

Technical Specifications (In-Cash Procurement)

Engineering Analyses to cover modifications in the design of the front wall of generic Diagnostic First Walls (DFW)

This document describes technical needs of for specialist work relating to engineering analysis and production of related documents System Load Specifications and Structural Integrity Report for the redesign of the generic Diagnostic First Wall (DFW).

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1 Purpose

This document describes technical needs of for specialist work relating to engineering analysis and production of related documents System Load Specifications and Structural Integrity Report to cover some modifications in the design of the generic Diagnostic First Walls (DFW) aimed to mitigate several manufacturing risks associated to the current design.

2 Scope

The work comprises analyses required for assessing the design feasibility, for supporting the System Load Specifications production and for the Structural Integrity justification of the generic DFW, including the production of related documents.

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 a generic design configuration of a representative upper (UDFW) & equatorial port (EDFW) plasma-facing shielding module. These elements consist of a plasma-facing first wall element and a shielding block portion which is attached and replaceable from a supporting DSM.

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

StIR: Structural Integrity report

UDFW: Upper Diagnostics First Wall

VV: Vacuum Vessel

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 fo the generic DFW designs.

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

[2] [DFW load specification \(EDFW for FDR\) \(ITER_D_LDEJTT v1.6\)](#)

[3] [DDD Upper Diagnostic First Wall \(FDR version\) \(ITER_D_Q8VRAE v1.0\)](#)

[4] [DFW System Load Specifications \(UDFW for FDR\) \(ITER_D_Q94WH2 v1.2\)](#)

[5] [Upper DFW Structural Integrity Report \(FDR version\) \(ITER_D_QB3QCJ v1.2\)](#)

- [6] [EDFW Structural Integrity Report - FDR version \(ITER_D_QC2KN6 v1.1\)](#)
- [7] [DFW-DSM-PP Structure Interface Load Transfer \(ITER_D_Q45MZXX v1.0\)](#)
- [8] [DFW coolant line stress at DSM supports \(ITER_D_QC7TNL v1.0\)](#)

5 Estimated Duration

The duration shall be for 12 months from the starting date of the task order. Services are to be provided off-site. However periodic attendance to meeting on-site (IO premise) of the staff undertaking the work may be required in a monthly basis. In addition, performers may be required to attend the DR scheduled by end of March 2018 to present the tasks developed.

6 Work Description

The work involves the components and related tasks:

1. DFW design and feasibility analyses.

- Analyses oriented to determine the stress/strain profiles in the front face of generic DFWs for the different wall configurations, including sensitivity analysis of the different geometrical solutions determined by the different manufacturing approaches adopted;
- Detailed elastoplastic transient analyses for the assessment of ratcheting and fatigue damage risks in the front wall (analyses to be conducted following requirements and recommendations in RCC-MR 2007);
- Elastic-plastic fracture mechanic analysis with crack growth prediction oriented to determine the evolution of an eventual crack generated in front face;
- Thermal design of the cooling scheme for the whole DFW compatible with the manufacturing approach followed (thermal hydraulic coupled analysis);
- Production of CAD models resultant from the design and feasibility analysis activities.
- Preparation of the analysis assessment reports justifying the design solution aimed to support the design review to be held in March including the presentations to be showed during the review (analyses aimed to welding distortions and residual stresses prediction are excluded from this point);
- Completion if the actions derived from the design review aimed to complete its close-out. That includes pending analysis or activities not completed at the PDR presentation time, answering actions, etc...

2. SLS and StiR production of generic DFWs (upper and equatorial).

- Review and completion according to IO indications of EM supporting analyses for the production of the System Load Specifications of the DFWs (upper and equatorial);
- Production of the System load Specifications for the DFWs (upper and equatorial);
- Structural assessment of the DFW designs (upper and equatorial) based on the SLS built in the previous point (in this assessment, DFWs shall be taken as part of the assembled PP and the main analyses shall include the all common components of such assembly);
- Small scale analysis (based submodelling if required) supported by the assessment specified in the previous point aimed to demonstrate the integrity of the DFW tabs;

- Preparation of the structural assessment reports and the structural integrity report supporting the design review including all presentations to be showed during the review (thermal-hydraulics analyses are excluded from this point);
- Completion of the actions derived from the design review aimed to complete its close-out. That includes pending analysis or activities not completed at the DR presentation time, answering actions, etc...

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;
- 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	Supporting analyses results and sensitivity assessment in terms of stresses & strains of the different options for the configuration the DFW front face. Report of activities developed.	T0 + 2 months
D02	Elastoplastic fatigue analysis of the design option adopted aimed to justify the structural behaviour of the front wall in terms of ratcheting and fatigue damage. Report of activities developed.	T0 + 3 months
D03	Elastoplastic fracture mechanics analysis with prediction of a crack evolution (generated on the surface exposed to the plasma) of the design option adopted aimed to justify the structural behaviour of the front wall in terms cracking. Report of activities developed.	T0 + 4 months
D04	Supporting analyses (EM) and related activities (interpolation of loads between physics...) aimed to provide loads to the DFW SLS (upper and equatorial level). Report or presentation	T0 + 5 months

	of activities developed.	ITER_D_XXXXXX
D05	Production of a System Load Specification for the generic DFW at Equatorial level (EDFW). Document in IDM.	T0 + 6 months
D06	Production of a System Load Specification for the generic DFW at Upper level (UDFW). Document in IDM.	T0 + 7 months
D07	Completion of the structural assessments (analyses) for the generic DFW at Equatorial and Upper levels (EDFW & UDFW). Report of activities developed.	T0+8 months
D08	Production of the structural integrity reports (StIR) and related presentations for the design review of generic DFWs at Equatorial and Upper levels (EDFW & UDFW). Documents in IDM.	T0+9 months
D09	Final version of the Structural Integrity Reports (StIR) and SLS for generic DFWs at Equatorial and Upper levels (EDFW & UDFW) implementing comments and actions resulting from the design review. Reports approved in IDM.	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 8, Table of deliverables.

9 Specific requirements and conditions

- Experience in Mechanical Engineering;
- Advanced capabilities on using FE codes (submodelling, fields interpolation between physics) with emphasis in ANSYS Code (classic/workbench) and associated programming tools (APDL...);
- Experience in advanced structural integrity FE evaluations including ratcheting, fatigue, fracture mechanics 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;
- Understanding of schematics and 3D models and use of 3D modellers aimed to FEA (Spaceclaim, ANSYS prep...);
- Knowledge of ITER requirements and guidelines;
- Excellent skills in writing technical reports in English Language;

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 8 “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 \(AW6JSB v1.0\)](#)).