

Technical Specifications (In-Cash Procurement)

Detailed thermal and structural design of 6 Diagnostic First Walls

CFE for:-

This document describes technical needs of for specialist work relating to the cooling design and engineering analyses aimed to customize the generic DFW design to the configurations derived from the integration of the Equatorial Port Plug #17 and Upper Port Plug #2 (six items).

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1 Purpose

This document describes technical needs of for specialist work relating to the cooling design and engineering analyses aimed to customize the generic DFW design to the configurations derived from the integration of the Equatorial Port Plug #17 and Upper Port Plug #2 (six items).

2 Scope

In ITER, many diagnostics are inserted through port plug to diagnose the plasma temperature, density, radiative properties, first-wall resilience, etc. The diagnostic instruments and components are sensitive to high heat load, neutron damage, coating by dust and metallic vapour deposition, etc. On each port a DFW is installed to protect diagnostic instrumentation and components. The DFW is an assembly of FW and shielding elements that attaches to the diagnostic port plug.

The scope of this activity is to develop customized design configurations of six DFWs belonging to the EQ#17 (4 items) and UP#2 (2 items) port plug (EDFW). These elements consist of a plasma-facing first wall element and a shielding block portion which is attached and replaceable from a supporting DSM.

The work comprises integration and design of the cooling scheme compatible with the techniques and methods assessed for the generic component, the analyses required for assessing the design feasibility (thermal-hydraulics) and those required for justifying the Structural Integrity of the customized DFWs.

3 Definitions

DFW: Diagnostics First Wall

DR: Design Review

DSM: Diagnostics Shielding Module

EDFW: Equatorial Diagnostics First Wall

FEA: Finite Element Analysis

IO: ITER Organization

IO-TRO: ITER Organization technical Responsible Officer

PP: Port Plug

SLS: System Load Specification

For a complete list of ITER abbreviations see: [ITER Abbreviations \(ITER_D_2MU6W5\)](#).

4 References

The following reference documents compile the design information of the current status of the generic DFW designs.

[1] [DDD Diag DFW \(EDFW for FDR\) \(ITER_D_LWBPC8 v1.1\)](#)

[2] [System Load Specification of EDFW \(ITER_D_2ABEPK v1.0\)](#)

[3] [EDFW Structural integrity report \(ITER_D_2ABH2M v1.1\)](#)

[4] [DFW-DSM-PP Structure Interface Load Transfer \(ITER_D_Q45MZX v1.0\)](#)

[5] [DFW coolant line stress at DSM supports \(ITER_D_QC7TNL v1.0\)](#)

[6] [Analyses Check Lists \(RT2NKT\)](#)

5 Estimated Duration

The duration shall be for 12 months from the starting date of the task order. Services may be provided partly on-site (20%) and partly off-site (80%). In addition, periodic attendance to a meeting on-site (IO premises) of the staff undertaking the work may be required.

6 Work Description

The work involves the components and related tasks:

- Thermal design of the cooling scheme for the whole DFW compatible with the manufacturing approach followed in the design of the generic DFW (thermal hydraulic coupled analysis).
- Production of CAD models resultant from the design, integration and feasibility analysis activities.
- Detailed elastoplastic transient analyses for the assessment of ratcheting damage risks in the front wall (analyses to be conducted following requirements and recommendations in RCC-MR 2007).
- Structural assessment of the DFW designs based on the SLS provided.
- Preparation of the analysis assessment reports justifying the design solution aimed to support the design.

All analyses report will follow the templates provided by the IO either for thermal-hydraulics and structural analyses.

The exact list of input references, models and documents for performing the following activities shall be delivered to the Contractor during the KoM of this task.

Geometrical models shall be delivered to the Contractor through the official DET procedure.

Together with the report, the Acceptance Data Package (ADP) shall contain the analysis dbs and input files as well as technical check and review records of the analyses as per ITER quality procedures [6] and made by SQEP other than those who took part in the original analysis.

The qualifications (CVs) of the persons involved both in the analyses and in the independent verifications shall be delivered together with the verification reports.

6.1 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, profiles must be accredited by CVs and background summary.
- Provide independent verifications performed by suitably qualified and experienced persons.
- 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.

6.2 IO's Responsibilities

The IO shall:

- Nominate the Responsible Officer to manage the Contract.
- Organise a monthly meeting(s) on work performed (minutes and agendas shall be prepared by the contractor).

7 List of Deliverables and due dates

The main deliverables are provided in the table below.

D #	Description	Due Dates
D01	Cooling design (CAD models) and Supporting analyses results justifying the performance of 3 first DFWs in Equatorial PP#17. Thermal hydraulics report using template provided by IO.	T0 + 3 months
D02	Structural integrity justification including cyclic elastoplastic ratcheting analysis of 3 first DFWs in Equatorial PP#17 following template provided by IO.	T0 + 6 months
D03	Cooling design (CAD models) and Supporting analyses results justifying the performance of 3 last DFWs in Equatorial PP#17 and upper PP#2. Thermal hydraulics report using template provided by IO.	T0 + 9 months
D04	Structural integrity justification including cyclic elastoplastic ratcheting analysis of 3 last DFWs in Equatorial PP#17 and upper PP#2 following template provided by IO.	T0 + 12 months

8 Acceptance Criteria

The deliverables will be posted in the Contractor's dedicated folder in IDM, and the acceptance by the IO will be recorded by their approval by the designated IO TRO. These criteria shall be the basis of acceptance by IO following the successful completion of the services. These will be in the form of reports as indicated in section 7, Table of deliverables.

9 Specific requirements and conditions

- Advanced capabilities on using FE codes (submodelling, fields interpolation between physics).
- Demonstrated advanced capabilities on using CFD Codes and full coupled thermal hydraulic analysis of actively cooled in-vessel components in the fusion filed.
- Demonstrated experience in thermal and mechanical designs with integration of complex cooling networks in actively cooled in-vessel components in the fusion filed.
- Experience in advanced structural integrity FE evaluations including ratcheting, fatigue and elastoplastic analyses.
- Experience in application of Codes and Standards nuclear/conventional (RCC-MR 2007, ASME, EN, etc) to the structural integrity justification of systems, structures and components;
- Availability to use extensive computational resources for FEA of big models (>2MDOF in highly non-linear analysis with multiple load steps >50).

10 Work Monitoring / Meeting Schedule

Work is monitored through reports on deliverables (see List of Deliverables section) and at monthly project meetings.

11 Delivery time breakdown

See Section 7 “List Deliverables section and due dates”.

12 Quality 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 (if applicable)

For the contracts where CAD design tasks are involved, the following shall apply:

The Supplier shall provide a Design Plan to be approved by the IO. Such plan shall identify all design activities and design deliverables to be provided by the Contractor as part of the contract.

The Supplier 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](#)), and with the Procedure for the Management of CAD Work & CAD Data (Models and Drawings [2DWU2M](#)).

The reference scheme is for the Supplier to work in a fully synchronous manner on the ITER CAD platform (see detailed information about synchronous collaboration in the ITER [GNJX6A](#) - Specification for CAD data production in ITER Contracts.). 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 call-for-tender package. Any cost or labour resulting from a deviation or non-conformance of the Supplier with regards to the CAD collaboration requirement shall be incurred by the Supplier.

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 ([PRELIMINARY ANALYSIS OF THE IMPACT OF THE INB ORDER - 7TH FEBRUARY 2012 \(AW6JSB v1.0\)](#)).