Technical Specifications (In-Cash Procurement)

**CFE - Divertor Flow Monitor coherence imagining expert support**

This document describes technical needs for the 55.GE Flow Monitor diagnostic coherence imaging expert support.
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1 Purpose
This document describes technical needs for the 55.GE Flow Monitor diagnostic coherence imaging expert support.

2 Scope
The objective of this contract is to provide the 55.GE Flow Monitor Diagnostic with the coherence imaging expert support for the Preliminary Design Review of 55.GE, including:
- Creation of the technical specification for the raytracing modelling work of the entire system, including reflections from plasma facing surfaces
- Support to review the results from the raytracing modelling
- Experimental validation of relevant material reflection properties
- Response to selected 55.GE Conceptual Design Review chits.
The design of the 55.GE Flow Monitor diagnostic is within the scope of IO-CT.

3 Definitions
CDR Conceptual Design Review
CRO Contractor Responsible Officer
IDM ITER Document Management system
IO ITER Organization
IO-CT ITER Organization – Central Team

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

4 Estimated Duration
The duration of this contract is 11 months.

5 Work Description
The objective of this contract is to address the following chits from the ITER Flow Monitor diagnostic Conceptual Design Review:

<table>
<thead>
<tr>
<th>Chit title</th>
<th>Chit description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low s3 component reflection from wall tiles</td>
<td>The suppression of reflection is based on the idea that the majority of light reflected by the wall tiles comes from that emitted nearest to it, which necessarily comes perpendicular to the field and is therefore predominantly linearly polarised. This assumes: a) The diffuse reflection is dominant over specular, and b) reflected linear polarisation does not become circularly polarised. This should be shown for at least clean tungsten, but preferably also beryllium coated tungsten if at all possible.</td>
</tr>
</tbody>
</table>
If (a) is not true, specular reflection from lines of sight hitting tiles almost tangentially will contain a strong S3 component from the reflected continuation of that line of sight. If (b) is not true, the diffuse reflection of nearby plasma may be strongly circularly polarised due to phase shifts between the S and P reflected components.

| Polarisation modelling of optical system with realistic mirror/glass coatings. | Polarisation ray tracing of the optical system has been demonstrated at the CDR and has not shown major issues, with assumptions of ideal mirrors for most elements, and mixing of light in to the S3 component has not been directly assessed. This is reasonable at the CDR stage but more detailed analysis which directly assesses mixing in to S3, and whether the Mueller matrix of the system will be sufficiently invertible, needs to be performed since this is a crucial issue for the measurement scheme.

The polarisation modelling of the optical system should be repeated with realistic mirror/lens coatings to determine if the ideal relay system can be characterised by an invertible Müller matrix.

Faraday rotation in the vacuum window should also be modelled and stress-induced birefringence should be considered as far as possible since this may introduce a variable modification to the Müller matrix. |

The first chit is asking to measure the S3 component of reflection at large angle to a tungsten tile illuminated by an extended light source that also covers the reflected line of sight direction (or reference existing publications/documents examining the polarisation properties of large angle reflection from unpolished metal surfaces).

The second chit is asking to perform polarisation ray trace modelling of the relay system using realistic surface properties (including coatings) for all optical elements and to demonstrate that the mixing in to S3 component is tolerable and/or the Mueller matrix of the system is expected to be sufficiently invertible to interpret the measurements.

The contract includes the following tasks:

1. Provide technical specification for the raytracing modelling work of entire system, including simulation of polarised plasma emission and reflections from plasma facing surfaces. This modelling work is not in the scope of the current contract and will be performed by IO as a separate contract.

2. Provide review of the results from the raytracing modelling performed based on the technical specification developed within the previous task.

3. Perform experimental validation of the reflection model used for the raytracing modelling by validation against measured reflection properties of two different metals. The proposal for the experimental validation is to be provided with the contract offer.

6 Responsibilities

6.1 Contractor’s Responsibilities
In order to successfully perform the tasks in these Technical Specifications, the Contractor shall:

- Strictly implement the IO procedures, instructions and use templates;
- Provide experienced and trained resources to perform the tasks;
- Contractor’s personnel shall possess the qualifications, professional competence and experience to carry out services in accordance with IO rules and procedures;
- Contractor’s personnel shall be bound by the rules and regulations governing the IO ethics, safety and security IO rules.

6.2 IO’s Responsibilities
The IO shall:

- Nominate the Responsible Officer (CRO) to manage the Contract;
- Organise regular progress meetings;

7 List of Deliverables and due dates

<table>
<thead>
<tr>
<th>D#</th>
<th>Title</th>
<th>Due date</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>Technical specification for the raytracing modelling of 55.GE</td>
<td>T0+1m</td>
</tr>
<tr>
<td>D2</td>
<td>Report on experimental validation of the material reflection properties</td>
<td>T0+3m</td>
</tr>
<tr>
<td>D3</td>
<td>Review of the results from the raytracing modelling</td>
<td>T0+10m</td>
</tr>
<tr>
<td>D4</td>
<td>Response to 55.GE CDR chits 12 and 28</td>
<td>T0+11m</td>
</tr>
</tbody>
</table>

T0 represents the date of the contract Kick Off Meeting, organized within two weeks from the contract signature.

8 Acceptance Criteria
These criteria shall be the basis of acceptance by IO following the successful completion of the services:

- The deliverables will be in the form of reports as specified in Section 7.
- The deliverables will be uploaded in the Contractor’s dedicated folder in the ITER Organization’s document management system IDM.
- The CRO for the contract is the Approver of the delivered documents.
- The CRO can ask modifications to the report in which case the Contractor must submit a new version.

The acceptance of the document by the Approver is the acceptance criterion.
9 Specific requirements and conditions

The person(s) to carry out the work described in this document must have proven experience in all of the following:
- Development and testing of the tokamak Coherence Imaging systems
- Measurements and modelling of the material reflection properties
- Raytracing techniques
- Writing technical documentation or scientific papers

10 Work Monitoring / Meeting Schedule

The work will be managed by means of Progress Meetings and through the formal exchange of documents and transmitted by emails which provide detailed progress.

Progress Meetings will be called by the ITER Organization. They will be held as needed and at least bi-monthly, either on the IO site or via videoconference. External experts will be invited to discuss technical matters.

11 Delivery time breakdown

See Section 8 “List Deliverables section and due dates”.

12 Quality Assurance (QA) requirements

The organisation conducting these activities should have an ITER approved QA Program or an ISO 9001 accredited quality system.

The general requirements are detailed in ITER_Procurement_Quality_Requirements (ITER_D_22MFG4).

Prior to commencement of the task, a Quality Plan must be submitted for IO approval giving evidence of the above and describing the organisation for this task; the skill of workers involved in the study; any anticipated sub-contractors; and giving details of who will be the independent checker of the activities (see Procurement_Requirements_for_Producing_a_Quality_Plan (ITER_D_22MFMW)).

Documentation developed as the result of this task shall be retained by the performer of the task or the DA organization for a minimum of 5 years and then may be discarded at the direction of the IO. The use of computer software to perform a safety basis task activity such as analysis and/or modelling, etc. shall be reviewed and approved by the IO prior to its use, in accordance with Software qualification policy (ITER_D_KTU8HH).

13 CAD Design Requirements (if applicable)

For the contracts where CAD design tasks are involved, the following shall apply:

The Supplier shall provide a Design Plan to be approved by the IO. Such plan shall identify all design activities and design deliverables to be provided by the Contractor as part of the contract.
The Supplier shall ensure that all designs, CAD data and drawings delivered to IO comply with the Procedure for the Usage of the ITER CAD Manual (2F6FTX), and with the Procedure for the Management of CAD Work & CAD Data (Models and Drawings 2DWU2M).

The reference scheme is for the Supplier to work in a fully synchronous manner on the ITER CAD platform (see detailed information about synchronous collaboration in the ITER GNJX6A - Specification for CAD data production in ITER Contracts.). This implies the usage of the CAD software versions as indicated in CAD Manual 07 - CAD Fact Sheet (249WUL) and the connection to one of the ITER project CAD data-bases. Any deviation against this requirement shall be defined in a Design Collaboration Implementation Form (DCIF) prepared and approved by DO and included in the call-for-tender package. Any cost or labour resulting from a deviation or non-conformance of the Supplier with regards to the CAD collaboration requirement shall be incurred by the Supplier.

14 Safety requirements

ITER is a Nuclear Facility identified in France by the number-INB-174 (“Installation Nucléaire de Base”).

Compliance with Defined requirements for PBS 55 - Diagnostics (NPEVB6 v2.0) or its flowed down requirements in SRD-55 (Diagnostics) from DOORS (28B39L v5.2) is mandatory.