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EXTERNAL REFERENCE / VERSION

Call for Nomination Documents

Call for Nomination: Technical Specification for the IVC Feedthroughs design verification, qualification and production

This Call for Nomination is associated with the qualification, manufacturing and delivery of the IVC Feedthroughs for the ITER In-Vessel Coils System.

IVC Feedthroughs design verification, qualification and production

Call for Nomination

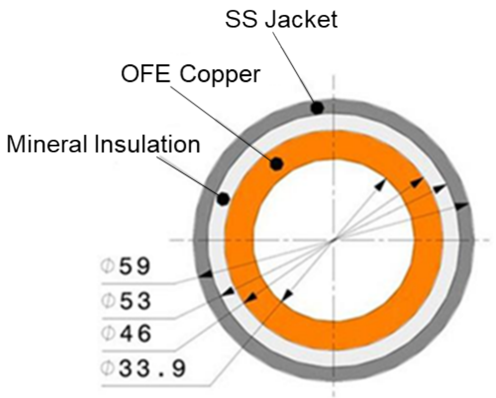
1 Purpose

This Call for Nomination is associated with the qualification, manufacturing and delivery of the IVC Feedthroughs for the ITER In-Vessel Coils System.

2 Introduction

ITER is a joint international research and development project aiming to demonstrate the scientific and technological feasibility of fusion power for peaceful purposes. The seven members of the ITER Organization (IO) are: The European Union (represented by EURATOM), Japan, People's Republic of China, India, the Republic of Korea, the Russian Federation and the USA. The ITER Organization is located in Saint Paul lez Durance – France. Further information is available on the ITER website: http://www.iter.org.

In-Vessel Coils (IVC) are normal-conducting coils located behind the Blanket Shield Modules inside the Vacuum Vessel. The system is composed by two set of coils, VS and ELM. Both coils systems are exposed to a considerable amount of dissipated power inside the Vacuum Vessel (VV), mainly coming from the gamma and neutron plasma irradiation and neutron heating during Deuterium-Tritium operations. This is combined with the VV normal operating temperature of 100°C and the in-vessel components bake-out temperature of 240°C. To withstand this environment while providing the required performance, the IVCs are made from water cooled, stainless steel jacketed, mineral-insulated conductors (SSMIC) – see Figure 1.



Materials description:
- Jacket: modified 316LN Stainless Steel
- Insulation: Magnesium Oxide compacted powder
- Conductor: OFE Copper (CW009A)

Materials thickness:
Jacket 3.0mm
Insulation 3.5mm
Conductor 6.05mm

Figure 1. IVC SSMIC composition.

IVC Upper Feedthroughs and Lower Feedthroughs are used to facilitate the transfer of electrical power and cooling water across the separation boundary of the VV. On one side of this boundary is the external environment of the ports cells or interspaces ("Air Side") and on the other side is the Ultra-High Vacuum (UHV) environment of the VV – see Figure 2. In between these two sides there is the middle section which is a vacuum monitored interspace required by the Vacuum Quality Classification (VQC3A). A stainless steel double-ply Bellow is providing primary vacuum sealing (VQC1A) whilst allowing relative deformation resulting from temperature variations and electromagnetic forces between the feedthrough conductor and the vacuum vessel. The nude copper conductor on the "Air Side" is the location of the connection to the power supply. The Pipe adaptor is the conjunction with the cooling water pipes and electrical insulating breaks.

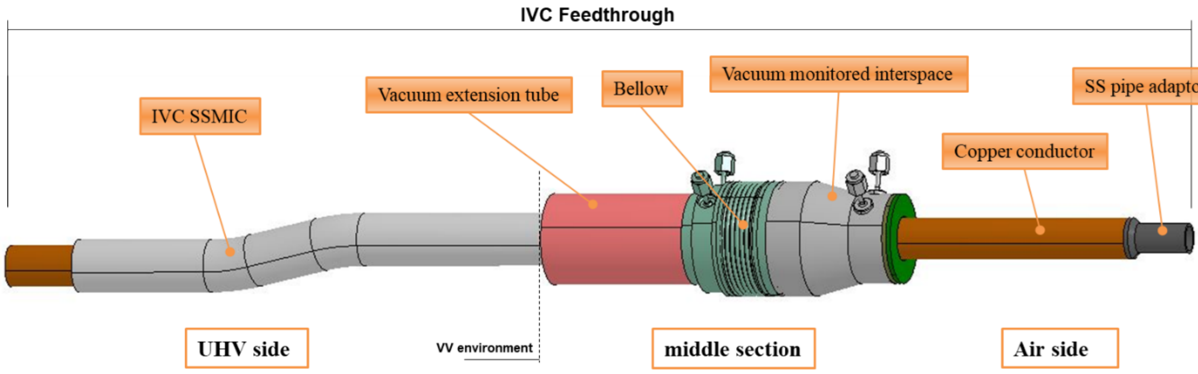


Figure 2. IVC Feedthrough general overview.

Each Feedthrough is composed by several internal components (middle section) – see Figure 3. All of the components acting as insulating volumes or layers are designed in Torlon PAI 4203L or high-grade Alumina Type IV (Al_2O_3) seen the expected high operating temperatures of the Feedthroughs. The "SVS Fittings" are used for the Service Vacuum System which is aimed at monitoring all vacuum interspaces.

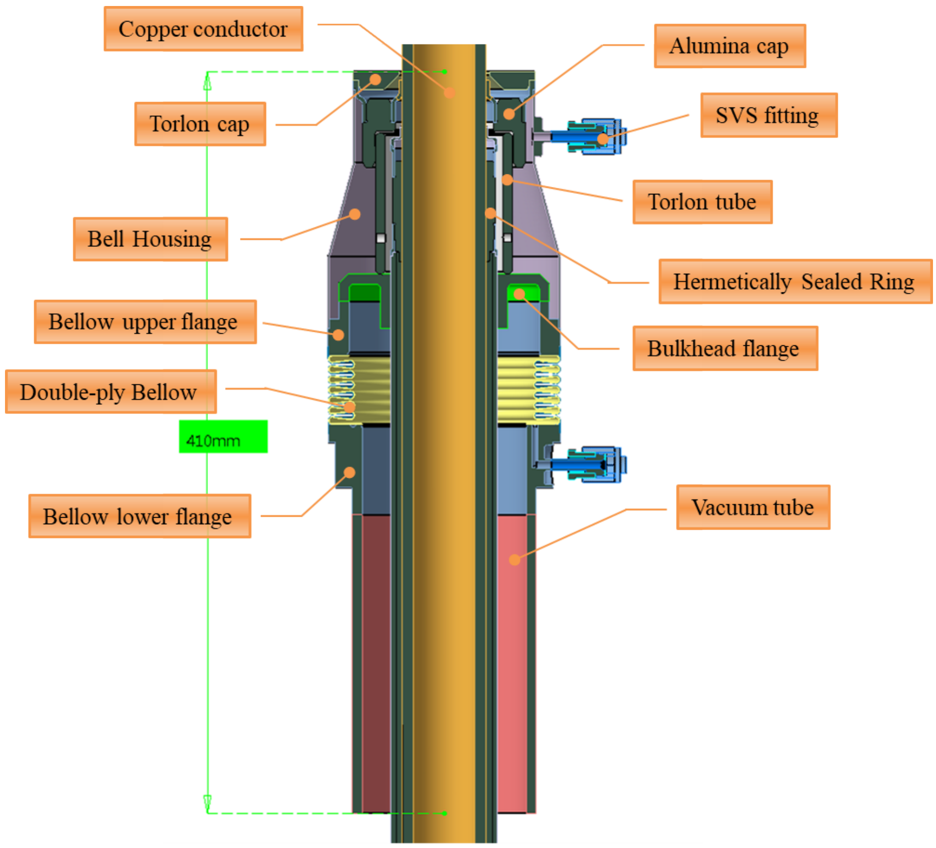


Figure 3. IVC Feedthroughs internal components.

In order to provide protection against excessive displacement which may damage the bellows, a supporting structure is designed around the bellows and rigidly support the copper conductor against all external forces. This stainless steel structure is insulated from the nude copper conductor and the busbars using Torlon PAI 4203L. The overall set of two Feedthroughs, one supporting structure and the power supply connection (busbars clamps) forms one IVC Feedthroughs Assembly – see Figure 4.

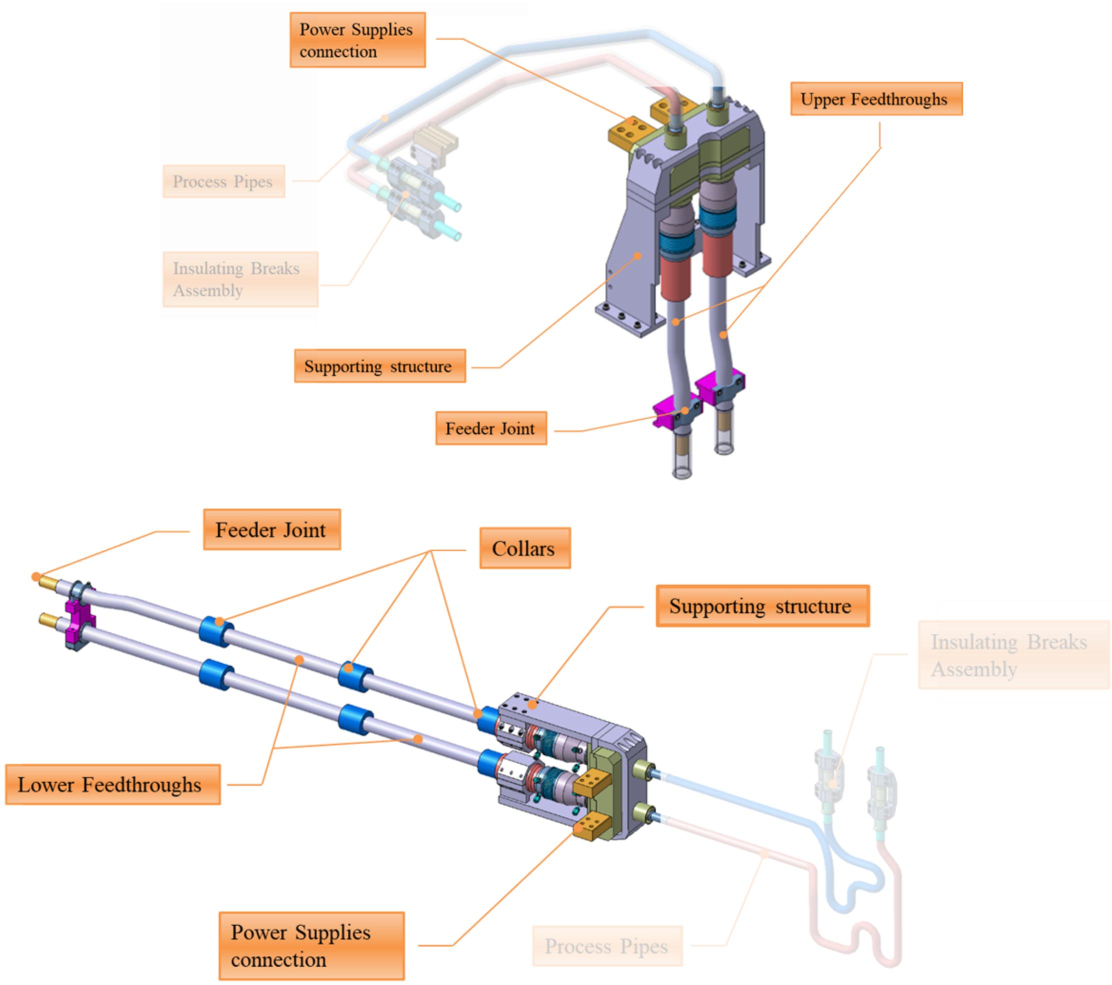


Figure 4. IVC Feedthroughs Assembly: Upper (top) and Lower (bottom).

3 Scope of the work

The overall work shall cover the design verification, the qualification and the production of the IVC Feedthroughs to be installed in the Tokamak building. This work is split into three phases:

1. Phase I covers the design verification and the qualification of the Feedthrough's internal components and their joints. This phase foresee the manufacture of mock-ups to be delivered at the end of the phase (~ 20-30 mock-ups depending on qualification process needs).
2. Phase II covers the qualification of one or two full Feedthroughs Assembly prototype(s). The completion of this phase will be achieved through a Manufacturing Readiness Review.
3. Phase III covers the final series production of all Feedthroughs Assemblies (~ 40-45).

The overall work is foreseen to be completed in a timeframe of around 3 years. The preliminary activities for qualification of internal components and prototype(s) shall cover around the first 2 years of the overall work and be completed by the Manufacturing Readiness Review.

Each phase foresees the delivery of certain products together with deliverables and certificates upon request.

Globally, the work includes the following activities:

a) Design verification and qualification of the internal components
   - Development of welding/brazing procedures for the Feedthrough joints;
   - Development of inspection and qualification plans for each internal component;
   - Production of manufacturing drawings;
   - Realization of mock-ups representative for the real pieces;
   - Verification of welding/brazing processes and related inspections;
   - Testing following the specific requirements for Protection Important Components (PIC/SIC) and VQC classes as per *ITER Vacuum Handbook*.

b) Prototyping
   - Manufacturing of the complete prototype(s);
   - Development of installation and assembly procedures;
   - Development of conductor bending and cutting procedures;
   - Inspection of welding/brazing;
   - Testing following the specific requirements for PIC/SIC components and VQC classes as per *ITER Vacuum Handbook*;
   - Manufacturing Readiness Review, whose objects are
     - Final manufacturing drawings;
     - Implemented manufacturing procedure;
     - Implemented qualification program;
     - Results of prototypes qualification campaign;
     - Final approval of drawings and procedures to start production phase;
     - Time schedule of production phase;
     - Quality control program to be implemented during production phase.

c) Series production
   - Bending and cutting of SSMIC;
   - Manufacturing and assembling of all final products;
   - Inspection of welding/brazing;
   - Factory and site acceptance tests;
   - Packing and shipment to the IO.

4 Tentative timetable

A tentative timetable as it follows:

Call For Nomination	March 2019
Pre-Qualification	April – May 2019
Call for Tender	June 2019
Tenders Submission	August – September 2019
Contract awarding	November – December 2019

5 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 cannot be modified later without the approval of the ITER Organization.

6 Experience and key competencies

The Candidates will need to demonstrate that they have the capabilities to successfully perform the entire scope of work mentioned above and in particular:

- Previous experience in manufacturing components for Ultra-High Vacuum and Nuclear applications;
- Comprehension of Technical Specifications and experience in writing Manufacturing Inspection Plans and Qualification Plans;
- Understanding of all technical challenges related to the work and capability to provide alternative technical solutions if asked/required;
- Knowledge of ASME and ISO standards the qualification of welding/brazing procedures, joint preparation, inspection and testing;
- Experience in development of high-quality welding and brazing procedures and design of joints;
- Experience in development of Non-Destructive Testing procedures for welding and brazing;
- Capability to perform qualification tests at its premises (i.e. Helium leak tests, Pneumatic and Hydrostatic pressure tests…);
- Experience in handling, bending and cutting metallic pipes and conductors similar to the presented SSMIC.

6.1 Quality Assurance (QA) requirements

The organization conducting these activities should have an ITER approved QA Program or an ISO 9001 accredited quality system.

Prior to the commencement of the task, a Quality Plan must be submitted for IO approval giving evidence of the accredited quality system and describing the organization of this task, the skill of workers involved in the study, any anticipated sub-contractors and giving details of who will be the independent checker of the activities.

Prior to commencement of any manufacturing, a Manufacturing Inspection Plan (MIP) must be approved by ITER who will mark up any planned interventions.

6.2 Safety requirements

ITER is a Nuclear Facility identified in France by the number INB-174 ("Installation Nucléaire de Base"). For Protection Important Components (PIC) and in particular Safety Important Class components (SIC), the French Nuclear Regulation must be observed, in application of the Article 14 of the *ITER Agreement:*

- The *Order 7th February 2012* applies to all the components important for the protection (PIC) and the activities important for the protection (PIA).
- The compliance with the INB-order must be demonstrated in the chain of external contractors.
- In application of article II.2.5.4 of the *Order 7th February 2012*, contracted activities for supervision purposes are also subject to a supervision done by the Nuclear Operator.

For all Protection Important Components, structures and systems of the nuclear facility and Protection Important Activities (PIA), the Candidates shall ensure that a specific management system is implemented for his own activities and for the activities done by any subcontractor following the requirements of the *Order 7th February 2012*.

7 Applicable documents and references

[1] *IVC Feedthroughs design report* https://user.iter.org/?uid=XJPN9W&version=v1.0

[2] *ITER Vacuum Handbook*, https://user.iter.org/default.aspx?uid=2EZ9UM&version=v2.3

[3] *List of ITER-INB Protections Important Activities*, https://user.iter.org/default.aspx?uid=PSTTZL&version=v2.2

[4] *Provisions for Implementation of the Generic Safety Requirements by the External Interveners*, https://user.iter.org/default.aspx?uid=SBSTBM&version=v1.1

Drawings are enclosed in attachment to this document. They only serve for illustrative purposes and are not part of the contract documentation.