

Technical Specifications (In-Cash Procurement)

Technical Specification-Electrical Engineering Support for DMS

This document concerns engineering support for the DMS design and integration. The work requires technical expertise in the field of electrical engineering, in particular related to the design of the DMS Instrumentation & Control (I&C) and in the low to medium voltage ranges (up to 2-3 kV DC).

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1 Purpose

This document (ITER_D_7U9P5P) describes the technical needs to support the Fuelling and Wall Conditioning section in the preparation of the Final Design Review (FDR) of the Disruption Mitigation System (DMS), which will be held in mid-2023.

2 Scope

This document concerns engineering support for the DMS design and integration. The work requires technical expertise in the field of electrical engineering, in particular related to the design of the DMS Instrumentation & Control (I&C) and in the low to medium voltage ranges (up to 2-3 kV DC).

3 Definitions

For a complete list of ITER abbreviations see: [ITER Abbreviations \(ITER_D_2MU6W5\)](#).

Acronym	Meaning
BOM	Bill Of Material
CAD	Computer Aided Design
CRO	Contract Responsible Officer
DCIF	Design Collaboration Implementation Form
DMS	Disruption Mitigation System
EM	Electro-Magnetic
EMI	Electro-Magnetic Interference
EP	Equatorial port
FDR	Final Design Review
IDM	ITER Document Management
INB	Installation Nucléaire de Base
IO	ITER Organization
ISS	Interspace Support Structure
I&C	Instrumentation & Control
MoMs	Minutes of Meeting
PDR	Preliminary Design Review
PIA	Protection Important Activity
PM	Progress Meeting
RO	Responsible Officer
TBC	To Be Confirmed
TRO	Task Responsible Officer
UP	Upper Port

4 References

- [1] ITER Procurement Quality Requirements [[22MFG4](#)]
- [2] Requirements for Producing a Quality Plan [[22MFMW](#)]
- [3] Working Instruction for the Qualification of ITER safety codes [[258LKL](#)]
- [4] Procedure for the Usage of the ITER CAD Manual [[2F6FTX](#)]
- [5] Procedure for the CAD management plan [[2DWU2M](#)]
- [6] Diagrams and Drawings Management System Working Instruction [[KFMK2B](#)]
- [7] Specification for CAD data Production in ITER direct contracts [[P7Q3J7](#)]
- [8] CAD Manual 07 - CAD Fact Sheet [[249WUL](#)]
- [9] List of ITER-INB Protections Important Activities [[PSTTZL](#)]
- [10] PRELIMINARY ANALYSIS OF THE IMPACT OF THE INB ORDER - 7TH FEBRUARY 2012 [[AW6JSB](#)]
- [11] Defined requirements PBS 18 DMS [[45P8YK](#)]
- [12] SRD-18-DM (Disruption Mitigation System) from DOORS [[BEJQWA](#)]

5 Estimated Duration

The overall duration of this work is 12 months.

6 Work Description

6.1 Introduction

The purpose of the ITER 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 uses cryogenic hydrogen and neon pellets, which are pneumatically propelled, in the period of milliseconds, towards the plasma and, just before entering the plasma, shattered into small fragments to reduce damage to the plasma facing components and to other structures inside the ITER tokamak. The pellets, which are fired by 27 toroidally and poloidally distributed injectors, are generated inside the cold head of each injector, which is located in the Interspace Support Structure (ISS) of the associated Port Cell. The DMS is a large system where all the units on the equatorial ports (EPs) share a common and modular design and so do the units on the upper ports (UPs). On the equatorial plan, the concerned ports are: EP#02, EP#08 and EP#17. On the upper level, the concerned ports are: UP#02, UP#08 and UP#14. An example of a DMS injector integrated in EP #02 is visible in fig. 1.

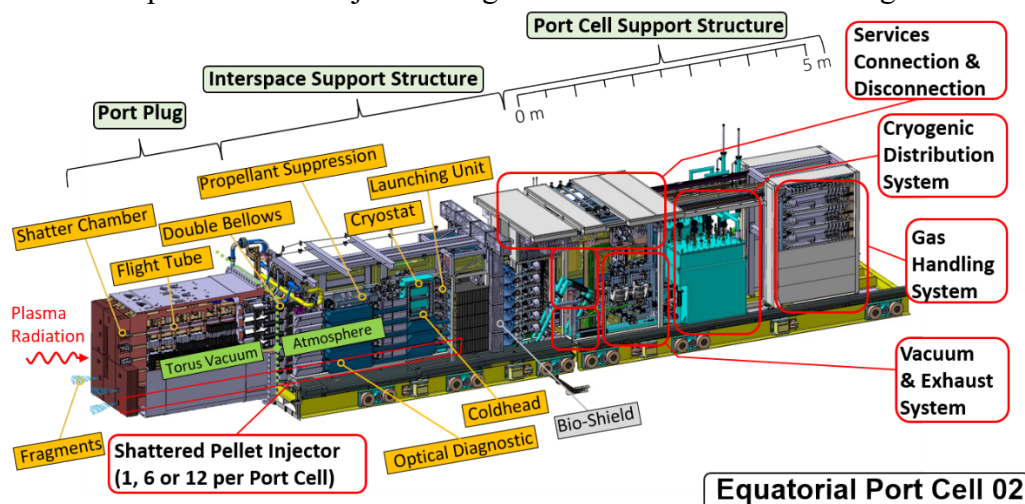


Figure 1: Example of DMS in injector integrated in EP#02

The realization of the DMS can be broken down into a series of work packages such as Pellet Injector, Cryogenic System, Gas Handling System, Vacuum System and Control System, as shown in figure 2. Each of these work packages can be further broken down into individual components or assemblies. The work package of interest for this contract is mainly the Control System.

The DMS I&C system spans from the most sensitive components located close to the vacuum vessel up to the control cubicles located in the tokamak and diagnostics buildings (B11 and B74 respectively) and is subject to tough environmental constraints mostly related to ionizing radiations and electro-magnetic fields.

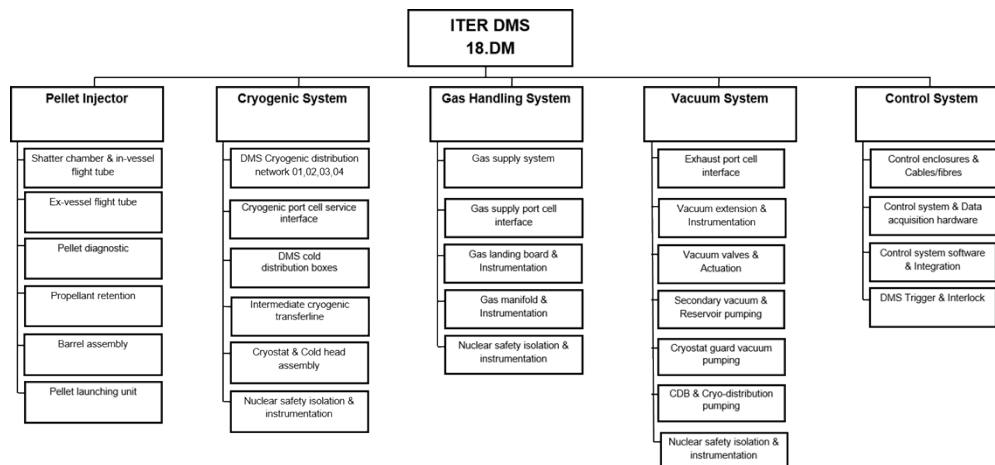


Figure 2: DMS plant breakdown

6.2 Electrical Engineering Support

The Contractor shall support the DMS group in:

- Resolving electrical-services and I&C electrically related tasks connected to the Preliminary Design Review (PDR) chit resolution and to the post-PDR phase.
- Checking and complementing the list of selected bill-of-material (BOM) components of the DMS electrical part.
- Reviewing the DMS electrical design and providing a list of changes.
- Assessing the requirements and the strategy for electro-magnetic (EM) compatibility and electro-magnetic interference (EMI) protection of the DMS electrical services and validating their implementation.
- Developing a grounding and bonding strategy for wiring and other conductive plant components such as mechanical support structures
- Developing a strategy for validation and testing of the selected electrified equipment, taking into account system requirements and FDR input package, and preparing the associated documentation.
- Preparing and carrying out the necessary calculations of electrical parameters based on the analysis data and reports.
- Supervising the preparation of the cabling diagrams and reviewing them.
- Selecting the right electrical equipment (cable and connectors), in particular with respect to the foreseen sensors and actuators.
- Choosing the correct equipment for the I&C cubicles (breakers, terminal blocks, etc.).
- Assessing the connections of the instrumentation equipment with the control equipment (type of connectors, wires, etc.).
- Determining the electrical and cabling needs for the DMS I&C test bench.
- Interacting with PBS 44 (Cable Trays) to establish the correct layout of the cables.
- Studying and proposing a maintenance plan related to the DMS electrical part.
- Helping to prepare the input package for the DMS FDR.
- Carrying on the DMS FDR and tackling the post-FDR phase (helping on chit resolution).
- Any other task required for the design and validation of the DMS electrical system.

6.3 Services Location

The services are to be provided onsite at least four days per week, the remaining day being offsite.

7 Responsibilities

7.1 Contractor's Obligations

In order to perform successfully the tasks described in these Technical Specifications, the Contractor shall:

- Strictly implement the IO procedures, instructions and strictly use templates.
- Provide experienced and trained resources to perform the tasks.
- Provide personnel who possess the qualifications, professional competence and experience to carry out services in accordance with IO rules and procedures.
- Agreed that its personnel will be bound by the rules and regulations governing the IO ethics, safety and security 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.

7.2 Obligations of the ITER Organization

The IO shall:

- Nominate a Contract Responsible Officer (CRO) to manage the Contract.
- Nominate a Technical Responsible Officer (TRO) to manage the technical content of this Contract.
- Provide necessary information for the creation of the deliverables and provide the Contractor's personnel with relevant source of information.
- Provide an office at IO premises and all the necessary equipment to execute the tasks (laptop, etc.).

In addition, the IO shall:

- Give the possibility to the Contractor to review documents on IDM.
- Make available, to the Contractor, all the technical data and documents that are required to carry out its obligations in a timely manner.

8 List of Deliverables and Due Dates

The deliverables list is provided in the following table. T0 is the date of the contract signature.

N°	Target date (months)	Deliverable description
D1	T0+3	Familiarize with the DMS design. Discuss with the IO TRO and start supporting the DMS electrical design with respect to the different electrical subjects, in particular to close the DMS PDR and to prepare the DMS FDR phase. Provide report #1 on IDM summarizing the work performed for this deliverable.
D2	T0+6	Continue to support the design of the DMS electrical system, with emphasis on the EM compatibility and on the EMI protections and starting to produce a philosophy of validation and testing of the equipment. A possible update of the BOM has to be taken into account too. Provide report #2 on IDM summarizing the work performed for this deliverable.
D3	T0+9	Continue to support the design of the DMS electrical system, focusing on cabling diagrams, I&C cubicles and DSM FDR preparation. Provide report #3 on IDM summarizing the work performed for this deliverable.
D4	T0+12	Support the DMS team during the DMS FDR and post-FDR phases. Provide report #4 on IDM summarizing the work performed for this deliverable.

9 Acceptance Criteria

The following criteria shall be the basis of the acceptance of the successful accomplishment of the work.

9.1 Delivery-date criteria

On-time delivery of deliverables according to the target dates defined in Chapter 8.

9.2 Deliverable-review criteria

The deliverables shall 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 ("The Approver"). The Approver can name one or more Reviewers in the area of the deliverable's expertise. The Reviewer(s) can ask modifications to the deliverable; in this case, the Contractor

must submit a new version. The acceptance of the document by the Approver is an acceptance criterion.

10 Specific Requirements and Conditions

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

- University degree in electrical engineering.
- Proven expertise in electrical engineering (at least five years).
- Knowledge of electrical engineering codes and standards (also nuclear power-plant standards).
- Proven knowledge of cabling requirements for harsh environments (EMI, radiations, etc.).
- Hands-on experience on cabling and wiring diagrams.
- Experience in validation and testing of electrical equipment.
- Experience in grounding and bonding.
- Practical experience of the electrical-equipment suppliers.
- Hands-on experience on I&C systems design and development.
- Experience in writing technical documents and proficiency in the English language.

The following skills are advantageous:

- Experience with designing and operating equipment in high magnetic fields
- Experience in assessment of the design compliance with technical requirements.
- Experience in cryogenic systems.
- Experience with passive fire protection.
- Experience with ATEX directives.
- Experience with vacuum system.
- Proactivity.
- Capability to work in an international environment.

11 Work Monitoring / Meeting Schedule

The work progress will be officially managed by means of Progress Meetings (PMs) and through the formal exchange of documents transmitted by emails or through IDM.

The main purpose of the PMs is to allow the IO and the Contractor TROs to:

- Review the completed and planned activities and assess the progress made.
- Clarify the forthcoming activities and solving possible issues.

The following table shows the scheduled meetings:

N°	Target date (months)	PM description
PM0	T0	Kick-off meeting
PM1	T0+3	PM #1 with discussion about D1.
PM2	T0+6	PM #2 with discussion about D2.
PM3	T0+9	PM #3 with discussion about D3.
PM4	T0+12	Closure meeting with discussion about D4.

These meetings shall have an agenda and Minutes of Meeting (MoMs), in charge of the Contractor. The MoMs shall be drafted by the Contractor within five working days following the meeting. The IO will review the draft version or the MoMs within five working days after the issuing date by the Contractor.

Deliverables D1, D2, D3 and D4 shall be discussed during PM1, PM2, PM3 and PM4 respectively. In these occasions, the Contractor shall upload in IDM the due deliverable, which shall undergo the review process as explained in Chapter 9.

Additional weekly technical meetings between IO and the Contractor shall take place, where the Contractor will present the status of the work. These meetings shall be supported by presentations uploaded in the IO-Contractor exchange folder.

12 Quality Assurance Requirements

The organization conducting these activities should have an ITER approved Quality Assurance program or an ISO 9001 accredited quality system. The general requirements are detailed in [1].

Prior to commencement of the task, a Quality Plan must be submitted for IO approval, giving evidence of the above and describing:

- The organization for this task.
- The skill of worker involved in the Contract.
- Who will be the independent checker of the activities (see [2]).

Documentation developed as the result of this Contract shall be retained by the performer of the task for a minimum of five 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 [3].

13 CAD Requirements (if Applicable)

For the contracts where Computer Aided Design (CAD) design tasks are involved, the following shall apply:

- The Contractor shall ensure that all designs, CAD data and drawings delivered to IO comply with the “Procedure for the Usage of the ITER CAD Manual” [4] and with the “Procedure for the CAD management plan” [5].
- Drawing Registration in the IO system shall be performed according to the “Diagrams and Drawings Management System Working Instruction” [6].
- The reference scheme is for the Contractor to work in a fully synchronous manner on the ITER CAD platform (see detailed information about synchronous collaboration in the “Specification for CAD data Production in ITER direct contracts” [7]). This implies the usage of the CAD software versions as indicated in the “CAD Manual 07 – CAD Fact Sheet” [8] and the connection to one of the ITER project CAD databases. Any deviation against this requirement shall be defined in a Design Collaboration Implementation Form (DCIF) prepared and approved by the Design Office and included in the call-for-tender package. Any cost or labor resulting from a deviation or non-conformance of the Contractor with regards to the CAD collaboration requirement shall be incurred by the Contractor.

14 Safety Requirements

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

The French Nuclear Regulation must be observed, in application of the Article 14 of the ITER Agreement.

In such case, the Contractors and Sub-contractors must be informed that:

- The Order – 7th February 2012 applies to all the Protection Important Components (PICs) and to all Protection Important Activities (PIAs).
- The compliance with the Order – 7th February 2012 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 PICs, PIAs and structures and systems of the nuclear facility (as per [9]) the Contractor shall ensure that a specific management system is implemented for its own activities and for the activities done by any Contractor and Sub-contractor following the requirements of the Order – 7th February 2012 [10].

Notes:

- Compliance with [11] and its derived requirements in [12] is mandatory.
- DMS design activities are PIAs.