iter
china eu india japan korea russia usa

Summary: ITER Leak Localisation – Cryostat Concentration Map Technique

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.
Methods of leak localisation can be characterized by two groups – invasive and non-invasive. Invasive techniques require a vessel vent and hence a longer intervention to localise and subsequently repair a leak is required it therefore preferable to utilise non-invasive techniques. It has been proposed that by the use of multiple sensors permanently installed in the vacuum system the location of a leaking component can be identified by the creation of a concentration map derived from the sensor signals. The feasibility of this method it to be studied under the scope of this contract.

2 Scope

Under the scope of the contract the Contractor shall perform studies into the feasibility of the concentration map technique for leak localisation in the ITER Cryostat. Based on the results of the studies the Contractor shall propose a concept design of leak localisation system based on the method and study the feasibility of integration of the system with the current ITER design. The Contractor shall develop an R&D plan which when executed will practically demonstrate the applicability of the method to ITER should the method proven viable through the studies. The execution of the R&D plan is outside of the scope of this contract.

3 Planned Approach

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

3.1 Collection of Data

The Contractor and ITER shall agree the leak type (helium, water) and leak magnitude to be studied the position of the leak shall also be agreed.
The Contractor shall collect and agree the conditions (geometries, radiation, temperature etc.) under which the concentration map technique will operate and will collect all the necessary (CATIA) models from ITER required to perform the task. From this data the Contractor shall compile a requirements document detailing requirements (spatial resolution, time to build the map etc.) of the concentration map and provided detailed description of how the modelling of the system(s) is to be performed.

3.2 Modelling

Modelling of the concentration map resulting from a leak into the cryostat is split into two subtasks. Sub-task 1 will assess feasibility of the concept and shall extend only to a simplified

model of the cryostat. If the concept is show to be feasible the Contractor shall extend the studies to full model of the cryostat and simulate the concentration maps resulting from leaks in known positions under the scope of sub-task 2. If the feasibility of the concept is not shown to be viable then the Contract shall terminate at end of sub-task 1.

3.2.1 Sub-task 1: Feasibility Model

The Contractor shall develop a simplified model of the cryostat. The model only shall include the surfaces of the cryostat components which may also be modelled with simplified geometry. The Contractor shall model the leak species concentration map in the cryostat resulting from a leak in the cryostat in a predetermined position. The Contractor shall create concentration maps at agreed time periods after the leak occurrence and a concentration map in the steady state condition.

3.2.2 Sub-task 2: Full Model

On successful demonstration of the concept the Contractor shall extend the model to represent the full ITER cryostat geometry including ports, pumping systems, magnet systems and thermal shields. Taking into account the effect of pumping on the cryostat the Contractor shall simulate a leak from a known position and create the resulting concentration map. The Contractor shall present the concentration map temporally evolving from T=0 (no leak) to the steady state condition.

3.3 Concept Design

Using the results of sub-task 2 the Contractor shall make a concept design of leak localisation system based on the concentration map technique. The Contractor shall describe in the design the number, location, sensitivity and response time of the sensors required to realise the technique. The Contractor shall study the feasibility of integration of the concept with existing ITER systems and propose enhancements to the ITER design where necessary to accommodate the system.

3.4 Plan to Demonstration

The Contractor shall develop a resource loaded plan which if executed will practically demonstrate the concentration mapping technique and it's applicability to ITER.

4 Schedule

Action	**Tentative date(s)**
Call for Nomination	08 July 2011
Call for tender	12 August 2011
Tender submission	23 September 2011
Contract Award	End October 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 modelling of complex systems.

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