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TECHNICAL SUMMARY

Call For Nomination

IO/20/CFT/70000549/LLU

Engineering and Supply Framework Contract

Density Interferometer Polarimeter (DIP) FDR and up to SAT

1 Scope

The work described below is related the Density Interferometer Polarimeter (DIP): Mechanical design and analyses of the full system, from the in-vessel optics, which will be installed in Blanket First wall and in Port-Plugs, to the back end optics in the diagnostic hall. The goal of this contract is (1) to progress the DIP design from the Preliminary Design Review, *PDR*, to the Final Design Review, *FDR*, and (2) to procure the complete system with multiple deliveries matching ITER phased approach. This will involve iteratively progressing the hardware design by performing mechanical, optical, thermal and Electro-Magnetic analyses, including accident scenarios, implementing solutions to issues found and producing a full Structural Integrity Report (StIR). A framework contract will be awarded with Task Orders covering different foreseen task of the project: completion of the FDR, manufacturing studies, procurement management, prototype work... Instrumentation & Control (I&C) will not be included in this framework contract. I&C design and manufacturing will be handled by a different contract managed by IO.

2 Estimated Duration

The duration of the contract is estimated to be 4 years with an option of extending another 2years: 12 months to reach FDR, followed by procurement and manufacturing of first plasma components delivered in 2023-2024, procurement and manufacturing of remaining components are expected in 2025.

3 Tentative Schedule of this Call for Tender

The indicative Call for Tender milestones are:

Call for Nomination	Beginning of April 2020
Issuing of Prequalification invitations	End of April 2020
Issuing of Call for Tender	End of June 2020
Submission of Tenders	Mid of August 2020
Award of Contract	Mid of November 2020

4 Work Description

The tasks to be performed within this framework fall within the following categories:

- Update design to previously identified requirements and following outcome of previously performed PDR
- Perform mechanical, structural, thermal, nuclear and EM analysis

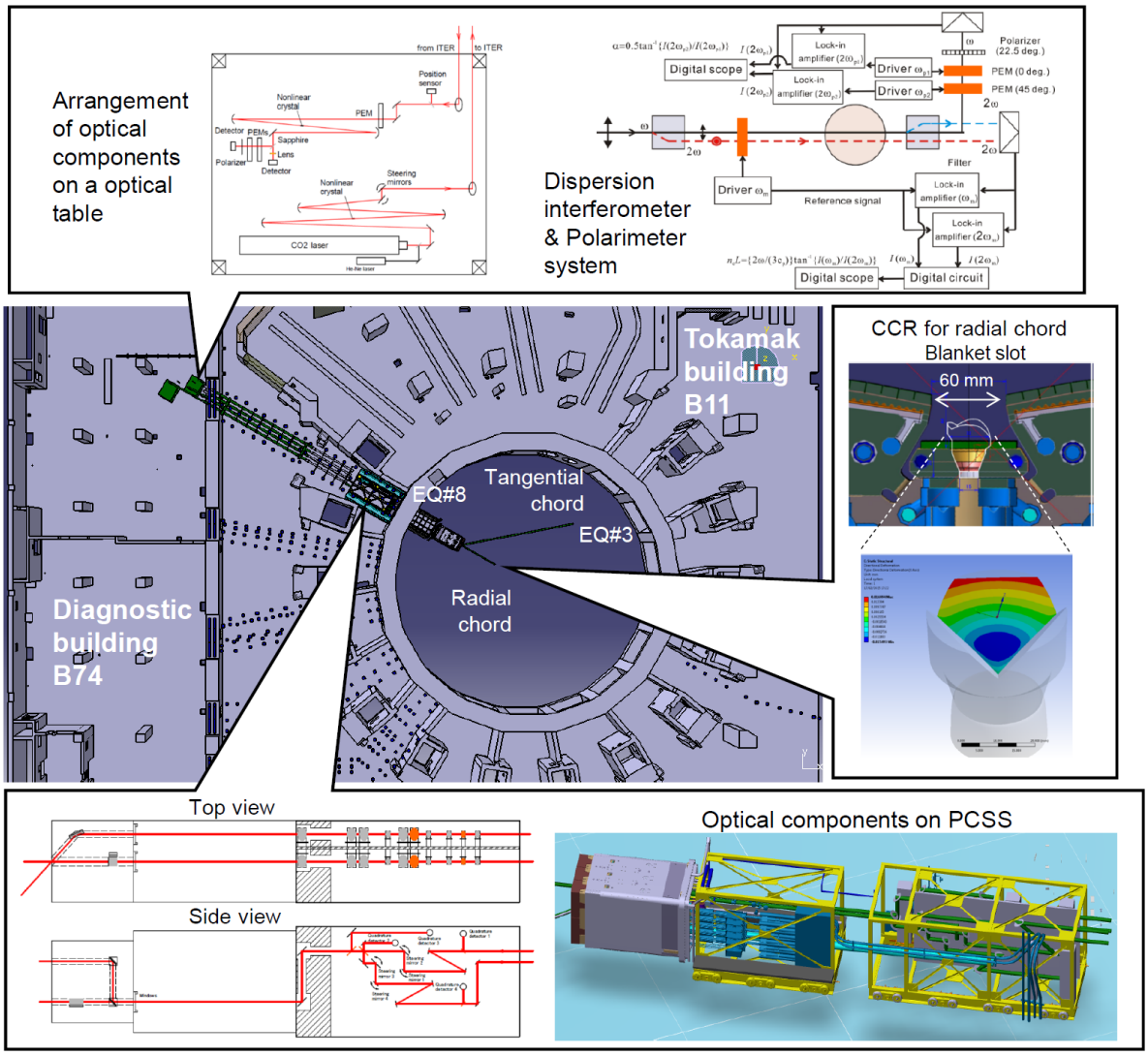
- Iteratively update the design to incorporate findings of the previous steps and work towards a design able to survive the harsh ITER environment
- Produce a full Structural Integrity Report
- Progress the design of the DIP from PDR (current status), to FDR
- Liaise with I&C contractor
- Detail prototypes and final system, provide manufacturing and assembly drawings for these
- Manage procurement and manufacturing.
- Organise the Site Acceptance Test of delivered components
- Built and test prototypes of critical part of the system.

4.1 Description of the system

A key objective of ITER is to demonstrate a power multiplication of Q=10 (generation of 10 time larger power from fusion reaction then heating power) for extended periods of time ~ 400 s. ITER will be the first magnetic fusion devices to be licensed as a nuclear facility (INB-174). Diagnostic systems are critical for the successful and safe operation of ITER. They provide the means to observe, control, and sustain the plasma performance over long time scale.

The electron density is one of the physically and operationally important plasma parameters. An interferometer and a polarimeter have been typically used to measure the line-averaged electron density. The fueling (how much gas is put into a tokamak) is controlled based on the electron density. The Toroidal Interferometer and Polarimeter (TIP) system is the main electron density diagnostics. Redundancy of the electron density measurement is required because of the importance of the electron density for ITER operation. Density Interferometer Polarimeter (DIP) system, which utilizes a dispersion interferometer, will be installed as a “parallel” density diagnostics to the TIP. DIP will have two measurement chords: radial and tangential ones. While the radial chord is a “dispersion interferometer” only, the tangential chord is a combination of the dispersion interferometer and the polarimeter. One of the advantages of the dispersion interferometer is the high density resolution. On the other hand, the risk of fringe jump, which gives wrong electron density value, is not zero for the interferometer in the high density range. The density resolution of the polarimeter is generally lower than that of the interferometer but the risk of fringe jump is inexistent. Hence, the polarimeter can be used for corrections of the fringe jump of the interferometer. This is a reason why the tangential chord is a combined system.

The Dispersion Interferometer relies on a powerful (about 50 W) continuous laser in the 10 µm range. A non-linear crystal is used to double the frequency of the laser beam with both wavelenght propagating into the plasma. The polarimeter uses the same laser beam to perform its measurement. As the optical path is rather long (close to 90 m in total) and retro-reflectors rather small (less than 50 mm diameter), active beam alignement system is required in the Port Cell to ensure proper alignment of the laser beam.



A conceptual Design Review (CDR) for the DIP was held in 2017 and Preliminary Design Review (PDR) is scheduled for June 2020. The figure gives a schematic overview of the DIP conceptual design. It has the front-end optics in equatorial port #8 in the tokamak building B11 and the back-end instruments in the diagnostic building B74. The four laser beams are transmitted inside the beam ducts between the diagnostic building and the tokamak building.

The DIP will operate with the radial chord only in the ITER 1st plasma operational phase planned to start in 2025. The tangential chord will be added when the port plug and blankets are installed in the vacuum vessel for the following 2nd plasma phase (PFPO-1).

After PDR, an FDR is planned before moving to the manufacturing phase. Deliveries of components to ITER site are expected to happen between 2023 and 2025.

4.2 Details of expected output

The purpose of this framework contract is to progress the mechanical design, of the full diagnostic system, from its current status to FDR, by iteratively performing improvements until an acceptable level of output of the load analyses (mechanical, structural, thermal, nuclear and EM) is achieved. This framework also includes the procurement and manufacturing of prototype during FDR-1 and of the full system after completion of FDR. It should be emphasised that the different geographical areas have very different requirements.

In-vessel (including in Port-Plugs): The goal of the work is to further the design of the in-vessel components by performing calculations on load specification (thermal, EM, nuclear, mechanical) and structural integrity analysis, and reduce/remove temperature rise, temperature inhomogeneity and thermal deformation. Input the designed components into 3D CAD and check of clashes with other diagnostics by communicating with the port integrators. Consideration should be given to manufacturing methods and tolerances and to maintainability. After which the next step of design and analyses can be performed in order to iteratively reach an optimal design.

ISS and PCSS: Design of the optical supports and frames on the PCSS and adjustable optical mounts of mirrors and beam splitters and their load specification. Design of the beam alignment system in PCSS. Design of beam transmission lines between the Closure plate, through the ISS and towards the Port Cell lintel penetrations, according to the existing optical design. Perform calculations on load specification (thermal, EM, nuclear, mechanical) and structural integrity analysis. Consider maintenance scenarios in the port cell, including manned access requirements. Ensure clash-free integration with penetrations, beam ducts, windows and other equipment owned by other PBSs.

Gallery and diagnostic building: Perform calculations on load specification (thermal, EM, nuclear, mechanical) and structural integrity analysis on gallery beam ducts, supports and wall penetrations. Design the optical tables with lasers, optics, detectors, ancillary equipment and cubicles containing diagnostic components and perform relevant analyses, identify equipment and components requiring testing/qualification.

Once a high level of maturity of the design has been reached, in agreement with IO, the contractor is to provide full manufacturing drawings and assembly specifications. The contractor will be in charge of procurement and manufacturing of FDR-1 prototype, first plasma components (radial chord) and 2nd phase components (tangential chord and port-plug components). All these components are to be delivered, installed and commissioned at ITER site.

5 Specific requirements and conditions

- Experience in complex mechanical design for nuclear, or space industry
- Experience in optical instrumentation using high power laser in the 10 µm range
- Experience in mechanical, thermal, nuclear and EM load analyses
- Experience in manufacturing complex instrumentation
- Experience with plasma, space or high energy physics devices
- Experience with the technical follow-up of CAD activities
- Experience in commissioning complex instrumentation.

6 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 and surveillance 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.

7 Candidature

Participation is open to all legal persons participating either individually or in a grouping (consortium) which is established in an ITER Member State. A legal person cannot participate individually or as a consortium partner in more than one application or tender. A consortium may be a permanent, legally-established grouping or a grouping, which has been constituted informally for a specific tender procedure. All members of a consortium (i.e. the leader and all other members) are jointly and severally liable to the ITER Organization. The consortium cannot be modified later without the approval of the ITER Organization. Legal entities belonging to the same legal grouping are allowed to participate separately if they are able to demonstrate independent technical and financial capacities. Bidders' (individual or consortium) must comply with the selection criteria. IO reserves the right to disregard duplicated references and may exclude such legal entities form the tender procedure.

On 31 January 2020, the UK left the EU and Euratom with a transition period from 1st February to 31 December 2020 to be used to determine the conditions of their future relationship. Euratom is the ITER Member and the withdrawal of the UK from Euratom leads to the fact that UK is not anymore party to the ITER project.

Until the 31 December 2020, current end date of the transition period, UK entities retain the right to participate in IO procurement procedures.

8 Reference

Further information on the ITER Organization procurement can be found at:

http://www.iter.org/org/team/adm/proc