

Technical Specifications (In-Cash Procurement)

Neutronics analysis for H-alpha, CXRS Edge and Dust Monitor Diagnostics systems

This document describes technical needs of ITER/TED/PPD Division, with particular reference to the Neutronics analysis for H-alpha, CXRS Edge and Dust Monitor Diagnostics systems

Technical Specifications

for

Neutronics analysis for H-alpha, CXRS
Edge and Dust Monitor Diagnostics
systems

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Purpose

This document describes technical needs of ITER/TED/PPD Division, with particular reference to the **Neutronics analysis for H-alpha, CXRS Edge and Dust Monitor Diagnostics systems**.

1 Scope

The work involves technical expertise for assessing the neutronic features of the Diagnostics and Port Integrations systems Fig.1 and 2. This activity will cover the area of Neutronics analysis, e.g. determination of neutron and gamma fluxes as well spectra, evaluation of background noise, response functions of neutron and gamma detectors, nuclear heating, Plasma operation and Shut Down dose rates, nuclear damage, helium generation, material activation, Radwaste assessment and human dose rates.

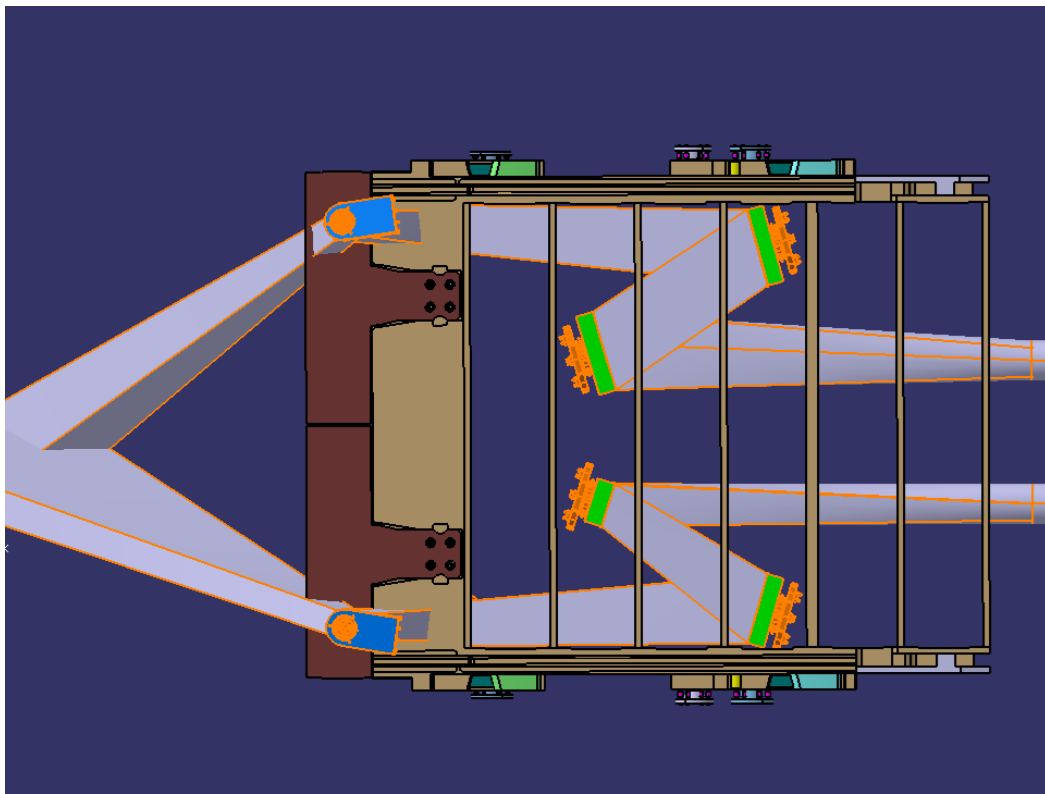


Fig 1. 55 EC CXRS diagnostics in EQ#3 Port Plug.

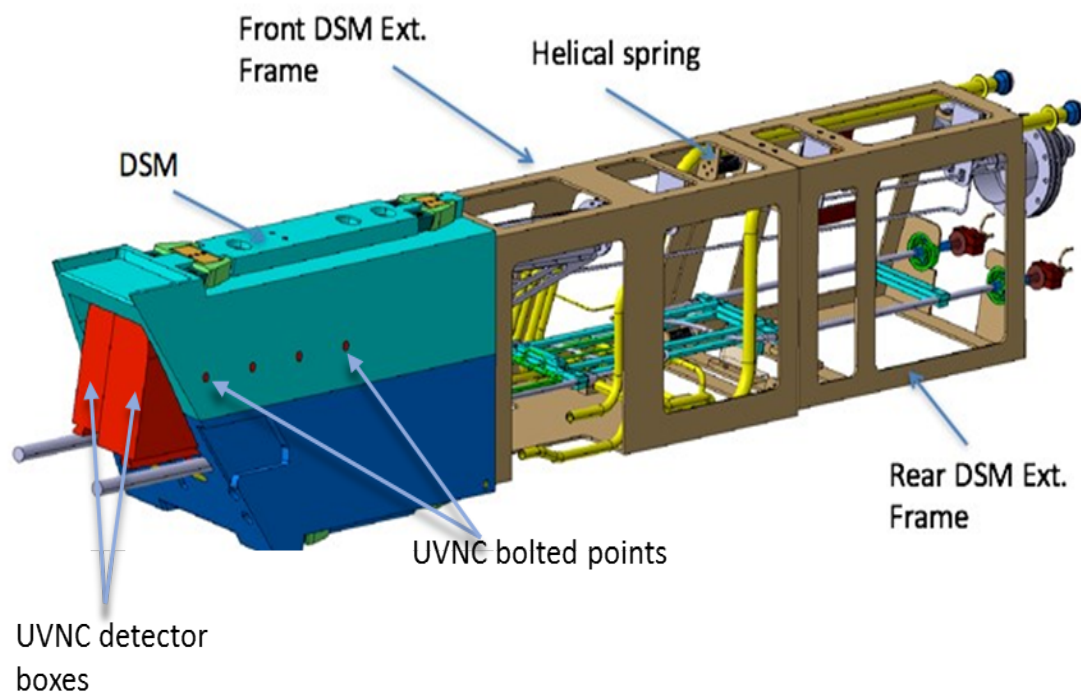


Fig 2. Upper Port Plug #18

2 Definitions

IO: ITER Organization

DA: Domestic Agency

SDDR: Shut Down Dose Rate

IO-TRO: ITER Organization technical Responsible Officer.

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

3 References

[4]	Instructions for Nuclear Analyses	R7XRXB	V4.3
[5]	Neutronics guidelines for ITER Diagnostics Division	RLVRDP	V1.0

4 Estimated Duration and Start of activity

The duration shall be for 9 months from the Kick Off Meeting date of the contract. Services to be provided 95% at Contractor premises and 5% at the IO work site.

Signature date is foreseen for the 15th of September 2020

The start of the activity is foreseen on the 15th of September 2020 at the KoM.

5 Work Description

The work involves technical/neutronics expertise for diagnostics and Port integration projects. The work to be done is in collaboration with the IO Technical Responsible Officer (TRO) as follows

1. Calculation/Analysis of the neutron / gamma fluxes and related spectra in the Port Plug, Port interspace and Port cells and on the tokamak subsystems (Blanket, Vacuum Vessel, PF coils. and TF coils)
2. Calculation/Analysis of the nuclear heating (neutron and gamma heat loads) particularly for the various components in the Port Plug, as well in the Port Interspace and on the tokamak subsystems (Blanket, Vacuum Vessel, PF coils. and TF coils)

The following three tasks have to be performed:

6.1 ...55.EC CXRS Edge First mirror.

A local neutronics model for the 55.EC CXRS Edge diagnostic was prepared in 2019 and a local neutronics analysis was carried out as input to the 55.EC CXRS Edge PDR.

The CXRS Edge team has, therefore, updated their optical and mechanical design (end 2019) to position the first mirror units further away from the plasma, allowing some DFW shielding in front of the mirror unit (something that was absent in the PDR model).

The new task would involve:

- the update of the neutronics model to reflect the retracted position of the 1st mirror units and the modification of the DFW in front of these now retracted 1st mirror units. All other parts of the model remain the same (position and size of other optical elements was not affected, nor the cut-outs of the optical paths after the 1st mirrors)
- Run a neutronics analysis to assess the nuclear heating and the dpa on the 1st mirror units.

6.2 55 G9 Dust Monitor

Update of [D02 - Dust Monitor Nuclear Analysis: Nuclear Heating, Activation and SDDR assessment \(VDLYB6 v2.0\)](#).. Cut-out in front part of lower shield has been increased in comparison with previously analyzed configuration. Need to re-assess tubes (fig 1) passing through and under lower shield in that area (fig 2, updated). Tubes configuration hasn't been changed much and previous model of tubes can be used. Calculations are needed to estimate the neutron and gamma fluxes as well nuclear heating (neutron and photons ones), i.e. loads on the VV and TF impacted by the cut out .

Update is needed only in limited area (red) under front part of lower shield where the cut out is.

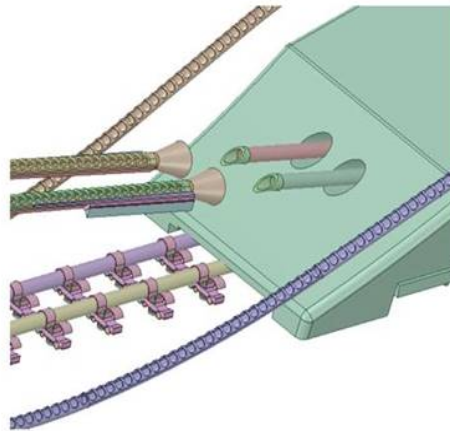


Fig. 6: Detail of the cutouts to be included in the shielding blocks already located in C-model.

Fig.1 Model that was used in the report

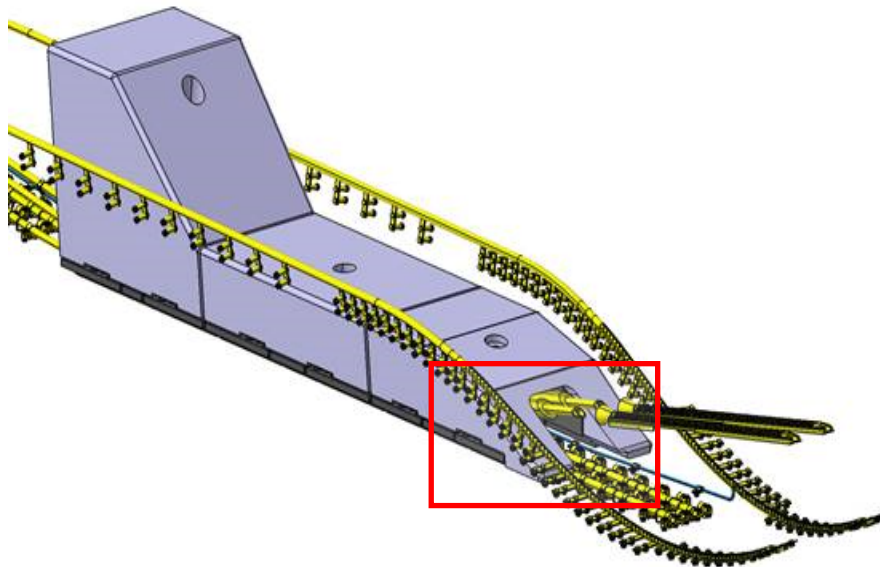
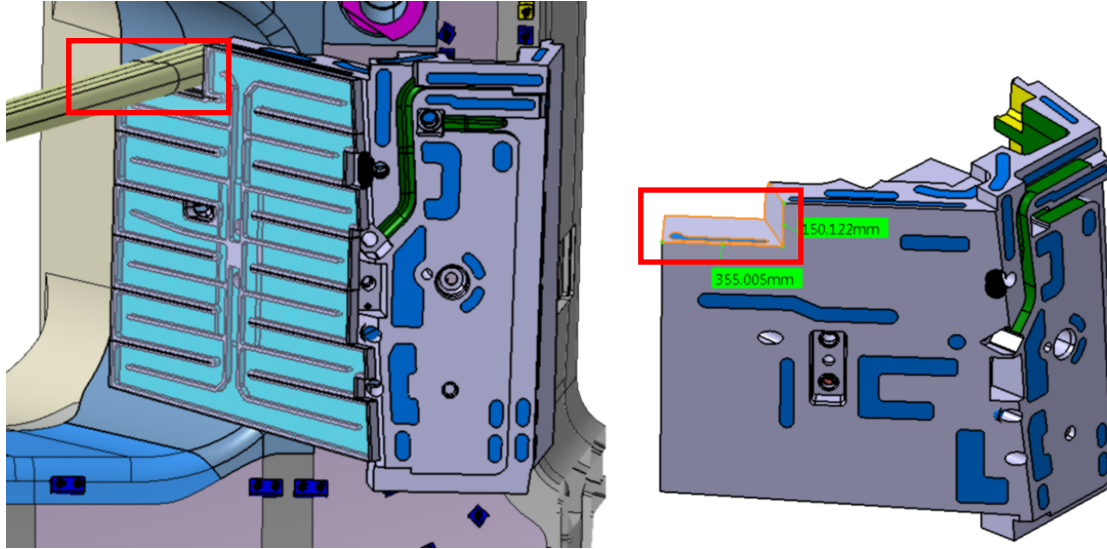


Fig.2 Updated Lower shield at front part (bigger cut out):

6.3 55 E2 H-Alpha tangential Lines of Sight and cut out in the Blanket SB#15 NDL

The 55E2 H-alpha diagnostics has tangential lines of sight going through cutout in the Shield Block #15 NDL acting as optical dump for divertor stray light suppression. It is requested to evaluate the effect of material removal from Heating Neutral Beam shield block (SB#15 NDL) on VV heat loads and TF heat loads. See pictures a) and b) below

Therefore it is needed to develop MCNP model which takes into account the implementation of the cut out into the module #15 NDL for the H-alpha



a)

b)

6 Responsibilities

Services to be provided mainly (~ 95 %) at the Contractor site and (5%) at IO site.

In order to successfully perform the tasks in this Technical Specification, 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.
- The supplier shall appoint a responsible person who shall be permitted to use the codes which are subject to export conditions.

7 List of deliverables and due dates

Deliverable		Due date
D1	Update of MCNP model and analysis of 55 EC CXRS Edge Diagnostic First Mirror new position	T.0 +2 months
D2	Completion of MCNP model and analysis of Shield Block #15 (SB#15 NDL) with the new cut out for the tangential lines of sight of 55E2 H-alpha diagnostics	T.0 + 6 months
D3	Update of MCNP model and analysis of Dust Monitor in the area under front part of lower shield	T.0 + 9 months

8 Acceptance Criteria

The deliverables will be posted in the Contractor's dedicated folder in IDM, and the acceptance by the IO will be recorded by their approval by the designated IO TRO. These criteria shall be the basis of acceptance by IO following the successful completion of the services. These will be in the form of reports as indicated in section 8, Table of deliverables.

9 Specific requirements and conditions

All the nuclear analysis activities described in this technical specification must be conducted in agreement with the ITER Instructions for Nuclear Analysis (INA) [4]. In addition the guidelines for PBS55 [5] must also be followed, which act as a complement to the INA.

All the files involved in the execution of the work must be submitted to ITER IO as a specific deliverable called "Acceptance Data Package" (ADP). This ADP will include, as minimum, the original CAD models, the simplified CAD models, all the MCNP inputs, variance reduction files, MCNP outputs and records of independent verification. Additional content of the ADP can be specified by the TRO until the contract-closing meeting.

The ITER reference C-model must be considered.

Contractor to carry out the work described in this document must have proven experience, as appropriate.

- Knowledge and working experience of nuclear systems/devices (in particular fusion or high energy physics devices/systems)
- Basic knowledge of ITER Diagnostics systems
- Demonstrated knowledge and experience of CAD models and MCNP modelling
- Expertise in performing Neutronics MCNP analysis on ITER Diagnostics systems and ports
- Experience in the development and applications of tools and methods for shutdown dose rate analysis and data pre and post-processing
- Radwaste calculations/analyses
- Technical document generation

10 Work Monitoring / Meeting Schedule

The process of work monitoring shall be followed as follows.

- Upon entry into force of the task order, within 1 week, the kick-off meeting shall be held to agree calculation techniques to be used and approximations to be adopted, define terms of reference, identify any missing input data, clarify task specification, task schedule, etc.
- The Supplier shall submit task schedule to IO for IO's approval.
- The Supplier shall inform/discuss IO, if any mistakes/clarifications in the inputs need to be rectified before doing the analyses.
- The Supplier shall inform IO about any non-conformance or deviations within one week of observance.
- The Supplier shall inform IO about the expected delays and reasons for delays.
- The supplier shall submit to IO written bi-weekly progress reports and hold meetings with IO.

The contract close out meeting shall be held at the time ADP is approved. In this meeting, it shall be concluded whether the defined tasks are completed or not.

More meetings may also be organized if required by IO and/or considered to be necessary for successful execution of the contract.

11 Delivery time breakdown

See List of Deliverables section.ch 8

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 document [ITER Procurement Quality Requirements \(22MFG4\)](#)

Prior to commencement of the task, a Quality Plan [Quality Plan \(22MFMW\)](#) 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.

Prior to commencement of any manufacturing, a Manufacturing & Inspection Plan [Manufacturing and Inspection Plan \(22MDZD\)](#) must be approved by ITER who will mark up any planned interventions.

Deviations and Non-conformities will follow the procedure detailed in IO document [MQP Deviations and Non Conformities \(22F53X\)](#): version 7.0 for the Non-conformities and version 6.2 for Deviation request

Prior to delivery of any manufactured items to the IO Site, a Release Note must be signed [MQP Contractors Release Note \(22F52F\)](#).

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, it should fulfil IO document on Quality Assurance for ITER Safety Codes [Quality Assurance for ITER Safety Codes \(258LKL\)](#).

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”).

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 \(AW6JSB v1.0\)](#)).

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.

This task is a PIA.

“The supplier must comply with the all requirements expressed in “Provisions for implementation of the generic safety requirements by the external actors/intervenors” (SBSTBM)”