Route de Vinon-sur-Verdon - CS 90 046 - 13067 St Paul Lez Durance Cedex - France

Technical Summary

Supply of Materials, Manufacturing, Assembly and Integration for Inter-Space Support and Port Cells Support Structures of IO ports

IO/21/CFT/70000704/LLU

1 Purpose

The purpose of this Contract is for the procurement and site integration of IO Interspace Support Structure (ISS) and Port Cell Support Structure (PCSS) components and sub-assemblies for the Equatorial Port Assemblies # 8 & 17 and Lower Port Assemblies # 14. The scope of work is detailed in Section 3.0 below.

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.

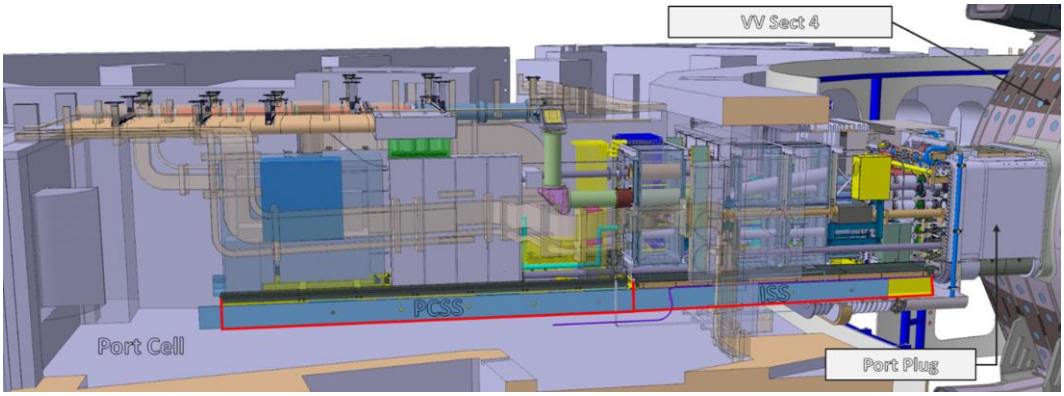

Figure 1. Integrated Equatorial Port #08 overall view.

There are 25 diagnostic ports in ITER Tokamak hosting diagnostic systems. Many diagnostics, as well as systems like DMS and GDC, are integrated into ports and their infrastructure, which hold these systems in place. Each port hosts one or more tenants such as diagnostic systems, Glow Discharge Cleaning (GDC) and Disruption Mitigation Systems (DMS) and services (water, gas, electrical).

Figure 1 gives an overview of a typical Integrated Diagnostic Equatorial Port Assembly on the example of Integrated Equatorial Port #08 in the Final Design Review (FDR) stage. Port system conventionally divided into in-vessel (out of scope) and ex-vessel parts. In-vessel part consists of port plug assembly (Figure 1) immersed in vacuum and some air side auxiliary elements (such as water cooling circuit connections, vacuum and gas pipes, mating flanges, etc.) fixed to the port plug closure plate. Port plug is inserted in the vacuum vessel port and bolted to the vacuum vessel flange via a closure plate. Ex-vessel part is composed of Interspace Support Structure (ISS) and Port Cell Support Structure (PCSS) (Figure 1).

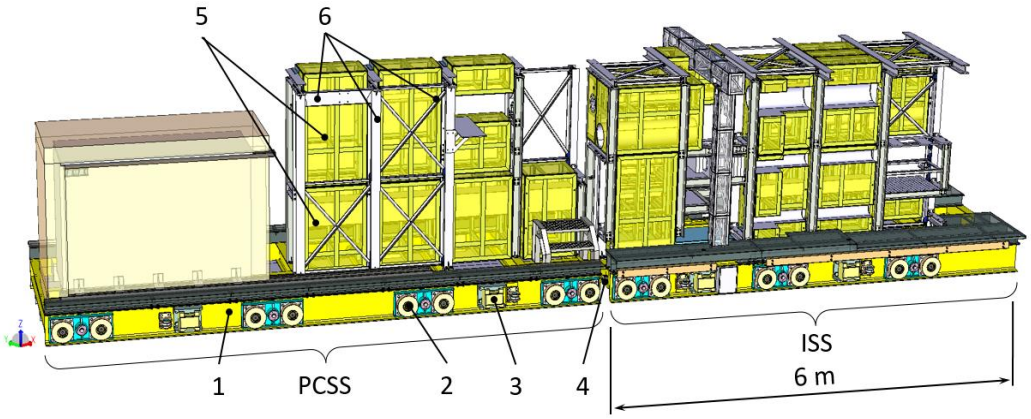

Figure 2. Equatorial Port #08 ISS (on the left) and PCSS (on the right) with integrated shielding blocks. Port Plus is on the right (not shown). Diagnostic and Disruption Mitigation Systems are hidden. 1 – chassis, 2 – bogies, 3 – positioning and locking mechanisms, 4 – buffers, 5 – shielding blocks, 6 – structural beam.

The Interspace and Port Cell Support Structures (Figure 2) support diagnostic systems on the way that the structural integrity and performance of each individual diagnostic are not degraded under various load conditions. The supports for diagnostic components located on the ISS and PCSS allows for the proper alignment of the optical elements to match the apertures and to compensate for relative movement. To shield the critical elements of diagnostics from neutrons and gamma radiation, additional shielding blocks are provided to protect sensitive elements of diagnostic systems. The second aim of shielding blocks is to reduce neutron and gamma leakage from the reactor to port cell, to lower materials activation and, respectively, to reduce Shut Down Dose Rate in port cells. Shielding blocks are fixed on the ISS and PCSS. ISS and PCSS are made to enable quick removal of the structures with tenant systems. Where possible, the integration scheme of ISS and PCSS allows the access for some maintenance and inspection operations.

Both ISS and PCSS designs are based on a chassis (Figure 2, pos.1) main structure formed by longitudinal and transversal beams, and interface with the Port Cell Cask Docking Station (not shown, out of scope) by means of bogie wheels (Figure 2, pos.2). The ISS primary structure is formed by pillars and horizontal beams (Figure 2, pos.6) forming ribs that are bolted to the chassis. Supports for tenants elements are also made on the basis of standard beams. Shielding blocks (Figure 2, pos.5) are formed by concrete encapsulated into metal structure. ISS and PCSS are equipped with positioning, stopping and locking systems (Figure 2, pos.3). Between the ISS and PCSS frames, 2 buffering systems are installed (Figure 2, pos.4). ISS and PCSS structural elements are fixed each other by welding of bolting. Services (electrical, gas, liquids) are routed on the ISS and PCSS from the connection points to the tenant systems and clamped to the ISS and PCSS beams.

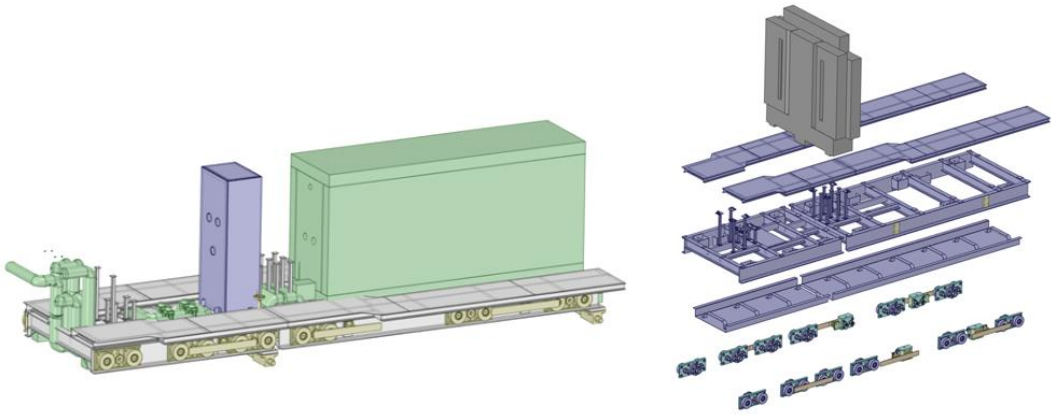

Figure 3. Lower Port #14 ISS and PCSS in a preliminary design maturity level. On the left – overall view; on the right – exploded view.

3 Scope of work

3.1 This contract shall cover the Supply and site integration of ISS, PCSS and its sub-assemblies for the Equatorial Port #8, #17 and Lower Port Assemblies #14. The detailed scope of work for the subject contract is detailed below.

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

a. Manufacturing design of all the components, sub-assemblies and assemblies of the ISS and PCSS indicated in 3.1 above

b. Material Procurement for all the components, other than those which are supplied by IO.

c. Manufacturing and assembly of the ISS and PCSS components and sub-assemblies that includes, but not limited to,
   i. ISS and PCSS chassis; backfilling blocks,
   ii. ISS and PCSS frames;
   iii. ISS and PCSS shielding blocks;
   iv. Buffers, locking and positioning mechanisms;
   v. Specialized fasteners;
   vi. Fire wrapping of structural ISS and PCSS beams;
   vii. Backing jackets;
   viii. Services clamps;
   ix. Assembly of the shielding blocks;
   x. Installation of diagnostics and common components
   xi. Assembly of the whole ISS and PCSS components;
   xii. Spare elements and spare fasteners.

d. Manufacture of the components using established fabrication techniques under required Quality Systems with duly qualified personnel. All the equipment shall be manufactured under a quality assurance plan, and with quality control, that shall follow the *ITER Management and Quality Programme (MQP)* or the ITER approved quality assurance program of the DAs.

e. The supplier will be provided with the integration design, material procurement specification requirements and the details of the ISS and PCSS Assemblies.

f. Following will be supplied by IO and procurement is not in the scope of the Supplier
   i. All the diagnostic systems;
   ii. Electrical service components (cables, connectors, etc.);
   iii. Service pipes.

g. The Factory Acceptance Tests (FAT, including dimensional and electrical tests that shall include signal validation).

h. All the components and assemblies shall be put together in a suitable clean room conditions.

i. All onsite welding shall undergo NDE on-site as required by the applicable codes and Standards.

j. Shipment of the integrated ISS and PCSS to IO premises.

4 List of deliverables

Main envisaged deliverables, but not limited to, are listed in the Table 1.

Table 1.

Deliverables		**Description**	**Due dates**
System	Item		
EP#08	D1.1	Manufacturing design of all the components, sub-assemblies and assemblies of the Equatorial Port #08 ISS and PCSS. Manufacturing Readiness Review.	2022
	D1.2	Manufacturing and assembly of the Equatorial Port #08 ISS and PCSS components and sub-assemblies.	2023
	D1.3	Physical integration of Equatorial Port #08 ISS and PCSS with diagnostic systems, services and shielding blocks. Factory Acceptance Test, Delivery Readiness Review and delivery.	2024
EP#17	D2.1	Manufacturing design of all the components, sub-assemblies and assemblies of the Equatorial Port #17 ISS and PCSS. Manufacturing Readiness Review.	2024
	D2.2	Manufacturing and assembly of the Equatorial Port #17 ISS and PCSS components and sub-assemblies.	2025
	D2.3	Physical integration of the Equatorial Port #17 ISS and PCSS with diagnostic systems, services and shielding blocks. Factory Acceptance Test, Delivery Readiness Review and delivery.	2026
LP#14	D3.1	Manufacturing design of all the components, sub-assemblies and assemblies of the Lower Port #14 ISS and PCSS. Manufacturing Readiness Review.	2024
	D3.2	Manufacturing and assembly of the Lower Port #14 ISS and PCSS components and sub-assemblies.	2026
	D3.3	Physical integration of ISS and PCSS with diagnostic systems, services and shielding blocks. Factory Acceptance Test, Delivery Readiness Review and delivery.	2027

5 Indicative Schedule

Issue Call for Nomination to DAs ..... June 2021

Issue Pre-Qualification Application ..... August 2021

Closing date for Pre-Qualification Application ..... October 2021

Issue Call for Tender ..... December 2022

Submission of tenders ..... February 2022

Contract Start date ..... April 2022

6 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's company and its personnel shall have adequate experience for the work as detailed below.

- Expertise in concept, design, realisation, interface definition and documentation for complex mechanical and nuclear systems,
- Mechanical design engineering,
- Expertise in Human and Organizational Factors definition and assessment,
- Expertise in RAMI and technical risks assessment of complex integrated systems,
- Expertise in electromagnetic and structural analysis of complex mechanical and nuclear systems,
- Integrated project organization and implementation,
- Expertise in manufacturing of nuclear components following international nuclear codes and standards,
- Interface management in complex mechanical, fusion and/or nuclear systems,
- Design engineering (with the aid of CATIA V5).
- Precision stainless steel construction and fabrication,
- Machining of heavy stainless steel components,
- Welding stainless steel (manual and automatic);TIG, PAW, EBW (advisable),
- Non-Destructive Testing and examination (Visual, die-penetrant, X-Ray and UT),
- Capability to conduct acceptance testing of final components (Pressure, draining/drying, flow, hot/cold helium leak testing),
- Experience and expertise in the assembly and integration of multi-disciplinary speciality equipment which include electrical, electronic, optical, mechanical components.
- Experience in fire wrapping installation.

7 Duration of services

The Contract will be carried out over an initial firm period of four (4) years and an optional period of two (2) years. The Contract is scheduled to come into force in April 2022.

8 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.

9 Reference

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