IDM UID
TVL3N8

VERSION CREATED ON / VERSION / STATUS
21 Oct 2016 / 1.2 / Approved

EXTERNAL REFERENCE / VERSION

Call for Nomination Documents

Vacuum Vessel In-Service Inspection_Phase 2 (WP3+WP6): Summary of Technical Specifications

The purpose of this project is to provide the designing and procurement of mobile In-Service Inspection (ISI) equipment for performing remote inspection of the ITER Vacuum Vessel (VV) after putting the Tokamak into operation

VACUUM VESSEL IN-SERVISE INSPECTION
Phase 2: Work Packages #3 and #6

Call for Nomination (C4N)
Ref. IO/CFN/16/10013392/PMT
Summary of Technical Specifications

1 Purpose

The purpose of this project is to provide the designing and procurement of mobile In-Service Inspection (ISI) equipment for performing remote inspection of the ITER Vacuum Vessel (VV) after putting the Tokamak into operation.

There are seven Work Packages (WPs), in total, which are intended to support the implementation of the IO strategy for In-Service Inspection of the Vacuum Vessel (VV ISI):

- WP1: Equatorial Port 7 ISI access penetration;
- WP2: Lower Ports ISI penetrations;
- WP3: VV shell inspection tools and RH equipment;
- WP4: VV acoustic monitoring;
- WP5: VV lip seal inspection tool;
- WP6: VV bolts inspection tool;
- WP7: Corrosion Monitoring Chambers.

The seven WPs are planned to be launched in three separate Calls for Tenders (CFT), as follows:

- Phase 1 (WP1+WP2+WP4): Call for Tender Ref. IO/CFT/16/10012745/PMT;
- Phase 2 (WP3+WP6): Call for Tender Ref. IO/CFT/16/10013392/PMT;
- Phase 3 (WP5+WP7): Call for Tender to be launched in Q1-2018.

The work to be carried out within this second Call for Tender is for work packages WP3+WP6 divided into two lots (two contracts):

- Lot 1 for WP3: split into 3 batches WP3/1, WP3/2 and WP3/3
- Lot 2 for WP6

2 Background

ITER is a joint international research and development project that aims to demonstrate the scientific and technical feasibility of fusion power. The partners in the project - the ITER Parties - are the European Union (represented by EURATOM), Japan, the People's Republic of China, India, the Republic of Korea, the Russian Federation and the USA. ITER is being constructed in Europe, at Cadarache in the South of France. General information on the scope and design of the ITER Machine is described in the www.iter.org website.

ITER is a Basic Nuclear Installation (INB-174) licenced by the French Nuclear Authority (ASN).

The ITER Vacuum Vessel is a Protection Important Component (PIC) Class 1 as it provides the first confinement barrier of the Tokamak and Decay Heat Removal (DHR) function. VV is classified as a level N2 Cat IV Nuclear Pressure Equipment following the French Decree 12 December 2005 (ESPN). The VV design involves inherent access restrictions for In-Service Inspection and very specific design and load conditions.

On the ground of its nuclear classification, the ITER Vacuum Vessel requires In-Service Inspection. IO has developed a VV ISI strategy involving continuous load monitoring and load following and dedicated periodic inspection and requalification.

3 Scope of work

The services to be provided are grouped in two separate lots:

Lot 1. WP3 split into 3 batches: WP3/1, WP3/2 and WP3/3

- ***WP3/1 "VV ISI equipment for remote inspection of the VV outer wall field weld joint accessible through Equatorial Port 7 penetration"***

The Equatorial Port 7 VV ISI system consists of two integral parts:

1) Inspection infrastructure
2) Inspection equipment

The scope of Lot 1, batch WP3/1 includes design and procurement of the second integral part, i.e. equipment (crawler) for remote inspection of the VV outer wall field weld joint between Sector 3&4 and closest surrounding areas accessible through Equatorial Port 7.

The scope of Lot 1, batch WP3/1 does not include design and procurement of the first integral part, i.e. inspection infrastructure (penetration + rails) which is subject of another Contract already launched as a part of the VV ISI Phase 1 tender process.

- ***WP3/2 "VV ISI equipment for remote inspection of the VV poloidal gussets and VV inner wall inboard field joints accessible through lower ports penetrations"***

The Lower Ports VV ISI system consists of two integral parts:

1) Inspection infrastructure
2) Inspection equipment

The scope of Lot 1, batch WP3/2 includes design and procurement of the second integral part, i.e. equipment (endoscope, ET/UT probes) for remote inspection of the VV poloidal gussets and VV inner wall inboard field joints accessible through lower ports penetrations.

The scope of Lot 1, batch WP3/2 does not include design and procurement of the first integral part, i.e. inspection infrastructure (penetration + guide tubes) which is subject of another Contract already launched as a part of the VV ISI Phase 1 tender process.

- ***WP3/3 "VV ISI equipment for remote inspection of the VV inner wall from the plasma side"***

The scope of Lot 1, batch WP3/3 includes design and procurement of equipment for remote inspection of the VV inner wall from the plasma side. This equipment will not be independent from viewpoint of functioning and shall be designed compatible for handling by the In-Vessel Manipulators of the Baseline ITER Remote Handling Systems (Multi-Purpose Deployer or In-Vessel Transporter).

The scope of Lot 1, batch WP3/3 does not include design and procurement of the In-Vessel Manipulators or any other part of the Baseline ITER Remote Handling Systems which is a dedicated ITER Project scope managed by the IO Remote Handling Team (PBS 23).

Lot 2. WP6 "VV ISI equipment for remote inspection of the VV Gravity Supports"

The scope of Lot 2 includes design and procurement of equipment for remote inspection of the VV Gravity Supports. This equipment will be independent from viewpoint of functioning in the

area of the VV Gravity Supports; however, it shall be designed compatible for deployment through so called "In-Cryostat maintenance rails" installed at the Cryostat skirt.

The scope of Lot 2 does not include design and procurement of the In-Cryostat maintenance rails which is a dedicated ITER Project scope managed by the IO Remote Handling Team (PBS 23).

Technical Specifications

Individual Technical Specifications will be issued for each of the three batches of Lot 1, as well as for Lot 2, and all Candidates, once they have been prequalified by the IO, will be invited to provide proposals.

There will be one common award for Lot 1 (WP3) based on the Candidate's ability to meet the requirements defined in the Technical Specification of the batches (WP3/1 + WP3/2 + WP3/3).

The award of Lot 2 (WP6) will be based on the Candidate's ability to meet the requirements defined in the Technical Specification of that lot.

Areas of Expertise

Following Areas of Expertise (AoE) are prerequisite for successful execution of the work in the scope of the two Lots:

1) Design of ISI equipment for performing remote inspection of Nuclear Pressure Equipment to evidence adequate safety;
2) Prototyping and Qualification of designed ISI equipment;
3) Manufacturing of designed ISI equipment;
4) Assembly/Installation/Testing of manufactured ISI equipment;
5) Commissioning of manufactured ISI equipment.

The required AoE include, but are not limited to, the following topics:

- *Electromagnetic analysis:* Off-normal plasma conditions (i.e. plasma disruptions and Vertical Displacement Events) generate eddy and halo currents in the tokamak components, including pipes and pipe bundles. These currents interact with the toroidal and poloidal magnetic field thus generating large electro-magnetic (EM) forces. Eddy and halo currents in the structures shall be calculated on the basis of inputs provided by the DINA code. After that the EM loads shall be evaluated and properly interpolated on very detailed thermo-structural models.
- *Thermal analysis:* Both steady state and transient, including surface heat flux and volumetric heat loads, heat transfer by radiation and convection.
- *Mechanical analysis:* Both static and dynamic analysis (linear and non-linear), including a variety of loads, typically: seismic, EM, thermal.
- *Structural Integrity:* To assess the acceptance of the thermal and stress fields, generated by various loads combinations, against the applicable structural design criteria (including "Structural Design Criteria for ITER In-Vessel Components", "RCC-MR 2007 Construction Rules for Mechanical Components of Nuclear Installations", "ASME B31.3 Process Piping", "ASME Boiler and Pressure Vessel Code", EUROCODE & EN13-445 for pressure vessels, EN13001 for lifting systems and EN13480 for piping systems).
- *French Regulations:* To prepare analysis report to be submitted to the Agreed Notified Body (ANB), as required by ASN (Autorité de Sureté Nucléaire). Familiarity with the "French Decree 99-1046 of 13 December 1999 on Pressure Equipment (ESP - Equipement Sous Pression)" and "French Order of 12 December 2005 on Nuclear Pressure Equipment (ESPN - Equipement Sous Pression Nucléaire)".

- *System engineering analysis:* To analyse the propagation of requirements and to perform functional analysis. Global requirements from high level ITER documents like the Project Requirements have to be propagated to all systems and vice versa it has to be analysed whether the propagated requirements fulfil the global ones. Functional Analysis (FA) shall be used to derive the functional specifications for ITER Systems. The FA shall also be used as entry point to risk analysis and RAMI (Reliability, Availability, Maintainability, and Inspectability) analysis.
- *Manufacturing feasibility and optimization:* To provide feedback to the design from a manufacturer's perspective, to identify areas of the design with feasibility issues, to propose improvement of the design with the aim to facilitate the fabrication and reduce the construction cost without impact to performance or quality of the components.
- *Cost studies:* To develop cost assessment of proposed design solutions and in support of Project Change Requests. Cost breakdown should typically include engineering and manufacturing activities, to a level sufficiently detailed to allow identification of cost drivers and including, e.g., the cost for manufacturing drawings, materials, manufacturing jig and fixtures, welding, non-destructive testing, tolerances, test and inspection, QA documentation.
- *Schedule evaluation:* To support the ITER Organization for manufacturing and assembly schedules evaluation to have realistic and reliable schedule based on the experiences from existing similar projects.
- *Manufacturing inspections:* To provide the ITER Organization on welding experiences of design, materials and process, as well as on non-destructive examination (X-ray, ultrasounds, helium leak test, dimensional tests, pressure tests, etc.). Familiarity with the corresponding EN standards and/or similar code and standard for nuclear facility is an advantage.
- *Instrumentation & Control:*
    - *Qualification:* To contribute to the follow up of qualifications of instruments.
    - *Procurement:* To assist in the follow up of the procurement of instrumentation with a particular emphasis on signal conditioning and data acquisition. This works includes in particular the development of procedures for factory acceptance and site acceptance with high quality assurance standards.
- *Assembly feasibility and optimization:* To identify areas of the design with assembly feasibility issues, to propose improvement of the design with the aim to facilitate the assembly on-site and reduce the construction cost without impact to performance or quality of the components. Assembly feasibility assessment shall include all aspects of assembly including rationalisation of assembly requirements (including testing), lifting, handling and alignment and the corresponding interfaces to the relevant tools, transport from factory to assembly site, interfaces with other systems and their assembly activities.

4 Experience Requirements

The ITER Organization is looking for Contractors with demonstrated experience in each Area of Expertise. The companies or consortia of companies selected shall be recognised for their knowledge and expertise in the field of ISI engineering and supply within the realm of nuclear technology, e.g. international experience in implementation of large-scale nuclear projects and recent generation nuclear power reactors, and will have experience in:

- Developing remote inspection solutions and procedures for plants with a similar profile to ITER;

- Carrying out mock-up work-up (virtual and physical) to validate remote inspection equipment and procedures;
- Controlling operating costs through standardisation, simplification and optimisation of the design solutions;
- Developing documentation for the nuclear installation licensing basis, including design justifications for proper implementation of ALARA principle.

The companies or consortia of companies are expected to provide direct evidence of this work in their submissions. Previous experience and knowledge of the ITER project is not required, however, the companies need to be self-sufficient in seeking out detailed information in order to accomplish the contract successfully.

In addition, during the tendering process the Supplier will have to provide evidence of:

- *QA system:* The Tenderer shall have and maintain a valid ISO 9000 certification and shall have the duty to verify and document the equivalent quality level of all its subcontractors and consultants.
- *Professional Software:* The Tenderer shall provide a list of the professional software available and used, e.g. for structural (static, dynamic, seismic), thermal and thermo-mechanical analyses, electromagnetic analyses (such as ITER conventional multi-physic analysis software ANSYS), CAD software (such as ITER conventional CAD software CATIA V5 and/or V6, if it is applicable) etc.

5 Award of Contracts

One contract will be awarded for WP3 (Lot 1) and another contract will be awarded for WP6 (Lot 2), in order to provide the full range of services required. It is not expected that a single company will have the full capability required for all AoE, and as such, companies are encouraged to tailor their proposed support in areas relating to their specific skills and interests. Suitable teaming arrangements for multiple companies are also encouraged, where appropriate, to enhance the offering of the Tenderer.

The language used at ITER is English. A fluent professional level is required (spoken and written English).

6 Candidature – Expression of Interest

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 (IO).

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 prequalification.

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 prequalification procedure.

7 Timetable for the Tender Process

The tentative schedule for this tender process is as follows:

Call for Nomination (C4N)	October/November 2016
Pre-Qualification	January/March 2017
Call for Tenders	April 2017
Tenders Submission	May/June 2017
Award of Contracts	September 2017