Procurement of Vacuum Vessel Operational Instrumentation: Optical accelerometers and displacement sensors

Call for Nomination

Purpose

This document is a summary of the technical specification of sensors to be procured for the vacuum vessel of ITER. It covers the following work that comprises displacement and acceleration optical sensors for the ports, sectors and gravity supports. The document addresses all aspects of the works to be implemented by the contractor and including design, qualification, fabrication, conditioning and shipment to the ITER site so as related quality assurance provisions and submission of the related documentation.

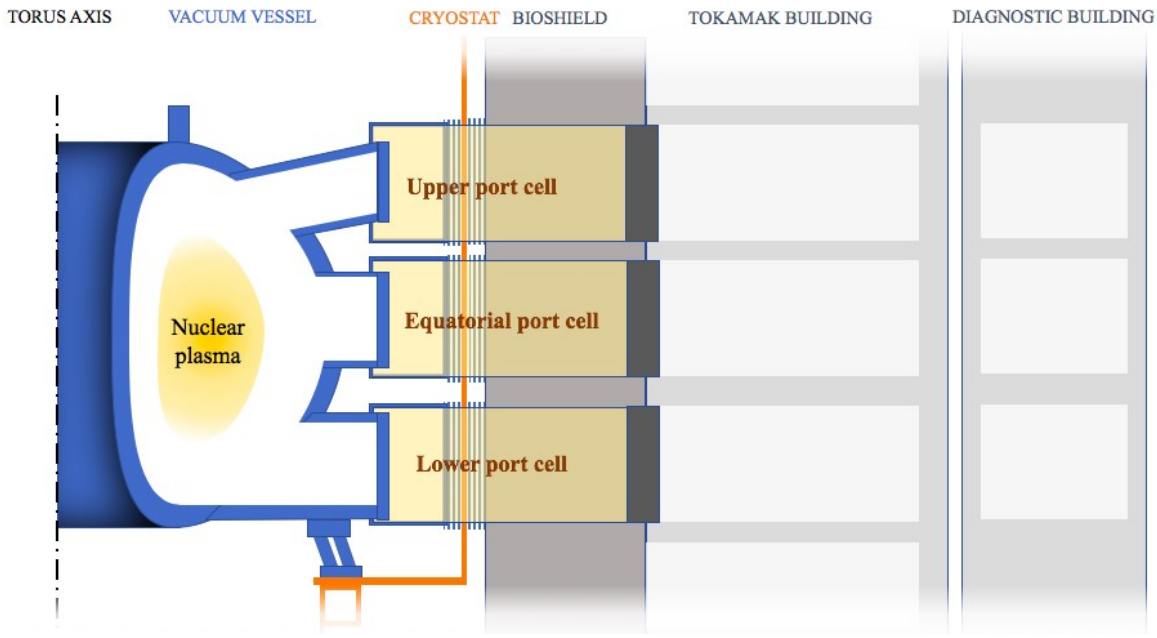
Background

ITER is a large-scale scientific experiment that aims to demonstrate the technological and scientific feasibility of fusion energy. During its operational lifetime, ITER will test key technologies necessary for the next step: the demonstration fusion power plant that will prove that it is possible to capture fusion energy for commercial use.

The vacuum vessel is a hermetically-sealed steel container that houses the fusion reaction and acts as a first nuclear confinement barrier. It operates at 100°C and can be baked at 200°c (or 240°C at port extremities) to guarantee clean ultra-high vacuum needed to operate plasmas. Forty-four openings, or ports, in the vacuum vessel provide access for remote handling operations, diagnostics, heating, and vacuum systems. The vacuum vessel is seated on 9 gravity supports that allows its thermal radial expansion.

The vacuum vessel is housed inside a cryostat. The cryostat provides the high vacuum, ultra-cool environment for the superconducting magnets. The cryostat vacuum isolates the VV and hot pressurized water pipes operating between 100 and 240°c from magnets operating at cryogenic temperatures. The cryostat has multiple penetrations that provide access to VV ports. The Cryostat is connected to ports by large rectangular bellows.

Port cells are openings through the thick concrete walls that encloses the cryostat. The cryostat is located in a pit surrounded by the bioshield that form a thick barrier for neutrons and other radiations. Port cells are openings through the bioshield that provide access to the VV ports through the cryostat. Port cells are closed by another set of large bellows connected to the cryostat penetrations on one side and large hermetic doors on the other side. Port cells form the limit of the second barrier of radiological confinement of the machine.



The specified contract covers only part of the instrumentation of the VV that is supplied through several work packages. The following scope deals exclusively with displacement sensors and accelerometers, which transducers will be installed on the vacuum vessel supports, sectors outer surface and port extremities. The design is based on optical interferometry technologies of transducers.

Scope of work

The contractor shall

- Select appropriate signal conditioning.
- Design displacement and acceleration optical sensors based on design requirements specified hereafter,
- Adapt sensor supports to the final design of transducers
- Provide justifications of the respective design,
- Prepare documentation for the procurement, fabrication and QA control to be accepted before start of fabrication.
- Fabricate a pre-series using the developed fabrication and control procedures,
- Test the pre-series to qualify the design,
- Fabricate series,
- Transport items to IO, while preserving their cleanliness and integrity through adequate handling and packing.

The procurement includes:

- Optical accelerometers based on light interferometry technologies
- Optical displacements transducers based on FBG
- Optical signal conditioners for the respective transducers
- Support structures of the transducers

There is a total of **119** displacement sensors and **201** accelerometers. These quantities include sensor installed on the ITER vacuum vessel and spares. Transducers are either located inside the cryostat or inside the port cells of the ITER Tokamak and requirements vary with their

destination. The total of sensors installed is **285** corresponding to the number of channels to be considered for signal conditioning, but not including thermal compensation.

All transducers and related supports shall

- Be compatible with the radiations of the cryostat or ports cells
- Be non-magnetic
- Limit cryostat vacuum contamination through outgassing and radiological contamination.
- Operate over the full operating temperature range

Timetable
The tentative timetable is as follows:

Tender submission	June	2019
Contract placement	September	2019
First deliverable	October	2020
Completion of Contract	December	2022

Experience
The contractor and its personnel shall have adequate experience in optical instrumentation. It includes but is not limited to:

- R&D in optical displacement sensors and accelerometers
- Expertise in optical sensor usage in harsh environment, high temperature, maintenance free and under irradiated environment
- Expertise in qualification for high temperature and irradiation environment.
- Design and procurement of sensor supports

Candidature
Participation is open either to all legal persons participating 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 groupings shall be presented at the pre-qualification stage. The tenderer's composition cannot be modified without the approval of the ITER Organization after the pre-qualification.

Legal entities belonging to the same legal grouping are allowed to participate separately if they are able to demonstrate independent technical and financial capacities. Candidates (individual or consortium) must comply with the selection criteria. The IO reserves the right to disregard duplicated reference projects and may exclude such legal entities from the pre-qualification procedure.