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TECHNICAL SUMMARY
Call For Nomination
IO/23/CFT/70001000/AJI
Framework Contract on
Test, prototyping and manufacture of electrical harnesses for
diagnostics

1 Scope

The Diagnostic Electrical Services provide signal and power transmission lines to link vital diagnostic sensors and instrumentation in the ITER Vacuum Vessel with their associated electronics and power supplies in the surrounding buildings.

The Diagnostic Electrical Services encompass the following sections (with tag in brackets indicating the system breakdown codename):

- In-Vessel Electrical Services (55.NE.V0)
- In-Divertor Electrical Services (55.NE.D0)
- In-Vessel Electrical Feedthroughs (55.NE.V0-EFT)
- In-Cryostat Electrical Feedthroughs (55.NE.C0)
- Ex-Vessel Electrical Services (55.NE.X0)

This contract focusses on the following parts of the overall Electrical Services:

- Ex-Vessel Electrical Services (55.NE.X0)

In particular, the Ex-Vessel Electrical Services (55.NE.X0) encompasses the following components:

- Subdistribution Power Boards
- Wiring and I&C Cubicles
- Shared Cubicles
- Feedthrough Connectors (including related cabling)
- Port-cell Connectors (including related cabling)
- Port-cell Cabinets for Magnetics

This contract focusses on the following parts of the overall Ex-Vessel Electrical Services:

- Feedthrough Connectors (including related cabling)

The feedthrough connector assemblies are complete electrical harnesses originating in bulkheads with groups of custom or COTS bulkhead connectors (circular or D-type) and generally terminated several meters away with cable termination crimps. The harnesses may include one or multiple cable sub-assemblies, with halogen free high temperature insulation such as polyimide, and overall layers of mechanical, fire, dust and electrical screening.

The ITER Organization needs specialist engineering services and supply in order to successfully support the final design of these connector assemblies by executing and documenting prototyping and testing activities; and subsequently, preparing and performing the manufacturing on time and to high levels of quality.

A framework contract will be awarded in order to establish Task Orders covering the different foreseen tasks of the project.

2 Estimated Duration

The IO plans to award a Contract before the end of Q1 2024. The estimated contract duration is 4 years with an option of extending for another 2 years.

3 Tentative Schedule of this Call for Tender

The indicative Call for Tender milestones are:

Call for Nomination	End of August 2023
Issuing of Prequalification invitations	End of September 2023
Issuing of Call for Tender	End of 2023
Submission of Tenders	Mid of February 2023
Award of Contract	End of March 2024

4 Work Description

The selected contractor will be required to work on a range of tasks, including testing, prototyping, manufacturing, and:

- Production of detailed design documents, 3D CAD models, 2D diagrams and 2D drawings;
- Attendance at Design Review meetings and associated follow-up meetings;
- Manufacturing Preparation, Reporting;
- Manufacturing of the feedthrough connectors;
- Produce manufacturing documentation (e.g. MIPs, manufacturing specifications, factory testing reports);
- Organise, perform and thoroughly document Factory Acceptance Tests;
- Develop and write test, manufacturing and verification procedures;
- Develop prototypes and tests with attention to minimization of maintenance, assure compliance with IO design;
- Manufacture and test prototypes and tooling to support the development of design procedures and/or qualification;
- Project management – scheduling, reporting of work, producing and tracking of Deviation Requests and Non-Conformities; □ Requirements management and verification.

ITER may require the contractor to perform the work either at remote locations such as the contractor's usual place of business, or at the ITER site, or at a location to be established and maintained by the contractor within easy reach of the ITER site.

4.1 Description of the system

The 55.NE.X0 connectors design is at Preliminary Design (PDR) status, with the PDR (Preliminary Design Review) dating back to November 2021. As mentioned, these latter components are within the scope of this Contract.

For information, Figure 1 shows the development plan for the connectors. The activities under the scope of this task order are falling under the blocks “Connectors Final Design”, “Connectors Manufacturing Design”, and “Manufacturing”.

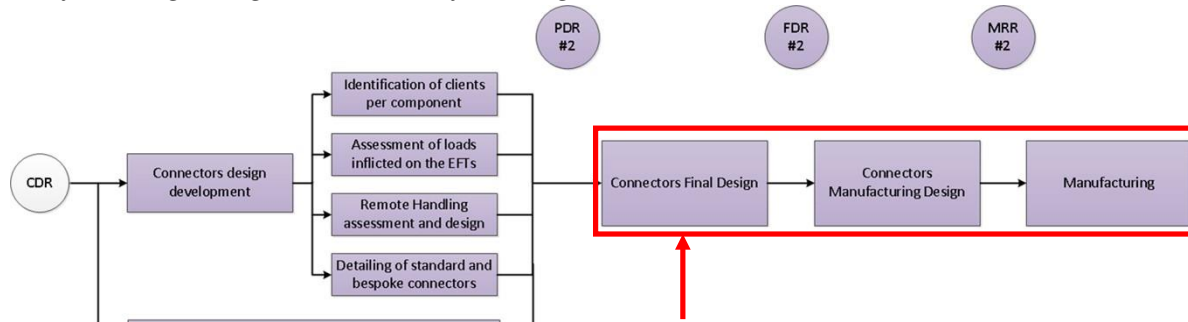


Figure 1. 55.NE.X0 connectors development plan. The red square indicated the steps under the scope of these technical specifications, whereas the red arrow indicated the current phase of the development.

Several groups can be identified for the 55.NE.X0 connectors and are all within the scope of this contract.

Group 1. Vacuum Vessel Feedthrough Connectors: these are electrical connectors with custom sockets which shall connect to the custom feedthroughs developed for the ITER vacuum vessel. They are circular connectors with several signal-type connections, spanning from DC to high-frequency signals, from low-power to kW-range. There are 130 connectors belonging to this group.

An example of the mechanical and electrical architecture of the Vacuum Vessel Feedthrough Connectors is given in Figure 2. This group is organized in different types of connectors, according to the signals and dimensions of the connectors.

With the expression “Group 1 Connector”, one shall consider the assembly of

- the connecting part with sockets mating the corresponding pins;
- the bulkhead hosting the sockets;
- the mechanical assembly providing the mating mechanisms and clamping the wires;
- the backshell conveying the external cables onto the sockets;
- the external cables exiting the connector’s backshell, for a finite length;
- the cable braids and/or conduits that protect the external cables.

Group 2. Cryostat Feedthrough Connectors: there shall be electrical connectors with commercial sub-connectors integrated on a metal plate, which shall connect to the commercial-based feedthrough developed for the ITER cryostat. They are made of normal-density and high-density sub-connectors, accommodating signals in the lowpower regime.

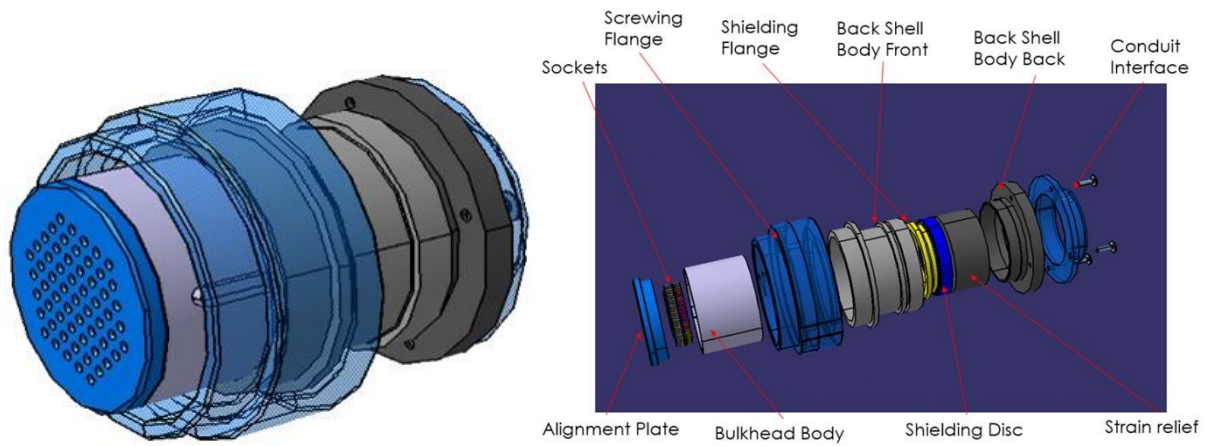


Figure 2. Representation of a connector belonging to Group 1. (Top) assembled view and (bottom) exploded view.

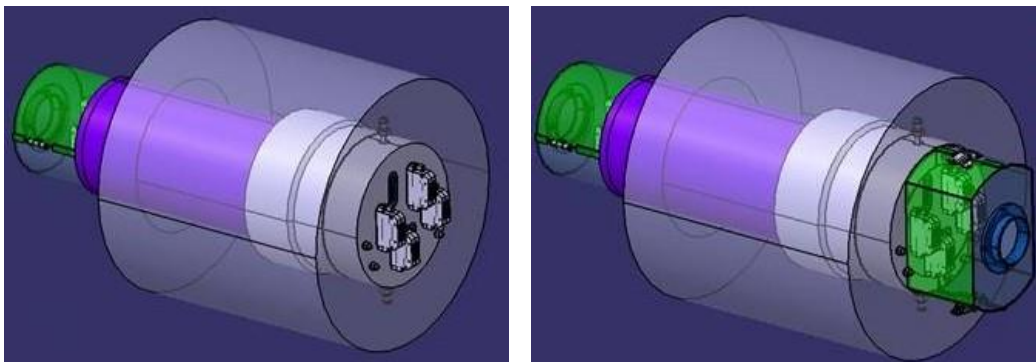


Figure 3. Representation of a connector belonging to Group 2. (Left) Sub-connectors plugging onto the electrical feedthrough; (Right) Protective metal cover for the connector.

There are 11 connectors belonging to this group.

An example of the mechanical and electrical architecture of these connectors is given in Figure 3. This group is organized in different types of connectors, according to the signals and dimensions of the connectors. It is expected that these connectors are made of several Commercial-Off-The-Shelf (COTS) sub-connectors integrated on a mounting plate.

With the expression “Group 2 Connector”, one shall consider the assembly of

- a. the COTS sub-connectors mating with the commercial-based feedthrough side;
- b. the mounting plate and/or mechanical structure hosting the sub-connectors;
- c. the backshell conveying the external cables onto the sub-connectors;
- d. the external cables exiting the connector’s backshell, for a finite length;
- e. the cable braids and/or conduits that protect the external cables.

Group 3. Closure Flange Feedthrough Connectors: these are electrical connectors with custom sockets which shall connect to the custom feedthroughs developed for the ITER port closure flanges. They are mostly (but not limited to) circular connectors with several signal-type connections, spanning from thermocouples, DC to high-frequency signals, from low-power to kW-range.

There are 70 connectors belonging to this group.

The mechanical and electrical architecture of these connectors is similar to the one shown to Group 1 (see Figure 2). Group 3 is organized in different types of connectors, according to the signals and dimensions of the connectors.

With the expression “Group 3 Connector”, one shall consider the assembly of

- a. the connecting part with sockets mating the corresponding pins;
- b. the bulkhead hosting the sockets;
- c. the mechanical assembly providing the mating mechanisms and clamping the wires;
- d. the backshell conveying the external cables onto the sockets;
- e. the external cables exiting the connector’s backshell, for a finite length;
- f. the cable braids and/or conduits and/or trays that protect the external cables.

4.2 Details of expected output

The purpose of this framework contract is to provide specialist engineering services and supply in order to successfully support the final design of these connectors by executing and documenting prototyping and testing activities; and subsequently, preparing and performing the manufacturing on time and to high levels of quality.

In more detail (note that these are indicative activities and not intended to cover all of the activities to be performed):

Group 1, Group 2, Group 3 Connectors

- Requirements Study: familiarize with the requirements related to the design and testing of these connectors;
- Prototype Study: perform a construction and feasibility study of a working prototype of connector.
- Prototyping: build a prototype according to the result of the previous step;
- Full Testing, including
 - Electrical Tests, including but not limited to
 - Electrical Continuity
 - Insulation Resistance
 - Signal Integrity
 - Voltage Standing-Wave Ratio
 - Insertion Loss
 - Dielectric Withstanding Voltage
 - EMI/EMC
 - Mechanical Test, including but not limited to
 - Mating Force
 - Mating/unmating
 - Pull force
 - Contact Retention verification
 - Flex/Bend test
 - IP66/67 Water Ingress Protection
 - Fire test
 - Vibration
 - Seismic Test

- Mating/unmating simulation with inflates suit
- Refinement: discuss intermediate results with IO before the production of final report;
- Finalization: produce the final report of the full tests performed and refined according to the previous steps;
- Revision: answer the comments of IO reviewers, by amending the report and possibly further refine the tests;
- FDR Resolution support: collaborate in producing reports and/or presentations related to the previous steps, and present them at the connectors FDR;
- Manufacturability Study: perform an analysis of manufacturability of these connectors, highlighting possible difficult points (e.g. welds, dimensions, tolerances, materials) and outlining the manufacturing procedures/steps to follow during manufacturing;
- Preparation of Manufacturing Readiness Review (MRR): produce an approved set of documents constituting the input package for the Manufacturing Readiness Review (MRR) of the connectors;
- Closure of MRR chits: proceed to the closure of the MRR and related actions/chits identified during the review in order to start the manufacturing;
- First-of-Series Manufacturing: manufacture a first-of-series connector;
- Manufacturing: manufacture the totality of the connectors belonging to each group;
- Factory Acceptance Tests: execute the FATs according to the approved procedure agreed upon MRR;
- Shipping and Delivery: organize the Delivery Readiness Review (DRR) according to the related instructions;
- Support to Site Acceptance Tests: collaborate in assisting IO answering questions raised during the Site Acceptance Tests, performed by IO.

Common General Activities

- Project Management: produce documents to describe the organization of the tests, prototyping and qualification trials. Participate and drive regular progress meetings;
- 2D Diagrams and Drawings: produce and/or supervise the production and update of 2D drawings as required for manufacturing of prototypes and/or final manufacturing of the components;
- Response to Design Review Chits: investigate the chits given in previous Design Reviews (DRs), propose a strategy to address them and propose solutions to the design/documentation as required;
- Specific Documents related to Design Review Meetings: produce a number of specific documents in order to assist in the steps of preparing, undertaking and closing the Design Reviews, closely supporting the Design Developer;

5 Specific requirements and conditions

The candidate shall demonstrate their knowledge, experience and capabilities in the implementation of providing the service for “Test, Prototyping and Manufacturing of Diagnostics Connectors for Electrical Feedthroughs” in accordance with the IO technical requirements, including:

- Experience in cable management for large electrical installations comparable with those of ITER

- Design and manufacturing of electrical connectors with several different electrical characteristics and harsh environments
- Design of RF transmission lines (impedance matching)
- I&C expertise
- Calculation and analysis of cable cross talk (experimental verification also desirable)
- Good ability to draft/revise technical reports and documentation
- Experience on nuclear and/or complex research facilities highly desirable, including a good understanding of radiation effects on cables and electronic components, shielding, etc.

The working language of ITER is English, and a fluent professional level is required (spoken and written).

6 Safety requirements

ITER is a Nuclear Facility identified in France by the number-INB-174 (“Installation Nucléaire de Base”).

For Protection Important Components 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.

In such case, the Suppliers and Subcontractors must be informed that:

- 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 and surveillance done by the Nuclear Operator.

For the Protection Important Components, structures and systems of the nuclear facility, and Protection Important Activities the contractor shall ensure that a specific management system is implemented for his own activities and for the activities done by any Supplier and Subcontractor following the requirements of the Order 7th February 2012.

NOTE: There are Protection Important Activities (PIA) related to these components. Specific PIA identification shall be performed before start of the activities (e.g. at KOM).

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. 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 from the tender procedure.

8 Reference

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

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