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Technical Specifications (In-Cash Procurement)

CFE - Expert analysis support for the justification of structural integrity and production of related EWP documentation of diagnostic in-vessel systems

This document describes the technical needs of expert analysis support for the justification of structural integrity and production of related EWP documentation of diagnostic in-vessel systems in the scope of the ITER assembly contracts A6-P1: Welding of VV attachments, A6-P2: Diagnostic installation and A6-P3: Final mechanical installation.

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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 EWP documentation of diagnostic in-vessel systems in the scope of the ITER assembly contracts A6-P1: Welding of VV attachments, A6-P2: Diagnostic installation and A6-P3: Final mechanical installation.

2 Scope

Diagnostic In-Vessel systems are mounted on the V through specific attachment that are welded onto it. Apart from the own integrity justification of the systems, the verification of the safety conditions on the VV subject to RCC-MR 2007 Code and additional limits (**Typical Attachments to the VV Walls (2M6JLU v2.2)**) has to be developed as part of the documents to be cleared for the EWP production (package needed to proceed with the assembly works on the VV). While for some In-Vessel diagnostic systems the justification has been already cleared, for others this justification is still needed.

The scope of this contract includes the support in the engineering analysis tasks aimed to demonstrate the structural integrity of the systems and their attachments to the ITER VV walls.

The typical analysis task involves, thermal-mechanical simulation of the systems and interfaces (VV walls) with application of loads of different nature (defined in the corresponding System Load Specification) including Electromagnetic, Seismic, Thermal and other accidental loads as well as the deformations induced by the VV on the system (interface loads). VV interface data (thermal –temperatures- and structural – displacements-) will be available for the analysis tasks. A first general model of the system and interfaces is built (see figure 1 and 2) to capture the effect of the interfaces (VV) and to accurately determine the actions on the attachments. For the analysis of specific parts of the system, submodelling analysis may be needed. The structural assessment shall include verification against P and S type damage as per RCC-MR 2007, including the additional limits defined in **Typical Attachments to the VV Walls (2M6JLU v2.2)**.

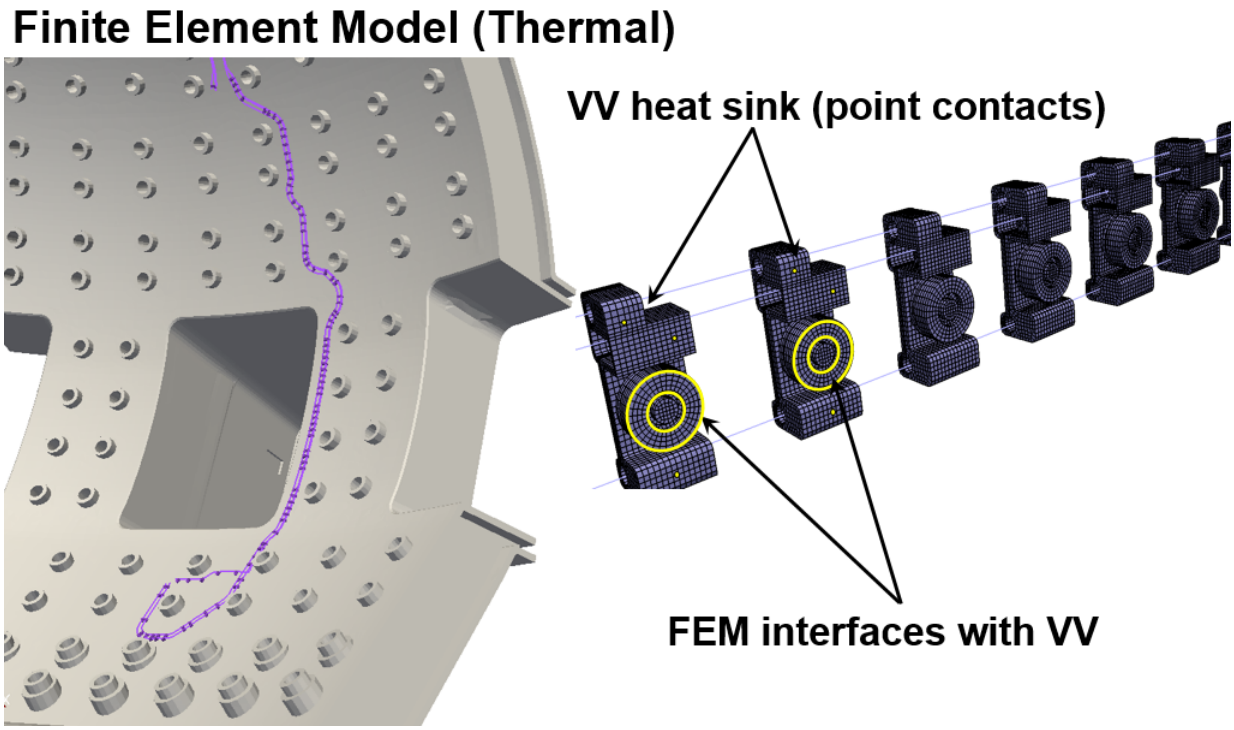

Figure 1: Thermal generic model of a typical in-vessel system.

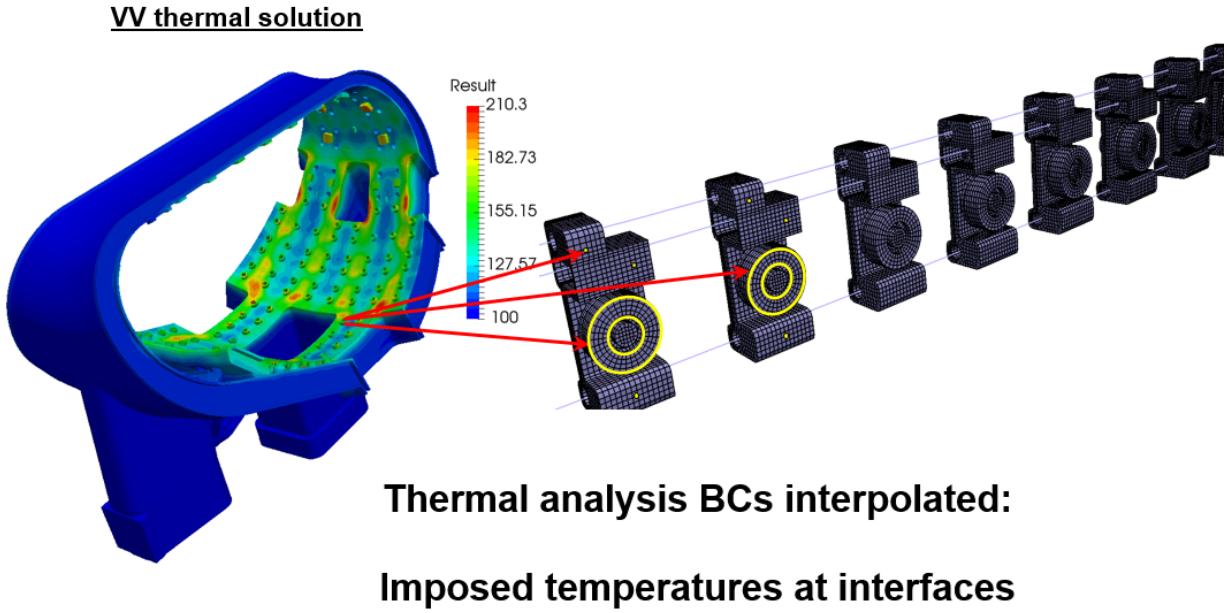

Figure 2: Thermal interface loads for a generic model of a typical in-vessel system.

3 Definitions

EWP: Engineering Working Package.

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)

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 work involves the justification for four in-vessel systems that will be restricted to the analysis of a single main branch (of cables, pipes…) attached to the VV. Each system may have their own clamp design, cables, pipes…

Each structural justification shall involve the following steps:

- Global thermal analysis of the system including interface VV loads.
- Global mechanical analysis of the system including interface VV loads and thermal distributions derived from the previous analysis.

- Code assessment [RCC-MR 2007] of specific components (for example, clamps, cables, boxes) of the systems as per SLS and damage limits agreed. This step may involve submodelling of certain parts.
- Determination of loads exerted on attachments on the VV walls.
- Code assessment [RCC-MR 2007] of attachments including additional margins imposed by **Typical Attachments to the VV Walls (2M6JLU v2.2)**.

The activities in the context of the Technical Specification may be related to Protection Important Components (PIC) and therefore classified as Protection Important Activities (PIA). Therefore, section 14 of this document will remain applicable in the frame of this contract.

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	*Structural justification of in-vessel system 1 involving all parts as described in section 6 (acceptance data package shall include all elements mentioned in section 8)*	T0 + 3 months
D02	*Structural justification of in-vessel system 2 involving all parts as described in section 6 (acceptance data package shall include all elements mentioned in section 8)*	T0 + 6months

D03	*Structural justification of in-vessel system 3 involving all parts as described in section 6 (acceptance data package shall include all elements mentioned in section 8)*	T0 + 9 months
D04	*Structural justification of in-vessel system 4 involving all parts as described in section 6 (acceptance data package shall include all elements mentioned in section 8)*	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 will 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 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.
The analysis package will 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);
- 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 ITER complex 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)).