IDM UID
7N2GJW

VERSION CREATED ON / VERSION / STATUS
04 May 2022 / 1.2 / Approved

EXTERNAL REFERENCE / VERSION

Technical Specifications (In-Cash Procurement)

Port Plugs Mechanical Instrumentation design and qualification, and Tokamak Systems Monitor interfacing sensors specification

This specification 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 integration, predominantly in the following areas:
Machine instrumentation Feedthroughs design and manufacture, and safety important components qualificationOptic fiber sensors' technology Rad-hard optic fiber transmission lines

Table of Contents

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 integration, predominantly in the following areas:

- Machine instrumentation
- Feedthroughs design and manufacture, and safety important components qualification
- Optic fiber sensors' technology
- Rad-hard optic fiber transmission lines

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: There are Protection Important Activities (PIAs) within the scope of this work as the feedthrough is a Safety Important Category 1 component.

3 Definitions

CAD	Computer aided design
CMM	Configuration and management model
DA	Domestic Agency
DM	Detailed model
IN	Integration Node
IO	ITER Organization
IO-TRO	ITER Organization Technical Responsible Officer
PIA	Protection Important Activities
PPMI	Port Plugs Mechanical Instrumentation
UHV	Ultra High Vacuum
TSM	Tokamak Systems Monitor

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 40% on average at the IO work site. The IO expect some missions within Europe (to contractor premises), they will be defined in the course of the contract.

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:

- Engineering design proposals, produced in consultation with interfacing parties and stakeholders (e.g. Design Integration, Safety)
- Record of progress against schedule, with proposals for improvements;
- Updated and re-evaluated loads, including nuclear loads and other engineering specifications;
- Technical requirements collection and production of Technical Specifications, including follow up/oversight of Third Parties (e.g. DAs, manufacturers, etc.);
- Review and iteration of technical documents (e.g. Design Description Documents, Maintenance and Inspection procedures, Technical Specifications) produced by Third Parties;
- Reviewing draft interface sheets;
- Reviewing draft assembly/installation procedures;
- Input documents, presentations and meeting notes related to Interface meetings.
- Input documents, presentations, meeting notes related to Monthly IO meetings;
- Technical review notes for 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;
- Implementation reports for IO-related actions from IO meetings;
- Implementation reports for Chit resolution from IO design reviews; Amended and reviewed sections of IO schedule;
- Record of progress against schedule;
- Schedule improvements and fix scheduling problems;
- Review and iteration of 2D drawings and diagrams (e.g. cabling diagrams, P&IDs) produced by Third Parties;

Within the broader topics listed above, the work will predominantly focus on the following three main activities belonging to the Integration Node for Port Plug Mechanical Instrumentation (IN-55.PPMI). This Node covers all optic fibre sensors required to determine the dynamic behaviour of the port plugs. For this, three upper port plugs and two equatorial port plugs are planned to be instrumented with accelerometers and strain gauges.

An additional activity will give complementary support as instrumentation and sensor expert to the Tokamak Systems Monitor development activities (PBS-55.GT). This is a software only system that gathers data from all tokamak operational instrumentation in order to define the health of the engineering systems.

6.1 IN-55.PPMI Accelerometers

Optic fibre FBG accelerometers are being developed for the PPMI project by an external contractor. These are grouped into two different assemblies:

- Two sets of three accelerometers for upper port plugs
- Two sets of two accelerometers for equatorial port plugs

The contractor will follow up the day-to-day evolution for this contract, raise any risks and issues to the TRO, and interface with the port integrators to define the final layout, integration, assembly and installation procedures of the sensors.

6.2 IN-55.PPMI Strain gauges

Optic fibre strain gauges will be developed for the PPMI project by an external contractor. These are grouped in six rosettes for each port and installed outside the port plug structure. Due to their location, special protection needs to be provided within a very limited space.

The contractor will follow up the day-to-day evolution for this contract, propose design and manufacturing solutions, raise any risks and issues to the TRO, and interface with the port and design integrators (TROs and DIRO) to define the final layout, integration, assembly and installation procedures of the sensors.

6.3 IN-55.PPMI Port Plug Feedthrough

A dedicated optic fibre feedthrough will be developed for the PPMI project by an external contractor. The design will be equal for all 5 ports, although it will installed at different locations. This component is bespoke as the space available is limited and it will host few fibre bundles.

The contractor will follow up the day-to-day evolution for this contract, propose design and manufacturing solutions, liaise with Safety RO for ensuring the feasibility and acceptance of the SIC qualification, raise any risks and issues to the TRO, and interface with the port integrators to define the final layout, integration, assembly and installation procedures of the sensors.

Note that some of the activities related with this task will be Protection Important Activities. Refer to section 15 for further information.

6.4 55.GT interface sheets and reconstruction support

The TSM gathers information from the operational instrumentation signals around the machine and calculates engineering parameters using reconstruction algorithms. Some systems, such as the vacuum vessel, cryostat, blankets, divertor and port plugs use optic fibre sensors.

The contractor will apply her/his expertise for supporting the definition of the sensor real parameters within the computational models. In addition, some of this relevant information will be agreed with the system owners in the interface sheets, with the contractor being responsible for drafting sensor specific interface requirements.

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 personnel to perform the tasks;
- Provide monthly schedule updates for the tasks being worked on by the Contractor;
- 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;
- Review documents in a timely fashion

8 List of Deliverables and due dates

D#	Description	Due Dates
D1	Progress Report 1 for Topics 1 & 2 (including links to reviewed documents, risks, outstanding issues, schedule updates and forward work plan)	T0 + 3 months
D2	Progress Report 1 for Topics 3 & 4 (including links to reviewed documents, risks, outstanding issues, schedule updates and forward work plan)	T0 + 6 months
D3	Progress Report 2 for Topics 1 & 2 (including links to reviewed documents, risks, outstanding issues, schedule updates and forward work plan)	T0 + 9 months
D4	Progress Report 2 for Topics 3 & 4 (including links to reviewed documents, risks, outstanding issues, schedule updates and forward work plan)	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 instrumentation of large experimental installations and knowledge of tokamak systems;
- Design of mechanical components for high vacuum environments;
- Experience of working with and specifying optic fibres operating in the IR range;
- Development of sensor designs for experimental facilities; experience with rad-hard sensors will be an advantage;
- Operational and/or maintenance experience of instrumentation within large experimental devices;
- Testing and qualification oversight experience;
- Schematics definition;
- Design organisation;
- Technical document generation;
- System requirements management;
- Technical risk analysis

11 Work Monitoring / Meeting Schedule

Work is monitored through fortnightly 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_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 (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.

There are Protection Important Activities (PIAs) within the scope of this work within topic 3.

The supplier must comply with the all requirements expressed in “Provisions for implementation of the generic safety requirements by the external actors/interveners” (SBSTBM)