Technical Specifications (In-Cash Procurement)

Technical Specifications_thermal-hydraulic FE model of the integrated equatorial port plugs

This document describes technical needs of for specialist work relating to design, engineering and FEA support of CPPE Section in the construction of a thermal-hydraulic FE model of the integrated equatorial port plugs.

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1 Purpose

This document describes technical needs of for specialist work relating to design, engineering and FEA support of CPPE Section in the construction of a thermal-hydraulic FE model of the integrated equatorial port plugs.

2 Scope

The work comprises thermal design of integrated equatorial port plug Diagnostic Shielding Modules and the implementation of this thermal design on FE models including the full assembled PP and the Port. Those models will also implement the complete set up to carry-out the coupled field thermal-hydraulic analysis of the assembled PP.

3 Definitions

APDL: ANSYS Parametric Design Language

CPPE: Common Port Plug Engineering

DSM: Diagnostic Shielding Module

EPP: Equatorial Port Plug

FEA: Finite Element Analysis

IO: ITER Organization

IO-TRO: ITER Organization Technical Responsible Officer

IVH: ITER Vacuum Handbook

PP: Port Plug

PR: Project Requirements

SLS: System Load Specification

For a complete list of ITER abbreviations see: ITER Abbreviations (ITER_D_2MU6W5).

4 References

Links inserted in text (where applicable). Also, the current guidelines and descriptive documents to for the production of System Load Specifications would be applicable references for the proper execution of works:

- Building good Load Specifications *(ITER_D_SNT6NX v1.0)*
- General description of LEGO DSM concept (*T78WVK v1.1*)
- DSM Workshop_Rigid_interfaces_v4 *(ITER_D_QEN6GU v1.0)*

5 Estimated Duration

The duration shall be for a period of 1 year from the commencement of the Contract. No work shall be carried out before Contract has been agreed and signed. Services may be provided off-site under the full supervision of IO-CT staff.

6 Work Description

The work includes technical involvement on the design activities aimed to justify standardized solutions of shielding of First Plasma EPP DSMs. That includes:

- Thermal design of the 3 pre-integrated DSMs of integrated equatorial port following the modular concept developed by IO to meet the target of having 30% of water in the front part of the DSM.
- Development the thermal FE of the assembled integrated equatorial port able to simulate the thermal –hydraulic (coupled field) behaviour of the system during operation and baking conditions of the ITER Machine.
- Set-up of the previous models up to the condition "ready to run" implementing the different heat transfer mechanisms (conduction, convection and radiation) required for the correct simulation of the system. The validation of the conceptual model in terms of relevant effects to be included or in terms heat transfer mechanisms is performed by IO staff.
- Production of explicative presentations and reports explaining the design and models details, the quality tests that guarantee the correctness of the analyses and the guides for use of the models.

Travel to the IO premises may be required to carry out the work.

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 Responsible Officer to manage the Contract;

• Organise a monthly meeting(s) on work performed;

• Provide offices at IO premises.

8 List of Deliverables and due dates

The main deliverables are provided in the table below. Expertise in italic are linked to those which were agreed in the Framework Contract Technical Specifications.

D #	Description	Due Dates
D01	Thermal design for the three DSMs of the first integrated equatorial port aiming to maximize the content of water in the front part of the modular DSM concept developed by IO (the target would be up to 30%). The design shall keep the manufacturability restrictions imposed by the ITER PR and IVH. Additionally the design shall demonstrate that the pressure of the coolant is not a relevant driver of the DSM mechanical design. The deliverable includes the design (geometrical files oriented to simulation [Spaceclaim – Catia is not specifically required], report and presentation describing the design, isolated DSM thermal-hydraulics analyses supporting the design and justification report stating the relevance of pressure as design driver	T0+3 months
D02	Thermal design for the three DSMs of the second integrated equatorial port aiming to maximize the content of water in the front part of the modular DSM concept developed by IO (the target would be up to 30%). The design shall keep the manufacturability restrictions imposed by the ITER PR and IVH. Additionally the design shall demonstrate that the pressure of the coolant is not a relevant driver of the DSM mechanical design. The deliverable includes the design (geometrical files oriented to simulation [Spaceclaim – Catia is not specifically required], report and presentation describing the design, isolated DSM thermal-hydraulics analyses supporting the design and justification report stating the relevance of pressure as design driver	T0+6 months
D03	Construction of a thermal-hydraulic FE model of the first integrated equatorial port. The model shall consider the thermal design of DSMs developed in D01 above and the current thermal design of PPS. Set-up of the model implementing the heat transfer mechanisms, boundary conditions and interpolated fields (nuclear heating [provided by the IO]) required simulating the operational and baking conditions of the ITER machine. The deliverable shall include the FE model itself (and submodels if applicable), all routines (in APDL or any other programming language) required to perform the set-up of the analysis and to launch the process and a report [and presentation] describing the principles of conceptual model, its implementation in the FE model, the setting-up, the model characteristics and how the analysis has to be launched.	T0+9 months
D04	Construction of a thermal-hydraulic FE model of the second integrated equatorial port. The model shall consider the thermal design of DSMs developed in D01 above and the current thermal design of PPS. Set-up of the model implementing the	T0+12 months

| | heat transfer mechanisms, boundary conditions and interpolated fields (nuclear heating [provided by the IO]) required simulating the operational and baking conditions of the ITER machine. The deliverable shall include the FE model itself (and submodels if applicable), all routines (in APDL or any other programming language) required to perform the set-up of the analysis and to launch the process and a report [and presentation] describing the principles of conceptual model, its implementation in the FE model, the setting-up, the model characteristics and how the analysis has to be launched. | |

9 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.

10 Specific requirements and conditions

Good and demonstrable skills in thermal-hydraulics, CFD and structural (linear/non-linear, static/transient) analysis using ANSYS/CFX (classic and workbench): analysis pre-processing, solution setting-up and advanced post-processing procedures.

Good and demonstrable skills using creation of CAD models oriented to FE analyses using Spaceclaim.

Demonstrable experience in ANSYS APDL programming and use of advanced analysis features (contact interactions, submodelling…).

Experience in nuclear Codes (RCC-MR 2007 / ASME III) is highly desirable.

Experience in Mechanical Engineering.

Experience in Manufacturability and Welding skills.

Experience in vacuum systems is also highly recommendable.

Monitoring and reporting of status of projects.

Generation of technical, administrative, and managerial documents.

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.

11 Work Monitoring / Meeting Schedule

Work is monitored through quarterly reports (see List of Deliverables section) and at monthly project meetings for each of the four projects.

12 Delivery time breakdown

See Section 8 "List Deliverables section and due dates".

13 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).

14 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.

15 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)).