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Technical Specifications (In-Cash Procurement)

Technical Specifications for services in support of plasma engineering and analysis for ITER Internal Components

Technical Specifications for contract to be placed on provision for Services in Support of Plasma engineering and analysis for ITER Internal Components

Provision for Services in Support of Plasma engineering and analysis for ITER Internal Components

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1 Purpose

The Blanket and Divertor systems are among the most technically challenging components of the ITER machine, having to accommodate high heat fluxes from the plasma, large electromagnetic loads during off-normal events and demanding interfaces with many key systems and the plasma itself.

The Blanket System is now in its Procurement Arrangement (PA) phase with the first PAs having been signed in November 2013. The effort on the Blanket System at this stage requires analysis to assess design changes resulting from by post-PA deviation requests and/or Project Change Requests (PCRs).

The First Plasma Protection Components (FPPC) will be required for first plasma in the physical absence of the Blanket first wall and divertor. The Conceptual Design Review for this component took place in November 2016. Further design verification is needed in support of detail design developments.

As regards the Divertor, due to the introduction of W in the target regions as decided by the ITER project in 2013, very tight misalignment tolerance between Tungsten monoblocks is tolerable, so that the protection of the target leading edges is mandatory. For this purpose a shaping strategy for Plasma Facing Components (PFCs) was developed and implemented, that affects in particular the heat loads expected onto the component. The effort on the Divertor at this stage requires specific analysis to assess how these design changes affect the plasma loads specifications, these latest being furthermore impacted by the new phase approach (thus requiring a consequent update in accordance with the new ITER Research Plan). Meantime, post-PA deviation requests, in particular any modifications of tolerances could impact the shaping strategy and shall be carefully assessed as well.
Additionally, some high heat flux testing performed at the ITER Divertor Test Facility in Russia and R&D contracts on Critical Heat Flux and CuCrZr behaviour under baking conditions require thermal modelling.

The objective of the services required under these Specifications is to provide the above-mentioned support in plasma-engineering to the Internal Components Division.

2 Scope

The scope of work includes the following tasks:

- To refine or prepare relevant plasma Heat Load Specifications (HLS) in collaboration with Divertor and Blanket physicists and engineers. This means in turns:
    - To get acquainted with the current HLS
    - To act as effective interface / liaison officer with physicists. To organize, chair and minutes meetings with relevant engineers and physicists;
    - To participate to the elaboration of the related Interface documents and to maintain the tolerance documentation.

- To update the corresponding HLS and check the consistency with the current LS documentation. To evaluate the 3D heat load distributions on PFC envelopes. This means in turns:

- To select the CATIA model from the IO database for the meshing of the "shadowed" and "shadowing" components;
- To perform the 3D field line tracing with dedicated plasma-engineering code (e.g. PFCFLUX), interfacing with magnetic equilibrium reconstructions from scenario development codes used at the IO (CORSICA, DINA);
- To post-process the data;
- To provide the proper analysis report including all the compiled results.
- To propose an alternative shaping solution, if needed

- To perform thermal calculations on the PFC. This means in turns:
  - To select the CATIA model from the IO database for the meshing of the components or to create the relevant model;
  - To perform the analysis (with ANSYS, Matlab or any other plasma engineering code);
  - To post-process the data;
  - To provide the proper analysis report including all the compiled results.

3 Definitions

For a complete list of ITER abbreviations see: ITER Abbreviations (ITER_D_2MU6W5).

4 References

Not applicable.

5 Estimated Duration

The duration of the engineering support services will be for one year.
The IO may exercise the option to extend these services for an additional period of one year. Such option shall be exercised by written notice to the Contractor no later than 90 days before the expiration of the initial term of the contract or of the additional period.

This is a deliverable based contract.
The contract activities shall start on the signature of this contract (T0).

6 Work Description

The work description of the engineering support to be provided by the Contractor comprises the following:

1. Evaluate the 3D heat load distributions at the target region and baffle region for the Dome, Inner and Outer Vertical Targets (IVT & OVT).

2. Perform 3D Finite Element thermal calculations on target region and baffle region for the IVT & OVT and provide 3D maps of temperature.

3. Assess the consequences of tolerances relaxation following Cassette Body prototypes manufacturing on the current shaping strategy by performing 3D field line tracing and heat load mapping if required. Maintain the tolerance documentation up-to-date.

4. Perform thermal analysis on W monoblock models, in support of high heat flux testing, R&D contract on CuCrZr evolution under baking conditions and Critical Heat Flux.

5. Refine /Update the Divertor heat load specifications and reference plasma scenarii used as basis for the shaping analysis, following the recommendations raised by the panel expert during *the ITER Divertor Monoblock Shaping Workshop* held at IO in September 2016. Perform or provide assistance for any associated plasma-engineering modelling (Lightools, Raclette or any other plasma engineering code).

The work description found in the present Technical Specifications is open to revision during the contract. Any change, if required, will be discussed during progress meetings to agree on the associated workload.

7 Responsibilities

Contractor's Obligations

The Contracted engineer will be fully dedicated to performing the Services.

The contracted engineer is expected to be on assignment at the ITER Site of Cadarache, France, to perform the work for the entire duration of this Expert Contract.

The contract does not allow reassignment of the contracted engineer for the duration of the task without the prior approval of the ITER Organization (IO).

The contracted engineer will be bound by the rules and regulations governing IO safety and security.

In case of a non-EU citizen, it is required for the Contracted engineer to obtain his/her French working visa prior their arrival in France.

Obligations of IO

IO shall make available to Contractor's Personnel dedicated and located on IO site at Cadarache:

- Procedures, information and data and any other information for the Contractor to perform its functions under this Scope of Work;

- User facilities on equipment (including communication lines and computers) with adequate capacity necessary for a proper execution of the Services by the Contractor; Computers, software and all data produced during the contract shall remain property of the ITER Organisation.

- A safe work area which meets the requirements which are generally made for such an area for the satisfactory execution of the Services.

8 List of Deliverables and Due Dates

The deliverables for the first year of the contract (firm part) are described below and the reports on the completion of these deliverables should be provided by the due dates.

	DELIVERABLES	DUE DATES
1	Report on expected 3D heat loads on Divertor Components	T0 + 2 months
2	Report on 3D thermal modelling of Divertor Components	T0 + 4 months
3	Report on assessment of tolerances relaxation following Cassette Body prototypes manufacturing and impact on PFC shaping strategy	T0 + 7 months
4	Report on thermal modelling of W monoblock, in support of high heat flux testing, R&D contract on CuCrZr evolution under baking conditions and Critical Heat Flux	T0 + 10 months
5	Report on design dependent Heat Loads Specifications for the Internal Components	T0 + 12 months

The priority order of the Deliverables can be modified by the IO Responsible Officer.

9 Acceptance Criteria

Invoices will be paid following acceptance of the deliverables described in Section 6.

The reports shall be reviewed by the IO Responsible Officer who shall inform the contractor in writing of its approval or disapproval of the report within 20 working days after the receipt of each report. In case of disapproval, the IO shall provide a justification to the contractor and necessary measures for improvement shall be taken by the contractor without delay.

10 Specific Requirements and Conditions

The Contracted engineer assigned to perform the services described under these Specifications agrees to abide by the following nondisclosure conditions:

- Not to disclose, deliver, or use for the benefit of any person other than the IO, or its authorized agents, any restricted or confidential information or material he or she receives from the IO, other than material or information previously in the records of the Contractor or obtainable prior to such disclosure, delivery, or use, from third parties or from the public domain, or required to be disclosed by law or court order;

- To adhere to any reasonable policies or instructions provided by the IO as to the classification, use or disposition of any restricted or confidential information or materials;

- To not use any restricted or confidential information or material for personal gain.

The Contractor further agrees to take such reasonable steps as may be needed to ensure that the terms of the nondisclosure statements are observed during and after the termination of the Services.

Technical Requirements

The contractor shall propose an engineer/physicist with the following competences:

- PhD in Physics or in Engineering
- Advanced knowledge on Plasma Wall Interactions: at least 5 years of practical experience on heat loads specifications development;
- Advanced knowledge on PFC shaping activities: at least 5 years of practical experience in PFC shaping optimization and as field line tracing code user;
- Knowledge on thermal analysis activities: at least 3 years of experience as Finite Element code user.
- Programming and modelling skills:
    - CATIA CAD software (awareness and understanding)
    - Field line tracing code (expert level required)
    - Interfacing and maths language like matlab (advanced level required)
    - Finite Element code (advanced level required)
- Ability to work effectively in a multi-cultural environment in English language
- Ability to work in a multidisciplinary team, with engineers and physicists
- Ability to organize and monitor activities
- Good planning and organisational skills
- Good writing and communication skills

11 Work Monitoring / Meeting Schedule

The contracted engineer will work at the ITER site to execute the deliverables foreseen in this contract. Meetings will be arranged with the IO Responsible Officer, and any other required specialist, on a need basis. They are aimed at providing the required input data and monitoring the progress of work.

12 Delivery Time breakdown

See Section 8.

13 Quality Assurance (QA) Requirements

Not applicable for this expertise contract.

14 CAD Design Requirements

Not applicable.

15 Safety Requirements

Not applicable for this expertise contract.