IDM UID
638EWS

VERSION CREATED ON / VERSION / STATUS
23 May 2022 / 1.0 / Approved

EXTERNAL REFERENCE / VERSION

Technical Specifications (In-Cash Procurement)

Technical Specification - Maintenance Support for the Disruption Mitigation System

The purpose of this technical specification (ITER_D_638EWS) is to outline and define how the development of the Disruption Mitigation System (DMS) shall be supported towards the FDR.

This document concerns the engineering support for the DMS design team on reliability, availability, maintainability and inspectability with a specific focus on maintenance task definition. Furthermore, support for the assembly and commissioning of the DMS shall be provided. The work involves also the preparation ...

Table of Contents

1 Purpose

The purpose of this technical specification (ITER_D_638EWS) is to outline and define how the development of the Disruption Mitigation System (DMS) shall be supported towards the FDR.

2 Scope

This document concerns the engineering support for the DMS design team on reliability, availability, maintainability and inspectability with a specific focus on maintenance task definition. Furthermore, support for the assembly and commissioning of the DMS shall be provided. The work involves also the preparation of inputs for the ORE assessment and hands-on or assisted/ distantly operated tooling design.

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
CPD	Construction Process Descriptions
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
RAMI	Reliability, Availability, Maintainability and Inspectability
RO	Responsible Officer
PIA	Protection Important Activity

4 References

[1] ITER_D_27ZRW8 - Project Requirements
[2] ITER_D_ BEJQWA - SRD 18.DM
[3] ITER _D _45P8YK - Defined requirements PBS 18 DMS
[4] ITER_D_2NC6CB - 18.DM System Design Description for DMS.
[5] ITER_D_RUGWUK - Safe Access for Maintainability
[6] ITER_D_258LKL - Quality Assurance for ITER Safety Codes
[7] ITER_D_QUK6LF - ITER Human & Organizational Factors Policy

[8] ITER_D_2MU6W5 - ITER Abbreviations
[9] ITER_D_KTU8HH - Software Qualification Policy
[10] ITER_D_YH3TFW - Working Instruction for the Preparation of System Maintenance & In-Service Inspection Plans
[11] ITER_D_VH9LAB - Maintenance Management Procedure
[12] ITER_D_YH2XTM - Template for System Maintenance & In-Service Inspection Plans
[13] ITER_D_39DWTY - Working Instruction for Scoping and Identification of Critical Components for Operations
[14] ITER_D_24VQES – Quality Classification Determination

5 Estimated Duration

The overall duration of this work is 12 months.

6 Work description

The engineering support may include the activities to support the DMS integration of EP#02, EP#08, EP#17, UP#02, UP#08, UP#14 and associated equipment in other Tokamak complex areas; Preparation of technical documentation, presentations and design reviews.
Details on the specific work are listed in chapter 6.2

6.1 Introduction

The purpose of the ITER Disruption Mitigation System (DMS) is to provide machine protection in order to reduce the detrimental effects of plasma disruptions and to ensure the appropriate lifetime of all affected ITER components. It utilises cryogenic hydrogen and neon pellets which are generated inside the injectors which are located in the ISS. These pellets are pneumatically propelled in the time frame of milliseconds towards the plasma and just before entering the plasma are shattered into small fragments to enter the plasma and to reduce damage to the plasma facing components and other structures inside the ITER tokamak.

The DMS is located in ITER ports on the equatorial level and the upper levels (see system for equatorial systems as an example in fig. 1). All DMS units on the equatorial share a common design and so do the units on the upper ports. Since most of the ports are home to various diagnostics and other systems, each port environment can differ and the common DMS design solutions may have to be adapted. The DMS units are located in Equatorial Port (EP) #02, EP#08, EP#17 and Upper Port (UP) #02, UP#08, UP#14

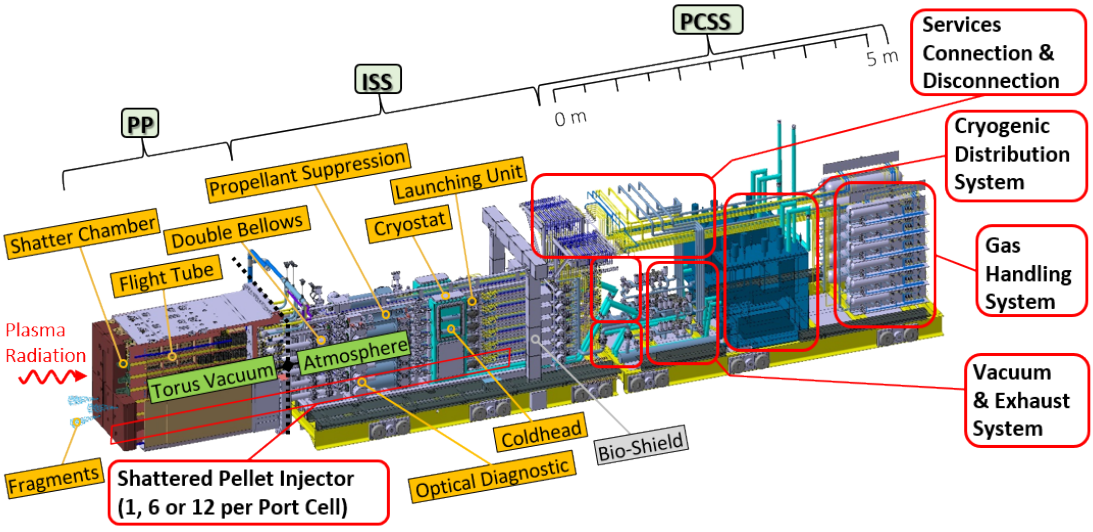

Figure 1 Typical DMS in EP integrated into the ISS and PCSS.

During ITER operation, the Diagnostic Port Plugs (Upper or Equatorial) are regularly removed from the tokamak and delivered to the Hot Cell Facility for refurbishment using the Remote Handling Equatorial Cask System. After cleaning, it is then passed on to the maintenance area or buffer storage area. This is a zone, where no human access is allowed due to the high contamination (Tritium and Beryllium) and gamma radiation levels. Port plug maintenance will generally consist of replacement of damaged or malfunctioning components plus simple operations, such as cleaning, adjustment, and minor refurbishment. The Diagnostic Shield Module/ Diagnostic First Wall assembly is taken off the Port Plug structure in the vertical orientation by a crane operated remotely. After refurbishment, the Port Plug is delivered to the Port Plug Test Facility for environmental and functional tests.

The Port Interspace and Port Cell equipment (see Figure 1) is not maintained by the Remote Handling tools, but rather by assisted-manual tools which imply semi-robotic and distantly manipulated operations due to the activation of equipment and possible contamination by beryllium and tritium. Once removed from the Port Cell, this equipment will be handled hands-on in a dedicated area in the Hot Cell Facility where human presence is allowed but restricted.

6.2 Maintenance engineering support

The objective is to continuously support the DMS design and the integration of the design into this highly constraint environment and to develop solutions appropriate for the DMS. The list of specific and general activities expected to be performed is

- Develop and support a maintenance strategy, for the DMS both equatorial and upper ports, which requires identification of tasks, proposals for tooling, hands-on or distant operations assessment, worker's exposure assessment and time to perform all necessary maintenance tasks
- Develop and support a criticality assessment (according to [13]) of components to identify the level of needed maintenance
- Propose and justify maintenance and handling schemes by analysis taking into account the needs for a workstation to perform maintenance tasks, as well as maintenance of the individual systems integrated within the given ports and their specific requirements
- Develop, analyse and support the DMS assembly sequences
- Develop, analyse and support the DMS alignment strategy
- Develop, analyse and support the DMS commissioning procedures
- Develop and support the DMS team in Occupational Radiation Exposure (ORE) assessment tasks
- Propose and support the design of maintenance and alignment tools required to service the DMS which would satisfy quick and reliable refurbishment of systems in-situ or in the Hot Cell
- Follow-up and prepare the input packages for upcoming Design Reviews
- Review and update existing reliability, availability, maintenance and inspectability documentation
- Review and update existing failure mode effects and criticality analysis documentation
- Review and update the human occupational factor analysis documentation

6.3 Engineering documentation

Some of the engineering documentation which may be expected to be prepared are

- Update of System Design Description document (DDD);
- Update functional analysis reports;
- Support in updating of the interface documentation, namely Interface Control
- Documents (ICD) and Interface Sheets (IS);
- Prepare system classification documents;
- Support in preparation of ORE calculation notes;
- Support in creation of Engineering and Construction Work Packages (EWP, CWP);
- Support in creation of Construction Process Descriptions (CPD);
- Support in creation of assembly related documents and work packages;
- Preparation of presentations for design reviews and design integration reviews (DIR);
- Input to any other required ITER design documentation

7 Responsibilities

7.1 Contractor's obligations

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.
-

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.

7.2 Obligations of the ITER Organization

The ITER Organization shall

- Nominate the Responsible Officer to manage the Contract;
- Organise regular meeting(s) on work performed;
- Provide offices at IO premises.

The ITER Organization shall in addition give the possibility to the contractor to review documents on the ITER documents database (IDM). Furthermore the IO shall make all

technical data and documents available to the Contractor which will be required to carry out its obligations in a timely manner.

8 List of deliverables and due dates

N°	Target date (months)	Deliverable description
D1	T0+3	Familiarize with the DMS design and maintenance relevant documentation and propose a plan for PDR closure of chits related to maintenance. Discuss with the IO RO and upload supporting description document in the IDM as per request. Provide a report on IDM summarising the work of this deliverable.
D2	T0+6	Develop and support the criticality assessment of components to identify the level of needed maintenance. Review, extend/complete documentation related to RAMI and maintenance plans as part of the initial detail design phase in preparation for the FDR (June 2023). Discuss with the IO RO and upload supporting description document in the IDM as per request. Provide a report on IDM summarising the work of this deliverable.
D3	T0+9	Develop and support the assembly and alignment strategy and associated documentation. Review, extend/complete documentation related to RAMI and specifically maintenance as part of the intermediate detail design phase in preparation for the FDR (June 2023). Discuss with the IO RO and upload supporting description document in the IDM as per request. Provide a report on IDM summarising the work of this deliverable.
D4	T0+12	Develop and support the commissioning strategy and associated documentation. Review, extend/complete documentation related to RAMI and specifically maintenance as part of the final detail design phase in preparation for the FDR (June 2023). Discuss with the IO RO and upload supporting description document in the IDM as per request. Provide a report on IDM summarising the work of this deliverable.

9 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 the approval of 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.

10 Specific requirements and conditions

In order to complete the tasks in a timely manner the following skills are required:

- Experience with operation and work in technologically challenging environments (e.g. aerospace engineering, particle accelerators, Nuclear Fission, Nuclear Fusion, etc.);
- Experience in mechanical engineering;
- Experience in Remote Handling/maintenance;
- Experience with human and organisational factors
- Experience in assembly and commissioning of complex systems;
- Experience in interpretation of neutronics/ shutdown dose rate analysis;
- Experience in application of French Nuclear Safety regulations;
- Experience with tolerance analysis
- Technical document generation;
- System requirements management;
- Technical risk analysis.

The following skills are advantageous:

- Experience in cryogenics
- Experience with metrology
- Experience with passive fire protection
- Experience with ATEX directive
- Experience with vacuum system
- Experience with pressurised systems
- Experience in reliability, availability and Failure Modes and Effects Analysis

11 Work Monitoring / Meeting Schedule

Work is monitored through reports (see List of Deliverables section).
The Contractor will work predominantly on the IO site.

12 Delivery time breakdown

T0 is the date of the contract signature. See Section 8 List *Deliverables section 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 Requirements (if applicable)

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

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).

Drawing Registration in the IO system shall be performed according to the Procedure for the Management of Diagrams and Drawings in pdf Format Using the SMDD Application (KFMK2B).

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 P7Q3J7 - Specification for CAD data Production in ITER direct 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.

15 Safety requirements

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

For Protection Important Components (PIC) 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 (as per *ITER D PSTTZL*) 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 *ITER D 45P8YK Defined requirements PBS 18 DMS* is mandatory.

Note: DMS Design activities are PIA

Refer the Quality class and Safety Class as per the SRD document (BEJQWA)