



Frame Work Contract for the Engineering Design and Tooling Procurement for the Port Integration Facility

IO/22/CFT/70000836/LLU

Technical Summary

1. Purpose

The purpose of this Contract is the development and the equipment of the Port Integration Facility (PIF) for the integration of the ITER ports, which consist of the ex-Port Plug Structures, the Port Plugs and the in-vessel components, prior to their installation in the ITER Tokamak Building.

The scope of work includes the procurement of all the necessary tools, fixtures and support equipment needed for the port integration. The detailed scope of work is given in Section 1 below.

This document specifies the scope of work and the requirements for the development and procurement of the Port Integration Facility. 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 500s 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 other systems like Disruption Mitigation System, Glow Discharge Cleaning, Ion Cyclotron Heating and Current Drive, Electron Cyclotron Heating and Current Drive and Test Blanket Modules shall be integrated into ports and their infrastructure, which hold these diagnostics or equipment in place. Figure 1 gives an overview of the typical integrated diagnostic port in ITER.

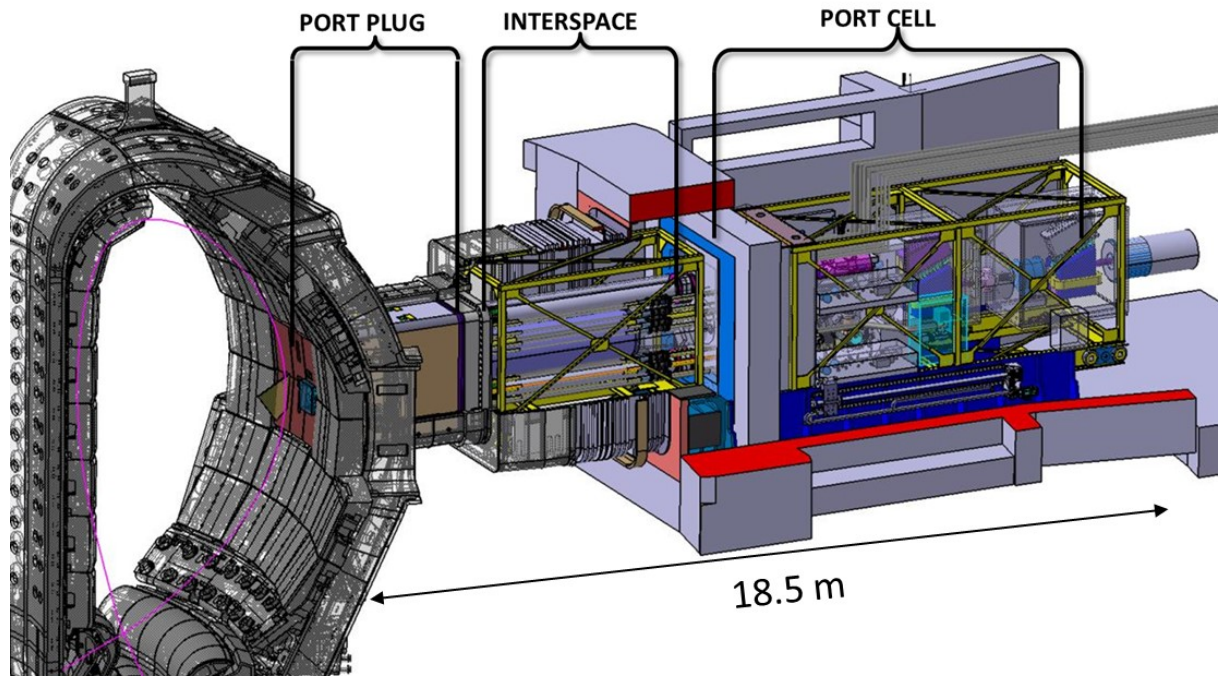


Figure 1. Example of a diagnostic equatorial port in the ITER Tokamak

There are 18 upper ports, 14 equatorial ports and 3 lower ports in ITER dedicated to these systems (with a large majority of diagnostic ports), which can be assembled or refurbished at the Port Integrator's sites at DAs or at IO.

Equatorial and upper diagnostic ports consist of a Port Plug Structure with integrated Diagnostic Shield Modules and Diagnostic First Walls (see Figure 2 and Figure 3), an Interspace Support Structure (Figure 4) and a Port Cell Support Structure (Figure 5). 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 purpose of the Port Integration Facility (PIF) is to perform the final assembly, testing, refurbishment / upgrade of the following port equipment on ITER Site.

- Ex-Port Plug Structures
 - Port Cell Support Structure (PCSS)
 - Interspace Support Structure (ISS)
- Port Plugs (PP) and in-vessel components

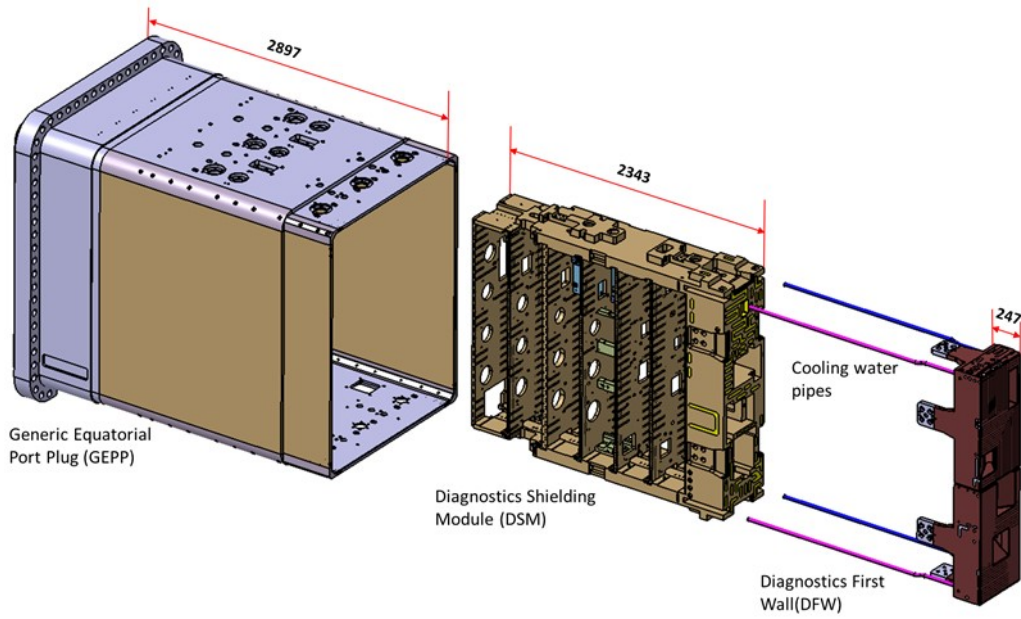


Figure 2. Example of modular design of the Equatorial Port Plug (total mass up to 48 t)

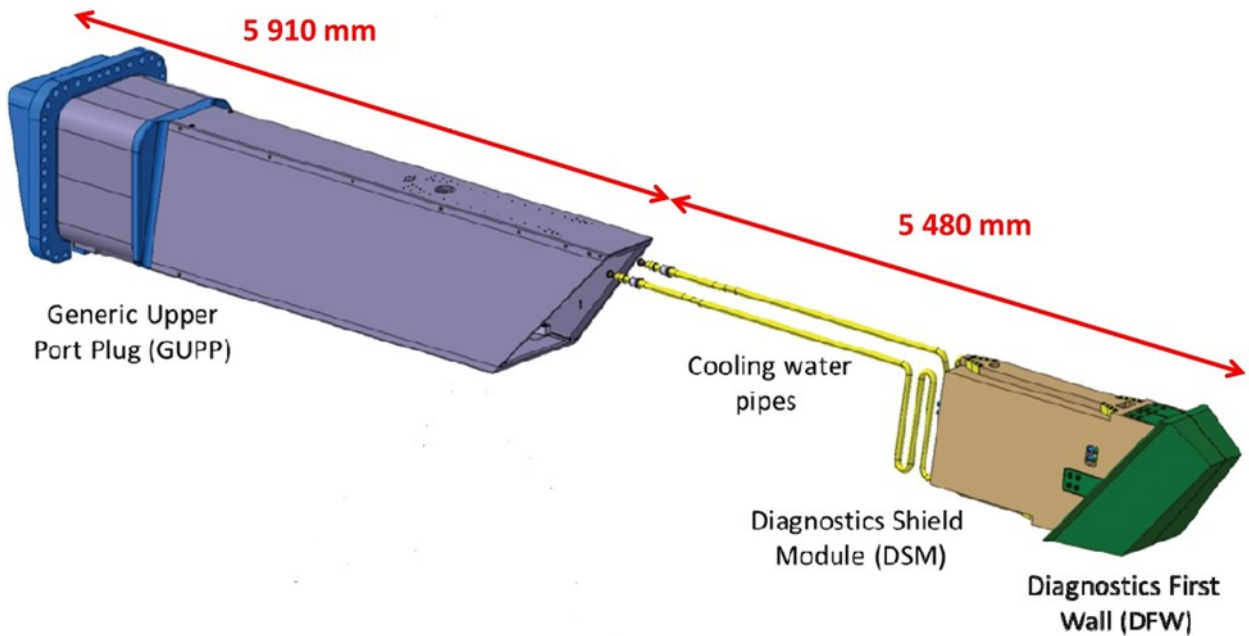


Figure 3. Example of design of the Upper Port Plug (total mass up to 25 t)

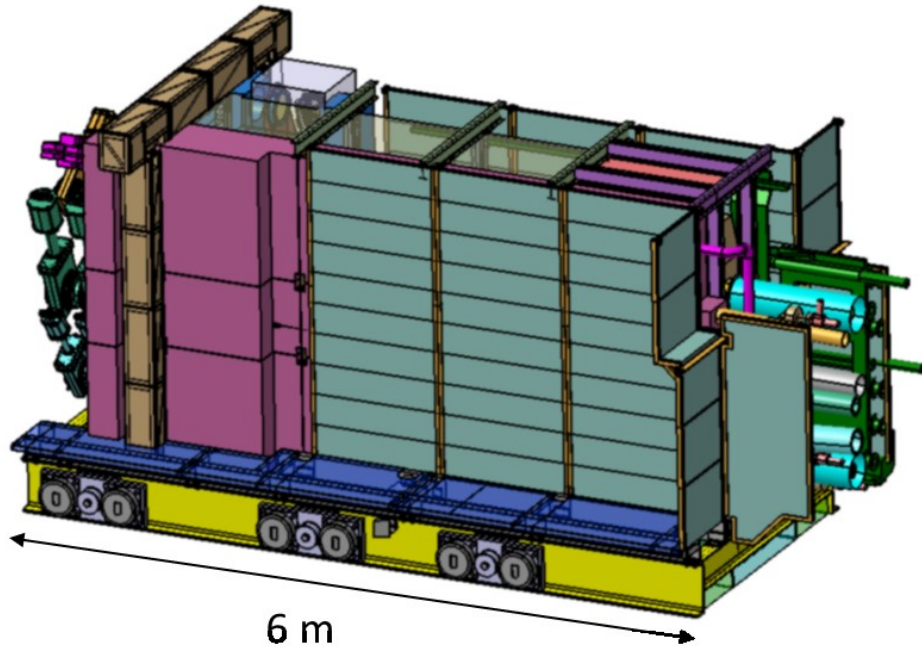


Figure 4. Example of Interspace Support Structure (up to 70 t)

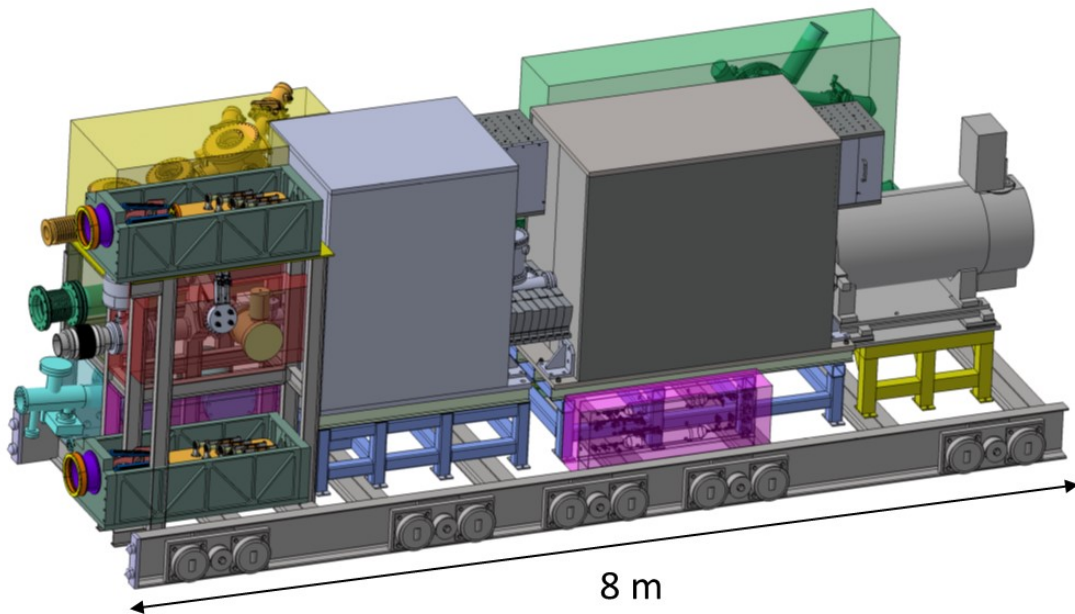


Figure 5. Example of Port Cell Support Structure

Diagnostic Shield Modules (DSM) shall be installed vertically in the Port Plug Structures. Some tilting tools have to be developed for these operations. Figure 6 to Figure 9 show an example of design of tilting tools.

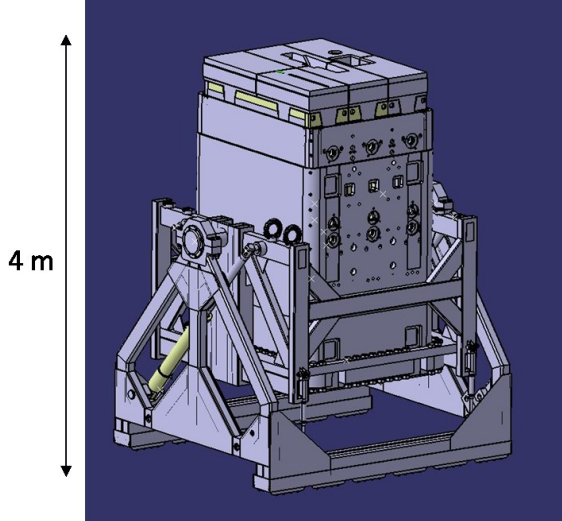


Figure 6. Equatorial PP tilting tool

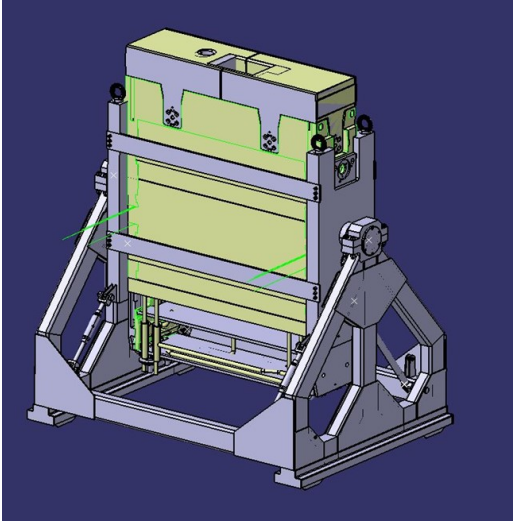


Figure 7. Equatorial DSM tilting tool

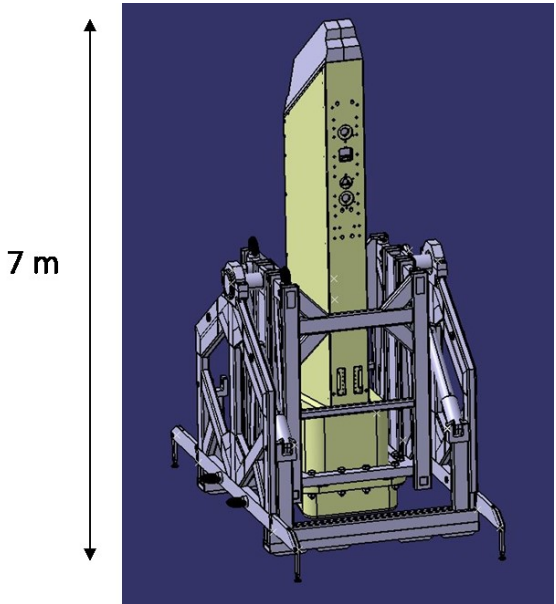


Figure 8. Upper PP tilting tool

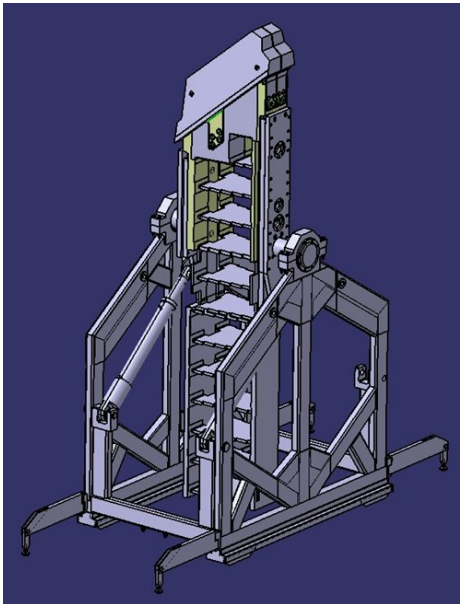


Figure 9. Upper DSM tilting tool

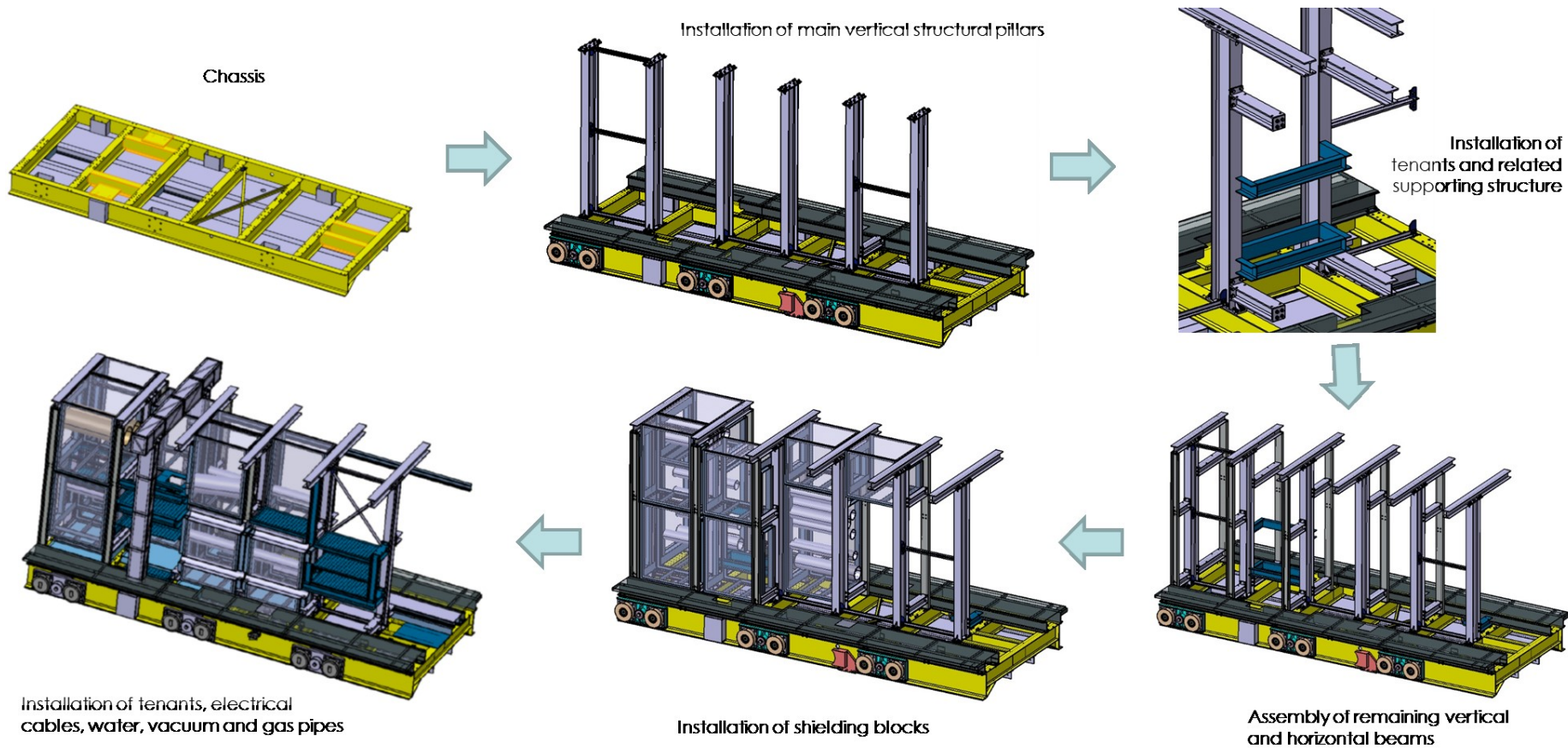


Figure 10. Example of an assembly sequence of an ex-vessel support structure

Port Plugs and In-Vessel Components (Diagnostic Racks, Divertor Cassettes, Shield Blocks and First Walls) are tested in the Port Plug Test Facility (PPTF). In-Vessel Components need an adapter to be tested in the PPTF (see Figure 11 to Figure 16). This equipment is a Protection Important Equipment (PIC), which will be used in the Hot Cell of ITER, which is INB-174 (Nuclear Basic Installation), and must comply with the French INB-order of 7 February 2012.

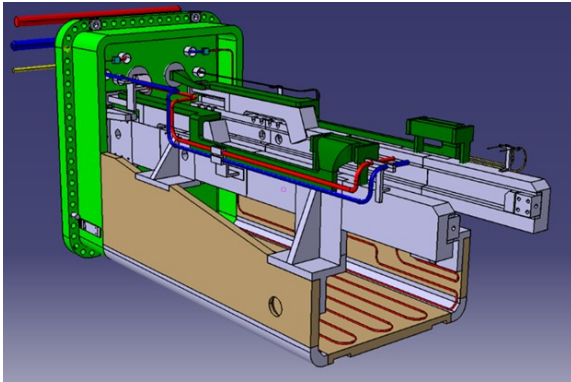


Figure 11. Concept of an adapter to test Diagnostic Racks in the PPTF

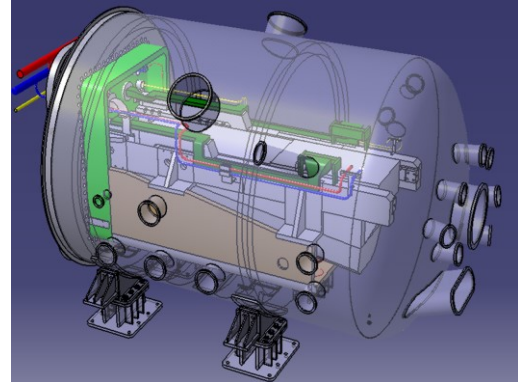


Figure 12. Conceptual adapter with a Diagnostic Rack in the PPTF test tank

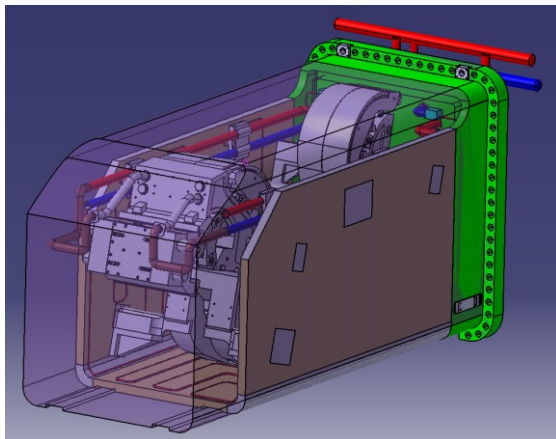


Figure 13. Concept of an adapter to test Divertor Cassette in the PPTF

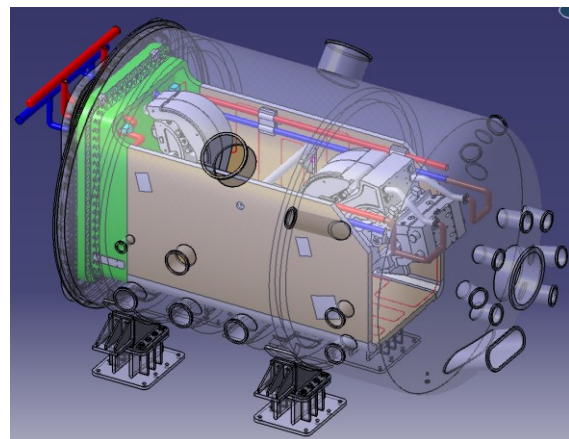


Figure 14. Conceptual adapter with a Divertor Cassette in the PPTF test tank

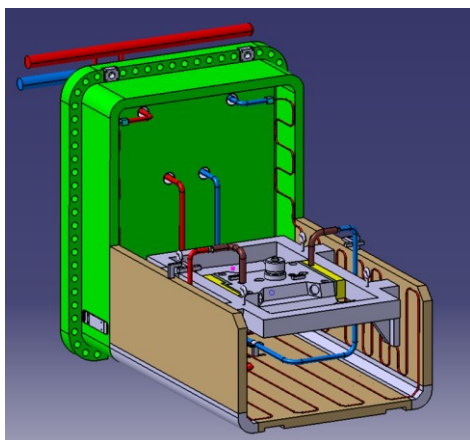


Figure 15. Concept of an adapter to test First Wall Panels in the PPTF

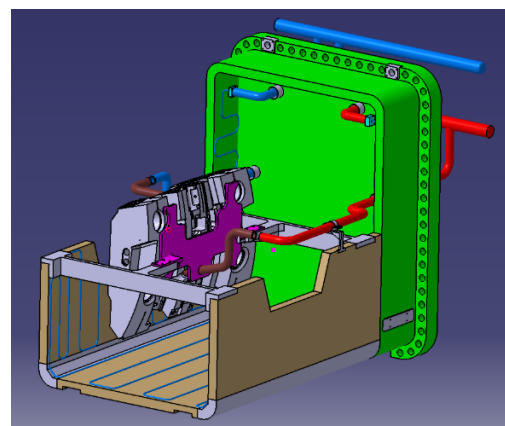


Figure 16. Concept of an adapter to test Shield Blocks in the PPTF

3. Scope of work

3.1 The purpose of this contract is the development and the equipment of the Port Integration Facility. The design of the facilities and the procurement of equipment is designated as the “deliverables” in the rest of this document.

The detailed scope of work for this contract is detailed below.

3.2 The scope of work includes as a minimum the following:

- a. Identification of the required facilities, standard and non-standard tools, fixtures, instruments and necessary equipment needed for the integration of the ports.
- b. Procurement of raw material and COTS items for all the deliverables, other than those which are supplied by IO.
- c. Manufacturing of the deliverables that include, but not limited to,
 - i. Design and procurement of the standard and non-standard equipment for the integration of the Port Plugs and the ex-Port Plug Structures,
 - ii. Design of the layout of the workshops and storage spaces,
 - iii. Design and procurement of equipment for diagnostic functional tests in the Port Plug Test Facility (PPTF),
 - iv. Design and procurement of a vacuum-compatible adaptor for testing in-vessel components in the Port Plug Test Facility (divertor cassettes, first walls, shield blocks and diagnostic racks),
 - v. Design and procurement of other such adaptors are an option, if a single adapter could not allow testing all the in-vessel components,
 - vi. Design and procurement of tools for cutting and welding of pipes and structures, and for non-destructive examination and dimensional control,
 - vii. Qualification and performance testing of all the deliverables wherever necessary.
 - viii. Assembly and installation of the workshops in the building
 - ix. Any other activity needed for the broad scope indicated in 3.1 above.
- d. Manufacture of the components using established fabrication techniques under required Quality Systems with duly qualified personnel. All equipment shall be manufactured under a quality assurance plan, and with quality control, that shall follow the *ITER Management and Quality Programme (MQP)*.
- e. Some of this equipment shall be designed to operate in the nuclear environment, following nuclear Codes and Standards. This will be detailed in the technical specifications.
- f. The supplier will be provided with the integration design, material procurement specification requirements and the details of the PIF.
- g. Following will be supplied by IO and procurement is not in the scope of the Supplier
 - i. Port Plug Test Facility (procured by DA)
 - ii. Port Plug Structures, Diagnostic Racks, Diagnostic Shield Modules, Diagnostic First Walls, Interspace and Port Cell Support Structures (procured by DAs or through separate contracts)

- iii. Diagnostic and their services (procured by DAs or through separate contracts)
- iv. Building to host the Port Integration Facility
- v. All assembly, operation and maintenance activities of the Port Integration Facility (will be a separate contract)
- h. All welding shall undergo the requisite tests that qualify the welds, including leak tests, where necessary, and NDE as required by the applicable codes and Standards. This will have to be done using procedures approved by IO.

4. Tentative Schedule Timetable :

Issue Call for Nomination to DAs	October 2022
Issue Pre-Qualification Application	End of November 2022
Issue Call for Tender	Mid of March 2023
Contract Start date	beginning of October 2023

5. Required Competences

Experience in Tokamaks is highly appreciated, and knowledge and experience in design for the following selected activities in nuclear environment is requested. The candidate company and its personnel shall have adequate experience and capability/capacity for the work as detailed below:

- Experience in concept, design, realisation, interface definition and documentation for tooling and fixtures, handling / erecting complex large and heavy equipment,
- Experience in structural analysis of complex tooling and fixtures,
- Experience in concept, design, realisation, interface definition and documentation of equipment for nuclear systems,
- Experience in manufacturing of nuclear components following international nuclear codes and standards,
- Experience in project organization and implementation,
- Capability of millimetric level precision stainless steel and carbon steel construction and fabrication,
- Capability of machining of stainless steel and carbon steel components up to 5 tons,
- Welding stainless steel and carbon steel (manual and automatic); TIG, SMAW, SAW
- Non-Destructive Testing and examination (Visual, die-penetrant, X-Ray, UT and Leak Tests),
- Experience in the handling of speciality equipment which include electrical, electronic, optical, mechanical components,
- Capability of manufacturing in a clean environment (the tools will be used in an ISO 8 cleanliness area to handle ultra-high vacuum components),
- Experience with French/European regulations applicable to the tooling and facilities (the deliverables shall comply with the regulation to be used in France): Machine Directive 2006/42/EC, French Orders on 1 and 2 March 2004 (relative to lifting devices checking and maintenance), Regulation on construction products 305/2011/EU, Low Voltage Directive 2014/35/EU, Electromagnetic Compatibility Directive 2014/30/EU.

Following competencies are desirable but not mandatory:

- Expertise in RAMI and technical risks assessment of complex integrated systems,
- Expertise in Human and Organizational Factors definition and assessment,
- Interface management in complex mechanical, fusion and/or nuclear systems.

6. Duration of services

The Contract will be carried out mainly off the ITER site over an initial firm period of four (4) years, plus two (2) years optional. The Contract is scheduled to come into force in June 2023.

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.

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.

8. Reference

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

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