officer is the Approver of the delivered documents. The Approver can name one or more Reviewers(s) in the area of the report's expertise. The Reviewer(s) can ask for modifications to be made to the report in which case the Contractor must submit a new version. The acceptance of the document by the Approver is an acceptance criterion.

## 10 Specific requirements and conditions

- Minimum 4 years of experience in structural design
- Knowledge of CATIA for mechanical design checking



- Experience with nuclear codes and standards, familiar with the RCC-MRx Design Code
- Expertise in performing technical report review
- Experience of working with CAD designers
- Experience in mechanical fabrication of complex components
- Ability to work in multidisciplinary, international team environment.
- Knowledge of Quality Assurance systems and their practical application (INB Order of 7 February 2012).
- Ability to balance quality/risk/cost when providing design information.
- Experience of vacuum application.
- Experience relevant to all techniques in deliverables list;
- Experience in Mechanical Engineering; or similarly complex research and nuclear environment;
- Understanding of schematics and 3D models.
- Written and oral communication shall be held in English

## **11 Work Monitoring / Meeting Schedule**

Personnel in charge of preparing the deliverables will be expected to attend regular Group Progress Meetings (as requested), and to respond when requested the formal exchange of documents which are transmitted by emails. Progress Meetings will be called by the ITER Organization, to review the progress of the work, the technical problems, the interfaces and the planning. Where necessary or appropriate, off-site contractor managers may be invited to participate in some progress meetings via videoconference.

The main purpose of the Progress Meetings between the ITER Organization/IC H&CD section and the Contractor Team Leader is to:

- Allow early detection and correction of issues that may cause delays;
- Review the completed and planned activities and assess the progress made;
- Permit fast and consensual resolution of unexpected problems;
- Clarify doubts and prevent misinterpretations of the specifications.

In addition to the Progress Meetings, if necessary, the ITER Organization and/or the Contractor may request additional meetings to address specific issues which may need to be resolved.

It is expected that occasionally the Contractor will be required to make a presentation to the Topical Technical Meetings. For all Progress Meetings, a document (the Progress Meeting Report) describing the tasks done, results obtained, blocking points and action items must be written by the Contractor. Each report will be stored in the ITER IDM in order to ensure traceability of the services provided.

On request and by agreement, meetings will be organized by videoconference. The Contractor shall facilitate proper tools for the videoconference.

Experts from the Domestic Agencies may be invited by ITER Organization to participate in the meetings or other involved parties.

## **12 Assurance (QA) requirements**

The organisation conducting these activities should have an ITER approved QA Program or an ISO 9001 accredited quality system.

The general requirements are detailed in [ITER Procurement Quality Requirements \(ITER\\_D\\_22MFG4\)](#).

Prior to commencement of the task, a Quality Plan must be submitted for IO approval giving evidence of the above and describing the organisation for this task; the skill of workers involved in the study; any anticipated sub-contractors; and giving details of who will be the independent checker of the activities (see [Procurement Requirements for Producing a Quality Plan \(ITER\\_D\\_22MFMW\)](#)).

Documentation developed as the result of this task shall be retained by the performer of the task or the DA organization for a minimum of 5 years and then may be discarded at the direction of the IO. The use of computer software to perform a safety basis task activity such as analysis and/or modelling, etc. shall be reviewed and approved by the IO prior to its use, in accordance with [Quality Assurance for ITER Safety Codes \(ITER\\_D\\_258LKL\)](#).

## **13 CAD Design Requirements**

The Contractor shall ensure that all designs, CAD data and drawings delivered to IO comply with the [Procedure for the Usage of the ITER CAD Manual \(2F6FTX\)](#).

The reference scheme is for the Contractor to work in a fully synchronous manner on the ITER CAD platform (see detailed information about synchronous collaboration in the [Specification for CAD data Production in ITER direct contracts \(P7Q3J7\)](#)).

This implies the usage of the CAD software versions as indicated in [CAD Manual 07 - CAD Fact Sheet \(249WUL\)](#) and the connection to one of the ITER project CAD data-bases. Any deviation against this requirement shall be defined in a Design Collaboration Implementation Form (DCIF) prepared and approved by DO and included in the all-for-tender package. Any cost or labour resulting from a deviation or non-conformance of the Contractor with regards to the CAD collaboration requirement shall be incurred by the Contractor itself.

[CAD Requirements & Deliverables Relative to Functional Design Milestone \(P49NTN\)](#) introduces CAD methodologies and details on required CAD deliverables for deliverable based Task aiming at Functional Design stage completion. **The non-respect of these requirements can lead to withhold of deliverable acceptance.**

## 14 Safety requirements

ITER is a Nuclear Facility identified in France by the number-INB-174 (“Installation Nucléaire de Base”).

For Protection Important Components and in particular Safety Important Class components (SIC), the French Nuclear Regulation must be observed, in application of the Article 14 of the ITER Agreement.

In such case the Suppliers and Subcontractors must be informed that:

- The Order 7th February 2012 applies to all the components important for the protection (PIC) and the activities important for the protection (PIA).
- The compliance with the INB-order must be demonstrated in the chain of external contractors.
- In application of article II.2.5.4 of the Order 7th February 2012, contracted activities for supervision purposes are also subject to a supervision done by the Nuclear Operator.

For the Protection Important Components, structures and systems of the nuclear facility, and Protection Important Activities the contractor shall ensure that a specific management system

is implemented for his own activities and for the activities done by any Supplier and Subcontractor following the requirements of the Order 7th February 2012 [20].

For the Protection Important Components, structures and systems of the nuclear facility, and Protection Important Activities the contractor shall ensure that a specific management system is implemented for his own activities and for the activities done by any Supplier and Subcontractor following the requirements of the Order 7th February 2012 ([PRELIMINARY ANALYSIS OF THE IMPACT OF THE INB ORDER - 7TH FEBRUARY 2012 \(AW6JSB v1.0\)](#)).