Diagnostics Specialized Engineering Design Framework Contract

IO/19/CFT/70000483/LLJ

Call for Nomination

1. Purpose

This tender is almost uniquely aimed at supporting the first plasma systems. It is imperative now that these systems do not fall behind in the schedule and as a result, we wish to get this in place urgently.
The purpose of this Contract is to provide specialized development services for many different Diagnostics. Most of the Diagnostics are the scope of the Domestic Agencies (DAs). About 30% of the Diagnostic scope is however completely IO scope. A large variety of Diagnostics techniques are covered by this contract.

2. Background

The Diagnostics System provides accurate measurements of plasma behaviour and performance, including those needed for machine protection and basic machine control; those required for advanced plasma control; and those required for evaluation and physics studies. Implicitly this includes also first wall measurement functions.
In total there are about 50 diagnostic systems grouped in 7 groups which respond to these requirements. The groups are these:

- Invessel loom development
- Port, building and Invessel analysis
- Magnetic diagnostics
- Diagnostics for neutrons and fusion products
- Optical diagnostics
- Bolometers
- Spectroscopic diagnostics
- Microwave diagnostics
- Plasma-facing diagnostics

The diagnostics scope includes also port-plugs and other infrastructure which hold these diagnostics in place, in the ports and the divertor. Figure 1 gives an overview of the diagnostic scope inside the tokamak.

Most of the diagnostic systems are being procured in kind from the Domestic Agencies (DAs) to functional specifications. Exceptions for which IO has to do detailed design work are the magnetic sensors, and in vessel cable looms which will be procured through built to print contracts. For several other diagnostics IO has even the full responsibility from conceptual design to procurement. These are thermocouples, erosion monitor, dust and tritium inventory

monitors, first wall samples and plasma boundary flow monitor, in vessel electron cyclotron heating protection probes.

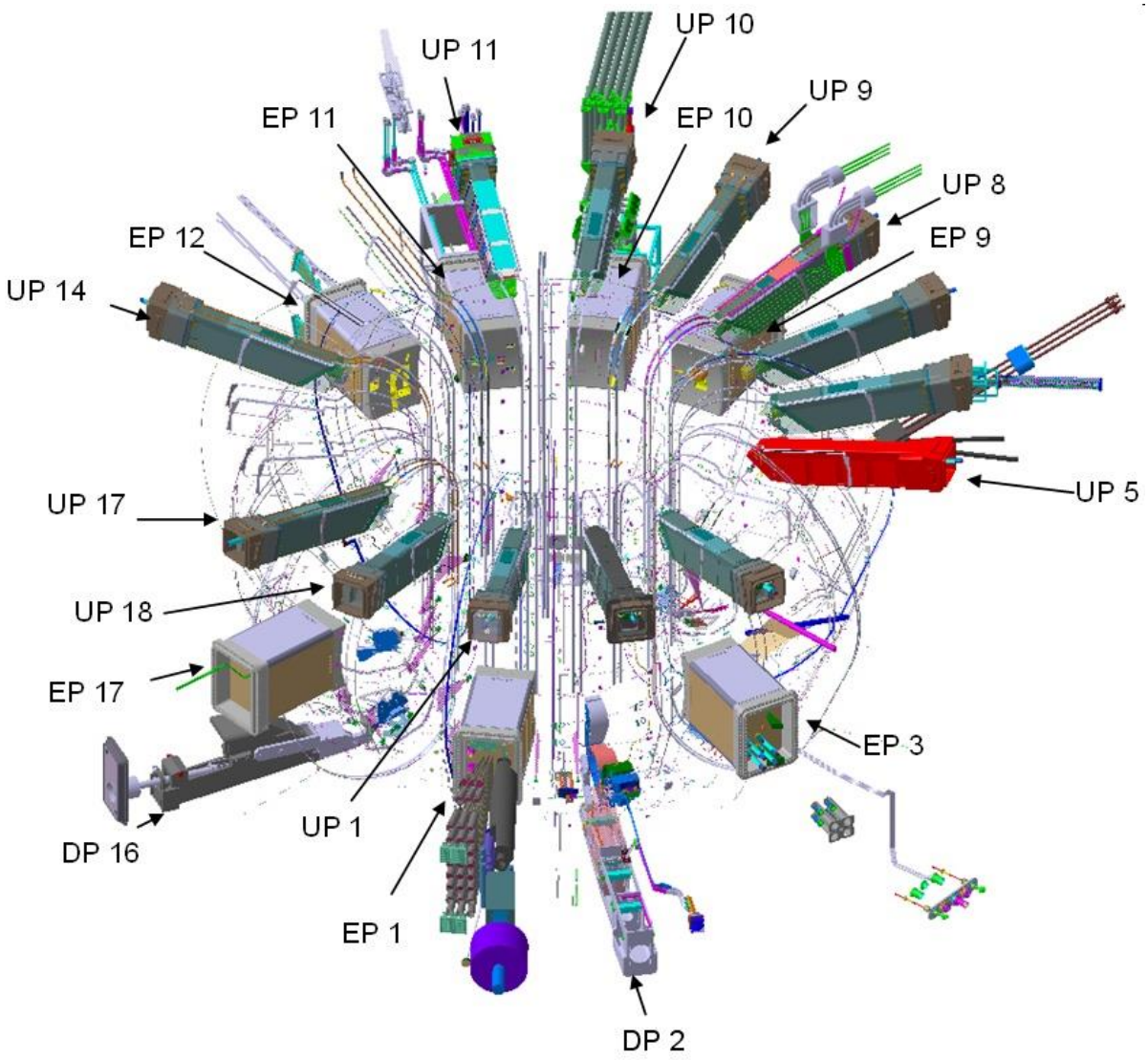

Figure 1: Overview of diagnostics inside the tokamak (EP means Equatorial Port, UP Upper Port, DP Divertor Port) – note regarding scale: one EP has a cross section of 2m * 2.5 m approximately

3. Scope of work

The scope of the development services requested in this specification requires that the contractor's company provides suitable and experienced personnel to contribute to, establish and reinforce the ITER diagnostic systems.

- Invessel loom development
- Port, building and Invessel analysis including optical
- Neutron calibration and analysis
- 3D-2D and interface engineering
- Requirements and RAMI checking

- Qualification and testing and assembly support for common components and distributed systems
- Diagnostic maintenance preparation for first plasma nuclear and occupational safety
- Manufacture of small components to demonstrate design aspects when needed

As a general statement, the details of the services to be provided by the contractor will be defined in the task order technical specification document.

These technical specifications will be defined specifically for each Task depending on the actual requirement and will include a technical scope, the organization of the task in IO and a description of the deliverables.

4. Timetable

The tentative timetable is as follows:

Prequalification Submission	beginning of December 2019
Call for Tender	March 2020
Tender submission	Mid of April 2020
Contract placement	July 2020

5. Experience

The contractor's company and its personnel shall have adequate experience for the work as detailed below.

Experience in Tokamaks is necessary in most cases.

Knowledge and experience for the following activities is requested – depending on the specific diagnostic and task in question:

- General Diagnostics physics, engineering, design and development with ability to cover issues from sensor to data analysis – including plasma-wall interaction physics, plasma physics, neutronics (MCNP calculations), vacuum-physics, low-pressure discharge physics (DC and RF discharges), mechanical design engineering, design engineering, electromagnetic analysis, thermo-mechanics, hydraulics, optics, opto-mechanics, Monte-Carlo-straylight analysis, data-analysis (conventional programming and baysian analysis), image-processing, data-mining technics,
- Physics, concept, engineering, design, realisation, interface definition, prototyping and manufacturing supervision, acceptance testing, installation, commissioning, operation, scientific exploitation and documentation of Plasma diagnostic systems,
- Magnetics systems physics, engineering, design, development and integration – including, magnetic systems electronics and software, Rogowski coils and other inductive sensors, steady state sensors, flux loops, fibre optical current sensors and high frequency pick-up coils,
- Neutron Diagnostics physics, engineering, design, development and integration – including neutron calibration, neutron cameras, micro-fission chambers, neutron flux monitors, gamma spectrometry, neutron activations systems, lost alpha monitors and neutron spectrometry,

- Optical Diagnostics physics, engineering, design, development and integration – including conventional and collective Thomson scattering systems, Interferometers and Polarimeters,
- Bolometric Diagnostics physics, engineering, design, development and integration,
- Spectroscopic Diagnostics physics, engineering, design, development and integration – including charge exchange recombination spectroscopy, H-alpha and visible light spectroscopy, VUV spectroscopy, Impurity monitoring in the XUV range, plasma core imaging X-ray spectroscopy, X-ray imaging, neutral particle analysis, laser induced fluorescence, motional stark-effect spectroscopy, X-ray plasma core spectroscopy, hard-x-ray monitoring and beam emission spectroscopy,
- Microwave diagnostics physics, engineering, design, development and integration – including electron cyclotron emission spectroscopy and microwave reflectometry,
- Operational Diagnostics physics, engineering, design, development and integration – including visible and infrared imaging and thermographic systems (including spectrally resolved and lock-in thermography), thermocouples, pressure gauges, residual gas analyser (quadrupole-mass analysers), Langmuir probes, Erosion monitoring (speckles interferometry), dust monitoring (endoscope with dust sampler), tritium monitoring (Laser induced desorption and laser induced breakdown spectroscopy) and first wall samples,
- Shutter system physics, engineering, design, development and integration – including movement (electrically, hydraulic or mechanically driven) in high vacuum and magnetic field technology,
- First Mirror cleaning system physics, engineering, design, development and integration -including low pressure discharge and radiofrequency technology expertise,
- In-Vacuum and ex-vacuum electrical distribution systems physics, engineering, design, development and integration – including electrical cables (signal and power), looms, connectors (remote handling and conventional) and vacuum feedthroughs
- Windows physics, engineering, design, development and integration
- In Vessel Viewing diagnostics, physics, engineering, design, development and integration – including high frequency amplitude modulated laser interferometric metrology and laser reflectometry based imaging and movement (electrically driven) in high vacuum and high magnetic field technology expertise,
- Diagnostics engineering interfaces resolution in complex environments – including in-vessel, divertor cassettes, ports, port plugs, cryostat, port interspaces, port-cells,
- Integration of Diagnostic systems in Buildings and site infrastructure – including galleries and diagnostic building and other buildings used by diagnostics,
- Diagnostics Instrumentation and Control, design and development,
- Diagnostics project organization and implementation,
- Manufacture of small components to demonstrate design aspects when needed

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 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.