Summary: Development of Light Weight Sensors for Remote Leak Detection and Localisation

1 Introduction

ITER will be the largest and most complex vacuum system yet to be built. Situated in Southern France, adjacent to the French CEA Cadarache site, the ITER facility covers approximately 190 hectares and is designed to study the fusion reaction between the hydrogen isotopes tritium and deuterium.

It is expected that water leaks from the Tokamak Cooling Water System (TCWS) Primary Heat Transfer Systems (PHTS) into the main vacuum vessel (VV) and helium leaks into the cryostat from the thermal shield and magnet systems will result in a reduction of the availability of the ITER machine and hence method(s) of leak localisation and repair must be developed to minimise machine down time caused by leaks.

The most reliable processing of the leaks would be with a help of a tool with direct access to the leak source to this end a Fast Deployment Device (FDD) has been proposed for ITER. The FDD is a remotely operated dexterous device which will have the capability to carry and position a payload of leak detection sensors in close proximity to the suspected leak. Once in position it is envisaged that area under investigation can be spatially scanned with the FDD/leak sensors and the position of the leak identified either by direct measurement or (for e.g.) centroiding of the sensor signal(s).

2 Scope

Under the scope of the contract the Contractor shall design, manufacture and test sensors which, when used in conjunction with the FDD[1], meet the following requirements:

- Detection of water and helium leaks with magnitude >1 x 10^{-6} $Pa.m^3.s^{-1}$ at a distance of approximately 10 cm from the leak source with a spatial resolution of < 10 cm. The response time of the sensor system shall be < 1 second.

It is envisaged that the Contractor will produce and deliver to ITER two prototype sensor systems, one each for water and helium leak localisation, though it is clearly an advantage to develop a single sensor which meets the requirements for both.

3 Planned Approach

The following describes how the work envisaged in executing the contract will be performed.

3.1 Prototype Design and Manufacture

The Contractor shall develop for demonstration a prototype of each (water and/or helium) sensor, control and readout system with the required technical characteristics. Where such sensor(s) are not commercially available, the Contractor shall design and manufacture a prototype of the sensor and associated control and readout equipment. In the case where the sensor(s) are commercially available the Contractor shall obtain the sensor and associated control and readout system.

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[1] FDD operational requirements are provided in Annex 1 to this technical specification

3.2 Preliminary Demonstration of Performance

The Contractor shall propose, for approval by ITER, a test plan which when executed will demonstrate that the performance of the sensor(s) meets the requirements of the Technical Specification. On approval of the test plan the Contractor shall prepare the necessary test equipment and execute the test plan. The Contractor shall account for any failure of the sensors to reach the performance as specified in the Technical Specification and detail design enhancements to the sensor system(s) required to meet the performance goals.

3.3 Delivery

On completion of the Contract the Contractor shall deliver to ITER the prototype sensor(s) control and readout systems developed under the scope of the contract.

4 Schedule

Action	Tentative date(s)
Call for Pre-qualification	July 2011
Call for tender	September 2011
Tender submission	End October 2011
Contract Award	November 2011
Start of contract	November 2011
End of contract	November 2012

5 Experience

The potential tenderers should have proven experience in the following areas:

1) The Contractor shall have adequate experience in the development of instrumentation.

2) The Contractor shall have adequate experience in vacuum technology.

6 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 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 groupings shall be presented at the pre-qualification stage. The tenderer's composition cannot be modified without the prior approval of the ITER Organization after the pre-qualification.

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

Appendix 1: FDD Operational Requirements.

The following describes the operational requirement and design constraints place on the FDD which shall be applied to the sensor(s) developed under the scope of this contract.

- The FDD shall have the capacity to support its own weight and a payload of 50mm dia, 100mm length and between 0.1 and 1Kg
- Shall be able to operate at a maximum tip / Point of Reference (PoR) speed of 50 mm/s
- Shall reach within 100mm of all plasma facing surfaces at the POR. (See Figure 1)

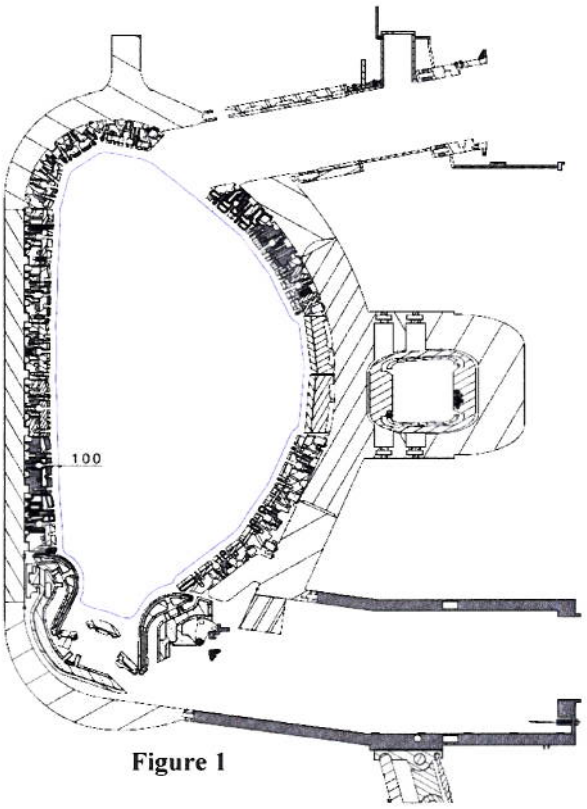

Figure 1

- Shall achieve a controlled POR positional resolution of 10mm
- Shall achieve a controlled POR positional repeatability of 25mm
- Shall achieve a controlled positional accuracy (wrt to global coordinates) of 100mm
- Shall respond to a stop command within 5 secs
- Shall be able to respond to a step change in velocity demand with no significant overshoot and settle time of less than 2 seconds
- Shall be able to move at controlled velocities between a minimum of 5mm/s and the maximum stated herein with an accuracy of 10%

- Shall be able to retain a steady position with no drift in undisturbed conditions
- Operate at normal atmospheric pressure in an air or Nitrogen gas environment
- Operate within a 'negligible residual magnetic field' (<0.1 Tesla)
- Operate within a temperature range of 20-100 °C
- Operate at a radiation dose rate of 500 Gy/hour.
- Withstand a total dose of 1MGy