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Technical Specifications (In-Cash Procurement)

Physics Modelling and Analysis expertise on CXRS Diagnostic

The work described below is related to the Physics Modelling and Analysis expertise of the ITER CXRS Diagnostics: 55.E1 CXRS Core, 55.EC CXRS Edge and 55.EF CXRS Pedestal.

The 3 diagnostics are being developed by 3 IO-DA's (respectively EU-DA, RF-DA and IN-DA). However, to support the diagnostic development input of CXRS spectral modelling is required, that needs to be cross checked against existing Fusion experiments.
Moreover, advanced integrated data analysis, that relies on accurate ...

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1 Purpose

This document describes technical needs for Physics Modelling and Analysis expertise in conjunction with the ITER Charge Exchange Recombination Spectroscopy (CXRS) Diagnostics.

2 Scope

The work described below is related to the Physics Modelling and Analysis expertise of the ITER CXRS Diagnostics: 55.E1 CXRS Core, 55.EC CXRS Edge and 55.EF CXRS Pedestal.

The 3 diagnostics are being developed by 3 IO-DA's (respectively EU-DA, RF-DA and IN-DA). However, to support the diagnostic development input of CXRS spectral modelling is required, that needs to be cross checked against existing Fusion experiments.

Moreover, advanced integrated data analysis, that relies on accurate physics modelling and spans over the 3 diagnostics, will be required to extract the relevant plasma parameters from the spectral measurements, as indicated in 55.E1 CXRS-core - Data analysis strategy and assumptions (ITER_D_R3CKLT). Again this data analysis will require cross checking against existing (and validated) analysis tools.

3 Definitions

C-R: Contractor Responsible. See Contract specifications for definition of duty.

C-TRO: Contractor Task Responsible Officer. Carrying out the contract tasks. See Contract specifications for definition of duty.

IO-CT: ITER Organization (Central Team)

IO-DA: Domestic Agency

IO-TRO: ITER Organization Technical Responsible Officer. See Contract specifications for definition of duty.

PPD: Port Plug and Diagnostics Engineering Division

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

4 References

Links inserted in text.

5 Estimated Duration

The work shall be spread over the period of 1 year starting from the signature date of the contract, although the amount of effort is estimated at 25%. Services are to be provided 60% (of that 25%) at the IO work site. The contractor may be asked by the IO-TRO to perform travel missions of a short duration for the purpose of the execution of the Contract, they will be defined in the course of the contract.

6 Work Description

Modelling the CXRS spectra as expected on ITER and the JET tokamak (which is the most ITER-relevant current device from the CXRS point of view). This modelling shall include:

- Active CXRS spectra of H/D/T I, He II, Be IV, C VI, Ne X and Ar XVIII with the intensity defined by modelling neutral beam attenuation and atomic data from ADAS
- Fast alpha and fast H/D (from the neutral beams) spectra
- Beam Emission Spectra
- Bremsstrahlung continuum emission
- Passive CXRS model for the edge of the plasma
- Collisional excited edge line emission of the bulk ions (H, D, T) and main expected impurities (He, Be, C, Ne, Ar, W and potentially Xe)
- Neutral beam and optical geometries
- Optical diagnostic total transmission, dispersion and detector quantum efficiency
- Statistical noise levels determined by Poisson shot noise of the detected counts per pixel.

The output of the modelling shall be a full CXRS spectrum, whereby the individual contributions can be "turned on or off", in counts per pixel and 'calibrated' back to photons per wavelength, in both cased with statistical noise applied.

The modelling will 1st be run using the geometries and (validated) plasma scenario input of JET (and any other tokamak under study) and cross checked against measurement results. This cross checking shall include:

- Cross checking neutral beam attenuation against measurements
- Cross checking modelled signal and noise count rates against measured signal and noise count rates, whereby the former are obtained by using absolute calibration results and spectrometer and detector properties for the total transmission, dispersion and detector quantum efficiency values.
- Cross checking specifically the Passive CXRS and Collisional excited edge line emission models against measurements, identifying the most relevant/sensitive parameters of the edge emission model(s).
- Cross checking SOS Fast Ion CXRS modelling against JET FIDA observations and FIDASIM predictions

The above work will be documented in a number of reports defined in Section 8 List of Deliverables and due dates.

7 Responsibilities

7.1 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.

7.2 IO's Responsibilities

The IO shall:

- Nominate the Responsible Officer to manage the Contract (IO-TRO);
- Organise a monthly meeting(s) on work performed;
- Provide offices at IO premises.
- Grant the access to the IDM as Author to the contractor, in order to upload documentations.

8 List of Deliverables and due dates

The main deliverables are listed in the table below

D #	Description	Due Dates
D01	1st draft Report containing the **Description of the CXRS modelling and modelled spectra for ITER**	T0 + 3 months
D02	Final Report containing the **Description of the CXRS modelling and modelled spectra for ITER**	T0 + 6 months
D03	1st draft Report on the **Cross check between modelling and CXRS measurements at JET**	T0 + 9 months
D04	Final Report on the **Cross check between modelling and CXRS measurements at JET**	T0 + 12 months

9 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 indicated in section 8 "List of Deliverables and due dates".
- The deliverables will be posted in the Contractor's dedicated folder in IDM.
- The IO-TRO is the Approver of the delivered documents.
- The Approver can name one or more Reviewers(s) in the area of the report's expertise.
- The Reviewer(s) 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.

10 Specific requirements and conditions

Experience of all skills and techniques in deliverable list – in particular:

- Experience in spectroscopic plasma modelling, especially CXRS and neutral beam spectroscopy modelling;
- Experience with spectroscopic data analysis, especially CXRS and neutral beam spectroscopy data analysis;
- Experience at fusion facilities, preferably JET;
- Experience in global data consistency procedures;

- Experience with scientific data processing software/programming languages (e.g. Matlab, IDL, Python, FORTRAN …)
- Experience with creating technical documents and presentations

11 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 or the C-TRO. They will be held as needed and at least bi-monthly, either on the IO site or via videoconference. Progress meetings will involve C-TROs and the IO-TRO. External experts will be invited to discuss technical matters. The C-RO will be invited in case of contractual discussions.

For all Progress Meetings, minutes, including action items, shall be written by the C-TRO and be stored in the ITER IDM in order to ensure traceability.

12 Delivery time breakdown

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

13 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 Quality Assurance for ITER Safety Codes (ITER_D_258LKL).

14 CAD Design Requirements (if applicable)

No CAD design tasks are foreseen for this contract.

15 Safety requirements

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

For Protection Important Components and in particular Safety Important Class components (SIC), the French Nuclear Regulation must be observed, in application of the Article 14 of the ITER Agreement.

In such case the Suppliers and Subcontractors must be informed that:

- The Order 7th February 2012 applies to all the components important for the protection (PIC) and the activities important for the protection (PIA).

- The compliance with the INB-order must be demonstrated in the chain of external contractors.
- In application of article II.2.5.4 of the Order 7th February 2012, contracted activities for supervision purposes are also subject to a supervision done by the Nuclear Operator.

For the Protection Important Components, structures and systems of the nuclear facility, and Protection Important Activities the contractor shall ensure that a specific management system is implemented for his own activities and for the activities done by any Supplier and Subcontractor following the requirements of the Order 7th February 2012 (PRELIMINARY ANALYSIS OF THE IMPACT OF THE INB ORDER - 7TH FEBRUARY 2012 (AW6JSB v1.0)).