

Technical Specifications (In-Cash Procurement)

Technical Specification - Cryogenics Expert Support for DMS

This document concerns DMS Cryogenics expert support activities performed for the DMS FDR closure, chit resolution, prototyping and manufacturing preparation, intended on a call for expertise (CFE) contract.

The work involves provision of technical expertise and to work together with the IO-TRO and the DMS design team primarily. It involves many areas of activity that have to be supported. The scope of work of the Contractor is to work with the IO Team in the role of a technical expert with ...

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1 Purpose

The purpose of this technical specification (ITER_D_8QNSA2) is to outline and define the requirements for a cryogenic expert to support the Disruption Mitigation System (DMS) FDR chits closure, prototyping and manufacturing preparation (MRR).

2 Scope

This document concerns DMS Cryogenics expert support activities performed for the DMS FDR chits closure, prototyping and manufacturing preparation (MRR).

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
DA	Domestic Agency
DET	Data Exchange Transfer
DFW	Diagnostic First Wall
DIR	Design Integration Review
DMS	Disruption Mitigation System
DSM	Diagnostic Shielding Module
EP	Equatorial port
FDR	Final Design Review
FP	First Plasma
HFE	Human Factors and Ergonomics
HIRA	Hazard Identification and Risk Assessment
HoF	Human Organizational Factor
IO	ITER Organization
ISS	Interspace Support Structure
ORE	Occupational Radiation Exposure
PCSS	Port Cell Support Structure
PDR	Preliminary Design Review
PFPO-1	Pre-Fusion Plasma Operation 1
PI	Port Integrator
PIA	Protection Important Activity
PIC	Protection Important Component
PP	Port Plug
RH	Remote Handling
RO	Responsible Officer
SDDR	Shutdown Dose Rate

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 PSTTZL - List of ITER-INB Protections Important Activities
- [11] ITER_D_7M2YKF v1.7 - Order dated 7 February 2012 relating to the general technical regulations applicable to INB - EN

5 Estimated Duration

The overall duration of this work is 12 months.

6 Work description

The work involves provision of technical expertise in the field of cryogenics and to be performed together with the IO-TRO and the DMS design team primarily. It involves many areas of activity that must be supported. The scope of work of the Contractor is to work with the IO Team in the role of a technical expert with a focus on cryogenics design, prototyping and manufacturing aspects, bringing expertise and contributing to the activities performed by the team to design associated systems.

6.1 Introduction

The purpose of the ITER Disruption Mitigation System (DMS) is to provide machine protection 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 located in the Interspace Support Structure (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. A typical injector design for the equatorial ports can be seen in fig. 1.

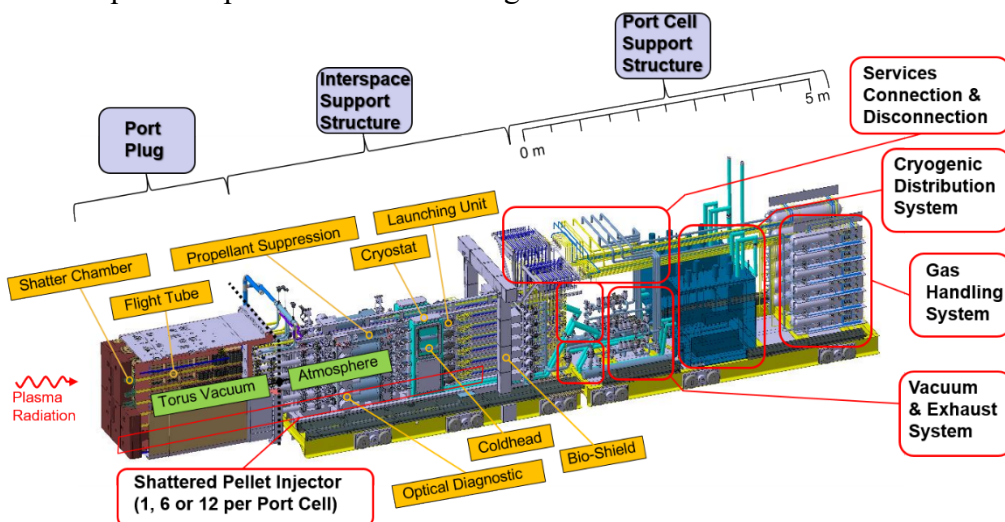


Figure 1 Typical DMS in EP integrated into the ISS and PCSS.

6.2 Cryogenic Engineering and Integration

The objective is to support the DMS final design review chits closure, prototyping and manufacturing preparation (MRR). The list of specific and general activities expected to be performed is:

- Development and integration of cryogenic components and services in the B11 galleries, vertical shafts and port cells.
- Development of cryogenic components and services in the ISS and Port Cell Support Structure (PCCS) and integration solutions:
 - Finding adequate space for the DMS components ensuring installation, assembly, 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,
 - Manage the relevant CAD models,
- Support Design reviews (e.g. FDR closure, MRR),
- Support Design Integration reviews (DIR);
- Support of maintenance operations development in the ISS and PCSS areas including area in between closure plate and ISS;
- Support of cryogenic and gas supply component installation activities
- Carrying out other related engineering tasks, upon line management request.
- Carrying out sophisticated process and thermal analysis by using commercial (Ansys, Ecosim-Pro) or custom (Matlab or Excel) analysis tools, and documenting the methodology and the results in written reports.
- Participation and technical support in prototyping procurement contracts with industry or laboratories.

6.3 Engineering documentation

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

Bill of Materials;
Design description documents
Documents to be used to define interfaces
Interface sheets
Provision of Engineering Work Packages
Input to any other required ITER design documentation

Furthermore it may be expected

to participate in regular DMS group meetings;
to participate in design and integration reviews;
contribute or provide presentation related to analysis, mechanical design, integration and assembly;

6.4 Contract management

Some of the activities, which may be expected are

- Drafting technical specifications

- Support in the execution of contracts with suppliers of cryogenic components and services.
- Review of deliverables.

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 the required 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;

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	Contribute to the chit resolution and completion of the DMS final design basis for FDR closure. Provide a report on IDM summarizing the progress of these activities.
D2	T0+6	Contribute to the technical specifications for the DMS cryogenic system Cold Distribution Box prototype. Enhance the completeness and clarity of the existing design basis. Provide a report on IDM summarizing the progress of these activities.

D3	T0+9	Contribute to the technical specifications for the DMS cryogenic system transfer lines prototype. Provide a report on IDM summarizing the progress of these activities.
D4	T0+12	Contribute to draft the technical specifications for DMS cryogenic ITER components manufacturing. Provide a report on IDM summarizing the progress of these activities..

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 experiences are required:

- Cryogenics technology, specifically with supercritical helium (SHe) distribution and control applied in large experimental environments such as particle accelerators or nuclear fusion experiments
- Vacuum technology including UHV pumping, diagnostic instrumentation, and associated equipment such as isolation and control valves
- Design of gas handling equipment, including pressure equipment design and qualification
- Development and integration of novel, complex multidisciplinary systems in a nuclear fusion-relevant environment, including design and selection of components for compatibility with tritium, radiation, and high magnetic fields
- The technical assessment, sizing, simulation and design of above technologies
- Procurement, installation and commissioning of components equipment in large experimental environments such as particle accelerators or nuclear fusion experiments requiring creation and management of work procedures, risk assessments etc. and the supervision of the work
- Producing and reviewing final design deliverables (e.g. design basis documents, P&IDs, design descriptions, operating descriptions, control systems, HAZOP, etc)
- Simulation and modelling of cryogenic processes (pressure drop, process control), heat load analysis for cryogenic systems, basic structural analysis.
- Previous knowledge of DMS cryogenic system by Shattered Pellet Injection (SPI) will be considered as a plus.

11 Work Monitoring / Meeting Schedule

Work is monitored through reports (see List of Deliverables section).

The Contractor will predominantly work offsite. Note that periodic visits to attend meetings at IO or at IO contractor sites might be required: please account for a minimum of 6 working days, divided in two visits in Europe, upon IO request.

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 [11]

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)