

Technical Specifications (In-Cash Procurement)

CFE - Thermal-Hydraulic Analysis and Structural Assessment of Equatorial Port #17 Port Plug with Integrated Disruption Mitigation System and Diagnostics

This document describes the technical needs of expert analysis support for the justification of structural integrity and production of related structural assessment reports of Equatorial Port #17 port plug with integrated Disruption Mitigation System and diagnostic systems. The impact of DMS has induced major changes in the overall integration layouts, caused redesign of integrated port, which should be justified structurally.

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1 Purpose

This document describes the technical needs of expert analysis support for the justification of structural integrity and production of related structural assessment reports of Equatorial Port #17 port plug with integrated Disruption Mitigation System and diagnostic systems. The impact of DMS has induced major changes in the overall integration layouts, caused redesign of integrated port, which should be justified structurally.

2 Scope

The scope of the work comprises:

- Thermal-Hydraulic (TH) analysis of 3 Diagnostic Shield Modules (DSM) with integrated DMS and diagnostic systems;
- Iterative implementation of water cooling channels in DSM in conjunction with TH analysis;
- Structural integrity assessment of 3 DSMs prepared on the basis of outcome from thermal-hydraulic and Electro-Magnetic (EM) analysis;
- Delivery of Structural Assessment reports and presentations.

EM analysis is out of scope of this task. The outcome of the EM analysis will be provided to Contractor in the form of EM analysis report accompanied with analysis data files.

3 Definitions

DSM Diagnostic Shield Modules
DMS Disruption Mitigation System
EM Electro-Magnetic
TH Thermal-Hydraulic

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

4 References

- [1] [Procedure for Analyses and Calculations \(22MAL7 v6.6\)](#)
- [2] [Instructions for the Storage of Analysis Models \(U34WF3 v2.0\)](#)
- [3] [Instructions for EM Analyses \(TSZ9KQ v2.11\)](#)
- [4] [Analyses Check Lists \(RT2NKT\)](#)
- [5] [55.QC - Thermal hydraulics analyses DSM-1 \(FINAL VERSION\) \(ITER_D_UZU8CU v1.3\)](#)
- [6] [55.QC - Structural Assessment of DSM-3 \(ITER_D_4ETRSK v1.3\)](#)
- [7] [Sign-Off Authority \(SOA\) for Project Documents \(2EXFXU v5.2\)](#)

5 Estimated Duration

The duration shall be **12 months** from the starting date of the task order. Services are to be provided off-site. However, periodic attendance to meetings on-site (IO premises) of staff undertaking the work may be required in a monthly basis.

6 Work Description

The design justification work under this technical specification is to advance design of the in-vessel part of EQ#17 (Figure) and to provide structural justification of the design and integration layout of respective DSMs. The outcome of the work will be used as an input for DMS and diagnostics design justification activities. The work comprises following tasks:

- Thermal design of the cooling scheme for the whole DSM compatible with the manufacturing approach followed in the design of the generic DSM (thermal hydraulic coupled analysis);
- Design of the water cooling channel network;
- Structural assessment of the DSMs (following RCC-MR 2007 code) based on the SLS provided;
- Preparation of the analysis assessment reports justifying the design solution aimed to support the design.

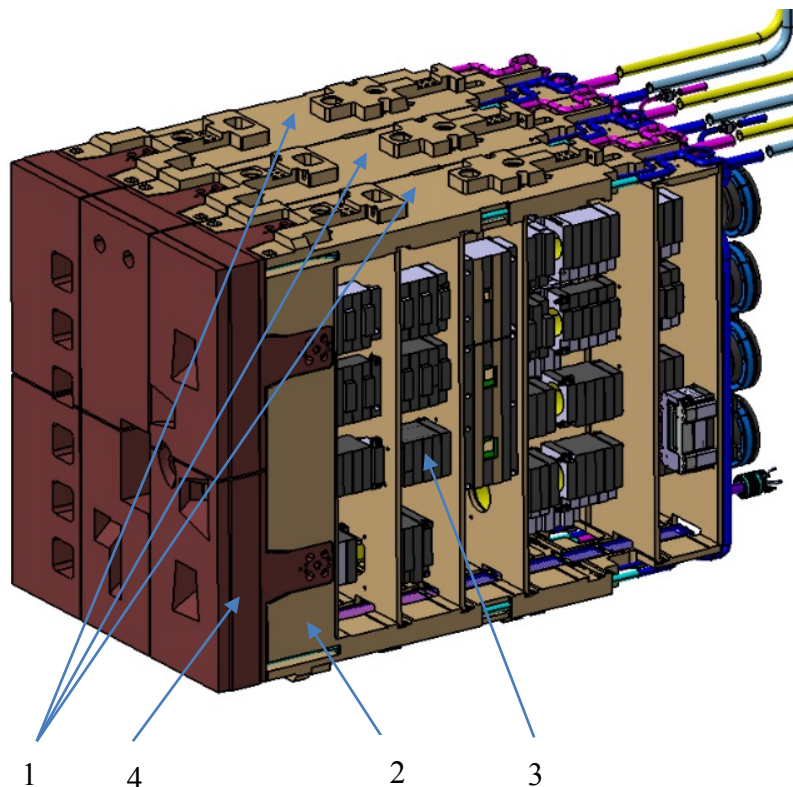


Figure 1. Overall view of Equatorial Port #17 at the PDR design level (1 – DSMs, 2 – forged section of DSM with water channel network to be implemented in the frame of this work, 3 – backfilling elements, 4 – DFW (out of scope)).

All analyses report shall 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 will 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 [4] and made by SQEP other than those who took part in the original analysis.

Examples of similar work and expected outcome reports can be found in [5] and [6].

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 identified in this Technical Specification, the Contractor shall:

- Strictly implement the IO procedures, instructions and use the corresponding templates.
- Provide all means hardware and software (including licenses) required to perform the tests specified in the previous section.
- 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, licenses, 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.

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 deliverables of this contract are shown in the table below.

D #	Description	Due Dates
D01	Design of cooling water channel network and supporting analyses results justifying the performance of 3 DSMs in Equatorial Port #17. Thermal hydraulics analysis report using respective IO templates.	T0 + 6 months
D02	Structural integrity justification of 3 DSMs in Equatorial Port #17 following template provided by IO. Structural assessment reports using respective IO templates. Presentations describing analysis procedures and analysis outcome.	T0 + 12 months

Note: The organization of deliverables is just for orientation. A different arrangement may be agreed with the supplier taking into account IO needs and possibilities of work parallelization of the supplier.

8 Acceptance Criteria

The analysis data packages generated in the different tasks shall contain the descriptive reports produced according to the ITER guidelines ([2] and [3]) as well as all analyses databases, scripts, macros, spreadsheets or any other file required to reproduce the analyses performed under this task order.

All the analysis shall be accompanied by review and a technical check as per [1] by different persons to those that participated in the analysis task. The records of the review are part of the delivery package.

The deliverables shall 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. The reviewer and approver of the reports shall be coherent with ITER Sign-Off-Authority [7].

The analysis package shall be also submitted by IO webdisk.

These criteria shall be the basis of acceptance by IO following the successful completion of the services.

9 Specific requirements and conditions

- Sound experience in FEA analysis:
- Experience in using ANSYS Classic & workbench v.15 or higher (and associated packages for analysis and pre-processing (SpaceClaim / DesignSpace)).
- Experience in FEA pre-processing, mesh generation and model's quality assessment;
- Experience in Mechanical (linear/non-linear/static/dynamic);
- Experience in thermal-hydraulic analysis (single and coupled) of port plug systems (can be DSM, DFW or Port Plug Structure);
- Experience in ParaView and post-processing tool (interface with ANSYS to be developed);
- Experience in advanced Finite Element Analysis techniques (sub-modelling, interpolation, contact technologies, programming (APDL) and coupled field analysis);
- Experience in structural assessment Code post-processing techniques (linearization and categorization of stresses, fatigue, limit analysis);
- Experience in structural assessments using ITER-relevant nuclear Codes and Standards (RCC-MR ed. 2007);
- Experience in use of Load Specifications for Port Plug integrated systems and management of interface loads between upper level components and tenant systems following an integrated analysis approach;
- Monitoring and reporting of status of projects;
- Communication with international local and remote teams in context of nuclear fusion research or similarly complex research and engineering environment;
- Organization, taking minutes and action tracking of international meetings;
- Understanding of schematics and 3D models.

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 the commencement of the task, a Quality Plan must be submitted for IO approval giving evidence of the abovementioned and describing the organisation for this task, the skill of workers involved in the study, any anticipated sub-contractors and giving details of who the independent checker of the activities will be (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 execution of this contract the documents Provisions for Implementation of the Generic Safety Requirements by the External Actors/Interveners (SBSTBM v2.2) and Propagation of the Defined Requirements for Protection Important Components Through the Chain of External Interveners (BG2GYB v3.3) remain applicable.

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 \(AW6JSB v1.0\)](#)).