

## Call for Nomination Documents

# Call for Nomination - Procurement of electrical strain gages and thermocouples for the ITER Vacuum Vessel

In the frame of the Call for Nomination of the electrical strain gages and thermocouples channels, this document summarizes the needs as part of the design, qualification and procurement.



## Call for Nomination

# Electrical strain gages and thermocouples on ITER Vacuum Vessel

Ref. IO/17/CFN/14097/SMS

### **Purpose**

In the frame of the Call for Nomination of the electrical strain gages and thermocouples, this document summarizes the needs as part of the design, qualification and procurement.

### **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 Vacuum Vessel (VV) is one of the major components of the ITER machine. The VV is a large, stainless steel structure. It is made up of a double wall structure that surrounds the plasma. Its primary function is to provide a high quality vacuum for the plasma and it is a major safety barrier for ITER. As such the monitoring of the Vacuum vessel conditions is required.

The aim of the operational instrumentation of the VV and in particular of the strain gages channels is to characterize the mechanical behaviour the vacuum vessel and determine the loads exerted onto the structure. In addition thermocouples located outside the VV ensure a continuous monitoring of its temperature. Transducers, as all front-end components will operate in a harsh environment combining fast electro-magnetic transients, dense magnetic fields, radiation and temperatures between 0 and 200° C. In addition, all front-end components are to be installed in the ITER cryostat, and therefore shall comply with specific vacuum requirements.

The technical specification is based on the final design undertaken by ITER. Strain gages shall be rugged spot welded sensors. Key aspects will be their compatibility with higher temperature, temperature cycles and radiations. Foreseen strain measurements shall proceed in full bridge and include temperature compensation. Required instruments shall operate in frequency modulation and include adequate filtering. Sampling rate shall be 2kHz .

Thermocouple type N shall be used for temperature sensing. The cold junction shall be deported near or within the signal conditioner. Sensors shall be mounted on pre-welded studs and compatible with the same operating conditions as the strain gages.

As a whole, 198 thermocouples shall be procured. Thermocouple instruments shall be as well procured for a total of 603 channels. Strain gages and instruments shall be procured for a total of 316 channels without consideration of the thermal compensation. The required number of channels for temperature compensation is to be defined as part of the design. In addition nearly 15% of spare thermocouples and 30% of spare strain gages will have to be delivered along with the first batch. Similarly, the instruments shall include at least 20% spare capacity.

Cables and feedthroughs will be procured separately because they are shared by different ITER systems. Such equipment has been standardized by ITER. However, the prototyping and qualifications of sensors will require the use of small quantities of cables and connectors to test sensors in their full configuration: e.g. transducer + 80m cables + signal conditioner. It is important that cables used during qualification are of the same nature as the one installed on site. Therefore these sections of cables will be free-issued by ITER

ITER being a first of kind machine and a nuclear facility, quality is a key aspect of procurements. All components have to be qualified for conditions in which they will be used. Foreseen qualifications include thermal test, mechanical tests, irradiation and outgassing tests.

First deliveries of sensors for installation are planned in June 2019 for strain gages and November 2018 for thermocouples.

## Experience

The bidder shall have adequate experience for the work and activities as detailed below.

- Be specialized in the integration of sensors and in the fabrication of either the transducers or the instruments.
- Recognized QA standards (ISO 9001 or equivalent)
- Experience with the development of applications for harsh environment (e.g. extreme temperatures or high vacuum or radiation)
- The bidder shall demonstrate experience in setting up testing of sensors, used in harsh environment.
- Any experience on the procurement of components for nuclear applications, ITER diagnostics or ITER instrumentation is a plus.

## Work description

The scope of the work will be divided in 6 steps with two distinct lifecycle for respectively the design and procurement of transducers and the procurement of instruments. The following table illustrates the scope of work and parallel activities.

step	Transducers and front end components	Instruments (signal conditioners)
1	<b>Design of transducers and front end components</b> Selection of equipment and eventual adaptation to the specific conditions of use and requirement of ITER. This work is based on the final design developed by ITER.	<b>Selection of equipment and design of sensors</b> Selection of equipment compatible with the selected/developed transducer and meeting requirements of this technical specification.
2	<b>Prototyping</b>	
3	<b>Testing</b> Qualification based on prototype transducers and selected instruments. The objective is to demonstrate that all requirements are met while limiting the risk on series production.	
4	<b>Series-production design and pre-series fabrication</b> Definition of the fabrication procedures, followed by first sample production. Pre-series shall reflect the full fabrication process of the transducers.	
5	<b>Qualification</b> Qualification based on pre-series and selected instruments. Qualified cables will be free-issued by ITER for these qualifications of the full sensor. Some qualification may be repeated by ITER with an independent laboratory.	
6	<b>Series production and delivery</b> Transducer shall be delivered to ITER with pre-assembled pigtails for site acceptance tests and installation.	<b>Delivery to third party for sub-assembly into cubicles</b> Signal conditioner modules shall be assembled into standard racks and delivered for assembly in standard

	cubicles selected by ITER..
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## Schedule

The tentative timetable is as follows:

	Thermocouples	Electrical strain gages
End of call for nomination	May 2017	
End of call for tender	July 2017	
Contract signature	August 2017	
Contract Kick-Off	October 2017	
Design and prototype testing	End in March 2018	End in March 2018
Pre-series fabrication and qualification	End in June 2018	End in February 2019
Series production batch 1	<b>Due to 16 November 2018</b>	<b>Due to 14 June 2019</b>
Series Production of subsequent batches	End before 5 November 2019	End before 8 November 2019

## 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.

## Reference

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