



Port-Cell & Vault to DS & LAC 0D & 3D CFD Modelling

Call for Nominations

IO/16/CFT/10012755/ABN

Purpose

The purpose of this Call for Tender is for the placement of a 2 years Services Contract for Dynamic Confinement Modelling for Nuclear Compartments with a flexible 0D Concentrated Parameter Model followed by a 3D Computational Fluid Dynamics Modelling and Analysis Study, in order to simulate over time the evolution of the Gas/ Air Conditions (Pressure, Temperature, Density, Contamination, Psychrometric's, etc) within the Volume of the Nuclear Compartments (Port-Cells, Vault, etc) in Normal Steady State Operation, Operation Transients and Extended Transients for the different ITER Modes of Operation. This Study has the main purpose to assess the impact on the main Nuclear Ventilation System at ITER (DS Detritiation System) and the internal Local Air Cooler (LAC) serving these rooms.

Background

ITER is the next generation fusion machine which is foreseen to operate with tritium-deuterium plasma. Therefore tritium collection and confinement is required. This requires a Ventilation System that provides Dynamic Confinement, in line with ISO-17873. The goal of the activities in the scope of the work of this contract will be an input to verify the loads to this system (DS), in terms of the flowrates versus time, and the conditions of the Feed Gas/Air (Pressure, temperature, humidity, composition, contamination, etc), that the DS system will have to both handle & process, plus demonstrating that the confinement under-pressure in the compartment can be maintained.

There are many compartments (e.g. Port Cells, Vault, etc) in the ITER Tokamak Complex, with many Client User Systems that issue either direct loads (e.g. process gas leaks, etc) or indirect loads (e.g. Thermal heat losses, Valve Actuator Venting, etc).

It is the Compartments themselves that have to be modelled, with the various input variables such as the heat loads and flow inlet/outlet from Client User System's located in the rooms, heat losses to the structures and systems, such as the compartment boundary walls and other cold sinks, as well as the operation of the conditioning equipment such as the Local Air Cooler (LAC) and the DS itself. The 0D concentrated parameter model will be set up for each of the compartments identified in the table below, i.e. 3 ports cell and 1 vault, that can be set-up and ran on suitably Robust, Precise & Fast Thermodynamic Calculations Software (e.g. Modelica type, Matlab, Flowmaster, etc). The analysis run on the model will cover a number of both Steady State & Transient analyses. Following this a 3D Model e.g. ANSYS Fluent will be set up, for each compartment, and a comparative number of both Steady State & Transient analysis run.

The work will involve taking the Client ITER Organization inputs such as boundary temperatures, heat transfer condition and flow inlet/outlet rates, and initial conditions from

source Client User Systems. The analysis will also be considered as an input to assess current design of the hydraulic control valves, sensors and associated Control Logic of both DS & LAC, as well as the primary requirements of defining the loads to these systems, i.e. Heat loads and flowrate, and their variations over time given a constant pressure. The results will be presented as time histories of the conditions within the compartment, as well as the variation of the output loads mentioned. For the 3D CFD model, 3D mapping of conditions in the compartment, such as flow patterns, pressure & temperature gradients over time are required.

Scope of work - for this services contract this is defined in the following table:

		Compartment Name & Deliverables			
Objective		Port Cell #1	Port Cell #2	Port Cell #3	Vault
Contractual		A Work Plan describing the contractor activities & deliverables planned, the associated schedule and who will perform the work. A Quality Plan demonstrating the contractors QA and how they plan to manage the delivery of the contract with checks ensuring quality			
Contract PHASE -1	Work & Quality Plan Inputs +Assumptions	A Data Input File will be set-up & maintained by the Contractor for the Design Basis Input Parameters (from the inputs will be transferred by IO at the Kick-off-Meeting) A Functions/ Assumptions & Operation Scenarios File will be set up & maintained by the contractor to define the various Analysis that the Client wants covering Steady State & Transient A collection of the 3D Layout Models Step Files have to be agreed & identified to form the input to the OD & 3D Modelling These files will form the agreed input definition for the modelling & analysis.			
	OD Model, Steady State & Transient Analysis	In Phase 1 a OD Model is to be developed for each of the four different Compartments above mentioned. On this the Contractor can run its OD Parametric analysis for the various agreed Operation Scenarios & Inputs. The Contractor must get a good Task understanding, producing a flexible Model used for studying rapid outputs, Sensitivity studies & control logic. The contractor has to deliver a Technical Report, the Native Model Files and the Parameter & Macro Input Files , explaining the basis for their model & approach, and a description of all the analysis scenario's that they run on their model, with the calculations & results with explanations, technical review, conclusions & recommendations, (time plots of outputs required).			
Option PHASE-2	Set up 3D Model & Meshing for CFD	In Phase 2, for a selection of Compartments among the above mentioned ones, a 3D Model & meshing for the CFD analysis will need to be set up. This will be generated from the CATIA Step-File to the 3D Modeller Software, to generate a suitable model mesh for CFD (ANSYS Fluent). With a cross-check to ensure Geometry Processing/ Meshing is successful. The contractor has to deliver the Native Model Files & Technical summary report explaining the basis for their model & approach, with validation.			
	3D CFD Analysis –Steady State	Phase 2 completion is to do the various Steady State CFD Analyses of the various scenarios based on the defined inputs on the set-up 3D Model. The contractor has to deliver a Technical Report, the Native Model Files and the Parameter & Macro Input Files , used in the Analysis. The Results should include snap-shots of the 3 dimensional flowmaps and numerical			

		tables giving the output in specific location, e.g. for the various conditions over the run time. This should include Airflow Velocity Streamlines, Pressure & Temperature Fields, Psychrometric Conditions, density, Contamination Spread fields. Compartment averages of various conditions should be plotted against time, along with the extract flowrate.
Option PHASE -3	3D CFD Analysis – Normal / Extended Transients	The Phase 3 first step is, for a selection of Compartments among the above mentioned ones, to do the various Normal/ Extended Transients CFD Analyses of the various scenarios based on the defined inputs on the set-up 3D Model. The contractor has to deliver the Native Model Files and the Parameter & Macro Input Files . A more comprehensive Technical & Results Report has to be issued, similar to that explained in Phase 2.

Procurement Timetable

The tentative timetable is as follows:

Call for Nomination Submission	April 2016
Pre-Qualification submission	May 2016
Tender Submission	July 2016
Contract Award	August 2016

Experience

The contractor and its personnel shall have adequate and documented experience in 0D and CFD analyses for Industrial and/ or Nuclear Facilities. This includes but not exhaustive:

- Ventilation System Design for compartments housing complex systems, e.g. Process Plants, Power Plants, Clean rooms, IT Server Installations, Nuclear Auxiliary Service, etc.
- 0D concentrated parameter modelling with feedback on implementation on real systems.
3D CFD modelling with Steady State & Transient analysis with feedback on real systems
- Demonstration of expertise & experience for similar study types, and Validated Modelling & Analysis for other critical services infrastructure, industrial process and/or Nuclear Installations.
- Suitably Qualified Experts Personnel to conduct the Modelling & Analysis Studies, with the practical expertise of its implementation/ use on real infrastructure.
- Evidence of use of accepted versions & licences of 0D & 3D CFD Software types.

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 groupings shall be presented at the pre-qualification stage. The tenderer's composition cannot be modified without the 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 reference projects and may exclude such legal entities from the pre-qualification procedure.