

Technical Specifications (In-Cash Procurement)

Diagnostics Design Review and Testing Follow Up

CFE for:

This document describes the technical needs for an expert specialist in engineering of Diagnostics. Specifically the technical needs of the Diagnostics Division with particular reference to design development and construction preparation

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1 Purpose

This document describes the technical needs for an expert specialist in engineering of Diagnostics. Specifically the technical needs of the Diagnostics Division with particular reference to design development and construction preparation, predominantly in the following areas:

- Mechanical design and integration
- Assessment and appraisal of engineering designs
- Follow-up of prototyping, testing and manufacturing
- Construction (realization) and installation preparation

2 Scope

The work aligns with the ITER project, currently under construction in France. This device will study the Fusion concept on a scale previously unequalled on earth. To study the behaviour of this device, a set of monitoring systems (called diagnostics) are required. This will provide all the information to show and understand the performance of the device. The work involves technical expertise for supporting multiple diagnostic projects.

NOTE: Some of the tasks associated with this contract are Protection Important Activities (PIAs).

3 Definitions

CAD	Computer aided design
CMM	Configuration and management model
DA	Domestic Agency
DM	Detailed model
IO	ITER Organization
IO-TRO	ITER Organization Technical Responsible Officer.
UHV	Ultra High Vacuum

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

4 References

Links inserted in text

5 Estimated Duration

The duration shall be for an initial 12 months from the starting date of the contract. Services shall be provided approximately 15% at the IO work site. The IO expect some missions within Europe (to DA and other premises) and they will be defined in the course of the contract.

Services shall be provided by 0.6 FTE.

6 Work Description

The work involves technical expertise for multiple ITER diagnostic projects working in close collaboration with the IO-TROs. It involves many areas of activity, including but not limited to:

- Supporting IO design reviews as an expert Panel Member or Chair
- Generating meeting preparatory notes, including agenda and draft attendee selection;
- Producing notes for IO meetings called by interfacing systems and review bodies;
- Drafting minutes for IO and DA meetings;
- Technical input in support of project change requests and other actions;
- Reviewing draft interface sheets;
- Reviewing draft assembly/installation procedures;
- Input documents, presentations and meeting notes related to Interface meetings.
- Technical review notes for DA technical documents in IO IDM. Documents include technical reports, draft deviation requests, compliance and requirements matrixes etc. Several technical documents per month need to be reviewed;
- Engineering design proposals, produced in consultation with interfacing parties and stakeholders (e.g. Design Integration, Safety)
- Input documents, presentations, meeting notes related to Monthly IO or DA meetings;
- Implementation reports for IO-related actions from IO or DA meetings;
- Implementation reports for Chit resolution from IO and DA design reviews; Amended and reviewed sections of IO schedule;
- Record of progress against schedule;
- Schedule improvements and fix scheduling problems;
- Input documents, presentations, meeting notes related to meetings of DA representatives with IO experts;
- Guidance notes for DAs on execution of PA technical activities;
- Updated and re-evaluated loads, including nuclear loads and other engineering specifications;
- Contributions to design workshops on specific topics (e.g. shutters, neutronics);
- Technical requirements collection and production of Technical Specifications, including follow up/oversight of Third Parties (e.g. DAs, manufacturers, etc.);
- Review and iteration of 2D drawings and diagrams (e.g. cabling diagrams, P&IDs) produced by Third Parties;
- Review and iteration of technical documents (e.g. Design Description Documents, Maintenance and Inspection procedures, Technical Specifications) produced by Third Parties;
- Input documents, presentations, meeting notes related to workshops and conferences. Travel to the DA or other sites in Europe may be required to carry out the work.

Within the broader tasks listed above, the work will predominantly focus on the following four main topics:

6.1 Topic 1: Design Reviews and DPI-PT Topical Reviews

The ITER machine includes over 60 diagnostic systems, to measure a vast range of parameters related to initiating, controlling and understanding the plasma pulse. In order to ensure that the design of these systems is robust, fit for purpose and satisfying the associated requirements, ITER performs rigorous Design Reviews at different stages of the project lifecycle (e.g. Conceptual Design Review, Preliminary Design Review, Final Design Review).

The Contractor shall act as Design Review Chair or as an expert Panel Member, as per the ITER Design Review Procedure (ITER_D_2832CF), for reviews on systems within the following diagnostic families:

- 55.A Magnetic Diagnostics
- 55.B Neutron Diagnostics
- 55.C Optical Diagnostics
- 55.D Bolometric Diagnostics
- 55.E Spectroscopic Diagnostics
- 55.F Microwave Diagnostics
- 55.G Operational Diagnostics
- 55.N Diagnostic Services
- 55.L/Q/U Diagnostic Ports

In addition, within the scope of 55.L/Q/U, there is a specific activity (known as the Diagnostics Port Integration Project Team, DPI-PT), which is responsible for the integration of the multiple and complex Diagnostic Ports. As part of this scope, the Contractor shall perform or lead expert reviews of key aspects affecting the design, manufacturing and operation of the ports, including:

- assessment of technical and design proposals
- document and drawing reviews
- integration aspects such as access to components for maintenance or repair
- component standardisation possibilities
- assessment of compliance with transversal functions (HELB, Fire, ORE, RAMI, etc.)
- ergonomics and occupational safety aspects

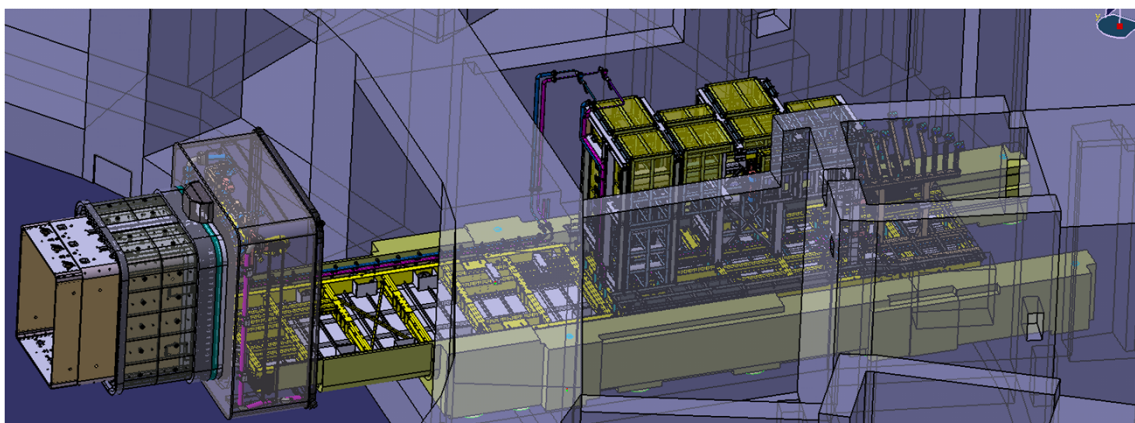


Figure 1: Example of ongoing port integration (some components hidden in this view)

6.2 Topic 2: Follow-up of Diagnostic Windows prototyping, manufacturing and testing

Several of ITER's diagnostics will be provided with viewing lines (optical, microwave, spectroscopic) for monitoring key characteristics of the plasma. The nature of the physical signal transmitted through the viewing lines requires the implementation of window assemblies incorporating a non-metallic window.

These windows form part of the nuclear and vacuum confinement barrier, and are therefore Protection Important Components (PIC).

The Safety function achieved by the diagnostic window assemblies is the confinement of toxic and radioactive products inside the vacuum vessel and attached vacuum extensions.

Each window assemblies is composed by:

- A structural body provided with a bolted flange, for the mechanical and vacuum tight attachment on a vacuum extension also called "mating flange".
- Two transparent discs (with or without an Anti-reflective coating, depending on optical requirements from each system) assembled into metallic ferrules by aluminium diffusion bonding.
- An interspace volume between both discs, whose pressure is permanently monitored by the Service Vacuum System (SVS).

An example of a Fused Silica window can be seen in Figure 2.

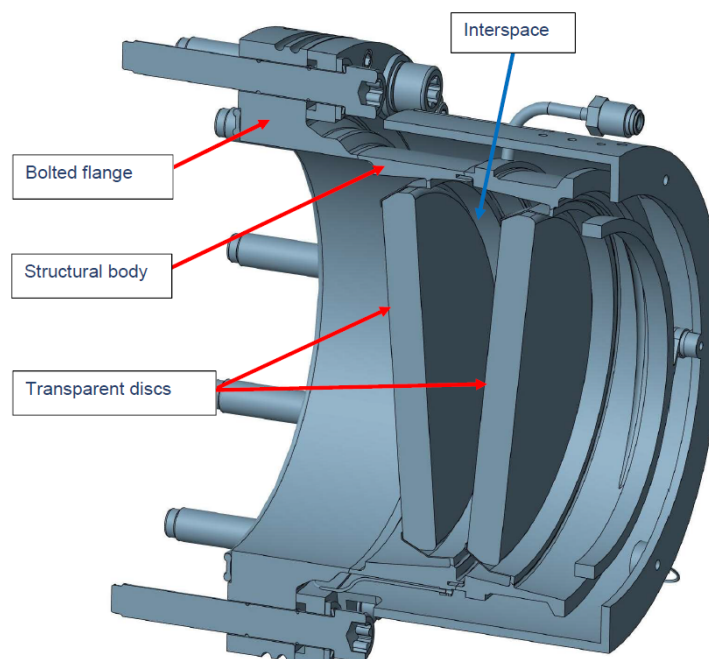


Figure 2: Section of Window Assembly

The design of the bolted flanges is similar to the one of the ITER standard vacuum flange. The size of the bolted flange is tailored to the clear aperture.

Currently IO is developing the Fused Silica variation windows through the following tasks (outside the scope of this present contract):

1. Validation of titanium windows in ITER environment
2. Qualification Welding Operations for the manufacturing of ITER windows

3. Characterization of the Sub-critical crack growth parameters of AR coated Samples
4. Qualification of Fused Silica windows
 - a. Manufacturing windows to be tested
 - b. Testing Aged window assemblies (with exception of irradiation)
 - c. Validation of aged specimens against cat 4 events
5. Manufacturing of First Plasma Fused Silica Windows

All of these activities require close follow-up due to the complex design and safety requirements of the windows. The contractor shall work with the Diagnostics Windows team and perform the following tasks:

- Follow up the manufacturing activities for mock-ups (including visits to the supplier)
- Review of documentation related to testing and manufacturing
- Witnessing of hold points for both the welding qualification, testing and final manufacturing (including visits to the supplier)

NOTE These tasks include Protection Important Activities (PIA)

6.3 Topic 3: Production of documentation and drawing packages for installation

Installation of ITER diagnostic systems, including the in-vessel electrical services, will commence in the near future. In preparation for these activities, IO is producing detailed installation documents (e.g. technical specifications, Scope of Work lists), drawings and diagrams, which will be studied and further elaborated by IO's installation contractor.

The Contractor shall coordinate the production of the documentation and drawing packages (by Third Party resources), perform a peer review of generated input documents and drawings, to ensure they are consistent and easily understandable by Third Parties, and provide regular status and progress updates to ensure the production of the required documents is tracked and on-time.

The Contractor shall also respond to comments from reviewers of the various documents, issuing or arranging for clarifications and document updates as required. If modified or further elaborated versions of the documents are received (e.g. from the installation contractor), the Contractor shall review them, including a comparison with the original IO documents and checking the validity of any additional procedures, tests or modifications proposed by e.g. the installation contractor.

6.4 Topic 4: Follow-up of Diagnostic Upper Port Plug Remote Handling compatibility trials

The diagnostic upper port plug is at the final design phase. To demonstrate the Remote Handling (RH) compatibility of the generic DFW/DSM removal and reinstallation in the hot cell, IO has launched a contract (Implementation Agreement #12) with RACE (Remote Applications in Challenging Environments). The purpose of the mock-up trials is to assess the use of a rigid extraction system (tower crane) to interface with the GUPP design and determine any impact on GUPP or Tower Crane design.

This contract has already started in 2020. The design of the mock-up (lifting tower crane, DFW, DSM, GUPP mock-up), including the control I&C has been finalized and now these components are under manufacturing. After manufacturing, the commissioning of the facility

and the mock-up trials for DFW/DSM removal/reinstallation will follow. The mock-up trials will be done based on the operation sequence already prepared and agreed. But if necessary, it would be possible to modify and add the trials under the agreement with RACE.

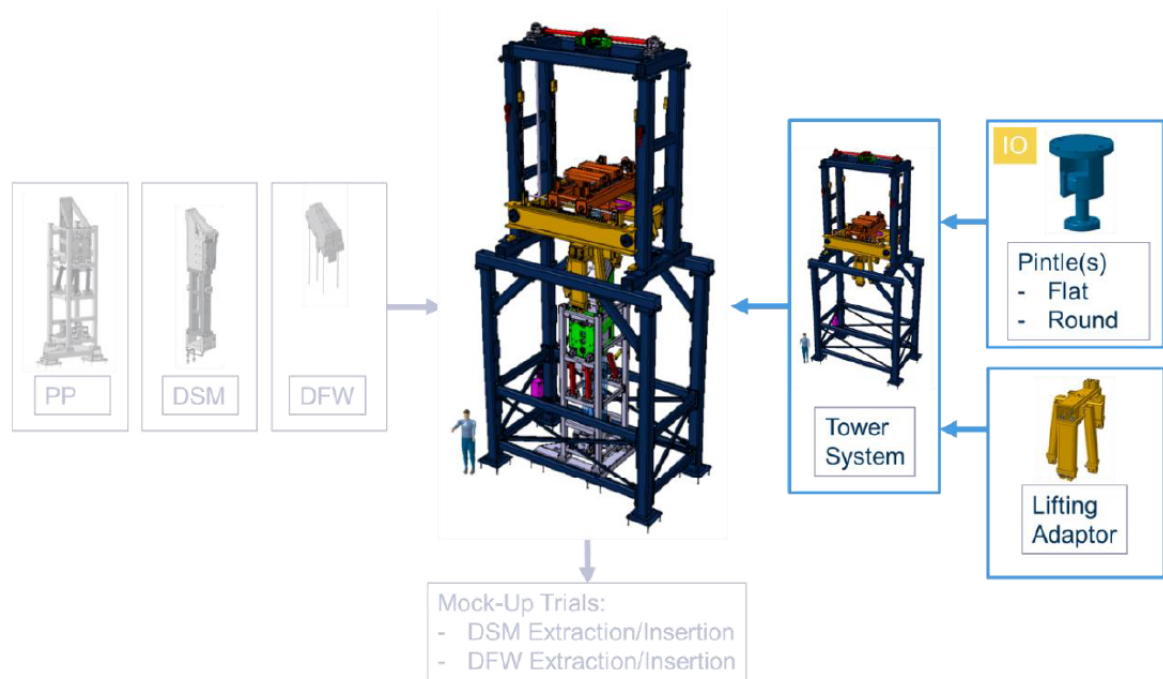


Figure 3: Mock-up of tower crane for upper DFW/DSM removal/reinstallation

The contractor shall work with the IO diagnostic upper port integration team with the following activities to follow up the UPP RH mock-up work under the collaboration with IO RH team and RACE:

- Follow up the fortnight progress meeting with RACE
- Review of mock-up manufacturing issues
- Review of documentation related to mock-up trials
- Witnessing mock-up trials and reporting of the outcomes to the IO diagnostic upper port integration team (including visits to the supplier)

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;
- Provide monthly schedule updates for the tasks being worked on by the Contractor;
- 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 rules.

7.2 IO's Responsibilities

The IO shall:

- Nominate a Responsible Officer to manage the Contract;
- Organise a monthly meeting(s) on work performed;
- Provide offices at IO premises during scheduled visits;
- Review documents in a timely fashion

8 List of Deliverables and due dates

D#	Description	Due Dates
D1	Progress report on Topics 1 and 3 (including monthly reports on each topic, a list of reviews performed and a list of documentation/drawing packages produced, their status, and any outstanding issues)	T0 + 3 months
D2	Progress report on Topics 2 and 4 (including monthly reports on each topic, a list of topics addressed and visit reports)	T0 + 6 months
D3	Progress report on Topics 2 and 3 (including monthly reports on each topic, including a list of the documents and drawings produced, their status, and any outstanding issues)	T0 + 9 months
D4	Progress report on Topics 1 and 4 (including monthly reports on each topic, a list of reviews performed, a list of topics addressed and visit reports)	T0 + 12 months

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.

10 Specific requirements and conditions

The personnel proposed by the Contractor to carry out the work described in Section 6 must have:

- A professional qualification in engineering with relevant experience in engineering design in a complex technical environment;
- Good technical writing skills;
- Good inter-personal skills;
- The ability to be consistent and work well under pressure with good attention to detail;
- Capability to work in English language, both verbally and written;
- Able to work with partners and the ITER host to define critical needs;
- Ability to align work priorities with overall project schedule;

Experience in the following areas is required:

- Design of diagnostics for large fusion installations and knowledge of tokamak diagnostic systems;
- Design of mechanical or electrical components for high vacuum environments;
- Design and manufacturing of optical transmission components for tokamak diagnostic systems;
- Design of equipment compatible with Remote Handling tools;
- Development of equipment designs for fusion facilities;
- Operational experience of large fusion devices;
- Installation preparation and oversight experience;
- Schematics definition;
- Design organisation;
- Technical document generation;
- System requirements management;
- Technical risk analysis

11 Work Monitoring / Meeting Schedule

Work is monitored through monthly project meetings as required (the frequency of meetings can be increased through agreement between the Contractor and the IO TRO).

12 Delivery time breakdown

See Section 8, "List of Deliverables 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 Software qualification policy ([Software Qualification Policy \(ITER_D_KTU8HH\)](#)).

14 CAD Design Requirements

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 ([ITER_D_2F6FTX](#)), and with the Procedure for the Management of CAD Work & CAD Data (Models and Drawings [ITER_D_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_D_GNIX6A](#) - 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 ([ITER_D_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 \(AW6JSB v1.0\)](#)).

Compliance with [Defined requirements for PBS 55 - Diagnostics \(NPEVB6 v2.0\)](#) or its flowed down requirements in [SRD-55 \(Diagnostics\) from DOORS \(28B39L v5.2\)](#) is mandatory.

NOTE: Some of the tasks associated with this contract are Protection Important Activities (PIAs), particularly related to the Design Reviews and work with the windows.