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Technical Summary

Framework Contract for Tools for Port Handling

IO/21/CFT/70000724/LLU

1. Purpose

This tender is for supporting of design and development of remote handling and assisted-manual maintenance tooling for diagnostic ports and systems in Port Cells and in the Hot Cell Facility. It is imperative now that these integrated ports do not fall behind in the schedule and as a result, the need for this work is urgent. Three ports are needed for the First Plasma.

The purpose of this Contract is to provide design and engineering justification of remote handling and assisted-manual maintenance tooling for the diagnostic port infrastructure handling, as well as tenant components located inside these ports, such as diagnostic systems, Disruption Mitigation System (DMS), Glow Discharge Cleaning (GDC) system and services (electrical, water, gas etc). The handling tools have to be compatible with remote handling operations foreseen in the Hot Cell facility. The nature of maintenance operations by these tools is: lifting and loading by the use dedicated spreaders and pintles, in the vertical direction, of multi-ton objects, such as Diagnostic Shield Modules (DSMs) and Diagnostic First Walls (DFWs), extraction of smaller objects, such as shielding blocks and backfilling forming neutron barriers around DMS and diagnostic lines-of-sight, diagnostic and DMS supports and components, from the DSMs and their re-installation, cutting and welding operations on the water cooling or gas pipes, frames to accommodate DSMs and DFWs during maintenance operations, tools to maintain and to replace components and services located in the Interspace and Port Cell Support Structures (ISS and PCSS) in ports with DMS, including vacuum extensions for DMS, etc.

This document specifies the requirements for the development of remote handling and assisted-manual maintenance tooling for diagnostic ports and systems in Port Cells and in the Hot Cell Facility and their engineering justification. It defines the scope of the services to be provided, the execution and the deliverables of those. This is a framework contract, where each task order is a free self-standing engineering activity with its own budget.

2. Background

Diagnostics are a critical part of the operation of ITER. They provide the means to observe, control and sustain the plasma performance over long timescales. ITER will operate with a plasma current in the region of 15 MA and toroidal fields of 5 T. The pulse lengths will be in the region of 500 s typically and will extend up to several thousand seconds during more advanced operation. A key objective of this device is Q=10 operation. This means that a typical fusion power of 500 MW will be provided for 50 MW input.
Many diagnostics, as well as systems line DMS and GDC, shall be integrated into ports and their infrastructure, which hold these diagnostics in place. Figure gives an overview of the typical integrated diagnostic port in ITER.

There are 25 diagnostic ports in ITER, and one more port, Equatorial Port #2, is also hosting diagnostic systems. Each equatorial and upper diagnostic port consist of the port plug structure with three integrated Diagnostic Shield Modules and Diagnostic First Walls (see Fig. 2), Interspace Support Structure and Port Cell Support Structure. The lower ports do not have port plugs but they use diagnostic racks to host in-vacuum components and diagnostics. Each port hosts one or more tenants (diagnostics, Glow Discharge Cleaning, Disruption Mitigation System) and services (water, gas, electrical). The in-port plug components will be assembled at Port Integrator's sites at DAs or at IO.

Most of the integrated diagnostic port systems are being procured in kind from the Domestic Agencies (DAs) to functional specifications. However, two (2) diagnostic equatorial ports, three (3) diagnostic upper ports, one (1) diagnostic lower port and one (1) equatorial port with DMS are the IO full responsibility from conceptual design to procurement.

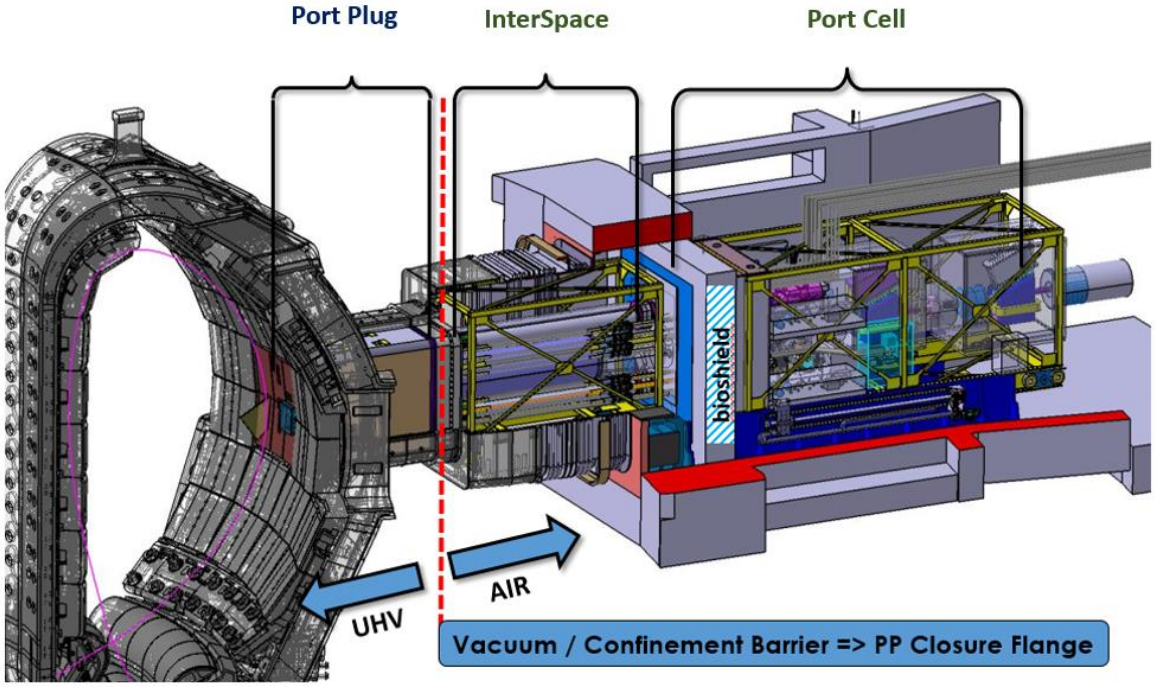

Figure 1: Example of diagnostics inside integrated port (top) and integrated port interspace structure (bottom).

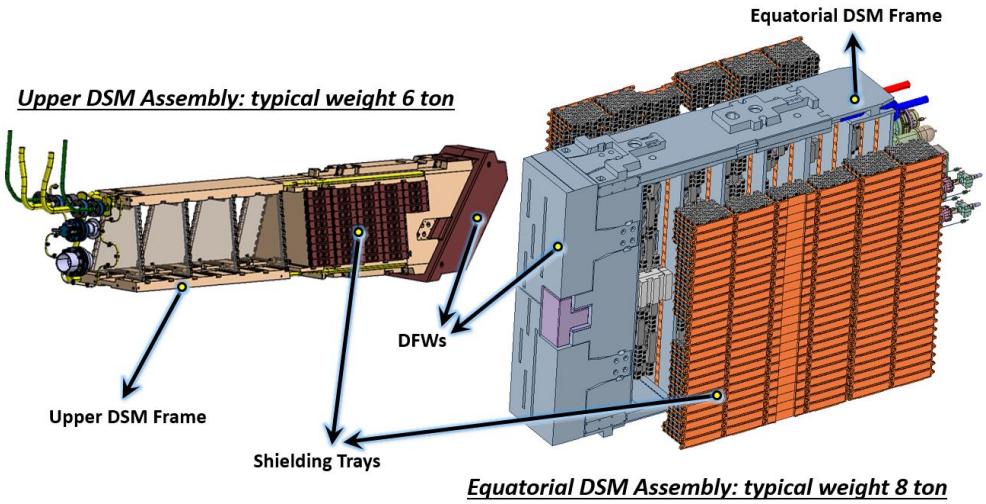

Figure 2: Example of in-vacuum port assembly (DSM/DFW) for the upper (left) and equatorial (right) ports.

3. Scope of work

The scope of the design and development of remote handling and assisted-manual maintenance tooling for diagnostic ports and systems in Port Cells and in the Hot Cell Facility requested in this summary requires that the future contractor provides suitable and experienced expertise to contribute to, to establish and to reinforce the ITER port integration systems with respect to the maintenance and remote refurbishment diagnostic-specific tooling. The work is to provide the maintenance and remote refurbishment services to progress the technical development of IO diagnostic integrated port-based systems and to ensure their maintainability by means of hands-on and remotely operating tooling (see examples in Fig. 3).

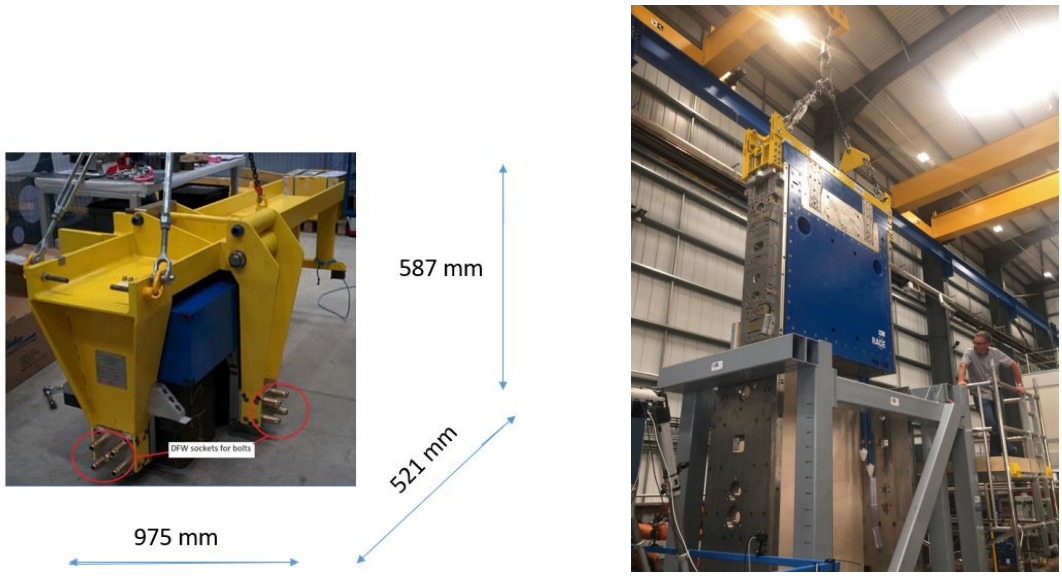

Figure 3. Left: Diagnostic First Wall lifting/ handling frame concept with typical dimensions and sockets for RH-operated bolts; right: Inserting the DSM into the PPS frame (courtesy of RACE), as it is foreseen to be done in the Hot Cell Facility.

The following activities are foreseen (but not limited to):

- Design of remote tools for handling of in-vacuum port infrastructure (Diagnostic Shield Modules (DSMs), Diagnostic First Walls (DFWs), Port Plug Structures (PPSs), Diagnostic Racks), such as: lifting/ loading frames and RH installation/ assembly features for port plugs and lower port racks, interfacing equipment for the RH overhead cranes, DSMs and DFWs, tooling to mount sub-components inside DSMs, such as shielding trays, backfilling, diagnostic supports etc, to be used in the nuclear environment of the Hot Cell facility,
- Design of maintenance/ distantly operating tools for in-vacuum port infrastructure (Interspace and Port Cell Support structures, ISS/PCSS), such as: lifting frames, end-effectors and tools for cutting/welding of vacuum extensions/ pipes (see Figure 4), loading/ removal of components (like shielding or supports) inside ISS/PCSS using bolting operations, removal/ installation of service looms located on the Port Cell rail below ISS/PCSS, visual inspection tools for safety-relevant components like diagnostic windows etc (see Figure 5), to be used in the contaminated by human-accessible environment of the Port Cells,
- Structural analysis of remote or assisted-manual tools acting on IO diagnostic ports and integrated systems under typical maintenance loads,

- Support in preparation of remote handling compatibility documentation for diagnostic systems and ports, following ITER guidelines and best RH practices, and in close collaboration with IO experts,
- Support in preparation of operation manuals for RH and maintenance tooling for diagnostic components and ports,
- Support in evaluation of Human and Organizational factors for remote or assisted-manual tools acting on IO diagnostic ports and integrated systems,
- Support in interface definitions between remote or assisted-manual tools acting on IO diagnostic ports and integrated systems, and remote or assisted-manual tools developed by other IO divisions for operations in the port cells, in the Hot Cell complex or at the PPTF in the Hot Cell Facility,
- Manufacture of small-scale prototypes and mock-ups for RH and maintenance demonstration,
- Support in manufacturing assessment, preparation for manufacturing activities and technical specifications for manufacturing of remote or assisted-manual tools acting on IO diagnostic ports and integrated systems.

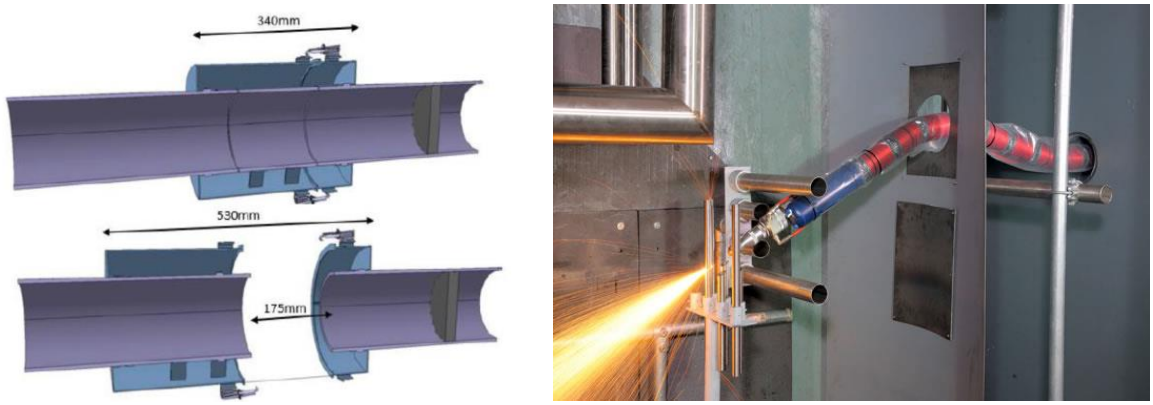

Figure 4. Vacuum pipe before and after cutting which has to be maintained remotely or assisted-manually (left) and a possible distantly-operated cutting robotic tool (right).

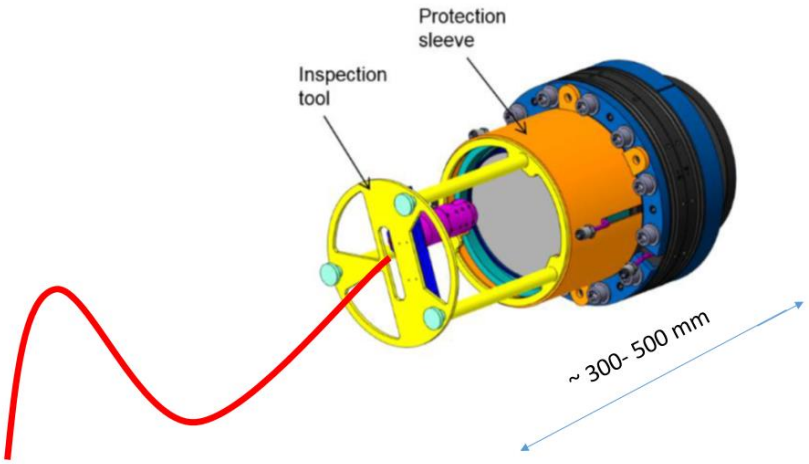

Figure 5. An idea of the assisted-manually operated inspection tool for a diagnistic window.

These technical specifications will be defined specifically for each Task depending on the actual requirement and will include a technical scope, the organization of the task in IO and a description of the deliverables. The work foreseen shall be executed both on-site and off-site.

4. Timetable

The tentative timetable is as follows:

Issue Call for Nomination to DAs	Mid of August 2021
Issue Pre-Qualification Application	Mid of September2021
Closing date for Pre-Qualification	End of October 2021
Issue Call for Tender	Mid of December 2021
Submission of tenders	End of January 2022
Contract Start date	Mid of March 2022

5. Required Competences

The candidate and its personnel shall have adequate experience for the work as detailed below.

Experience in remote handling and maintenance of components in Tokamaks is mandatory, and knowledge and experience in design for the following selected activities in nuclear environment is requested:

- Expertise in concept, design, realisation, interface definition and documentation for complex mechanical and nuclear systems,
- Expertise in remote handling and assisted-manual maintenance tasks for nuclear/ tokamak environment and systems,
- Experience in handling and refurbishment of ultra-high vacuum systems,
- Experience in refurbishment of tritiated or activated nuclear components,
- Expertise in Human and Organizational Factors definition and assessment,
- Expertise in RAMI and technical risks assessment of complex integrated systems,
- Expertise in fusion plasma diagnostic development and integration,
- Expertise in structural analysis of maintenance and RH tools,
- Integrated project organization and implementation,
- Mechanical design engineering,
- Expertise in manufacturing or manufacturing follow-up of remote handling or maintenance tools for nuclear components following nuclear codes and standards,
- Interface management in complex mechanical, fusion and/or nuclear systems,
- Design engineering (with aid of CATIA V5).

6. Duration of services

The Contract will be carried out over a period of four (4) years.

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 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.

ITER Organization reserves the right to broaden the eligibility to other countries if deemed appropriate.

8. Reference

Further information on the ITER Organization procurement can be found at:
http://www.iter.org/org/team/adm/proc