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**Technical Specifications (In-Cash Procurement)**

# CfN Divertor Integration Technical Specification Summary

This document summarizes the technical specification for the Divertor Integration activities.

# Divertor Cassette Assembly Integration

Call for Nomination (CfN)

Summary of Technical Specifications

## 1 Purpose

This Call for Nomination is the first step for the eventual Call for Tender of the Divertor Cassette Assembly (CA) Integration.

This document presents the technical objectives and the summary scope of the foreseen contract.

The detailed scope of the contract and their conditions including the technical and management requirements will be further defined in the Technical Specifications to be provided in later stage.

## 2 Background

The ITER Project aims to demonstrate the scientific and technological feasibility of fusion power for peaceful purposes and to gain the knowledge necessary for the design of the next-stage DEMOnstration fusion power plant.

ITER is a joint international research and development project for which the construction activities have started. The seven Members of the ITER Project form the seven Domestic Agencies (DA) and include: European Atomic Energy Community (EUDA), Japan (JADA), People's Republic of China (CNDA), Republic of India (INDA), Republic of Korea (KODA), Russian Federation (RFDA) and United States of America (USDA).

ITER is being constructed at St Paul Les Durance, in southern France, where the ITER Organization (IO) has its headquarters.

The main components of the ITER Tokamak are the Magnets, Vacuum Vessel, Cryostat, Blanket and Divertor. As a main component, the Divertor is a ring located at the bottom of the vacuum chamber that faces the thermonuclear plasma. It removes most of the impurities coming from the plasma. The figure below shows the Divertor (highlighted in orange) relative to the machine.

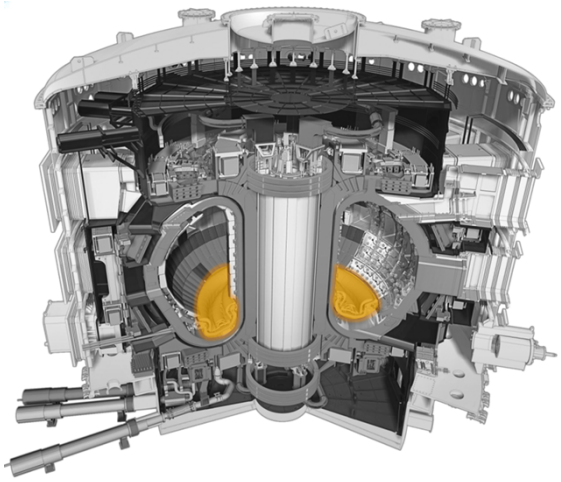

Figure 1: ITER Machine with the Divertor highlighted in orange

The Divertor consists of 54 Cassette Assemblies (CAs), plus 4 spares, that are made of one Cassette Body (CB) and three Tungsten Plasma Facing Components (PFCs), namely from inboard to outboard: Inner Vertical Target (IVT), Dome and Outer Vertical Target (OVT). There are 33 Standard CAs and 21 Non-Standard CAs. As shown in the figure below, the Non-Standard CA is similar to the Standard CA but also includes other components, essentially parts of Diagnostics and Instrumentation (sensors, looms, connectors, etc). Collectively, the PFCs, Diagnostics and Instrumentation are referred to as Free-Issued Items (FII). Each CA is about 3.3m long, 2.2m tall and weighs around 10tons.

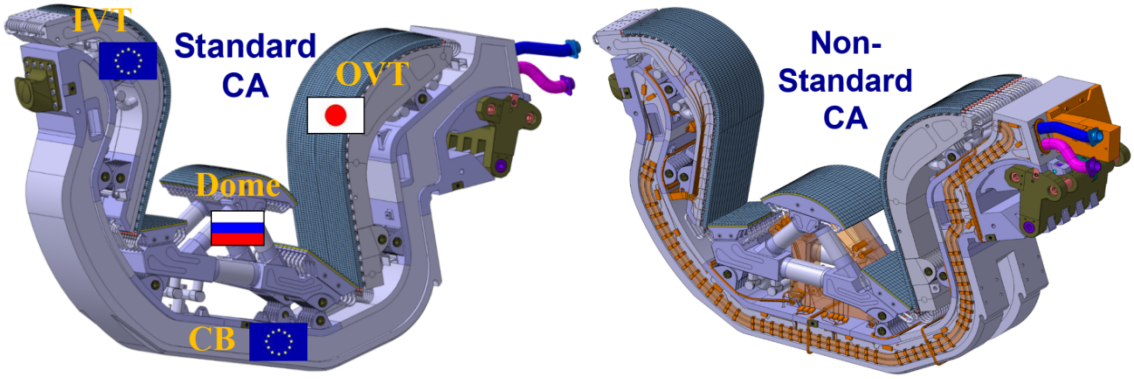


Figure 2: Standard and Non-Standard CAs

The table shows the 22 components and stakeholders involved with these activities.

Table 1: List of the Free-Issued Items (FII)

| Free – Issued Items | Quantity |
|---|---|
| 1. Central Cassette Outer Rail | 3 Sets |
| 2. Divertor Operational Instrumentation | 3 Sets |
| 3. Dome | 58 Components |
| 4. Inner Vertical Target | 58 Components |
| 5. Outer Vertical Target | 58 Components |
| 6. Cassette Body | 58 Components |
| 7. Bolometers | 5 Sets |
| 8. Diagnostic Electrical Services | 17 Sets |
| 9. Divertor Impurity Monitor | 1 Set |
| 10. Divertor Shunts | 6 Sets |
| 11. Dust Monitor | 2 Sets |

| | |
|---|---|
| 12. Equilibrium Coils | 6 Sets |
| 13. Erosion Monitor | 1 Set |
| 14. Langmuir Probes | 5 Sets |
| 15. Lower Vertical Neutron Camera | 1 Set |
| 16. Poloidal Polarimeter | 1 Set |
| 17. Pressure Gauges | 4 Sets |
| 18. Rogowski Coils | 6 Sets |
| 19. Thermocouples | 3 Sets |
| 20. Thomson Scattering | 2 Sets |
| 21. Lost Alpha Monitor | 2 Sets |
| 22. Toroidal Coils | 6 Sets |

# 3 Scope of Work

The following summarizes the current estimation of the scope of work required under the foreseen contract in order to integrate and prepare the CAs ready for installation in the Tokamak machine:

- Acceptance Tests of the FII and CBs
- Integration of the FII and CBs to form the CAs
- Factory Acceptance Tests of the CAs
- Kinematic testing of the CB movable parts
- Support to Functional Tests of diagnostics. The Integrator is only responsible for providing basic services and support (water, electricity, time and space) for the performance of the functional tests of the diagnostics. IO is responsible for performing the actual functional tests of the diagnostics, which consist of electrical tests, optical alignments and temperature response tests.
- Customization, welding and testing of cooling pipes on CA
- Cleaning, packaging and delivery of the CAs to IO
- Storage of FII and CAs (as needed)

This scope of work will be organized into Stages (see Sect. 3.4).

From a technical standpoint, these components are all classified Quality Class 1, Vacuum Quality Class 1 and Metrology Class 1. These components are classified non-Protection Important Components. The Divertor components are excluded from the application of the decree on pressurised equipment, No 99-1046 dated 13 December 1999, and consequently excluded from the ESPN order. Additionally, a number of them are classified Metrology Class 1. Overall, the manufacturing of these items requires state of the art industrial codes and standards.

## 3.1 Acceptance Tests of Free-Issued Items

The Acceptance Tests of the FII and CB at the Integration Site consists of the following:

- Visual Inspection and review of accelerometers
- Cold He Leak Test (as applicable)
- 3D Geometrical Survey (as applicable)
- Support to Functional Tests of diagnostics (for Non-Standard CAs)

## 3.2 Integration of CAs

The overall integration for completion of a CA for installation in the Tokamak consists in

- Mounting the PFCs onto the CB using the multilink and swaging procedure
- Welding the PFC cooling pipes to the CB cooling pipes
- Installing (for the non-standard CA) the diagnostics (welding sensors, boxes, connectors, looming cables)

- Welding cooling pipes on the CA
- Kinematic testing of the CB movable parts
- Support to Functional Tests of diagnostics (for Non-Standard CAs)

The figures below show a summary for integration of a Standard CA. Refer to Annex 2 for the full sequence of Non-Standard CA #41 (based on 2014 baseline). The technical specification for the contract will specify conceptual assembly sequences for each CA. The Integrator will have the charge to develop the detailed assembly sequences.

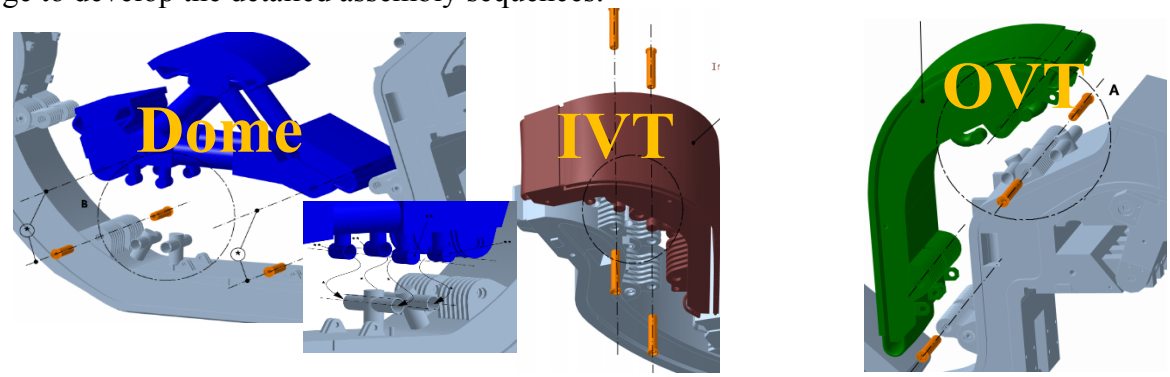


Figure 3: Mounting and Welding Cooling Pipes of Dome, IVT and OVT on CB

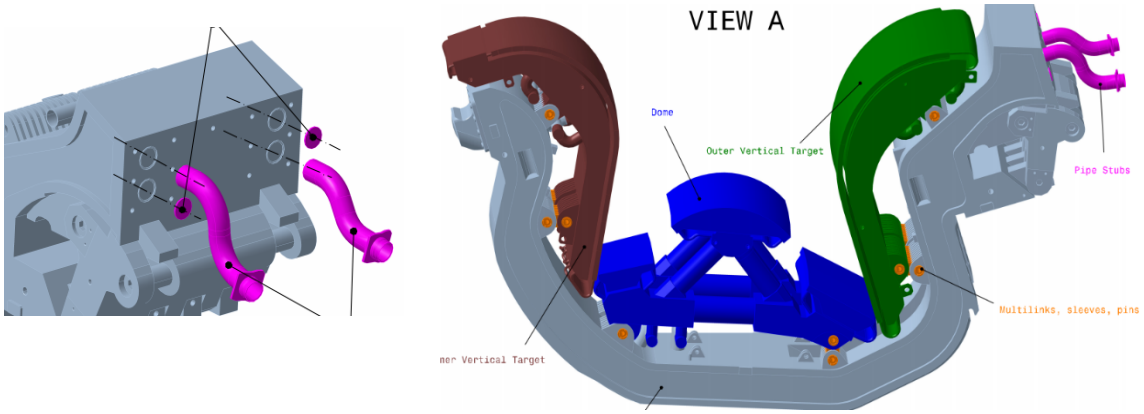


Figure 4: Welding of Customized Cooling Pipes and Complete Standard CA

## 3.3 Factory Acceptance Tests of the CAs

The Factory Acceptance Test of each CA following integration include:

- Cold Water Flow Test
- Hydraulic Pressure Test
- Cold Helium Leak Test (with local heating of welds)
- 3D Geometrical Survey
- Support to Functional Tests of diagnostics (for Non-Standard CAs)

## 3.4 Stages

As of today, the IO plans to implement this project in the 5-stage approach as indicated below.

1 **Stage 1: Prototype – Standard CA (PFC + CB)**

a) Reception and Acceptance Tests of PFC + CB (Sect. 3.1)
b) Integration of Prototype (Sect. 3.2)
c) Factory Acceptance Tests of CA (Sect. 3.3)
d) Cleaning and packaging
e) Shipment to IO (if applicable)

Stage 1 has to be performed at an already existing facility as part of the planning and qualification process, then scaling up for the Integration Site for subsequent stages.

2 **Stage 2: Prototype – Non-Standard CA (Free-Issued Items + CB)**
   a) Reception and Acceptance Tests of Non-Standard FII (Sect. 3.1)
   b) Dismounting of Standard CA Prototype
   c) Integration of Non-Standard CA (Sect. 3.2)
   d) Factory Acceptance Tests of CA (Sect. 3.3)
   e) Cleaning and packaging
   f) Shipment to IO or hand over to IO (as applicable)

3 **Stage 3: Series – Standard CA (PFCs + CB)**
   a) Reception and Acceptance Tests of PFC + CB (Sect. 3.1)
   b) Integration of Series Standard CA (Sect. 3.2)
   c) Factory Acceptance Tests of CAs (Sect. 3.3)
   d) Cleaning and packaging
   e) Hand over to IO

4 **Stage 4: Series – Non-Standard CA (Free-Issued Items + CB)**
   a) Reception and Acceptance Tests of PFC + CB + Non-Standard FII (Sect. 3.1)
   b) Integration of Series Non-Standard CA (Sect. 3.2)
   c) Factory Acceptance Tests of CAs (Sect. 3.3)
   d) Cleaning and packaging
   e) Hand over to IO

5 **Stage 5: Storage (as needed)**

The tasks for Stages 2, 3 and 4 are similar to the ones in Stage 1 and should be built on the lessons learned from Stage 1.

# 4 Skills and Equipment

As part of the past Divertor R&D, mock ups of the components were used to demonstrate the concept for integration of a standard CA. Based on this information and lessons learned in the prototyping and handling of the CB, the following technical skills and equipment are highlighted as key for performing the integration work, handling such heavy equipment, meeting tight tolerances and performing required testing:

- Engineering Skills
- Manufacturing/Assembly Skills:
  - Welding
  - Dimensional Inspections to perform reverse engineering
  - Vacuum Technique
  - Cleanliness
  - Milling
  - Customization and bending of mechanical parts
- Special Equipment: 5 axis milling machine, etc.

Based on current experience in managing interfaces and interactions with 20+ stakeholders and lessons learned from ITER facilities, the following project management skills are required:

  - High quality communication
  - High quality, clear procedures
  - Flexibility to understand and manage the various maturity of the components and stages

- Allow visits of the various personnel and inspectors to any site where activities are performed

The Candidates must prove its ability to provide in an organised way the competences specified in the Scope of Work above.

The Candidates should also have experience in working in a clean area, which shall only be operated by trained personnel to approved procedures.

The Candidates 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.

The detailed Selection Criteria will be disclosed to the nominated Candidates during Pre-Qualification stage.

# 5 Tentative assumptions for the site of the activities

The integration activities, as listed in Sections 3.1, 3.2 and 3.3 are expected to be executed at the Contractor's premises for Stage 1 and, eventually, for Stage 2.

As regards the following Stages 3, 4 and 5, the related site will be specified prior to issue the Call for Tender. To this respect, IO is exploring the possibility to provide a 5000m$^2$ area within a building at the IO site.

Other tasks, in support to the integration activities, can always be performed at the Contractor's premises at any Stage. A tentative and non-exhaustive list of these other tasks may include:

- Engineering activities including CAD
- Preparation of QA/QC documentation
- Welding procedure qualification, including fabrication of test coupons
- Customization and bending of pipes
- Machining of parts
- Data processing
- Fabrication of calibration samples (e.g. for non-destructive testing)
- Fabrication of jigs and tools to be used for the integration activities

# 6 Candidature

Participation is open to any legal entity either an individual or a group (consortium) which is established in an ITER Member State. A legal entity 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 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 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 to be disclosed at the Pre-Qualification stage.

# 7 Withdrawal of the United Kingdom from the European Union (EU) and from the Euratom (the so called BREXIT)

On 31 January 2020, the UK left the EU and Euratom with a transition period from 1 February to 31 December 2020 to be used to determine the conditions of their future relationship. Euratom is the ITER Member and the withdrawal of the UK from Euratom leads to the fact that UK is not anymore party to the ITER project.

Until the 31 December 2020, current end date of the transition period, UK entities retain the right to participate in IO procurement procedures.

# 8 Timetable for the Tender Process

The tentative schedule for this tender process is as follows:

| | |
|---|---|
| Call for Nomination | December 2020 – January 2021 |
| Information Day (*) | Late February 2021 |
| Invitation for Pre-Qualification | March 2021 |
| Pre-qualification submission | April 2021 |
| Invitation for Call for Tender | May 2021 |
| Tender Submission | July 2021 |
| Contract signature | December 2021 |

*Note for “Information Day”:

Prior to launch of the Pre-Qualification, the IO is planning to hold an event called “Information Day” in order to further provide you the anticipated scopes of the contract and the contract strategy. Also during this event, the IO would wish to receive some feedback from the Industry on our planned procurement so that we might reflect those feedbacks in finalizing in our Technical Specification to be provided at the Call for Tender stage. This event may be held either physically at the ITER premises or virtually as online. The details will be provided only to the companies and institutions nominated by DAs as a result of this Call for Nomination.