



Framework contract for Procurement of optical fiber sensors and connector boxes

Call for Nomination

1 Purpose

The purpose of this framework contract is the following:

- To manufacture, test and supply strain, displacement, temperature and acoustic optical fiber sensors (OFS), based on Fiber Bragg Gratings (FBG's) technique,
- To manufacture, test and supply optical fiber connectors.

This work is performed in frame of the ITER activity on Blanket and Divertor Operation Instrumentation (B&DOI).

2 Background

ITER 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.. The ITER Members - China, the European Union, India, Japan, Korea, Russia and the United States - are now engaged in a 35-year collaboration to build and operate the ITER experimental device, and together bring fusion to the point where a demonstration fusion reactor can be designed. General information on the scope and design of the ITER machine is described in the www.iter.org website.

Some of the most technically challenging components of the ITER machine are those, which directly face the thermonuclear plasma. A selected number of plasma-facing components will be equipped with instrumentation to monitor the temperature, strain, displacement and acoustic emissions in these components during ITER operation.

The measurements shall be performed during steady-state conditions and plasma fast transient events. During these latter events, there is a very fast variation vs time of the magnetic field (up to 100 T/s).

The OFS offer significant advantages in comparison with the conventional electrical sensors, such as:

- high radiation resistance,
- immunity from electromagnetic interference (EMI),
- high sensitivity,
- possibility to connect several sensors in one optical fiber.

Moreover, the OFS based on FBG's technique are the most promising for the ITER operating conditions, for the following reasons:

- The FBG technique is based on spectral measurements, and not on amplitude measurements. This eliminates the effect of light amplitude reduction due to radiation-induced transmission losses in the optical fiber;
- The accuracy is high: 0.1°C for temperature measurements and 10^{-6} ϵ for strains;
- FBG have a good radiation resistance and may work up to a neutron fluence of $5 \cdot 10^{19}$ n/cm² and a total dose of ionizing radiation of $2 \cdot 10^9$ Gy;
- Several FBG sensors may be used in one optical fiber (multiplex use);
- FBG sensors have full immunity to EMI.

Additionally, OFS can work in high vacuum and at high temperatures provided that the attachment of the FBG to the sensor body is designed for such a purpose. Recent R&D works have shown that such OFS can be designed and manufactured based on the concept of brazing optical fiber with a copper coating to a metal plate.

In the ITER machine, it is decided to use four types of OFS based on FBG technique, namely: strain, displacement, temperature and acoustic sensors. In total, a few thousands of OFS's are planned to be used. There is also the need to connect the cable from OFS with cables running onto the Vacuum Vessel (VV) positioned in bundles inside cable channels (so called "cable looms"). For this purpose, it is planned to use box-type connectors, so-called "connector boxes". These connector boxes will have as well the function to protect the welded (or spliced) part of the fibers.

3 Scope of Work

The scope of supply of this framework contract covers the following activities:

1. Selection of the OFS's and connector boxes design solution (which means reproduce the design already pre-qualified or adapt it and validate it);
2. Organisation and performance of a Manufacturing Readiness Review;
3. Manufacturing of sensors and connector boxes;
4. Definition and execution of Factory Acceptance Tests;
5. Packing and delivery of the sensors and connector boxes to the ITER site;
6. Quality Management and Supply of documentation.

The procurement is organized in batches, each one procured via a corresponding Task Order, as detailed hereinafter.

4 Procurement of Equipment

In accordance with the proposed delivery schedule the Supplier shall provide IO with the set of different OFS's and connector boxes identified in "Table 1 – Tentative quantities for the different types of OFS's and connector boxes".

Table 1 – Tentative quantities for the different types of OFS’s and connector boxes

Type	2020 (number)	2022 (number)	2023 (number)
Strain sensors	100	300	300
Displacement sensors	100	100	110
Temperature sensors	300	300	330
Acoustic sensors			40
Connector boxes (for OFS)	70		

5 Experience Requirements

The ITER Organization is looking for Suppliers with demonstrated experience in developing and manufactures the rad-hardness optical fiber sensors for high temperatures application. The Supplier must prove to be able to provide in an organised way the competences specified in the Scope of Work above, and specifically in manufacturing optical fiber sensors (temperature, strain, displacement and acoustic) based on FBG technology for high temperatures application (up to 600°C) and high irradiation environment.

In addition, during the tendering process the Supplier will have to provide evidence of:

- *QA system:* The Tenderer 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.

6 Award of the Framework Contract

It is contemplated that the ITER Organization will award a framework contract for an initial period of four years, which may be extended for two additional years, if the need arises.

The framework contract will be implemented by means of Task Orders, intended as a self-standing engineering and procurement activity. Each Task Order shall be signed by the Contactor and the ITER Organization.

The language used at ITER is English. A fluent professional level is required (spoken and written English)

7 Candidature – Expression of Interest

Candidature is open to all companies participating either individually or in a grouping (consortium) which is established in an ITER Member State. A consortium may be a permanent, legally-established grouping or a grouping, which has been constituted informally -- but formalized with engagement letters -- 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 consortia shall be presented at the pre-qualification stage, where they will be assessed as a whole. Consortia cannot be modified later without the prior approval of the ITER Organization.

8 Timetable for the Tender Process

The tentative schedule for this tender process is as follows:

Call for Nomination (C4N)	<i>November 2018</i>
Pre-qualification of Companies	<i>January - February 2019</i>
Invitation for Call for Tender	<i>March 2019</i>
Tender Submission	<i>May-June 2019</i>
Contract placement	<i>July-August 2019</i>
First Task Order signature	<i>September-October 2019</i>