Technical and Financial Quotation Documents

CFE - Mechanical engineering support for diagnostics Equatorial Port #08 and #17 integration and port systems development

This technical specification is to perform mechanical integration engineering tasks caused by DMS impact on Equatorial Port (EP) #08 and EP#17. The purpose is to support the development of EP #08 and EP#17 up to FDR level, by fulfilling the tasks below:To support DMS and diagnostic tenants mechanical integration in EP#8 and #17;To propose and develop mechanical solutions of the port systems appropriate for DMS and diagnostics integration;To develop common shielded cabinet design; To help in preparation of the CAD models, design reviews technical documentation and presentations.

	Approval Process		
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	Change Log		
CFE - Mechanical engineering support for diagnostics Equatorial Port #08 and #17 integration and port systems development (5DY7M5)			
Version	*Latest Status*	*Issue Date*	*Description of Change*
v1.0	Signed	12 May 2021	
v1.1	Approved	28 May 2021	common shielded cabinet is removed from the scope;
v1.2	Approved	08 Jun 2021	Updated to highlight DMS impact

Table of Contents

1   Purpose

This technical specification is to perform mechanical integration engineering tasks caused by DMS impact on Equatorial Port (EP) #08 and EP#17. The impact has induced major changes in the overall integration layouts and caused redesign of port structures.

The purpose is to support the development of EP #08 and EP#17 up to FDR level, by fulfilling the tasks below:

- To support DMS and diagnostic tenants mechanical integration in EP#8 and #17;
- To propose and develop mechanical solutions of the port systems appropriate for DMS and diagnostics integration;
- To advance implementation of nuclear shielding;
- To help in preparation of the CAD models, design reviews technical documentation and presentations.

2   Scope

The scope of work includes port integration, DMS integration and mechanical design activities performed in EP#08 and EP#17 Port Plugs, closure plate, Interspace and Port Cells areas.

3   Definitions

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

Acronym	Meaning
ALARA	As Low As Reasonably Achievable
CAD	Computer Aided Design
HoF	Human Organizational Factor
HFE	Human Factors and Ergonomics
DET	Data Exchange Transfer
DFW	Diagnostic First Wall
DIR	Design Integration Review
DSM	Diagnostic Shielding Module
FDR	Final Design Review
EP	Equatorial port
FDR	Final Design Review
FP	First Plasma
HIRA	Hazard Identification and Risk Assessment
ORE	Occupational Radiation Exposure
PCSS	Port Cell Support Structure
PDR	Preliminary Design Review
PFPO-1	Pre-Fusion Plasma Operation 1
PP	Port Plug
ISS	Interspace Support Structure
SDDR	Shutdown Dose Rate
SIC	Structural Integrity Component
RO	Responsible Officer
PIA	Protection Important Activity

4 References

[1] ITER_D_E6CNFY –55.Q8 System Design Description for Equatorial Port #08.
[2] ITER_D_3TYYRC – 55.QH System Design Description for Equatorial Port #17
[3] ITER_D_4BQJS9 – s-SRD for modular DSM equatorial ports
[4] ITER_D_NPEVB6 Defined requirements for PBS 55 - Diagnostics
[5] Safe Access for Maintainability ITER_D_RUGWUK
[6] Quality Assurance for ITER Safety Codes (ITER_D_258LKL)
[7] ITER_D_QUK6LF - ITER Human & Organizational Factors Policy
[8] ITER_D_2MU6W5 ITER Abbreviations
[9] ITER_D_KTU8HH Software Qualification Policy

5 Estimated Duration

The overall duration of this work is 12 months.

6 Work description

Port integration engineering support comprises

- DMS and diagnostics mechanical integration in EP#8 and #17;
- development of mechanical solutions of the port systems appropriate for DMS and diagnostic tenants integration;
- re-integration of diagnostic systems impacted by DMS development;
- preparation of technical documentation and presentations for design and integration reviews.

The scope of the work is limited by EP#08 and EP#17. It comprises Port Plug (PP) (Fig.1), closure plate (not shown), Interspace and Port Cell areas (Fig.2) of both ports.
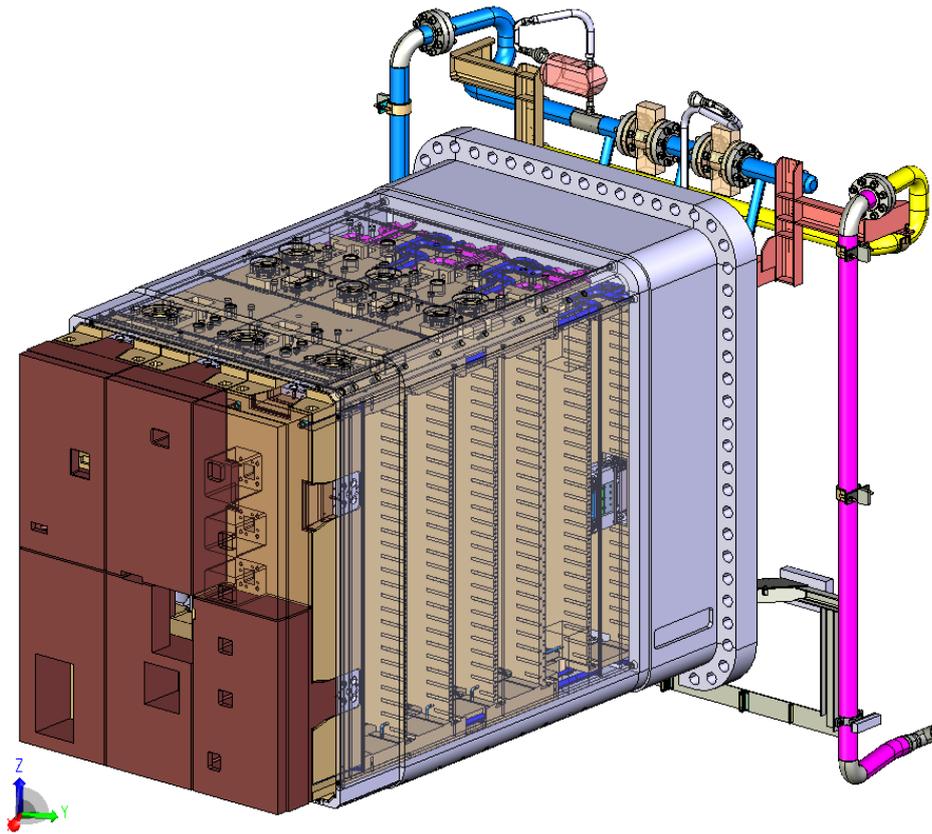
Figure 1. EP#08 Port Plug Assembly (post-PDR level integration).

6.1 Introduction

EP #08 is partially First Plasma (FP) system. The FP EP#08 configuration includes the Interspace Support Structure (ISS), Port Cell Support Structure (PCSS) and all necessary services (cables, gas, vacuum). In FP configuration, only two diagnostics tenant systems will be installed. After the FP operation EP#08 will be upgraded to Pre-Fusion Plasma Operation-1 (PFPO-1) configuration, which includes fully assembled and tested PP and fully assembled ISS and PCSS. This configuration is planned to remain until ITER decommissioning. More details on EP#08 system including list of tenants can be found in the respective Design Description Document, [1]. The second system, EP#17 is for PFPO-1; similar to EP#08, it is supposed to be operational until ITER decommissioning. Details on EP#17 are in [2].

PDR for EP#08 was held in 2019 and closed in Q2 2021. PDR for EP#17 was in 2020. FP configuration for EP#08 integration will be reviewed during FDR-1 meeting. Integrated PP of EP#08 will be reviewed at the FDR-2 meeting. FDR-3 is foreseen for the integrated EP#08 ISS and PCSS in PFPO-1 configuration.
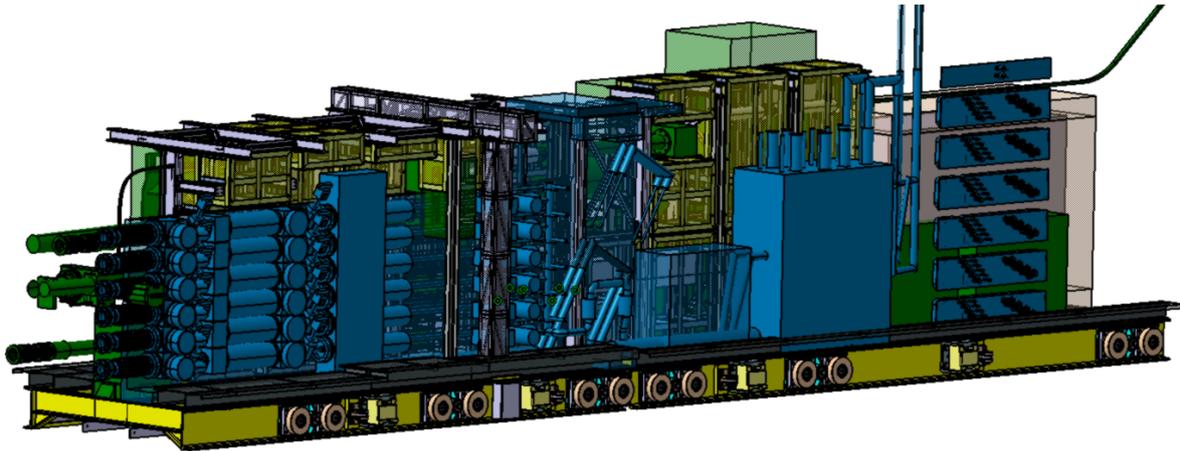
Figure 2. EP#08 integrated (post-PDR level integration) ISS (on the left) and PCSS (right side).

6.2 Mechanical integration

The objective is to continuously support port integration and develop solutions appropriate for DMS, Glow Discharge Cleaning and diagnostic integration development. The list of main activities expected to be performed is

- Providing recommendations and following up adaptation of tenants systems appropriate to the integration;
- Development of PP elements and integration solutions necessary for tenants integration:
  - finding proper place for tenant systems and shielding trays and developing of the fixation elements appropriate for integration;
  - suggest routing and service integration solution using standard solutions (clamps) for modular DSM structure;
  - continuously support the interfaces up-to-date, especially the interface with DFW, LEVI, windows, tenants systems, etc.
  - delivery of the relevant CAD models;
- Development of the closure plate elements and integration solutions :
  - finding proper arrangement of the flanges appropriate for inspection and maintenance,
  - support the development of services (SVS, cables), their routing and their integration,
  - participation in the development of the connection bridge between closure plate and building,
  - delivery of the relevant CAD models;
- Development of ISS and PCSS structural elements and integration solutions:
  - finding proper place for tenant systems and shielding blocks, appropriate for inspection and maintenance,
  - support the development of services, their routing and integration,
  - participation in the development of the connection of the services between ISS and PCSS, between ISS and building, between PCSS and building,
  - delivery of the relevant CAD models,
  - Development of shielding blocks for ISS and PCSS (if required)
- Delivery of CAD models of integrated ports in preparation for

      o   Neutronics analysis,

      o   Maintenance, ORE and inspection assessments,

      o   HFE analysis,

      o   Design reviews (PDR, FDR),

      o   Integration reviews (DIR);

- Support of maintenance operations development in the ISS and PCSS areas including area in between closure plate and ISS;
- Support of the development of human hazard and human occupational factor analysis;
- Launch CAD Data Exchange Transfer (DET) tasks following IO CAD rules;
- Support the IO port integration RO in launching and receiving CAD DET;

The integration of EP#08 and EP#17 shall comply with 55.Q8 and 55.QH requirements [3], which includes defined requirements [4]. In order to give a view, some of general requirements (but not limited to) are listed below:

The integrated port shall demonstrate structural integrity.

The integration shall be acceptable to tenant systems.

The integrated port and its systems shall meet RH requirements.

The integrated port and its systems shall comply with inspection and maintenance requirements.

The integrated port shall demonstrate ALARA neutron leakage.

The integrated port shall demonstrate ALARA SDDR in the ISS and PCSS areas.

The ports shall be integrated taking into account results of human organizational factor and ergonomics assessment.

6.3   Integration of DMS

The Disruption Mitigation System (DMS) (PBS-18, 18.DM DMS) is a rapidly growing system at post-CDR development level. The most critical for integration area is vacuum extensions and the services (vacuum, gas, cryogenic). The work on vacuum extensions is ongoing with support of maintenance and ORE assessments, and HOF analysis, provided by PBS-55. DMS design is evolving and vacuum extensions integration is being changed respectively. Abovementioned reasons require to perform following tasks :

- DMS integration models in ISS shall be updated;
- DMS integration models in PCSS shall be updated;
- DMS integration in PP shall be updated;
- Support DMS in creation of the CM;
- DMS services routing in ISS and PCSS areas, suggest integration solutions, discuss them with DMS and IO port integration ROs and produce CAD models accordingly;
- Coordinate integration of the shielding blocks (in port integrator scope) in DMS CM;
- DMS integration shall be put in line with recommendations from HOF studies (ongoing) in order to comply with ergonomics guidelines;
- When the results of DMS neutronics analysis is available (from PBS-18 either PBS-55), the integration shall be adopted accordingly (doglegs modification , adding/removal of shielding blocks, etc);
- Impact of DMS vacuum extension changing on diagnostics integration shall be assessed and re-integration solutions suggested to diagnostic systems ;
- Develop integration options for diagnostics affected by DMS.

6.4   Engineering documentation

The engineering documentation expected to be prepared is below
- Development of the ISS and PCSS assembly plans;
- Providing Bill of Materials;
- Providing documents with description of the input for neutronic analysis;
- Participation in the design and integration reviews;
- Preparation of the presentation related to mechanical integration and assembly sequence;
- Assistance to IO Port Integration RO to coordinate tenants integration.

7   Responsibilities

7.1   Contractor's obligations

The Contractor shall ensure that he complies with the provisions of the Framework Contract in particular with the following:

- The Contractor shall guaranty that all input information provided to perform the task remain property of IO and shall not be used for any other activity than the one specified in this specification.
- The Contractor shall be in charge of the training & coaching of all its resources.
- The contractor shall provide an organization suitable to perform the work as describe in this specification;
- The contractor shall work in accordance with the QA plan approved by IO;
- The contractor shall perform the activities accordingly to this specification taking into account all relevant additional documents and IO processes into account (hand books, export control, intellectual properties, …); The Contractor shall be responsible to produce and manage, using the ITER software platform, all the documents listed in chapter 11.
- The Contractor shall provide to the IO representative full access to its work premises and related documentation, to permit to follow up the progress of the work

Prior to the start of work on each activity, the Contractor shall review the input technical information provided to it by IO for completeness and consistency, and shall advise the IO representative of any deficiencies it may find. The contractor shall not be responsible for errors in the input technical information which could not be reasonably detected during such review; duration of this review will be agreed between Contractor and IO representative and will have no impact on the delivery schedule.

7.2   Obligations of the ITER Organization

The ITER Organization shall make available all data and information necessary to perform the activities specified in the present document.
- IO procedures required to achieve the activities according to ITER quality and safety rules;
- Information on diagnostic design and requirements for the development of the window assembly design.

The ITER Organization shall give the possibility to the contractor to review documents on the ITER documents database (IDM).

IO shall make available to the Contractor all technical data and documents which the Contractor requires to carry out its obligations pursuant to this specification in a timely manner. For delays of more than two weeks in making them available, the Contractor shall advise IO representative of the potential impact on the delivery of the Work Packages, to agree and define all the correction actions to take in place.

8 List of deliverables and due dates

N°	Target date (months)	Deliverable description
D08-1	T0+3	Update mechanical models (FDR level) of EP#08 ISS and PCSS following the results of the structural integrity assessment. Update mechanical models of EP#08 ISS and PCSS considering recent input from DMS design. Assess possible impact on tenants integration, discuss it with tenants RO and agree it. Discuss with IO RO and upload supporting description document in the IDM as per request. Advance implementation of shielding strategy. Advance routing of the services in ISS and PCSS. Prepare DET(s) as per request.
D08-2	T0+6	Update mechanical models of EP#08 port plug and closure plate integrations considering recent input from DMS and diagnostic systems. Consider recent results of the EM analysis and update interspace integration accordingly: implement electrical insulation where necessary, add potential equalization straps, etc. Prepare mechanical model of EP#08 for thermo-hydraulic and structural analysis. Prepare DET as per request. Update port plug integration accordingly to the results of analysis. Deliver port plug description presentations for EP#08 Design Integration Meetings. Deliver port plug description presentation for EP#08 Final Design Review-2 meeting.
D17-1	T0+9	Update mechanical models of EP#17 ISS and PCSS considering recent input from DMS and diagnostic systems. Propose Configuration Models layout to the tenants. Discuss with IO RO and upload supporting description document in the IDM as per request. Advance implementation of shielding strategy. Advance EP#17 port plug integration to post-PDR design level. Develop integration solutions for 55.GC diagnostic. Develop integration solution for 18.GC GDC anode. Update closure plate layout accordingly to recent integration solution. Deliver ISS and PCSS integration description presentations for EP#17 Design Integration Meetings. Deliver ISS and PCSS integration description presentations for EP#17 Preliminary Design Review closure meetings. Prepare DET(s) as per request.
D08-3	T0+12	Update mechanical models of EP#08 DSM integration considering recent input from tenant systems. Prepare port integration presentation for EP#08 DIR meeting. Develop services (cables, pipes) routing in ISS and PCSS from

		tenants blocks to ISS electrical connectors.
		Provide written updated sections for EP#08 DDD considering latest port systems design. Prepare DET(s) as per request.

9 Acceptance Criteria

The reports submitted via IDM will be always reviewed by technical experts of PBS55 nominated by the IO-TRO and by other relevant IO experts where applicable. Revision can be delegated upon consideration of the respective nominees.

The memos submitted via IDM by the Contractor are for general information. No revision nor approval processes are required.

10 Specific requirements and conditions

The Contractor shall have and maintain the necessary equipment and licenses to run the software tools required to carry out the tasks and produce the deliverables in accordance with the tools adopted by the IO. The Contractor shall ensure that experts are adequately supported and equipped. It shall ensure that there is sufficient administrative, secretarial and interpreting provision to enable experts to concentrate on their primary responsibilities.

The official language of the ITER project is English. Therefore, all input and output documentation relevant to this Contract shall be in English. The Contractor shall ensure that all the professionals in charge of the Contract have an adequate knowledge of English, to allow easy communication and adequate drafting of technical documentation. This requirement also applies to the Contractor's staff working at the ITER site or participating in meetings with the ITER Organization.

The work described here is a Protection Important Activity (PIA). As such, it must be independently reviewed by the supplier and records of the revision must be produced.

In addition, the following skills are necessary for the success of the activity:
- Ability to work with CATIA V5, AutoCAD 2D
- Experience in mechanical integration of sophisticated equipment and integration coordination activity
- Experience in nuclear engineering design (equipment to be maintained, maintenance tools, handling)
- Experience to integrate the system in the environment when HOF and ergonomics play an important role
- Experience in the design of shielding blocks and shielded cabinets
- Experience in mechanical engineering
- Experience in Remote Handling/ maintenance
- Ability to produce technical documentation
- Experience in application of French Nuclear Safety regulations
- Experience in interface management
- Schematics definition
- Design organization.

Contractor's personnel visiting the ITER site will be bound by the rules and regulations governing safety and security.

11 Work Monitoring / Meeting Schedule

The work will be started by a dedicated kick-off meeting (KOM) at ITER premises and managed by means of Progress Meetings. It is expected that Progress Meetings will be held biweekly at ITER premises.

The main purpose of the Progress Meetings is to allow the ITER Organization/Diagnostics Division and the Contractor Technical Responsible Officers to:

- Allow early detection and correction of issues that may cause delays;
- Review the completed and planned activities and assess the progress made;
- Permit fast and consensual resolution of unexpected problems;
- Clarify doubts and prevent misinterpretations of the specifications.

The ITER Organization and/or the Contractor may request additional meetings to address specific issues to be resolved.

The Contractor shall work at least 2 days on IO site in order to accelerate the common understanding of the context and focus the effort towards the needed direction. The Contractor shall attend FDR for EP#17, FDR-1 and FDR-2 for EP#08 at ITER premises if deemed necessary.

12 Delivery time breakdown

T0 is the date of the kick-off meeting.

The DIR-2 and PDR closure meeting for EP#17 are scheduled for Q4 2021.

The FDR-1 for EP#08 are planned for Q2 2021.

The DIR and FDR-2 for EP#08 are scheduled for Q2 2022.

13 Quality Assurance (QA) requirements

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

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 [6]).

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 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 Software Qualification Policy [9].

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 (ITER_D_7M2YKF).

Compliance with Defined requirements for PBS 55 - Diagnostics (NPEVB6 v2.0) or its flowed down requirements in SRD-55 (Diagnostics) from DOORS (28B39L v5.4) 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/interveners" (ITER_D_SBSTBM)".