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EXTERNAL REFERENCE / VERSION

Technical Specifications (In-Cash Procurement)

Technical Specification - CFE Engineering Analysis for DMS

Technical Specification for Engineering Analysis for DMS (post-FDR)
This is planned to be a Call for Expertise (CFE) contract

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1 Preamble

This technical specifications are to be read in combination with [AD1] that constitutes a full part of the technical requirements. In case of conflict, the content of the Technical Specification supersedes the content of [AD1].

2 Purpose

The purpose of this technical specification (ITER_D_ASLBG5) define how the development of the Disruption Mitigation System (DMS) shall be supported after the FDR.

3 Acronyms & Definitions

3.1 Acronyms

The following acronyms are the main ones relevant to this document.

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

3.2 Definitions

Site or ITER Site or IO Site: Covers the Construction site and Areas under Operation. By extension, any place where IO staff is operating on a regular basis is to be considered ITER Site, if specified as such by IO.

Offsite: Anywhere that is not ITER Site.

Contractor: Shall mean an economic operator who have signed the Contract in which this document is referenced.

4 Applicable Documents & Codes and standards

4.1 Applicable Documents

It is the responsibility of the Contractor to identify and request for any documents that would not have been transmitted by IO, including the below list of reference documents.

These technical specifications take precedence over the referenced documents. In case of conflicting information, this is the responsibility of the contractor to seek clarification from IO.

Upon notification of any revision of the applicable document transmitted officially to the contractor, the contractor shall advise within four weeks of any impact on the execution of the contract. Without any response after this period, no impact will be considered.

Ref	Title	IDM ID	Version
[AD1]	General Management Specification for Service and Supply	82MXQK	1.4
[AD2]	Project Requirements	27ZRW8	6.3
[AD3]	System Requirement Document (SRD) 18.DM	BEJQWA	2.4
[AD4]	Defined requirements PBS 18 DMS	45P8YK	2.3
[AD5]	18.DM System Design Description for DMS	2NC6CB	2.1
[AD6]	Safe Access for Maintainability	RUGWUK	1.4
[AD7]	Working Instruction for the Qualification of ITER safety codes	258LKL	3.1
[AD8]	ITER Human & Organizational Factors Policy	QUK6LF	1.1
[AD9]	ITER Abbreviations	2MU6W5	1.17
[AD10]	Software Qualification Policy	KTU8HH	2.0
[AD11]	Quality Classification Determination	24VQES	5.2
[AD12]	Order dated 7 February 2012 relating to the general technical regulations applicable to INB - EN	7M2YKF	1.7

4.2 Applicable Codes and Standards

It is the responsibility of the contractor to procure the relevant Codes and Standards applicable to that scope of work.

However, there are no particular Codes and Standards identified for the work under the scope of these technical specifications.

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Ref	Title	Doc Ref.	Version
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5 Scope of Work

5.1 Introduction

This section defines the specific scope of work for the service, in addition to the contract execution requirement as defined in [AD1].

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 utilizes cryogenic hydrogen and neon pellets which are generated inside the injectors, which are located in the Interspace Support Structure (ISS). These pellets are pneumatically propelled, in the period of milliseconds, towards the plasma and, just before entering the plasma, they are shattered into small fragments so as to reduce damage to the plasma facing components and to other structures inside the ITER tokamak. The DMS is located in ITER ports on the equatorial level and the upper levels (see an example of the DMS integrated in the Equatorial Port (EP) #2 in fig. 1). All DMS units on the equatorial share a common and modular design and so do the units on the upper ports.

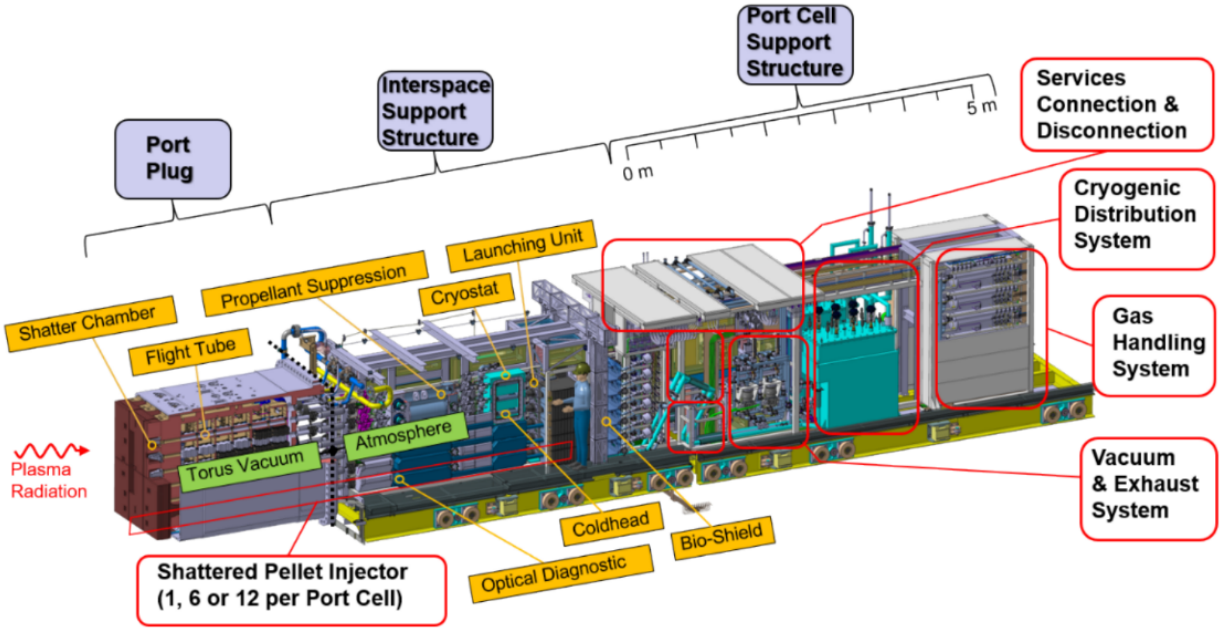

Figure 1 Typical DMS in EP integrated into the ISS and PCSS

The ITER DMS is a large system with a total of 27 injectors distributed toroidally and poloidally in EP #02, EP#08, EP#17 and Upper Port (UP) #02, UP#08, UP#14. Each of these systems can be broken down into a series of work packages such as the Pellet Injector, Cryogenic System, Gas Handling System, Vacuum System and the Control System as shown in figure 2. Each of these work packages can be broken down further into individual components or assemblies.

There is no specific work package of interest for this contract since it is of transversal nature covering the overall engineering analysis of the system.

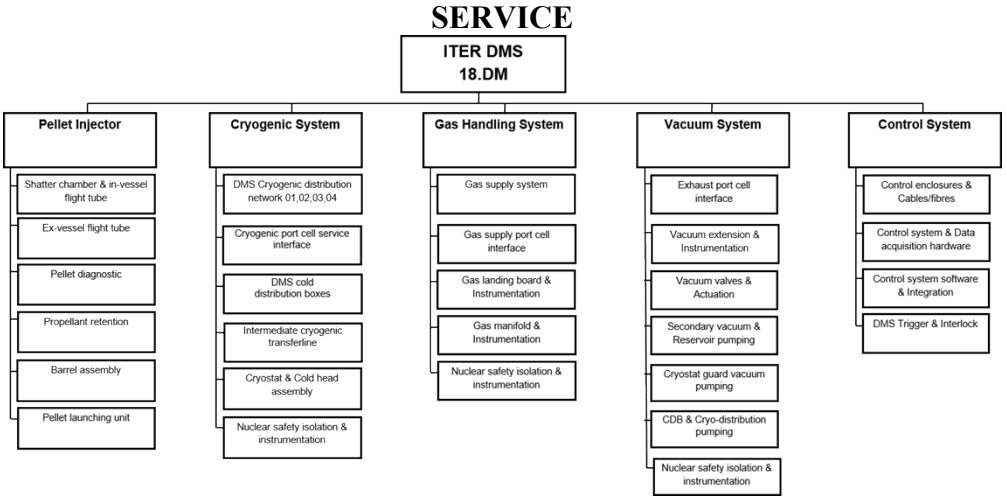

Figure 2 The DMS Plant Breakdown

5.2 Engineering Analysis

5.2.1 Description

The objective is to continuously support the DMS design. The list of specific and general activities expected to be performed is

- Preparation and/or update of Load Specification documents for DMS In-vessel component and Ex-vessel components, in strict compliance with ITER General Load specification
- Preparation and/or update of Structural Integrity Reports for DMS In-vessel and Ex-vessel components, in strict compliance with ITER MQP standards
- Performing thermal assessment of DMS In-vessel and Ex-vessel components
- Performing linear/non-linear excessive deformation analysis of DMS In-vessel and Ex-vessel components
- Performing linear/non-linear progressive deformation analysis (fatigue etc.) of DMS In-vessel and Ex-vessel components
- Performing elastic/elastoplastic instability analysis (buckling) of DMS In-vessel and Ex-vessel components
- Performing Seismic assessment of DMS In-vessel and Ex-vessel components
- Performing fatigue assessment of bolts/welds in accordance with analysis codes
- Carrying out other related engineering tasks, upon line management request.

5.2.2 Engineering Documentation

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

- Load specifications
- Analysis reports
- Technical specification for external engineering services
- Presentations

Furthermore it may be expected

- to participate in regular DMS group meetings and in person meetings if required

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5.2.3 Service Duration

The maximum expected duration for this activity is twelve months (see also Chapter 8).

6 Location for Scope of Work Execution

The Contractor will work predominantly off-site.

Note: The contractor will may be asked to be present on the ITER site for in person meetings on short notice for a non-specific number of weekdays throughout the contract period

7 IO Documents

Under the scope of work, IO will provide relevant / appropriate input documents as necessary during the course of the contract. A preliminary list of documents will be discussed during the Kick Off Meeting.

8 List of Deliverables and Due Dates

The Supplier shall provide IO with the documents and data required in the application of this technical specification, of [AD1] and any other requirement derived from the application of the contract.

The list of deliverables is available hereafter with associated due dates. The content of the deliverables has been detailed in sub-section 5.2.2

Technical Design Family (TDF)	Generic Document Title (GTD)	Further Description	Expected date (T0+X) *
Contract Management	D0 – Quality Plan	Quality Assurance Plan from the Contractor specific to the execution of the contract	T0 + 1
Report	D1 – Intermediate Progress Report #1	Assess the available and required analysis results and tasks in preparation of the FDR chit resolution and FDR closure planning. Provide a report on IDM summarizing the work of this deliverable.	T0 + 3
Report	D2 – Intermediate Progress Report #2	Support the DMS design team in chit resolution. Perform initial analysis tasks in preparation of the FDR closure. Provide a report on IDM summarizing the work of this deliverable.	T0 + 6
Report	D3 – Intermediate Progress Report #3	Support the DMS design team in chit resolution. Perform detailed analysis tasks in preparation of the FDR closure. Provide a report on IDM summarizing the work of this deliverable.	T0 + 9
Report	D4 – Final Report	Support the DMS design team in the initial setup towards the manufacturing phase and identify required engineering analysis tasks for DMS and related integration activities (analysis correlation with port	T0 + 12

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		integrators activities). Provide a report on IDM summarizing the work of this deliverable.	

(*) T0 = Start date of the kick-off meeting; X in months.

The Contractor is requested to prepare their document schedule based on the above and using the template available in the appendix II (click here to download) of [AD1].

9 Quality Assurance Requirements

The quality class (QC) under this contract is as per [AD3]. Chapter 8 of [AD1] applies in line with the defined QC.

10 Safety Requirements

DMS Design activities are Protection Important Activities (PIA), while the Safety Class is as per [AD3]. Hence section 5.3.3 of [AD1] apply.

11 Specific General Management Requirements

Section 6 of [AD1] applies in full, except for section 6.4, amended with the following specific requirement:

- The Contractor shall not subcontract any part of this contract.

11.1 Contract Gates

The contract gates are defined in section 6.1.5 of GMS [AD1]. This service contract shall have the following technical gates:

- Approval of deliverable D1 by the IO Technical Responsible Officer (TRO).
- Approval of deliverable D2 by the IO TRO.
- Approval of deliverable D3 by the IO TRO.
- Approval of deliverable D4 by the IO TRO.

11.2 Work Monitoring

As stated in [AD1], the work progress will be managed as explained in sub-sections 6.1.4 for progress reports and 6.1.6 for progress meetings.

Moreover, the work monitoring can also be complementary achieved through the formal exchange of documents transmitted by emails or over IDM.

11.3 Meeting Schedule

In addition to the Progress Meetings, the Contractor shall work closely with the DMS designers from PBS 18.DM and also of other PBSs if needed. Routine technical meetings will take place to monitor work progress and approaches, discuss and decide on technical solutions, provide additional information, address hold points, and identify actions which require follow-up. These meeting will have an agenda. Actions/issues identified in these meetings will be recorded and reviewed in subsequent meetings until completed/resolved. It is duty of the Contractor to properly upload in IDM the minutes of these meetings.

On request and by agreement, additional special subject meetings will be organized.

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11.4 CAD Design Requirements

As per section 6.2.2.2 of [AD1]

11.5 Specific Requirements and Conditions

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

- Experience in Mechanical Engineering;
- Sound experience in FEA analysis;
- Experience in using ANSYS Classic & workbench v.15 or higher (and associated packages for CFD (CFX or FLUENT), EM (Maxwell or ANSYS) analysis and pre-processing (SpaceClaim / DesignSpace)).
- Experience in FEA pre-processing, mesh generation and model's quality assessment;
- Experience in Mechanical (linear/non-linear/static/dynamic);
- Experience in thermal-hydraulic analysis (single and coupled);
- Experience in electromagnetic analysis; if particularized to ITER related loads defined from primary inputs (DINA) is considered as an advantage;
- Experience in ParaView and post-processing tool (interface with ANSYS to be developed);
- Experience in advanced Finite Element Analysis techniques (sub-modelling, interpolation, contact technologies, programming (APDL) and coupled field analysis);
- Experience in structural assessment Code post-processing techniques (linearization and categorization of stresses, fatigue, limit analysis);
- Experience in application of appropriate industrial Codes and Standards of nuclear/non-nuclear equipment (e.g. ASME VIII Div 2, ASME III, RCC-MR);
- Experience in creation of Load Specifications for ITER complex integrated systems and management of interface loads between upper level components and tenant systems following an integrated analysis approach;
- Monitoring and reporting of status of projects;
- Communication with international local and remote teams in context of nuclear fusion research or similarly complex research and engineering environment;
- Organization, taking minutes and action tracking of international meetings;
- Understanding of schematics and 3D models.

It is expected to have all the licenses for any software used for this contract on the contractor side (Office, Teams, Ansys or any other if was used for deliverables). IO does not provide any licenses.

All the work is supposed to be carried out 100% off site.