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Technical Specifications (In-Cash Procurement)

Technical Specification Summary for Cryostat Bellows Interface Thermal Insulation

In the frame of the Call for Nomination regarding the contract for the Thermal Insulation for Cryostat Bellows Interface with Tokamak Building, this document summarizes the requirements for the design & qualification, manufacture and on-site installation.

china eu india japan korea russia usa

Call for Nomination

Thermal Insulation for Cryostat Bellows Interface with Tokamak Building

Purpose

In the frame of the Call for Nomination regarding the contract for the Thermal Insulation for Cryostat Bellows Interface with Tokamak Building, this document summarizes the requirements for the design & qualification, manufacture and on-site installation.

Background

ITER ("The Way" in Latin) is one of the most ambitious energy projects in the world today. 35 nations are collaborating to build the world's largest tokamak, a magnetic fusion device that has been designed to prove the feasibility of fusion as a large-scale and carbon-free source of energy based on the same principle that powers our Sun and stars.

For more information on the ITER project: http://www.iter.org

The Cryostat is one of the major components of the ITER machine. The Cryostat is a large, stainless steel structure surrounding the vacuum vessel and superconducting magnets. It is made up of a single wall cylindrical construction and is roughly 30 meters tall and wide. The main functions of the Cryostat are to provide a vacuum environment and to support the Tokomak basic machine main components.

The Cryostat is interfacing with the Tokamak Building at the regular and irregular port penetrations through 54 bellows which functions are to ensure the leak tightness between the related environments and to compensate the relative movements between the Cryostat and the Tokamak Building.

The layout between the Cryostat Bellows and the Tokamak Building consists of specific embedded plates which are either:

- Rectangular for the 50 rectangular bellows interfaces at the regular ports of the lower (B1), equatorial (L1) and upper (L2) levels
- Circular for the 4 neutral Beam bellows interfaces at the irregular ports of the equatorial (L1) level

The structural capacity of the embedded plates is currently exceeded due to some thermal loading effects (fire and cryogenic accidents) which are applied directly on these structures. In

order to resolve this issue, thermal insulation is to be implemented at the Cryostat bellows / Tokamak Building interfaces. A conceptual design of such thermal insulation system is shown on Figure 1 and Figure 2.

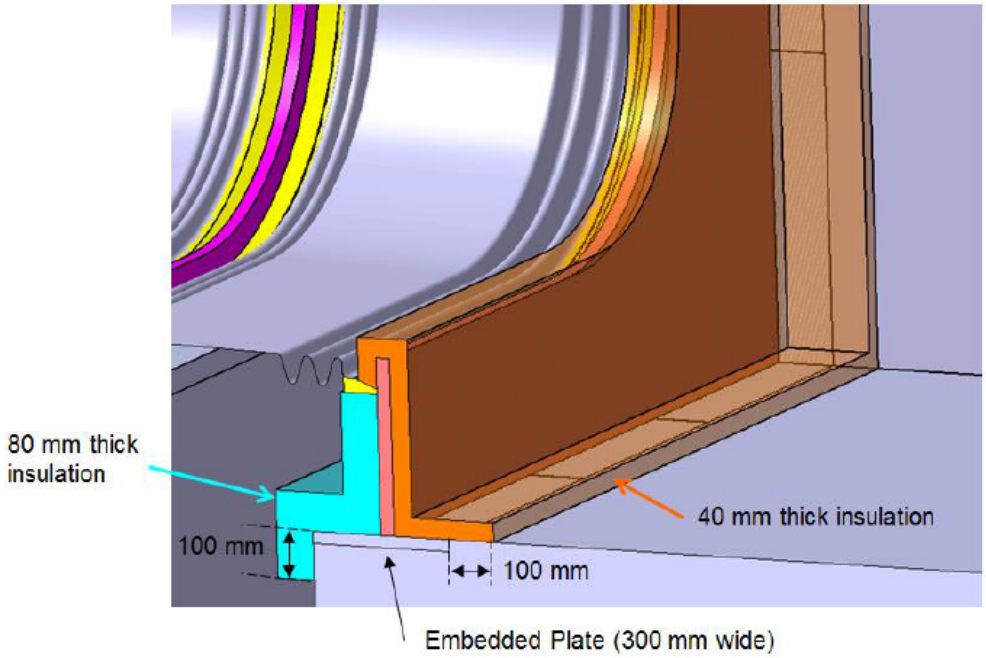

Figure 1 – Typical layout for the Thermal Insulation System at the regular ports Conceptual Design (dimensions subjected to change)

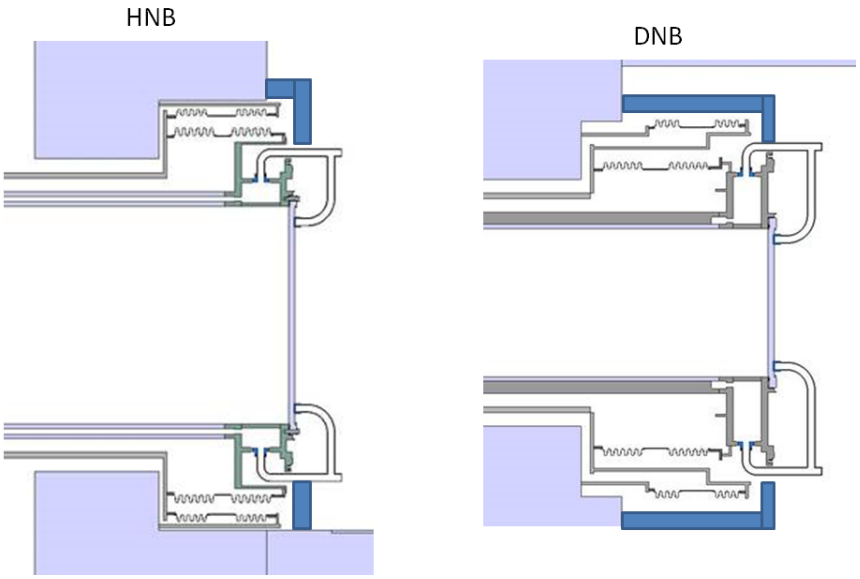

Figure 2 – Typical layout for the Thermal Insulation System at the irregular ports Conceptual Design (dimensions subjected to change)

Experience

The Contractor shall have adequate experience for the work and activities as detailed below regarding thermal insulation systems:

- Design development and design justification including R&D and analysis (Finite Element Analysis)
- Qualification, certification and testing against requirements such as fire, cryogenic temperatures, bellows relative movements, seismic loading …
- Development of systems compliant with nuclear requirements (radiation, aging, tritium permeability, decontamination …)
- Large scale manufacture of customized systems
- Integration and on-site installation in complex plant environment with restricted space constraints

Work description

The scope of work can be summarized as follows:

1. Design Development

The design of the thermal insulation system is currently functional. All integration and interface details have been defined. The final detailed design shall be developed in order to comply with all the functional, mechanical and interface requirements.
A specific design solution shall be developed for each Cryostat bellows / Tokamak Building interface configuration at the regular and irregular ports. In particular, the stringent space constraints in which the systems are to be implemented are to be closely respected.
The design shall be fully justified against all possible loading conditions including (but not limited to):

- fire (typically up to 350°C),
- cryogenic temperatures (typically down to -50°C),
- seismic loading (Frequency Response Spectrum data to be used) and inertial loading (typically up to 15g)
- relative movements (typically up to 30 mm),
- pressure (typically max 60 kPa differential pressure).

A design by analysis methodology shall be implemented. Thermal and structural Finite Element Analysis assessments shall be developed.

2. Qualification

The thermal insulation systems shall be qualified, certified and tested in order to validate their compliance and performance against the following requirements:

- Fire
- Overpressure and depression
- Seismic loading
- Bellows relative movements
- Cryogenic environment
- Radiative environment
- Aging
- Permeability to tritium
- Material with non-activable, non-magnetic without any halogen capacities
- Capacity of being removable for in-service inspection
- Decontamination capacity

Fire qualifications (reaction to fire and fire behaviour) shall be performed under the French regulation (Order 22-03-2004 related to the fire resistance of products, construction elements and works & Order of 21 November 2002 relating to the reaction to fire of construction and development products) and certified by a French agreed laboratory (Order of February 5, 1959, approving laboratories for testing the fire behaviour of materials).

Phase 1 (design) and 2 (qualification) shall be concluded by a Final Design Review which aims at demonstrating that all design requirements (regulatory if any, safety and functional & technical) have been met.

3. Manufacture

The manufacturing design and all the corresponding manufacturing documentation (manufacturing drawings, material supplier documentation, weld data packages, manufacturing procedures, Non Destructive Examination procedures, Manufacturing Inspection Plans …) shall be prepared. It shall be reviewed before the start of fabrication through a Manufacturing Readiness Review.
The fabrication of all thermal insulation systems for the 54 Cryostat bellows / Tokamak Building interfaces shall be performed. The fabrication shall be controlled and adequate quality assurance system and subsequent quality control activities shall be implemented. This manufacture activity will be subject to IO or IO representative inspection/oversight.
A Factory Acceptance Test (FAT) shall be conducted in order to conclude that the manufacturing activities have been satisfactory completed.

4. Integration and on-site installation

The integration and the installation of the 54 thermal insulation systems shall be performed on the ITER site. Before the actual installation activities can start, detailed installation procedure documentation shall be submitted to IO for review and approval process. The installation scheme shall properly consider all on-site constraints such as the restricted space/access to the interfaces to be insulated and the co-activity & coordination with the other assembly works to be performed in the surrounding areas. All applicable environment, safety and health provisions for work on the ITER Site shall also be closely observed.

Timetable

The tentative timetable is as follows:

Call for Nomination	December 2020
Prequalification	February 2021 – May 2021
Tender submission date	June 2021
Award contract date	October 2021
Contract start date	January 2022
Contract end date	December 2024

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.
Legal entities belonging to the same legal grouping are allowed to participate separately if they are able to demonstrate independent technical and financial capacities. Bidders' (individual or consortium) must comply with the selection criteria. IO reserves the right to disregard duplicated references and may exclude such legal entities form the tender procedure.

Reference

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