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Technical Specifications (In-Cash Procurement)

Modular Utility Skids - Work Specification

This Works Specification is included in the Document Package issued for the open tender for the contract for the Design, Qualification & Fabrication of the Modular Utilities Skids.
Before executing the Contract, IO shall validate the applicability of this document for use.

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1. Introduction

1.1. Purpose

This document provides the requirements for the Design and Fabrication (D&F) of the Modular Utility Skids (MUS). It presents the Contractor's Scope of Work, which includes the scope of supply and the scope of services (also referred to as 'the Work').

1.2. Scope

This document provides an overall description of the Contract Scope of Work. It is to be read in conjunction with the codes, standards and other documents referenced herein.

1.3. Applicability

This Work Specification is included in the Document Package issued at the start of the Contract for the Design & Fabrication (D&F) of the Modular Utility Skids. The Modular Utility Skids (MUS) are referred to as 'the Plant' within this Document Package.

1.4. Applicable and Reference Documents

In this document and its appendices, applicable and reference documents are shown with an index number between square brackets [index]. This index number identifies the document in the relevant Applicable & Reference Document List (FZJZEG).

2. Background

The ITER project aims at demonstrating the scientific and technical feasibility of nuclear fusion power. The project comprises seven members, i.e. the European Union, China, India, Japan, South Korea, Russia and the US. The ITER facility is being constructed at Cadarache in the south of France.

2.1. Introduction to the Modular Utility Skids

Within the ITER facility, the Tritium Plant supplies fuel gases to the plasma and recycles them after use. It also removes tritium from gaseous effluents prior to release into atmosphere and extracts tritium-contaminated air from the facility rooms as required. The Modular Utility Skids (MUS) Work Package comprises five unit packages skids within the Tritium Plant, which perform the following functions:

- Unit Package 1: First Exhaust System (FES) Skid - process and maintenance ventilation during the first operational phase
- Unit Package 2: Intermediate Cooling Loop (ICL) Skid – provides closed a loop for cooling the Tritium Plant process units
- Unit Package 3: House Vacuum (HV) Skid – centralised service process vacuum
- Unit Package 4: Suppression Tank Venting System (ST-VS) Skid – blower for the safety system used for emergency venting of the vacuum vessel
- Unit Package 5: Demineralised Water (DW) Skid – uninterruptable storage and supply of demineralised water to the system for tritium removal from effluents and room air.

These functions are performed by the equipment assembled on the skids. The Plant shall be prefabricated, assembled and tested prior to delivery to the site to facilitate installation.

Certain parts of the Plant shall perform key nuclear safety functions in normal and accident conditions. It includes protection-important components (PIC) and therefore must comply with French nuclear regulations, i.e. the French Order of 7 February 2012 [685], which establishes the general rules for licenced nuclear facilities in France.

ITER is a licensed nuclear facility identified in France under the number INB-174.

2.2. Client Expectations

The Plant is a key system essential to the success of the ITER Project. The Contractor shall work with the IO in a transparent, collaborative and efficient manner to deliver the project in accordance with the required quality, safety and performance standards, while meeting the project schedule and remaining within the agreed budget. The Contractor shall:

1. Demonstrate a strong safety culture across their organisation and apply it to the design and fabrication of the Plant
2. Use proven systems to control and assure quality at every stage of the Project
3. Possess the tools and capabilities to manage the Project efficiently, ensuring that risks are promptly identified and mitigated.

2.3. Scope of Services and Supply

The Contractor selected for the Design & Fabrication of the Plant ('the Contractor') shall perform the design, procurement, fabrication, testing and site delivery of the equipment, which will then be installed by others under its supervision. The equipment to be designed and supplied includes:

1. Process equipment items assembled on pre-fabricated units ('equipment skids') to enable testing prior to shipment, transportation, delivery and installation on site
2. Interconnecting pipework between equipment items and to tie-in points with other ITER facility systems up to the battery limits
3. Structures, including access platforms, pipe supports and pipe racks
4. Control system, including control cubicles, instrumentation, associated cabling, and instrumentation and control (I&C) software
5. Power supply equipment and associated cabling
6. Spares
7. Miscellaneous equipment required for maintenance and equipment handling.

The Scope of Work includes:

1. Scope of Services (see Section 8)
2. Scope of Supply (see Section 7).

The Contract is organised into two phases:

1. Phase 1: Detailed Design of the complete Plant
2. Phase 2: Procurement & Fabrication of Plant.

Further details on the Contract phases are given in Sections 3.1 and 3.3.

2.4. Summary of IO and Contractor Responsibilities

The IO is responsible for the process design represented on the P&IDs and for the specifications of the components.

The Contractor is responsible for all other aspects of the Plant to ensure compliance with the IO requirements. This includes:

1. The responsibility to design, specify, select and qualify appropriate components, ensure their correct integration to meet the technical and performance requirements of the system (e.g. flow, pressure drop, heating, cooling, etc.)
2. To develop the Plant design to integrate the selected components, taking into account component performance and installation requirements, the integration constraints of the surrounding 3D environment, and accessibility requirements for maintenance, inspection and installation
3. To perform the mechanical and structural design and associated analyses to verify the design and demonstrate that it withstands the specified loads under all normal and accident conditions.

For MUS components classified as nuclear safety components, the Contractor is responsible for ensuring compliance with nuclear safety requirements, and for providing evidence-based, traceable documentation demonstrating such compliance.

The Contractor's general responsibilities are set out in this Work Specification and in other specifications included in the Document Package. Component-specific responsibilities are defined in the Equipment Technical Specifications.

3. Project Phases and Schedule

3.1. Overview

The Contract shall be executed in two phases:

Phase 1: Detailed Design

1. The Scope of Services is the detailed design of the complete Plant
2. This scope is fixed and is committed upon Contract signature.

Phase 2: Procurement & Fabrication

1. The Scope of Services is the procurement, fabrication, testing and site delivery of the Plant
2. This scope will be authorised by the IO after the successful completion of Phase 1
3. This scope is fixed and is committed upon Contract signature.

The process to release the Phases is defined in the Contract.

3.2. Unit Packages

The Contractor shall organise the work into unit packages to optimise project delivery and enable the prioritisation of long-lead items.

The IO has defined the following unit packages. See Section 7 for details on the scope of each unit package.

1. Unit Package 1: First Exhaust System (FES) Skid
2. Unit Package 2: Intermediate Cooling Loop (ICL) Skid
3. Unit Package 3: House Vacuum (HV) Skid
4. Unit Package 4: Suppression Tank Venting System (ST-VS) Skid

5. Unit Package 5: Demineralised Water (DW) Skid.

This breakdown into unit packages is a possible way to organise the work. It is the responsibility of the Contractor to define the final unit packages according to their execution plan and proposed schedule to optimise project delivery.

Each unit package shall undergo gate reviews:

1. Detailed Design Review (DDR)
2. Manufacturing Readiness Reviews (MRR)
3. Delivery Readiness Review (DRR).

These gate reviews are further described in Section 8.4. The gate reviews for several unit packages may be combined into a single review as described in the next section.

The Contractor shall produce a Project Execution Plan at the start of the Contract. This Project Execution Plan shall describe how the work will be organised into unit packages, and the plan for the gate reviews, including the schedule and scope of review.

3.3. Project Schedule and Milestones

A high-level nominal project schedule is given in Table 1. The Contractor shall use the dates in this Table as a basis for its schedule.

Two types of milestones are used: fixed milestones and intermediate milestones.

1. Fixed milestones must be met to ensure that the Plant is installed in time to comply with the ITER project schedule. They constitute contractual commitments. The Contractor shall complete the work required to achieve each fixed milestone on or before the due dates shown in Table 1. These due dates shall not be modified without IO agreement
2. Intermediate milestones are not fixed at the time of tender. For milestones identified as ‘Note 1’ in the table below, the Contractor shall propose dates consistent with its proposed schedule. These dates shall be fixed at Contract commencement, and progress during Contract execution shall be monitored against them. They shall not be modified without IO agreement.

The milestones are based on the assumption that the work will be organised into unit packages as described in Section 3.2.

The kick-off meeting shall be held within two weeks after Contract signature.

Table 1: Nominal Project Schedule

Phase	Milestone Description (Note 2)	Duration	Milestone Type
Phase 1	Start of work / kick-off meeting	T0 (Time Zero)	Intermediate
	DDR 1 (Unit Package 1+2+3)	T0+18 w	Intermediate
	DDR 2 (Unit Package 4+5)	T0+18 w	Intermediate
Phase 2	MRR 1 (Unit Package 1+2+3)	Note 1	Intermediate
	MRR 2 (Unit Package 2)	Note 1	Intermediate
	MRR 3 (Unit Package 3)	Note 1	Intermediate
	FAT & DRR 1 (Unit Package 1+2+3)	Note 1	Intermediate
	FAT & DRR 4 (Unit Package 4)	Note 1	Intermediate
	FAT & DRR 5 (Unit Package 5)	Note 1	Intermediate

	Delivery to ITER site (Unit Package 1+2+3)	**29 Feb 2028**	**FIXED**
	Delivery to ITER site (Unit Package 4+5)	**15 Feb 2029**	**FIXED**

Note 1: Contractor to advise dates for these milestones based on their proposed schedule
Note 2: DDR, MRR, FAT & DRR are gate reviews as described in Section 8.4.

3.3.1. Hold Points and Authorisation to Proceed

The major hold points in the Contract are the Detailed Design Reviews, the Manufacturing Readiness Reviews and the Delivery Readiness Reviews (see Section 8.4).

Procurement of the main Plant items (pumps, blowers, vessels, etc.) shall begin only after successful close-out of the Detailed Design Reviews (DDRs). However, the IO recognises that certain components with long delivery times may need to be procured earlier (before the DDR close-out) to meet the overall project schedule and fixed milestones. For these components, the Contractor will be authorised to start procurement once the IO has agreed that the necessary requirements have been included in the procurement specifications.

Similarly, fabrication of the Plant shall begin only after close-out of the Manufacturing Readiness Review and completion of all qualification activities. However, if the duration of certain qualification activities impacts the schedule such that the fixed milestones cannot be met, the Contractor may, with agreement from the IO and at its own risk, begin fabrication in parallel with the qualification activities.

The Contractor's Project Delivery Schedule and Project Execution Plan shall identify any long-lead procurement items and any equipment qualification activities that need to begin before closure of the DDRs and MRRs.

4. Tender Document Package

The IO Tender Document Package provides the input documentation for Tenderers to prepare their offers. This document package is organised into three volumes as described below. The documents in each volume are listed in the List of Applicable & Reference Documents [2]. The definition of applicable and reference documents is also given in reference [2].

The IO Tender Document Package shall be read in conjunction with the Contract.

The more stringent requirement will generally apply where conflicting requirements exist within the Tender Document Package, unless otherwise agreed with the IO. The Contractor shall inform the IO of any conflicting requirements identified.

4.1. Volume I

Volume I contains the Work Specification (this document) which describes the Contractor's Scope of Services and Scope of Supply. Volume I also contains project instructions and requirements for the management and execution of the Work.

4.2. Volume II

Volume II contains the technical documents that describe the Plant design, as well as the technical and performance requirements to be used as inputs by the Contractor in carrying out the Work.

4.3. Volume III

Volume III contains additional ITER-related applicable and reference documents.

4.4. Input Document Package

It is anticipated that, between the launch of the Invitation to Tender and the selection of the Contractor and Contract award, the IO design may evolve (e.g. as a results of clarifications).

The IO will therefore issue an updated Document Package (the 'Input Document Package') at the start of the Contract, which will supersede the Tender Document Package.

5. Technical Requirements

5.1. Component Classification

Various classifications and their corresponding requirements apply to the Plant components. In general, the component-level classification applies to all sub-components that make up that component.

The component classifications are given in the lists included in the Document Package for each Unit package, as given in Table 3 of Section 7.1, including the classification of structures.

The classifications applicable to the Plant components and their corresponding requirements are described in Appendix A1.

The top-level classification is given in Table 2:

Table 2: Top-Level Classification

Component	Safety Class	Tritium Class	Quality Class	Seismic Class	ATEX	ESP/ESPN Class
FES Skid 320060-SFU-1100	Non-PIC/SIC	N/A	QC3	SC2	N/A	N/A
ICL Skid 320070-SFU-1000	Non-PIC/SIC	N/A	QC3	SC1(S)	N/A	ESP Art.4.3 SEP no ESPN
House Vacuum Skid 32DT70-SFU-0200	PIC/SIC-1* PIC/SIC-2**	TC-2A	QC1	SC1-S / SL-2	N/A	N/A
ST-VS Skid 32DTST-SFU-0100 32DTST-SFU-5100	PIC/SIC-1* PIC/SIC-2***	TC-2A	QC1	SC1-SF	N/A	N/A
Demin Water Skid 32DT10-SFU-1500 32DT20-SFU-6500	PIC/SIC-2***	N/A	QC1	SC1-SF	N/A	ESP Art.4.3 SEP no ESPN

* PIC/SIC-1 for the confinement of radioactive gases

** for isolation functions

*** for safety functions

5.2. Operability, Maintainability, Reliability and Availability

The Plant components and layout shall be designed to ensure operability and maintainability. The design shall include provisions describing how heavy components are to be lifted for maintenance or dismantling.

Maintenance procedures shall be detailed, clear and comprehensive.

The operating and maintenance procedures shall be reviewed jointly (Contractor and the IO) to ensure that any intermediate steps between operating and maintenance activities (e.g. cleaning or decontaminating a system to prepare for intrusive maintenance) are not omitted.

To support the ITER fusion programme, the Plant has the following reliability and availability targets:

1. Mean time between failure (MTBF) per Skid of 24 months or more
2. Mean time to repair (MTTR) per Skid of 1 week or less.

In addition, the Plant shall be capable of operating continuously for at least 24 months, with an additional margin of 6 months, without intrusive preventive maintenance (i.e. maintenance that renders the Plant unavailable)

The Plant design shall be based on components with proven operational performance in similar industrial applications.

The Contractor shall demonstrate that the Plant meets the required availability by:

a) Describing system redundancy and architecture
b) Identifying and eliminating single points of failure
c) Using proven industrial components
d) Providing justification for all active components with respect to meeting RAMI requirements
e) Defining a maintenance and spare parts strategy
f) Demonstrating that each Skid undergoes a continuous 100-hour operation test as part of factory acceptance test (FAT) without critical failure.

Where necessary, a simplified availability calculation shall be provided.

The Contractor shall provide supporting data with the references for similar installations, operating hours, and failure history (if available). The Contractor shall provide MTBFs and assumed MTTRs for each Skid based on vendor data.

5.3. Skid Design Requirements

The IO has completed the preliminary design of the Plant. The technologies and materials for the main Plant components have been selected, and preliminary sizing of the components and piping has been performed. The Contractor shall develop the design to comply with the General Mechanical, Piping and Structures Specification [18].

Based on the IO design, the Contractor shall complete the detailed design of the Plant, incorporating the details of the selected components to ensure that:

1) Components are adequately supported within the Skids to perform their function in all normal and accident conditions
2) Components are located within the Skids to provide access for operation, maintenance and inspection activities, and are installed in accordance with Vendor recommendations.

The Contractor shall design the Skids to be shop-assembled to the maximum extent possible in order to minimise and facilitate on-site installation work.

5.4. Constructability

The design of the Plant components shall be compatible with installation access constraints, site handling equipment, and the defined installation process and sequence.

The strategy is to pre-assemble components before delivery to the IO, with the following objectives:

1. To enable extensive testing of the components, and to demonstrate, as far as practicable, that the Plant meets the performance requirements before delivery to the IO site. Pre-assembled components shall undergo FATs. Further details are given in Section 8.3.5
2. To facilitate transportation of the Plant to the ITER site and minimise the delivery of loose items, i.e. items not integrated into pre-fabricated units
3. To minimise, as far as practicable, the amount and complexity of site installation work, particularly by reducing on-site welding

5.5. Standardisation

To the extent possible, the Contractor shall ensure that the design and materials used are standardised across the components in the Scope of Supply. This standardisation shall achieve the following:

a. A common look and feel of the Scope of Supply
b. Interchangeability of spare parts to reduce the inventory of spares and to facilitate the procurement of replacement parts
c. Minimisation of the need for special operation and maintenance tools
d. Ease of operations and maintenance of equipment through the use of common tools, common tasks and standard methodologies, thereby minimising the need for training and different procedures.

Materials to be standardised include pipe supports, cables, junction boxes, cable trays, conduits, bolting, insulation, I&C and electrical devices, as well as any other components such as valves and instruments that are used in various locations of the Plant.

Design aspects to be standardised include structural beam sizes, coatings, grating, handrails, ladders, terminations, connectors, maintenance power outlets, and in-skid lighting.

5.6. Use of Standard Commercial Components

The Contractor shall select standard components as defined in the Tritium Plant Standard Components List [712], subject to a suitability assessment performed by the Contractor for the intended Plant application.

Where a component is assigned a nuclear safety function, the Contractor shall ensure compliance with the equipment qualification requirements applicable to protection-important components (PIC) (see Section 5.7).

5.7. Equipment Qualification

Equipment qualification (EQ) shall be applied to components assigned a nuclear safety function, to demonstrate that PICs can perform their assigned safety function(s) under the defined normal, incident, and accident conditions.

PICs shall be considered according to the safety function they perform, including:

a) Components performing a **confinement function**, where qualification shall demonstrate the ability to maintain the confinement boundary
b) Components performing a **functional safety role**, where qualification shall demonstrate the required functional performance under applicable conditions.

The Contractor shall select and justify appropriate qualification methods to demonstrate the required safety functions.

The Contractor shall demonstrate that components not classified as PIC do not compromise the performance of safety functions under normal or accident conditions.

For Tritium Plant Standard Components (as defined in Section 5.6):

Where a Tritium Plant standard component is assigned a nuclear safety function, the Contractor shall apply the standard component qualification and application process defined in the TPP Quality Classification Determination [557]. The Contractor shall demonstrate configuration equivalence and applicability of the plant application within the qualified envelope, in accordance with the TPP Equipment Qualification Requirements and Guidance [745].

For Non-Standard Components:

Where a component credited with a nuclear safety function is not a Tritium Plant Standard Component, the Contractor shall define, justify, and execute Equipment Qualification in accordance with the TPP Equipment Qualification Requirements and Guidance [745].

Components used for equipment qualification testing shall not be used as final delivered components for the installation, unless explicitly agreed with the IO.

Refer to Appendix A3 for further information.

5.8. Human Factors Integration

The design shall integrate human factors to ensure conditions that promote safe behaviours and work practices. Further explanation and requirements are provided in Appendix A4.

5.9. Occupational Health & Safety

The Plant shall be designed to allow safe installation, operation, maintenance and decommissioning in compliance with applicable health and safety laws and regulations. The Work shall include all measures required to mitigate risks to workers.

5.10. Codes and Standards

The IO has established a List of Applicable Codes and Standards [78] based on the IO design of the Plant.

The IO List of Applicable Codes and Standards is not exhaustive. The Contractor shall identify and submit to the IO any additional codes and standards relevant to the components.

The Contractor shall keep the list of codes and standards updated as the project progresses.

The applicable version of codes and standards shall be the version in force at the time of contract signature, unless otherwise agreed with the IO.

5.11. Good Engineering Practice

The Contractor shall apply Good Engineering Practice (GEP) throughout the execution of the Work.

For the purposes of the Contract, GEP means:

a) Exercising the level of skill, care, diligence, prudence, and foresight that a competent and experienced contractor would reasonably be expected to apply when performing work of similar scope and complexity

b) Using proven and accepted engineering methods, procedures, and practices that result in appropriate, cost-effective, and well-documented designs, that ensure compliance with applicable regulations, and that reflect standard practice within the relevant industry for projects of comparable scope and size.

The Contractor shall apply GEP to all design decisions not explicitly addressed in the IO specifications. Upon request from the IO, the Contractor shall provide justification and evidence demonstrating that their design decisions are consistent with GEP.

5.12. Load Conditions

The Plant shall be designed, and its components selected, to ensure correct operation under the specified load conditions. This includes the environmental conditions, process conditions and mechanical loads. Further description is provided in the Load Description Document [262A]. Detailed load specifications for the MUS components will be provided as part of Input Document Package as described in Section 4.4.

5.13. Design Life

The Plant has a design life of 40 years, which corresponds to its intended operational period. The design shall ensure that the Plant can operate over this period with appropriate maintenance, inspections, and component replacement.

Passive components (with no moving parts) shall be designed to operate throughout the design life without replacement. However, the Plant shall be designed to allow access to repair or replace these components if required. Any corrosion allowance shall be calculated over the full design life. Active components shall be designed to support maintenance and replacement activities required to achieve the design life and the RAMI targets specified in Section 5.2.

To meet the design-life requirement, the Contractor shall ensure that:

1. Design-life requirements are included in the technical specifications provided to Subcontractors for the procurement of components
2. Subcontractor recommendations for the inspection and maintenance of individual components are incorporated into the design. For example, components shall be positioned and arranged to allow access for the required inspections and maintenance activities.

5.14. Equipment Protection

The design shall include features to protect against loss of investment, i.e. damage to components in the event of faults or failures. Such features should be specified to prevent irreparable damage and premature degradation in all reasonably foreseeable operating or environmental events.

The Plant shall incorporate appropriate safeguards—such as protective devices, monitoring features, control logic, materials of construction, and design margins—to ensure reliable performance throughout its intended service life. These safeguards shall also prevent damage from predictable misuse, operational anomalies, or environmental exposure.

5.15. Equipment Handling and Care

Requirements for handling and care are defined in the General Mechanical, Piping & Structural Specification [18]. These requirements shall serve as the basis for the Contractor to develop the Equipment Preservation Plan and related procedures.

5.16. Spare Parts

The Contractor shall supply spare parts for the Plant and shall develop a Spares Strategy covering commissioning, installation, and the first years of operation.

1. Commissioning and Start-up Spares

A commissioning kit shall be provided, including:

a. 200% of required quantities for sealing elements (gaskets, O-rings, soft seals)

b. 10% extra specialised fasteners (minimum of 5 items). These spares shall support testing, as per the Requirements for FAT, SAT and OPT [41].

2. Transport, Handling, and Installation Spares

To mitigate damage during storage, transport, and installation, the Contractor shall supply:

a. One additional N+1 spare for components where more than five identical units are installed

b. Fragile or shock-sensitive components, spared at 10% of the installed quantity.

3. Operational Spares (Years 1–2)

The Contractor shall propose spares for the first two years of operation, including:

a. High-wear or medium-probability-failure warehouse spares

b. Long-lead ‘insurance’ spares needed to avoid extended downtime.

4. Availability Requirements

Additional spares shall be provided or recommended as needed to meet the RAMI targets in Section 5.2 (including MTTR).

5. Documentation and Standardisation

All spares shall comply with QA requirements and be delivered with a cross-reference matrix linking Contractor, OEM and industry-standard part numbers. In line with Section 5.5, the Contractor shall minimise the variety of spares by selecting standardised components.

The Contractor shall select components to ensure that to the extent practical, spare parts and technical support from manufacturers will be available to support Plant operation for the duration of its design life. This requirement applies to all components, including electrical and I&C components where there is a risk of obsolescence.

5.17. Compliance with Building Load Limits

For fixation, the Plant is connected to the building’s cast-in-place embedded plates (EPs). As well as the capacity limitations of the individual EPs (see Section 8.2.5), the Contractor shall comply with the requirements of the General Mechanical, Piping and Structures Specification [18].

5.18. Use of Halogenated Materials

Halogenated materials are not permitted in as defined in the Nuclear Safety Requirements [5]. This is further described in Use of Halogenated Materials (see Appendix A5).

5.19. Minimisation of Combustible Fire Loads

The Contractor shall select materials to keep the combustible fire loads to a reasonably achievable minimum by the use of suitable non-combustible or fire retardant materials.

5.20. Waste Management

During Plant operation, any contaminated waste generated will require dedicated treatment, storage, and final disposal. Waste production shall therefore be kept as low as reasonably achievable (ALARA).

Throughout the Plant life, items will need replacement due to normal wear, tear and failures, e.g. filters, valve seals, etc. In the detailed design, the Contractor shall:

1. Seek to minimise solid waste generation
2. Ensure that levels of contamination are minimised, e.g. avoiding trapped volumes of water that are difficult to empty
3. Include aspects to facilitate safe removal and transport of waste (e.g. hooking points for temporary tenting, space for waste drums and trolley access, points for connecting drying air and measuring humidity before opening)
4. Ensure that any areas of the Plant where water leaks or spillages may occur during normal operation or maintenance are equipped with local sumps or collection trays.

6. Requirement Tracking & Compliance Matrix

The Contractor is responsible for ensuring that the Plant meets all the requirements contained in the Document Package.

The Contractor shall manage and track compliance with the requirements throughout all phases of the Contract. For this purpose, the Contractor shall set up a Compliance Matrix to track compliance with these requirements, and to record the demonstration of compliance.

The Contractor shall propose the format of the Compliance Matrix to the IO for approval at the start of the Contract.

7. Scope of Supply

7.1. General

The Contractor shall provide the components necessary for the Plant to meet the requirements specified in the Document Package.

The items in the Contractor Scope of Supply are summarised in Table 3 together with the related specifications and the quantities. Note that for some items the quantities are defined by the IO, whereas for other items that quantities shall be estimated by the Contractor.

Table 3: Components in Contractor Scope of Supply

1. Process Equipment, Valves & Actuators
<u>Component List</u> [35] Facility Exhaust System (FES) - Component Workbook List [35A] Intermediate Cooling Loop (ICL) - Component Workbook List [35B] House Vacuum (HV) - Component Workbook List [35C] Suppression Tank Ventilation System (ST-VS) - Component Workbook List [35D] Demin Water Storage and Supply (DW) - Component Workbook List <u>Battery Limit Schedules</u> [67] Facility Exhaust System (FES) – General Arrangement (GA) Drawing [67A] Intermediate Cooling Loop (ICL) - GA Drawing

[67B] House Vacuum (HV) - GA Drawing [67C] Suppression Tank Ventilation System (ST-VS)- GA Drawing Train A [67D] Suppression Tank Ventilation System (ST-VS)- GA Drawing Train B [67E] Demin Water Storage and Supply (DW) - GA Drawing Train A [67F] Demin Water Storage and Supply (DW) - GA Drawing Train B <u>Specifications</u> [42] First Exhaust System (FES) – Equipment Skids Technical Specification [42A] Intermediate Cooling Loop (ICL) - Equipment Skids Technical Specification [42B] House Vacuum (HV) - Equipment Skids Technical Specification [42C] Suppression Tank Ventilation System (ST-VS) - Equipment Skids Technical Specification [42D] Demin Water Storage and Supply – Equipment Skids Technical Specification
2. Instruments
<u>Component List</u> See Table 3 Section 1 <u>Specifications</u> [23] Modular Utility Skids - Control & Instrumentation Technical Specification
3. EI&C Equipment Items
<u>Component List</u> [29] Modular Utility Skids - EI&C Equipment List <u>Specifications</u> [30] Modular Utility Skids - Electrical Technical Specification
4. Electrical Cables, I&C Cables, Junction Boxes, Cabling termination hardware
<u>Component List</u> Contractor to estimate based on detailed design <u>Specification</u> [30] Modular Utility Skids - Electrical Technical Specification
5. Cable trays and conduits for electrical and control cables **6. Maintenance power outlets (sockets), electrical switches, emergency push buttons, lighting fixtures**
<u>Component List</u> Contractor to estimate based on detailed design <u>Specification</u> [30] Modular Utility Skids - Electrical Technical Specification
7. Piping & tubing (including fittings, flanges, gaskets, bolts)
<u>Component List</u> [35] Facility Exhaust System (FES) - Component Workbook List [35A] Intermediate Cooling Loop (ICL) - Component Workbook List [35B] House Vacuum (HV) - Component Workbook List

[35C] Suppression Tank Ventilation System (ST-VS) - Component Workbook List [35D] Demin Water Storage and Supply (DW) - Component Workbook List For final length and quantities contractor to estimate based on detailed design <u>Specifications</u> [652] Tritium Plant Pipe Classes [18] Modular Utility Skids - General Mechanical, Piping & Structural Specification [68] TPCS-02 - Tritium Plant Confinement Specifications [68A] TPCS-05 - Tritium Plant Confinement Specifications [68B] TPCS-06 - Tritium Plant Confinement Specifications [68C] TPCS-07 - Tritium Plant Confinement Specifications [68D] TPCS-09 - Tritium Plant Confinement Specifications
8. Structural steel (including secondary pipe supports, pipe racks, Skid frames, platforms, stairs, ladders, handrails)
<u>Component List</u> Contractor to estimate based on detailed design <u>Specification</u> [18] Modular Utility Skids - General Mechanical, Piping & Structural Specification
9. Primary Pipe Supports
<u>Component List</u> Contractor to estimate based on detailed design <u>Specification</u> [18] Modular Utility Skids - General Mechanical, Piping & Structural Specification
10. Thermal Insulation on piping, equipment, and structures (except PFP)
<u>Component List</u> Contractor to estimate based on detailed design <u>Specifications</u> [42] First Exhaust System (FES) – Equipment Skids Technical Specification [42A] Intermediate Cooling Loop (ICL) - Equipment Skids Technical Specification [42B] House Vacuum (HV) - Equipment Skids Technical Specification [42C] Suppression Tank Ventilation System (ST-VS) - Equipment Skids Technical Specification [42D] Demin Water Storage and Supply - Equipment Skids Technical Specification
11. Equipment Lifting & Handling Aids
Contractor to estimated based on Detailed Design
12. Spare Parts
Section 5.16 Spare Parts

The quantities indicated in the component lists reflect the current design status. The Contractor is responsible for completing the design, and any additional items required as a result of this completion shall be provided by the Contractor, for example:

a. Instruments for equipment monitoring, operation or protection or to meet reliability, availability or maintainability targets which were not anticipated or shown on the IO P&IDs (such as electrical heater voltage, current monitoring; blower vibration monitors; valve actuator pressure gauges)
b. Instruments or pressure relief valves following the Overpressure Protection Study
c. Instruments required for testing, whether temporary or permanently installed (e.g. leak testing, pressure testing)
d. Other items which are not identified in the IO Document Package, but which are incorporated as a result of the normal course of detailed design (e.g. additional filters, instruments or valves) as required for the correct operation or condition monitoring of the selected equipment.

The items in the lists above are not quantified by the IO in the Document Package. The Contractor is responsible for estimating the quantities needed to meet the requirements defined in the Document Package.

7.2. Unit Packages

The Scope of Supply is organised into Unit Packages as described in Section 3.2:

Unit Package 1: First Exhaust System (FES) Skid

Unit Package 2: Intermediate Cooling Loop (ICL) Skid

Unit Package 3: House Vacuum (HV) Skid

Unit Package 4: Suppression Tank Venting System (ST-VS) Skid

Unit Package 5: Demineralised Water (DW) Skid.

Each Unit Package consists of a fully assembled, standalone skid, delivered as a complete, self-supporting functional unit. The skid is designed and fabricated as an integrated package, incorporating all mechanical components, electrical systems, and instrumentation necessary for operation once connected to the defined battery limits.

Unit Packages are supplied mounted on a structural support frame designed for safe handling, lifting, transport, and permanent installation. The frame shall provide adequate stiffness and access for maintenance activities.

Electrical and I&C components required for Unit Package operation shall be fully integrated within the skid boundary. This includes all local junction boxes, cable trays, field instruments, control devices, and internal wiring. Unit Packages shall be pre-wired and pre-tested to the maximum extent practicable prior to shipment, enabling efficient installation and reducing commissioning time on site.

Unit Packages are therefore delivered as a complete, factory-tested package, requiring only the connection of the defined battery-limit interfaces (mechanical, electrical, control, and utilities) to achieve full operability.

Unit Packages include the following ancillary items, which form part of the complete skid delivery:

a. Nameplate: Permanently fixed identification plate showing the equipment tag, manufacturer, design data, and required regulatory markings
b. Shims: Levelling shims for accurate adjustment of skid supports during installation, ensuring proper alignment and load distribution
c. Transport attachments and supports: Supports to stabilise the skid during lifting, handling, and transport

d. Thermal Insulation: Factory-installed insulation on designated piping, vessels, or components to reduce heat loss and prevent condensation
e. Packing and Transport Protection: Protective coverings, bracing, and packaging to prevent vibration, moisture, impact, or contamination damage during transport and storage.

The battery limits for Unit Packages are those indicated on the applicable P&IDs, mechanical drawings, architectural diagrams and single-line diagrams.

All mechanical nozzles, utility take-offs, and instrumentation interfaces shall therefore comply with the specifications, connection details, and tag references defined in the corresponding P&ID set.

7.2.1. Unit Package 1: First Exhaust System (FES) Skid

There is one (1) FES Skid in the Scope of Supply as listed in Table 4 and shown in Figure 1. The IO design of the FES Skid showing the layout and overall dimensions is shown in the General Arrangement drawings [67] and in the 3D Model - Plant [36].

The FES Skid include components mounted on a structural steel frame.

Table 4: FES Skid

Skid Name	Skid Tag ID	Train	P&ID [17]	Location
FES Skid	320060-SFU-1100	N/A	320060-PID-1100	14-L5-20

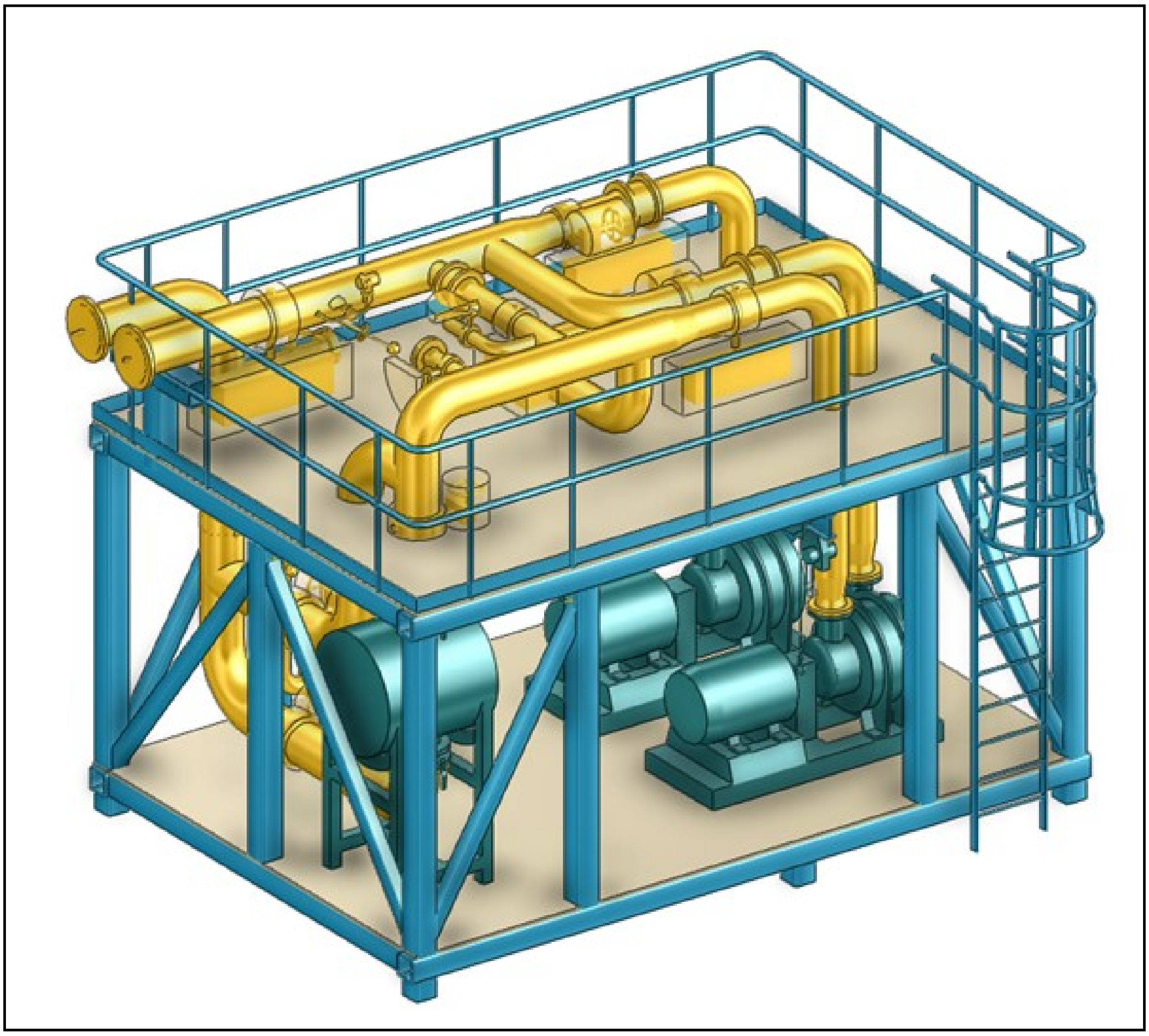

Figure 1: Illustration of the First Exhaust System Skid

The FES Skid includes the components as shown in the P&IDs [17] and in the Component List Workbook [35]. The FES Skid includes the main components as listed in Table 5.

Table 5: Main Components of the FES Skid Main

Tag ID	Name	P&ID ref. [17A]	Technical Specification
320060-FH-1101	FES HEPA Filter	320060-PID-1100/02	[42]
320060-PB-1111	FES Exhaust Blower 1	320060-PID-1100/02	
320060-PB-1112	FES Exhaust Blower 2	320060-PID-1100/02	

7.2.2. Unit Package 2: Intermediate Cooling Loop (ICL) Skid

There is one (1) ICL Skid in the Scope of Supply as listed in Table 6 and shown in Figure 2. The IO design of the ICL Skid showing the layout and overall dimensions is shown on the General Arrangement drawings [67A] and in the 3D Model – Plant [36A].

The ICL Skid include components mounted on a structural steel frame.

Table 6: ICL Skid

Skid Name	Skid Tag ID	Train	P&ID [17A]	Location
ICL Skid	320070-SFU-1000	N/A	32DTST-PID-0100/1002	14-L2-21

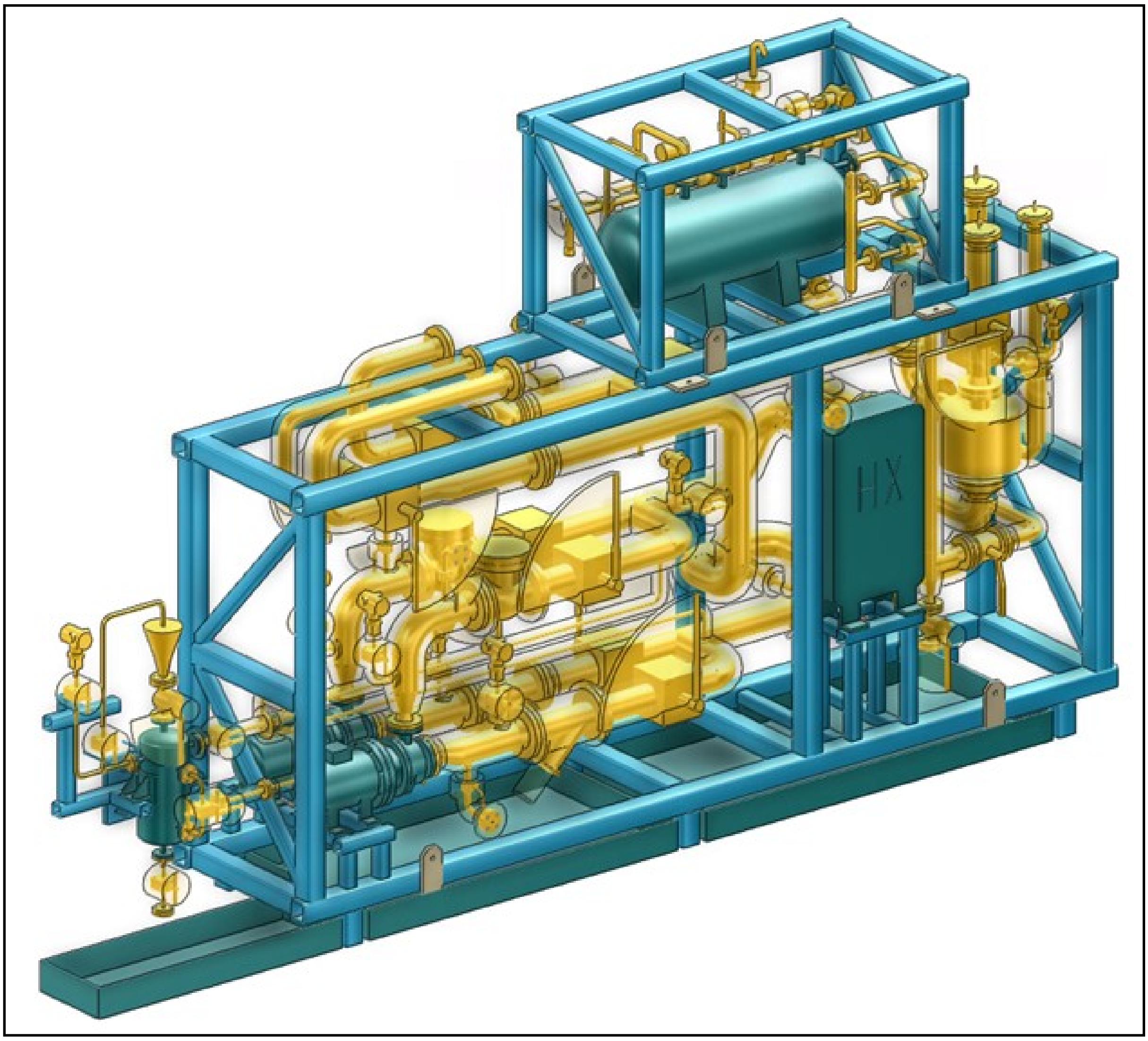

Figure 2: Illustration of the Intermediate Cooling Loop Skid

The ICL Skid includes the components as shown on the P&IDs [17A] and in the Component List Workbook [35A]. The ICL Skid include the main components as listed in Table 7.

Table 7: Main Components of the ICL Skid

Tag ID	Name	P&ID ref. [17A]	Technical Specification
320070-PL-1001	ICL Pump #1	320070-PID-1001	[42A]
320070-PL-1002	ICL Pump #2	320070-PID-1001	
320070-HX-1005	ICL Cooler	320070-PID-1002	
320070-TA-1006	ICL Expansion Tank	320070-PID-1001	
320070-TA-1007	ICL Chemical Charge Pot	320070-PID-1001	

7.2.3. Unit Package 3: House Vacuum (HV) Skid

There is one (1) HV Skid in the Scope of Supply as listed in Table 8 and shown in Figure 3. The IO design of the HV skids showing the layout and overall dimensions is shown on the General Arrangement drawings [67B] and in the 3D Model - Plant [36B].

The HV Skid include Components mounted on a structural steel frame.

Table 8: House Vacuum Skid

Skid Name	Skid Tag ID	Train	P&ID [17B]	Location
House Vac. Skid	32DT70-SFU-0200	N/A	32DTST-PID-0100	14-L2-21

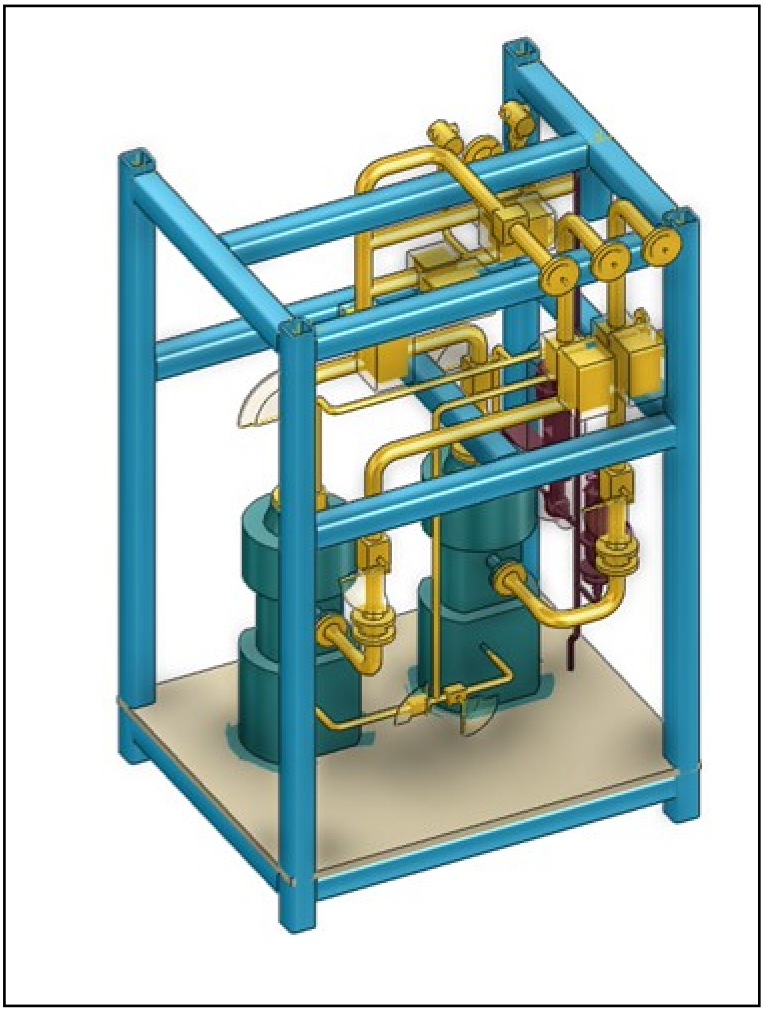

Figure 3: Illustration of the House Vacuum Skid

The HV Skid include the components as shown on the P&IDs [17B] and in the Component List Workbook [35B]. The HV Skid include the main components as listed in Table 9.

Table 9: Main Components of the House Vacuum Skid

Tag ID	Name	P&ID ref. [17A]	Technical Specification
32DT70-PV-0201	House Vacuum Pump 1	32DT70-PID-0200	[42B]

Tag ID	Name	P&ID ref. [17A]	Technical Specification
32DT70-PV-0202	House Vacuum Pump 2	32DT70-PID-0200	

7.2.4. Unit Package 4: Suppression Tank Venting System (ST-VS) Skids

There are two (2) ST-VS Skids in the Scope of Supply as listed in Table 10 and shown in Figure 4, one on Train A and one on Train B. The IO design of the ST-VS Skids showing the layout and overall dimensions is shown in the General Arrangement drawings [67C], [67D] and in the 3D model - Plant [36C].

The ST-VS skids include components mounted on a structural steel frame.

Table 10: ST-VS Skids

Skid Name	Skid Tag ID	Train	P&ID [17C]	Location
ST-VS Skid (Train A)	32DTST-SFU-0100	Train A	32DTST-PID-0100	14-L2-21
ST-VS Skid (Train B)	32DTST-SFU-5100	Train B	32DTST-PID-5100	14-L3-21

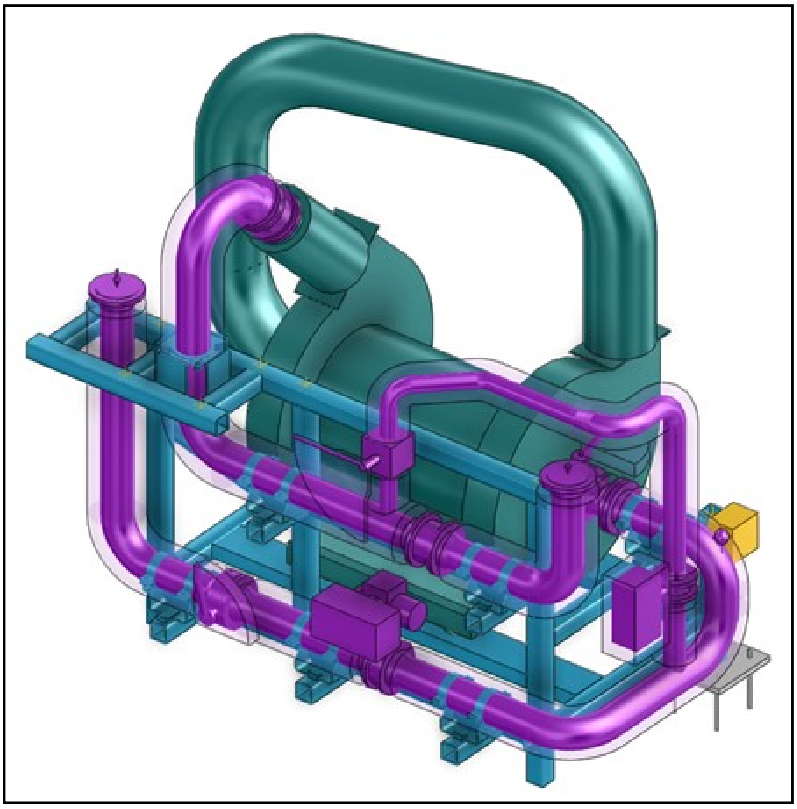

Figure 4: Illustration of the Suppression Tank Venting System Skid

The ST-VS skids include the components as shown on the P&IDs [17C]and in the Component List Workbook [35C]. The ST-VS Skids include the main components as listed in Table 11.

Table 11: Main Components of the ST-VS Skids

Tag ID	Name	P&ID ref. [17A]	Technical Specification
32DTST-PB-0101	ST-VS Blower	32DTST-PID-0100	[42C]
32DTST-PB-5101	ST-VS Blower	32DTST-PID-5100	

7.2.5. Unit Package 5: Demineralised Water (DW) Skids

There are two (2) Demineralised Water Tank Skids in the Scope of Supply as listed in Table 12 and shown in Figure 5, one on Train A and one on Train B. The IO design of the Demineralised Water Skid showing the layout and overall dimensions is shown on the General Arrangement drawing [67E], [67F] and in the 3D Model - Plant [36D].

Table 12: Demineralised Water Tank Skids

Skid Name	Tag	Train	P&ID ref. [17D]	Location
DW Tank Skid (Train A)	32DT10-SFU-1500	Train A	32DT10-PID-1500	14-L2-23
DW Tank Skid (Train B)	32DT20-SFU-6500	Train B	32DT20-PID-6500	14-L3-21

Figure 5: Illustration of the Demineralised Water Skid

The Demineralised Water Tank Skids include components mounted on structural steel base frames. The skids are organised into two levels, with ladder access to the upper level.

The Demineralised Water Tank Skids include the components as shown on the P&IDs [17D] and in the Component List Workbook [35D]. The Demineralised Water Tank Skids include the main components as listed in Table 13.

Table 13: Main Components of the Demineralised Water Tank Skids

Tag ID	Name	P&ID ref. [17A]	Technical Specification
32DT10-TA-1501	DW Tank A	32DT10-PID-1500	[42D]
32DT10-PL-1502	DW Pump A1	32DT10-PID-1500	
32DT10-PL-1503	DW Pump A2	32DT10-PID-1500	
32DT10-TA-1504	UV Sterilizer	32DT10-PID-1500	
32DT10-TA-6501	DW Tank B	32DT10-PID-6500	
32DT10-PL-6502	DW Pump B1	32DT10-PID-6500	
32DT10-PL-6503	DW Pump B2	32DT10-PID-6500	
32DT10-TA-6504	UV Sterilizer	32DT10-PID-6500	

8. Scope of Services

8.1. General

The Scope of Services is to design and fabricate the Plant, as detailed in the Scope of Supply in Section 7.

The Contractor Scope of Services is to:

1. Perform the detailed design of the Plant, which includes process design activities, selection of the components, and integration of the selected components into design up to and including the Detailed Design Reviews (DDRs) (see Section 8.4)
2. Carry out equipment qualification activities to demonstrate that PICs fulfil their safety functions under all normal and accident conditions
3. Perform the procurement and fabrication of the components
4. Perform the pre-fabrication and assembly of components at the Contractor's workshop
5. Conduct factory acceptance testing (FAT) at vendor facilities and following assembly on skids to demonstrate compliance with the Plant performance requirements
6. Ensure the handling and care of materials at the Contractor's warehouse until delivery is requested by the IO
7. Perform the packing, transportation, and delivery of all materials to the ITER site
8. Provide documentation as listed in the Contractor Deliverable List [7]

The Scope of Services is divided into two phases, as described in the following sections.

8.2. Detailed Design (Phase 1)

8.2.1. General

The Contractor shall perform the detailed design of the Plant.

The objective of the detailed design is to complete the Plant design to the level needed for procurement and fabrication. This phase confirms the ITER Organization's design inputs, integrates the selected components, and shows—using analyses and updated engineering documentation—that all technical, performance, safety, operability and maintainability requirements are met. It also defines the detailed layout, engineering specifications and Unit Package deliverables so that the Plant is fully defined, compliant with regulations and ready for the next phases of the Contract.

The detailed design will be completed with Close-Out Report(s) of the Detailed Design Review(s) (DDR). The DDRs may be organised into Unit Packages to facilitate overall project delivery.

The Contractor shall perform the detailed design in accordance with the Contract, the rules and the regulatory provisions in force, and the requirements specified in the Document Package.

The scope and responsibilities of the Contractor to complete the detailed design are described in the following sections.

The detailed design shall be based on the process design and component specifications provided by the IO, which shall be considered as fixed inputs. The Contractor shall:

1. Review the IO Input Document Package
2. Select the components based on the IO specifications and complete the necessary process design deliverables
3. Develop the component qualification plans
4. Develop the design to:
   a. Integrate the selected components and develop the arrangement and positioning of the components.
   b. Design the pipework, supports and frame structures to accommodate the components and withstand the specified loads and meet code requirements.
   c. Verify the loads on the interfacing embedded plates and post-installed systems to confirm that they are within the allowable limits.
   d. Design the instrumentation cabling routing within the Unit Packages from the instruments to the junction boxes located on the Plant
   e. Design the compressed air distribution tubing within the Plant from the components to the compressed air distribution point located on the Plant.
   f. Assess the design for installability and maintainability and incorporate any requirements into the design.
5. Produce the design documentation as listed in the Contractor Deliverable List [7].

The scope and responsibilities of the Contractor to complete the detailed design are described in the following sections.

8.2.2. Review of IO Document Package

At the start of the Contract, the Contractor shall review the updated IO Input Document Package, identify any errors, omissions or contradictory information, and, where necessary, submit a clarification request to the IO.

At the end of the review and once the IO has provided all requested information and/or the timescale to provide any incomplete data or clarify any discrepancies, the Contractor shall validate the Document Package as complete to begin the detailed design.

8.2.3. Process Design

The Contractor shall perform the detailed design considering the following as fixed inputs, which shall not be changed without approval from the IO:

1. Process design (i.e. process flow scheme, selection of unit operations, process control scheme) and configuration of the unit operations presented in Process Flow Diagrams [8], [8A], [8B], [8C] and [8D].
2. Range of feed conditions (i.e. flow, temperature, composition) at the Plant inlet given in the technical specifications for the skids listed in Table 3 of Section 7.1.

The Contractor shall develop the design, and then select and integrate the components to meet the requirements of the technical specifications. Design responsibilities are defined in the technical specifications listed in Table 3 of Section 7.1.

8.2.3.1. Process Design Constraints

1. Thermal performance shall ensure that Unit Packages achieves and controls the required temperatures across the range of flow conditions
2. Design and component selection shall ensure that the system operates within the specified constraints, namely:
   a. The system shall operate within the limits of the available utilities (electrical power, chilled water, demineralised water, and compressed air and nitrogen)
   b. The selected components shall fit within the constraints of the room layout and the constraints for installation and access for operation and maintenance.

8.2.3.2. Process Engineering Scope

The Contractor Scope of Services is to complete the detailed design, which shall include:

1. Preparing component specifications
2. Providing reports, calculation notes and detailed design studies to justify the selection and design of components
3. Confirming the final operating and design conditions, and checking that the components and materials selected are properly rated for these conditions
4. Identifying and integrating any components required for:
   a. Correct operation or condition monitoring of the selected components, e.g. additional filters, instruments, valves, or purge, drain or vent lines
   b. Compliance with IO procedures, requirements or Good Engineering Practice (see Section 5.11)
5. Incorporating any updates which are required as a result of the detailed design and process simulations, e.g. changes to component sizing, or selection of different construction materials or pipe classes to reflect changes in the operating or design conditions
6. Proposing any modifications to optimise the design, including improvements to performance, layout, operation, or cost.

Significant changes to the process design are not expected during the detailed design phase. In case significant changes are identified IO will perform the HAZOP study in order to analyse the design.

The following sections provide more details on the process design activities included in the Contractor's Scope of Services.

8.2.3.3. Process Engineering Deliverables

The Contractor shall update/produce the process engineering deliverables as listed in the Contractor Deliverable List.

Explanations and requirements for these deliverables are included in the Process Engineering Deliverables. More information is provided in Appendix A6.

8.2.4. Equipment Qualification

The Contractor shall ensure that equipment qualification (EQ) requirements are addressed as part of the detailed design activities.

EQ shall be performed in accordance with the Tritium Plant Project - Equipment Qualification Requirements and Guidance [745].

During the detailed design phase, the Contractor shall:

a) Consider EQ requirements in the selection and specification of components

b) Identify components requiring qualification, based on their classification and assigned safety functions

c) Define the required qualification approach and integrate it into the design and procurement strategy

d) Ensure that design decisions support the successful execution of qualification activities.

EQ-related assumptions, constraints, and requirements shall be clearly reflected in design documentation and shall be consistent with the Equipment Qualification Strategy and Component Qualification Plans.

For each component, or group of components, the Contractor shall prepare Component Qualification Plans defining:

a) Safety functions

b) Applicable conditions

c) Qualification methods

d) Acceptance criteria.

Qualification activities shall be planned and executed in alignment with the project schedule, including Detailed Design Review (DDR) and Manufacturing Readiness Review (MRR).

Qualification activities shall be completed prior to authorisation of fabrication, unless otherwise agreed with the IO.

All qualification deliverables shall be produced in accordance with Tritium Plant Project - Equipment Qualification Requirements and Guidance [745] and submitted for IO review and acceptance.

8.2.5. Mechanical and Structural Design

8.2.5.1. General

The Contractor shall carry out the detailed mechanical, piping, and structural design of the Plant to ensure compliance with the requirements defined in the IO Input Document Package and in the specifications listed in Section 7.1, including in particular:

1. Modular Utility Skids - General Mechanical, Piping and Structural Specification [18]
2. Modular Utility Skids - Load Description Document [262]
3. Skids Technical Specifications [42], [42A], [42B], [42C], [42D].

The Contractor shall update the design, as necessary, to incorporate changes arising from the detailed design review. This shall include adjustments required to accommodate the final selected components (e.g. changes in dimensions, support arrangements, and nozzle locations), as well as modifications resulting from installability, maintainability, and operability reviews.

8.2.5.2. Unit Package Design

The Contractor shall design the layout and arrangement of the Plant, including:

1. Integrating the selected components into the design, and modifying (if needed) the layout and pipe routing of the initial designs provided by the IO to accommodate the selected components
2. Verifying that the pipe connections at the battery limits are correctly aligned to facilitate connections with the field piping
3. Integrating insulation in the design
4. Designing the routing of the instrument cables and compressed air tubing within the Unit Package from the components to the battery limits
5. Designing the supports for the piping and components
6. Designing structural frames and connections to the building embedded plates (EPs) and post-installed systems (PDS). The Contractor shall select appropriate structural materials (e.g. shapes, stiffeners, plates, etc.) based on the structural analysis calculations. The Contractor shall specify and size the structural welds
7. Ensuring the design provides accessibility to perform maintenance and inspections of components, including filter replacements.

8.2.5.3. Pipe Routing, Pipe and Tube Classes

The Contractor shall update the pipe routing in the 3D model up to the Battery Limits as defined the P&IDs [17] to incorporate any changes resulting from the detailed design, including to:

1. Accommodate the final dimensions, orientation requirements and connection positions of the selected components
2. Ensure that piping stresses and loads on equipment nozzles are within the allowable limits and comply with code requirements
3. Ensure that loads on primary supports and frames, as well as loads transmitted to embedded plates and post-installed systems, are within the allowable limits
4. Implement any findings from the installability, operability and maintainability reviews to ensure sufficient access and space.

The IO has specified and assigned the pipe and tube classes to be used based on the Confinement Specification.

Confinement specifications and pipe classes for each line are defined in the corresponding Component Lists as given in Table 3 of Section 7.1.

Piping shall be seamless stainless steel in accordance with ASTM A312 Grades 304L and 316L, compliant with pipe classes 4-S3S0150-2, 4-S3S0150-5, AB11, and 4-S4S0150-2, as defined in the Tritium Plant Pipe Classes [652] and in Construction Design - PBS 62 63 and 65 - 04TSME - Specification for Design - Mechanical - Piping Material Classes Detail - OME_DH_SP_000004_ME [572]. Tubing shall comply with classes 4-T4T2500-2 and 4-T4T2500-3.

The Contractor shall select all pipes and pipe fittings from the pipe and tube classes specified by the IO.

8.2.5.4. Supports and Frames

Supports are composed of primary supports and secondary supports (the frames), as illustrated in Figure 6. Primary supports are generally not included in the IO 3D model.

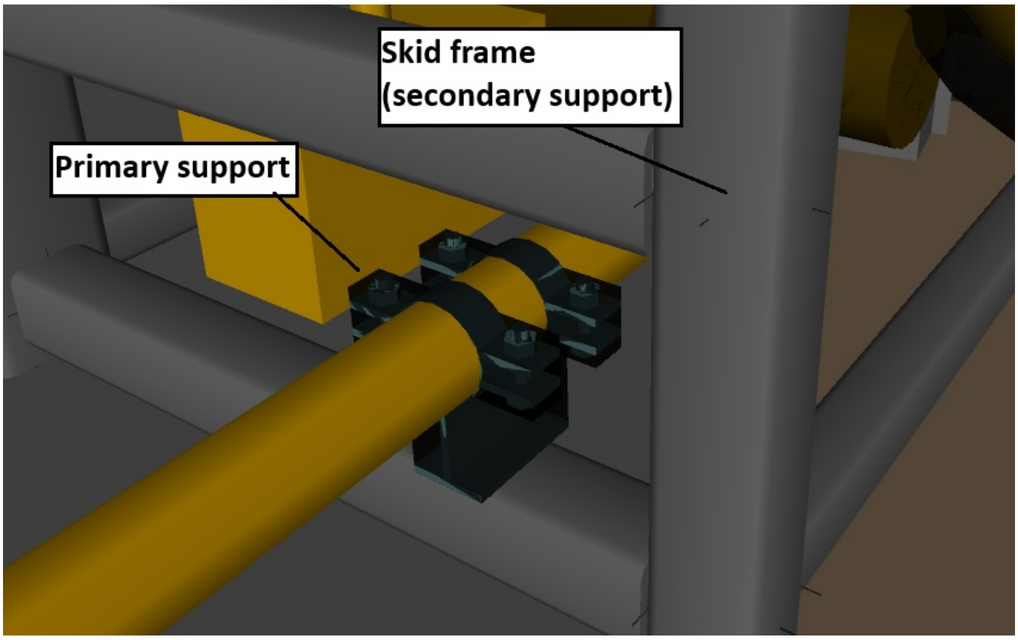

Figure 6: Illustration of Primary & Secondary Supports

- Primary supports are components that are in contact with the pipe, such as clamp bases or straps. The primary supports are typically COTS items. Primary supports also include welded attachments such as lugs welded to the pipe.
- Secondary supports are components that make up the frames and connect to the building's embedded plates, and support the pipes and primary supports. The secondary supports are generally fabricated from bulk materials such as steel shapes and plates.

The Contractor shall:

1. Design all components and pipe supports within the Plant boundaries
2. Design and model the frames and pipe supports in the 3D model, ensuring:
   a. Pipe support locations and functions (i.e. rest, guide, anchor, etc.) are consistent with pipe stress analysis assumptions
   b. Pipe supports do not cause clashes with other components.
3. Design and select the primary and secondary support components.

Further requirements for the design of the frame and pipe supports are given in the General Mechanical, Piping & Structural Specification [18].

8.2.6. Structural Analysis

The Contractor shall perform the structural analysis of the Plant to demonstrate compliance with the requirements. This shall include:

1. Stress and flexibility analysis of the piping to confirm that code requirements are met; and that loads on components, supports and connecting field piping and flange connections are within allowable limits.
2. Structural analysis of the frames to confirm that the Plant can support the piping and components, and can withstand loads transferred from the piping and other loading conditions, e.g. seismic events, in accordance with code requirements and without excessive deformation or deflection.
3. Calculation of the loads and moments transferred from the Plant to the building's embedded plates (EPs) and post-drilled systems (PDS) to:
    a. Demonstrate that the loads and moments are within the capacities of the EPs
    b. Design the PDS and demonstrate that the loads and moments are within the capacities of the designed PDS anchors and plate.
4. Verification of the flange connections for all loading conditions as described in the General Mechanical, Piping & Structural Specification [18].

Structural analysis shall be performed in accordance with the ITER Instructions for Structural Analyses [601].

Details of the loads and load combinations to be considered are given in the General Mechanical, Piping & Structural Specification [18].

8.2.6.1. Structural Analysis Specification

At the start of the detailed design, and before performing any structural analysis work, the Contractor shall produce a Structural Analysis Specification and submit it to the IO for review and approval. The Structural Analysis Specification shall describe how the structural analysis shall be performed, and shall cover all components (it may be split into separate documents), including:

1. Process equipment (i.e. filter housings)
2. Piping and tubing
3. Structures (frames and primary pipe supports)
4. Embedded plates
5. Post-drilled systems.

In the Structural Analysis Specification, the Contractor shall describe:

1. The methodology and criteria to be used for performing the analysis
2. How the analysis will comply with the IO Procedure for Analyses and Calculations [502] and the Instructions for Structural Analyses [601]
3. The software to be used and the plan for software qualification (if IO non-compliant software is selected)
4. The loads and load combinations to be assessed, and the methods for assessing them (i.e. response spectra analysis, time history, pseudo-static etc.)
5. How the piping will be organised into separate pipe stress models, and how interfaces between models and at the Battery Limits will be modelled and managed
6. How small bore lines will be qualified (e.g. by analysis or by another methodology)
7. The data flow between analysis models (pipe stress loads and displacements will be input for structural and component analysis models, and vice-versa)
8. The template(s) to be used for the structural analysis reports.

8.2.6.2. Structural Analysis Input Data Summary

The Contractor shall provide an Input Data Summary prior to performing any structural analysis calculation.

The Input Data Summary shall be specific to the component, pipe section, or structure to be analysed. The Input Data Summary shall describe:

1. The input data to be used for the analysis (materials, dimensions, etc.)
2. The loads and load combinations to be modelled
3. Details of the envelope frequency response spectrum (i.e. nodes considered) for seismic analysis, where applicable
4. The event category and service level for each load combination
5. The criteria (allowable stresses, displacements) for each load combination.

8.2.6.3. Structural Analysis Reports

The Contractor shall produce structural analysis reports to cover the Structural Analysis performed. Several calculations may be covered in a single report if they are of a similar nature.

The reports shall follow the IO Template for Structural Analysis Reports [650], or another template to be proposed by the Contractor and agreed with the IO prior to performing the work.

8.2.7. Instrumentation & Control Design

Taking into account the Control & Instrumentation Technical Specification [23] and the Instrument & Control Cubicles Specification [24], the Contractor shall:

1. Specify, select and supply I&C components including instruments, cables, cable routing, cable trays, cable conduits, support structures, junction boxes and cubicle hardware
2. Detail the Plant control functions and design the control logic based on the Plant Control Design Handbook (PCDH) deliverables development process.
3. Develop the software to implement the monitoring and control functions (including HMI), and allow future advanced control logic development and implementation by the IO
4. Design and configure the I&C cubicles, including design of the internal hardware arrangement, AC and DC distribution details, signal wiring, power supply and protection calculations, cubicle cooling analysis, cubicle seismic structural analysis, details of the cubicle installation arrangements, and connection to ITER electrical network
5. Provide deliverables described in the PCDH to allow the IO to complete the interface design
6. Provide the design of the actuation network, e.g. compressed air or actuated valves
7. Perform the verification and validation (V&V) of the control system in the framework of the safety lifecycle in accordance with IEC 61513 (for PIC/SIC functions) and IEC 61508 (for SIL-rated functions)
8. Provide all I&C deliverables as specified in the Contractor Deliverable List.

8.2.8. Electrical Design

8.2.8.1. General

The Contractor shall use the following document as input:

1. MUS Electrical Technical Specification [30] specifying the Scope of Work and the technical requirements for the electrical equipment.

In accordance with the Electrical Technical Specification [30], the Contractor shall perform the detailed design to meet the specified requirements, select the required components, integrate them into the overall Plant design, and manufacture, test and deliver the equipment to the IO Site.

8.2.9. 3D Design of the Plant

8.2.9.1. General

The IO has provided several 3D models in the Document Package in Navisworks:

- 3D model showing the Contractor Scope of Supply [36], [36A], [36B], [36C] and [36D].

The Contractor shall develop 3D models of the Plant to 60% completion level for the Detailed Design Review (DDR); and 90% completion level for the Manufacturing Readiness Review (MRR) and 100% completion for the Delivery Readiness Review (DRR). Definitions of the completion levels are given in the IO Initial 3D Model Review Checklist [100].

The Contractor may develop the models using the software of their choice (see Appendix A2 for more information). The Contractor shall use the Navisworks model of the complete environment provided by the IO to confirm the design is compatible with the environment.

The Contractor shall develop the 3D model of the Plant on a multi-disciplinary basis, including mechanical, piping, structural, instrumentation and electrical elements, and shall include appropriate space reservations for maintenance activities.

8.2.9.2. Model Reviews

The Contractor shall conduct model reviews at each design stage to ensure that all aspects of the design are examined and agreed with the IO, including:

1. Installability
2. Commissioning
3. Operability (See Section 8.2.14)
4. Maintainability & inspectability (See Section 8.2.14)
5. Human Factors
6. Safety.

8.2.10. Human Factors

The Contractor shall identify the required mitigation measures (which may relate to the Plant design, environment, procedures or worker competency) and implement them into the design and documentation to support reliable performance and minimise potential impact of human unreliability. This shall be performed by providing:

1) Human Factors Issues Register
2) Human Factors Implementation Plan
3) Task Analysis.

Further explanation and requirements are provided in Appendix A4.

The Contractor shall produce a Human Factors Implementation Plan and shall perform Human Factors assessments of operating and maintenance tasks as described in Section 8.2.10.

8.2.11. RAMI Analysis

The Contractor shall submit a RAMI Engineering Report. Where quantitative reliability data is unavailable, the Contractor shall use its expert judgment to assess and prioritise risks, and shall justify how the proposed design mitigates those risks. The purpose of the analysis is to confirm and demonstrate that the reliability and availability targets given in Section 5.3 are met.

8.2.12. Occupational Health and Safety

The Contractor shall provide a List of Chemical Products and Material Safety Datasheets for all chemicals that are expected to be needed for start-up, operation and maintenance of the Plant including any chemicals for cleaning.

The use of hazardous chemicals is subject to approval from the IO. The Contractor shall identity any hazardous chemicals and shall justify that non-hazardous alternatives are not available.

The Contractor shall incorporate instructions for safe handling and use of the chemical products in accordance with requirements in the MSDS in the Operating and Maintenance Manuals.

General requirements for handling of chemical products, including for the transportation of chemical products to the ITER site are given in ref. [529].

8.2.13. Site Activity Deliverables

The Contractor shall provide site activity deliverables including procedures, requirements, instructions, specifications, drawings, method statements, and any other documentation that is required for other parties to develop the final work procedures.

The preliminary versions of the deliverables will be reviewed at the Detailed Design Review (DDR), while the final versions will be reviewed at the Manufacturing Readiness Review (MRR).

During the detailed design phase, the Contractor shall issue the preliminary version in time for the DDR, and the final version for the MMR. These shall include draft procedures, requirements, specifications, and drawings covering lifting points, centre of gravity, method statements, special lifting requirements, and orientation limits. All movements on the ITER site, from offloading to final positioning, shall also be addressed, including provisions for using the e.g. special handling or moving equipment.

8.2.14. Operation and Maintenance Manual

The Contractor shall provide a preliminary Operating and Maintenance Manual for the Plant to cover all operating activities and procedures. The preliminary version shall be issued in time for the DDR, and the final version shall be issued for the MMR.

8.2.15. Handling and Care

The Contractor shall prepare plans and procedures for the care and maintenance of the plant during:

1. Fabrication of the Plant
2. Storage of the Plant at the Contractor storage facility after fabrication, until the time when the IO authorises the transportation to the ITER site
3. Transportation of the Plant to the ITER site
4. Storage of the equipment at the ITER storage facility before installation.

The handling and care plan shall describe:

1. Conditions needed for the storage locations (temperature, humidity, etc.)
2. Arrangements for regular inspection of stored materials, to confirm that the materials are stored in accordance with the requirements, and reporting of their condition during each stage of the project
3. Identification of the risks associated with storage and preservation, and mitigation actions

4. Details of how piping that terminates at the battery limits will be protected, e.g. using blind flanges or welded caps.

8.2.16. Obsolescence Risk Assessment

The Contractor shall perform an Obsolescence Risk Assessment (ORA) as integral part of the RAMI Engineering Report. The ORA shall, to the extent practicable, demonstrate that the Plant can be operated and maintained for its intended design life, e.g. 40 years.

8.2.17. Waste Management

The Contractor shall provide a schedule of all waste expected to be generated over the Plant lifetime as a result of operation and maintenance activities. This schedule shall be submitted for review at the Detailed Design Review.

8.2.18. Spare Parts

The Contractor shall provide a Spare Parts Plan to explain how these requirements are met, together with a list of the spare parts to be provided. The Spare Parts Plan and Spare Parts List shall be reviewed at the Detailed Design Review.

8.3. Procurement and Fabrication (Phase 2)

8.3.1. General

In Phase 2, the Contractor shall (not necessarily in this order):

1. Perform the Manufacturing Design
2. Perform equipment qualification activities
3. Procure all materials and components
4. Fabricate and pre-assemble the Plant and other items, e.g. platforms
5. Perform factory acceptance testing
6. Store the Plant until the IO is ready to receive it, and then deliver the Plant to the ITER site.

These steps are described in more detail in the following sections.

8.3.2. Manufacturing Design

The Manufacturing Design shall bring the design to the point where the components are ready to be fabricated, and shall conclude with a closed-out Manufacturing Readiness Review.

In the Manufacturing Design phase, the Contractor shall further update the deliverables presented at the Detailed Design Review to incorporate details from the selected component subcontractors, and shall produce or update deliverables related to the planning and execution of the fabrication, as per the Contractor Deliverable List.

8.3.3. Equipment Qualification

In Phase 2, the Contractor shall perform equipment qualification according to the Qualification Strategy and Qualification Plans developed in Phase 1 of the Contract. The Contractor shall produce all associated qualification records and deliverables meeting the Equipment Qualification Requirements [95].

The status of the Equipment Qualification activities shall be reviewed at the Manufacturing Readiness Review (MRR).

8.3.4. Procurement and Fabrication

The Contractor shall procure all materials and components from their Subcontractors, and shall fabricate and pre-assemble the Plant offsite.

During the Procurement Phase, the Contractor shall provide regular reporting on the status of equipment procurement activities in accordance with the Project Management and Quality Requirements [4].

Fabrication activities shall begin after the successful completion of the relevant Manufacturing Readiness Review. Requirements for fabrication and documentation including the Fabrication Completion Dossiers are given in the Fabrication Requirements [6].

The Contractor shall:

1. Identify and inform the IO of where fabrication activities will take place
2. Describe and list the fabrication activities, and the tools to be used.

8.3.5. Inspection and Testing

The Contractor shall execute inspections and tests for the all of the procured components in accordance with Project Management & Quality Requirements [4].

The Contractor shall perform factory acceptance tests for all procurement components in accordance with the requirements of technical specifications [18], [42], [42A], [42B], [42C] and [42D]. Two types of FAT shall be performed:

- Equipment FATs for individual components at Subcontractor facilities
- Skid FATs on pre-assembled units at the Contractor's facility including

For each skid FAT shall include a continuous 100-hour operation test as part of factory acceptance test (FAT) as defined in the 5.2.

Following the FATs, the Contractor (and/or Subcontractors) shall issue the As-Fabricated records (including original technical documentation for all components and sub-components) and Certificate of Conformity as described in the Fabrication Requirements [6].

8.3.6. Manufacturing Dossier

After successful factory acceptance testing, the Contractor shall prepare the manufacturing dossier (MD) as per Appendix A11.

8.3.7. ITER Manufacturing Database

The Contractor shall use the ITER Manufacturing Database (MDB) to implement the Manufacturing, Inspection and Test Plans (MIPs as described in the Project Management and Quality Requirements [4]). The MDB shall be used for the management of fabrication, inspection and testing activities and storage of quality records for all components in the Scope of Supply, including components fabricated by Subcontractors unless otherwise agreed with the IO.

The MDB allows for the centralised management and storage of documentation, and shall be used as follows:

1. The Contractor and all subcontractors that fabricate or supply components shall be set up in the MDB
2. Manufacturing, Inspection & Test Plans (MIPs) as described in the Project Management and Quality Requirements [4] shall be set up, managed and updated as electronic MIPs in the MDB
3. The MDB shall be used for management and storage of material traceability records and quality documents for components.

The IO shall provide remote training to the Contractor at the start of the Contract and, as required, to subcontractors throughout Contract execution. The duration of this training is half a day.

An overview of the MDB is given in the Manufacturing Database Introduction [741].

8.3.8. Packaging & Storage

After completion of all fabrication and testing activities, the Contractor shall package the Plant for:

1. Storage and preservation at the Contractor facility prior to delivery to the IO site
2. Transportation to the IO site
3. Storage and preservation at the IO site prior to installation.

Requirements for packaging are provided in the General Mechanical, Piping & Structural Specification [18].

8.3.8.1. Storage Prior to Transportation to the ITER Site

The Contractor shall store the Plant at their facility until the IO provides the instruction to deliver to it the ITER site. The requirements for the storage and the storage facility are given in the General Mechanical, Piping & Structural Specification [18].

The Contractor shall perform preservation activities during storage at its facility. In addition, the Contractor shall carry out a monthly visual inspection of the stored Plant and report the results to the IO, including photographs.

Any incidents, including but not limited to water ingress in the storage area, falling of components, or corrosion, shall be reported to the IO without delay, together with a proposed action plan to address the identified issues.

8.3.8.2. Procedures

The Contractor shall provide packing, storage and preservation procedures that cover:

1. Preparation of the Plant for packaging
2. Packaging
3. Storage and preservation (both at the Contractor's facility and at the IO site).

The Contractor shall provide instructions and procedures covering these activities to the IO for review and approval.

8.3.9. Transportation to the ITER Site

After completion of the Delivery Readiness Review and following instruction from the IO, the Contractor shall transport the Plant to the ITER site. Further explanation and requirements for this are provided in Appendix A9.

8.4. Gate Reviews

Gate reviews shall be conducted throughout Project execution. These gate reviews constitute mandatory hold points that must be successfully passed before progression to the next stage of work. The gate reviews are described in the following sections

Issues that are raised during gate reviews are categorised as follows:

- Issue Category 1: Major - must be addressed before moving on to the next stage of work
- Issue Category 2: Minor - can be addressed during the next stage of work
- Issue Category 3: Recommendation – for consideration, does not need tracking.

Any costs associated with the gate reviews shall be borne by the Contractor.

The types of gate reviews are detailed in Appendix A10.

8.5. Deliverables

Deliverables include the documents and drawings that the Contractor (and its subcontractors) shall produce to meet the Contract requirements.

Requirements relating to the quality of deliverables, as well as the deliverable production and review process, are defined in the Project Management & Quality Requirements [4].

If requested, the Contractor shall provide the IO with any additional documentation produced during Contract execution by the Contractor or its subcontractors that is not specifically listed in the Contractor Deliverable List (CDL). Exceptions may be granted by the IO where justified, e.g. in the case of commercially sensitive information

8.5.1. Contractor Deliverable List

The IO has defined the minimum deliverables that the Contractor shall produce during the course of the Contract in the initial Contractor Deliverable List [7]. This list also defines whether the types of deliverables that shall be submitted to IO either for acceptance, or for information.

The Contractor Deliverable List provides details on the stage at which the deliverables shall be first produced, e.g. the Detailed Design Review, the Manufacturing Readiness Review, etc. This is provided for information only, and shall be finalised in the Contractor.

At the start of the Contract, the Contractor shall review the Contractor Deliverable List (CDL) and expand it to develop an actual Contractor Deliverable List that includes all deliverables the Contractor intends to produce, including any additional documents required to meet the Contract requirements.

An example is the component specifications, which are listed as a single entry in the Contractor Deliverable List. In the actual list, however, the Contractor shall provide a detailed list of all individual equipment specifications that it intends to update or produce (e.g. blower specification, pump specification, etc.).

The Contractor shall submit this Contractor Deliverable List to the IO for review and acceptance.

The CDL shall use the same format as used for initial Contractor Deliverable List provided by IO, or another format to be proposed by the Contractor and agreed with the IO.

The CDL shall be used to list all the Deliverables to be produced during the course of the Contract, and to track the status and progress of each deliverable.

The CDL shall indicate, for each deliverable:

1. At which stage the deliverable shall be produced, e.g. for Detailed Design Review, Manufacturing Readiness Review, etc.
2. The quality class of the deliverable (see ref. [4] for quality class details and the corresponding requirements
3. The status of the deliverables, e.g. not started, in progress, completed, etc.
4. The purpose of the deliverable version, e.g. issued for review, approved for fabrication, etc.
5. The relevant WBS reference from the Project Delivery Schedule, at the lowest applicable WBS level
6. Whether the deliverable shall be submitted to the IO for review and acceptance, or for information only.

The CDL shall be updated and shared with the IO throughout the execution of the Contract every 2 weeks (or more frequently).

8.5.2. Subcontractor Deliverable Lists

Generally, all deliverables produced by subcontractors shall be included in the Contractor Deliverable List.

The Contractor may propose to maintain separate Subcontractor Deliverable Lists (SDLs) for specific portions of the subcontracted scope where this is advantageous for managing the status and review of deliverables produced by Subcontractors. The Contractor shall submit the SDLs to the IO for review and acceptance.

The requirements applicable to the SDLs shall be the same as those applicable to the MDL.

9. Battery Limits

The battery limits describe the boundaries of the Contractor Scope of Work. As general approach the Contractor shall consider the battery limits as:

- At the boundary of each Unit Package as defined below
- The list of Loose Items to be supplied.

9.1. Piping Battery Limits

Battery limits for piping (including process and utility piping) are shown in the P&ID [17], the Battery Limit Schedules are given in GA drawings listed in Section 7.1 Table 3 Section 1.

The Contractor shall provide all piping and related supports up to the battery limits, and shall install suitable welded caps, blind flanges or plastic caps to ensure preservation of the installed system until the piping on the other side of the battery limit is ready for connection.

The Contractor shall consider the routing and support arrangements s of the connecting piping on the other side of the battery limits as described in the Mechanical, Piping and Structural Basis of Design [18] and technical specifications listed in Section 7.1 Table 3 Section 1.

Process conditions at the battery limits are given in the technical specifications listed in Section 7.1 Table 3 Section 1.

Specific requirements are:

- At pipe stub connections, the piping shall protrude approximately 200mm from the Skid frames to facilitate on-site fit-up. The Contractor shall define the precise Battery Limit location for each connection to ensure it is in a convenient position for future site welding (i.e. away from any obstructions such as the Skid frame, away from elbows etc.). The stubs shall be provided with protective caps to prevent foreign materials entering the piping
- For flanged connection Battery Limits, the Contractor shall supply the flanges (and gaskets) on the Skid piping side. The flanges will be provided with protective caps to prevent foreign materials entering the piping during transportation and installation. The counter flanges will be provided by the IO and are not in the Contractor Scope of Supply. Note that for flanges within the Unit Package boundary, the complete flange assembly including bolts and gaskets are in the Contractor Scope of Supply.

9.2. Electrical Battery Limits

The limits of the Contractor Scope of Supply for electrical equipment are described in the Battery Limits section of the Modular Utility Skids - Electrical Technical Specification [30].

9.3. I&C Battery Limits

The limits of the Contractor Scope of Supply for I&C equipment are shown in the I&C Architecture Drawing [23].

9.4. Structural Battery Limits

The limits of the Contractor Scope of Supply are the connection to the building. Connections to the building use either embedded plates or post-drilled systems (PDS) as described in the Mechanical, Piping & Structural Basis of Design [18].

- For embedded plates, the Contractor Scope of Supply ends at the structural member connected to the plate. The Contractor shall be responsible for the design of the weld between the structural member and the embedded plate; however, execution of this weld shall be performed by others during installation at the IO site
- For post-drilled systems, the Contractor Scope of Supply includes the complete PDS including the mechanical anchors and baseplates.

The embedded plates are given in the GA drawings listed in Section 7.1 Table 3 Section 1.

10. Actions and Hold Points

The list of actions and hold points identified by the IO team, which must be discussed with the Contractor to support early resolution, can be found in the template document called Actions and Holds (see ref. [260])

11. Abbreviations and Definitions

The following abbreviations and definitions are either used extensively or exclusively in this document, for general abbreviations and definitions see ref. [1].

Term	Definition
ALARA	As Low As Reasonably Achievable
Component	Any equipment or part of equipment supplied by the Contractor or its Subcontractors. 'Component' is used as a generic term to cover all mechanical, process and electrical items that make up the Plant. The term 'component' is generally interchangeable with the term 'equipment'
Contract	The MUS Design & Fabrication Contract
Contractor	The D&F Contractor is the organisation that has entered into a Contract with the IO for the Design and Fabrication of the Modular Utility Skids
D&F	Design and Fabrication
DDR	Detailed Design Review
Deliverable	Documents produced during the course of the Contract by the Contractor or its subcontractors, which are necessary to complete the Scope of Work
DW	Demineralised Water
EI&C	Electrical, Instrumentation & Control
EQ	Equipment Qualification
ESP	*Equipement Sous Pression* (pressure equipment)
ESPN	*Equipement Sous Pression Nucléaire* (nuclear pressure equipment)

FES	First Exhaust System
GEP	Good Engineering Practice
HEPA	High Efficiency Particulate Air (filter)
HIRA	Hazard Identification and Risk Assessment
HMI	Human-Machine Interface
HV	House Vacuum
ICL	Intermediate Cooling Loop
Input Document Package	Document package issued by the IO at Contract award, which supersedes the document package issued at during Tender Phase
IO	ITER Organization
MUS	Modular Utility Skids
P&ID	Piping and Instrumentation Diagram
Phase	The specific period during which the Contractor shall complete the relevant Work. The Contract is organised into two phases: Phase 1 is the detailed design of the complete Plant; Phase 2 is the procurement and fabrication
PIA	Protection-Important Activity
PIC	Protection-Important Component
Plant	Modular Utility Skids
Project	Refers to the design and fabrication of the Plant, executed by the Contractor under the Contract
RAMI	Reliability, Availability, Maintainability and Inspectability
Scope of Work	The Contractor Scope, which includes the Scope of Services and the Scope of Supply
SSC	System, Structures and Components
Structures	Platforms, pipe supports, pipe racks, equipment skid frames, walkways, stairs, and steel gratings
ST-VS	Suppression Tank Venting System Skid
Subcontractor	Any vendor, supplier or service provider who enters into a legal commitment with the Contractor to perform a part of the Contract
Tender Package	Document package issued by the IO for the Call for Tender
TPP	Tritium Plant Project
Train	A train refers to one of two (or more) independent and redundant systems that perform the same safety function. For protection-important components (PICs) assigned a safety-importance class (SIC-1 or SIC-2), redundancy is required to ensure that the safety function is maintained in all conditions, including incident and accident conditions. Typical configurations are referred to as: • Train A • Train B • Train C (where applicable)
Work	The Contractor Scope of Services (activities) and the Scope of Supply (equipment, components). This includes design, fabrication, inspection and

	tests, documentation and deliverables, packaging, and transportation to the ITER site

Appendix A1. ITER Classification

A1.1. Safety Class

ITER is a nuclear facility, identified in France by the number INB-174 (*Installation Nucléaire de Base* or INB) under the French nuclear regulations, i.e. the INB Order (7M2YKF).

Under the INB Order, systems, structures and components (SSC) that provide nuclear safety functions are classified as protection-important components (PIC). The WORKPACKAGE TITLE performs nuclear safety functions in normal and accident conditions. Accordingly, the Plant system as a whole is classified as PIC, as well as its constituent components that perform nuclear safety functions.

The terms PIC, SIC and PIC/SIC are used for functions or components that perform nuclear safety functions. These terms shall be considered as equivalent by the Contractor.

There are two aspects to the nuclear safety classification of Plant components:

1. Confinement of radioactive materials is a nuclear safety function. The Plant process lines contain trace quantities of tritium. All the components (i.e. piping, fittings, process equipment and supporting structures) that support or form part of the pressure boundary of the process lines are classified as '**PIC for Confinement**'
2. Detritiation and filtration are nuclear safety functions. All components that are required for the Plant to perform these functions are classified as '**PIC for Function'.**

Each component is therefore assigned two safety classifications: one for confinement and one for function. The IO has established the safety classification of the Plant down to the main components. The safety classifications are given in the relevant lists and equipment specifications.

The nuclear safety requirements that apply to PICs are given in ref. [5]. The Contractor is responsible for ensuring that nuclear safety requirements are correctly applied in its own activities and in those of its Subcontractors throughout the execution of the Work.

The Contractor shall implement the requirements given in Nuclear Safety Requirements [5] throughout all stages of the Project.

At the start of the detailed design, the Contractor shall provide a Nuclear Safety Compliance Strategy to describe how the requirements will be met, which will be provided to the IO for review and approval. The Nuclear Safety Compliance Strategy may be integrated into the Project Quality Management Plan described in ref. [4].

The nuclear safety requirements do not apply to components that are classified as either safety-related (SR) or non-PIC. SR is an internal IO safety classification and does not impose any additional requirements on the Contractor.

A1.2. Quality Class

A quality class (QC) is assigned to all of the components in the Plant scope. The level of quality control and monitoring shall follow a graded approach based on the quality class assigned to the components. The quality class is assigned based on the risk of impact on the Project in the event of component failure, including potential impacts on technical performance, quality, safety, cost, or schedule.

Due to the nuclear safety role that the Plant plays, and the high requirements for performance and reliability, the system and associated components are generally assigned the highest ITER quality class (QC-1). Consequently, stringent quality requirements apply to both the activities to be performed and the components to be supplied. These include requirements for personnel training and qualifications, review and approval of documents and procedures, checks and monitoring of activities, material traceability, documentation and records, and any other requirements.

The requirements for quality controls and monitoring are given in Project Management and Quality Requirements [4], and the quality classifications of the components are given in the lists (see Section 7.1).

A1.3. Seismic Class

A seismic class (SC) is assigned to all components in the Plant scope. The Plant is classified as follows:

1. Component required to actively operate during and after a design-basis seismic event are assigned the seismic class **SC1 (SF)**
2. Components required to passively maintain confinement of aerosols, gases and liquids during and after a seismic event are assigned the seismic class **SC1 (S)**
3. Components not required to function or maintain confinement during and after a seismic event, however, need to be designed to ensure that they will not fail and cause damage to nearby SC1 equipment are assigned the Seismic Class **SC2**.

The seismic class of the Plant components is given in the lists and specifications provided in the Tender Document Package.

Further details of the design requirements for seismic classes is given in the Mechanical, Piping & Structural Basis of Design [14].

A1.4. Hardened Safety Core Components

Components needed to prevent cliff-edge effects leading to the escalation of extreme accident events are classified as hardened safety core components (HCC). In addition to their standard design requirements, HCCs shall be designed to withstand an extreme seismic event (SL-3), in accordance with the Mechanical, Piping & Structural Basis of Design [14].

HCCs are identified in the lists and specifications provided in the Tender Document Package.

A1.5. Tritium Class

Components in contact with tritium are assigned a tritium class. The tritium class determines requirements for the material selection and the leaktightness of the system.

Requirements for material selection are given in the equipment technical specifications and the General Mechanical, Piping & Structural Specification [18]. Requirements for leaktightness are given in the Process Basis of Design [9].

A1.6. ATEX

The Plant is installed in rooms that are not designated as hazardous areas. As a result, the equipment does not fall under the ATEX Directive (Directive 2014/34/EU – Equipment and protective systems intended for use in potentially explosive atmospheres). This means that the Plant does not require ATEX classification.

A1.7. Pressure Equipment Directive

Maximum allowable pressures and sizes are provided in the lists and specifications provided in the Tender Document Package.

Process lines and equipment that have a maximum allowable pressure not exceeding 0.5 Barg do not fall under the Pressure Equipment Directive (PED) 2014/68/EU.

Process lines and equipment with a maximum allowable pressure greater than 0.5 bar(g) are subject to the Pressure Equipment Directive; however, based on the IO design, these components are classified under Sound Engineering Practice (SEP).

The preliminary PED classification is given in the lists and specifications provided in the Tender Document Package.

A1.8. French Nuclear Pressure Equipment Classification (ESPN)

The French Nuclear Pressure Equipment (ESPN) regulations are applicable to pressure equipment falling under the Pressure Equipment Directive (PED) or classified as Sound Engineering Practice (SEP) when a failure could lead to the release of radioactivity.

Due to the low radioactive inventory, none of the Plant equipment falls under the ESPN regulations.

Appendix A2. Software

The Contractor shall procure and maintain the necessary equipment and licences to run the software tools required to perform the design work and engineering analyses in the Scope of Services.

The IO has a preferred list of software tools for a broad range of engineering work. The Contractor may choose to use alternative equivalent software, with appropriate justification and the agreement of the IO.

Any software that is used for Protection Important Activities (PIAs) needs to be qualified as described in Section A2.1.

Table 14: IO preferred software codes

Application	Preferred software
Pipe stress analysis	Caesar II version 2019
Structural analysis	GT Strudl version 2018
Pressure vessels design	PV Elite
Post-drilled plates and anchors analysis	Hilti Profis Engineering
Finite element analysis for mechanical & structural design	Ansys Workbench release 19.2

A2.1. Software tools used for PIAs

During the execution of the Contract, some of the engineering design and analysis work performed by the Contractor will be Protection-Important Activities (PIAs). An activity is a PIA if it may prevent a PIC item from performing its nuclear safety function if performed incorrectly.

In the scope of the Contract, it is envisaged that the following activities will be PIAs:

- Structural calculations to demonstrate the integrity of piping, equipment, structures, embedded plates and post-drilled systems

Any software codes that are used for PIAs need to be qualified to demonstrate that they are suitable to be used for the specific calculations; and that they are working and installed correctly to produce correct results.

For analyses calculations that are PIAs, the preferred approach is to perform them using hand calculations, or to use codes that are already qualified. The list of codes already qualified by the IO is given in Table 15.

If another code is proposed for a PIA, the Contractor shall qualify the code in accordance with IO procedures as explained in Project Management and Quality Requirements [4].

For codes that are already qualified, a verification dossier is needed to demonstrate that the code is correctly installed and is producing accurate results. Details of the requirements are given in ref.[4].

Table 15: List of codes already qualified by ITER

Application	Already-qualified Software Codes
Pipe stress analysis	Caesar II
Structural analysis	GT Strudl; Staad; SAP2000
Pressure vessels design	PV Elite

Application	Already-qualified Software Codes
Post-drilled plates and anchors analysis	Hilti Profis Engineering
Finite element analysis	Ansys

A2.2. Caneco

The Contractor shall perform electrical studies, analyses, calculations and sizing of electrical equipment and cables as described in Section 8.2.8 using Caneco BT.

A2.3. SEE Electrical Expert

The Contractor shall use IGE+XAO SEE Electrical Expert for electrical and I&C detailed design and to produce wiring diagrams for electrical switchgear, panels and control cubicles. Further details are given in the Modular Utility Skids - Electrical Technical Specification [30] and I&C Cubicles Technical Specification [24].

A2.4. Native Software Files

The Contractor shall provide to the IO native software files for all work performed under the Scope of Services.

Appendix A3. Equipment Qualification

A3.1. General

This appendix provides project-specific context for the application of Equipment Qualification (EQ) requirements to the Modular Utility Skids (MUS).

EQ shall be performed in accordance with the Tritium Plant Equipment Qualification Requirements and Guidance [745] and associated applicable documents. This appendix does not redefine those requirements.

A3.2. Applicability

EQ shall apply to all components within the Scope of Supply that are credited with a nuclear safety function (Protection-Important Components, PIC).

The identification and classification of PICs are defined in the applicable Component Lists and Equipment Technical Specifications.

Where components are not classified as PIC, formal EQ is not required. However, the Contractor shall demonstrate that such components:

1. Are suitable for the defined operating conditions; and
2. Do not adversely affect the performance of PIC components under normal or accident conditions.

A3.3. Application of Qualification Requirements

The Contractor shall:

1. Define and justify an overall Equipment Qualification Strategy
2. Prepare Component Qualification Plans for components requiring qualification
3. Select and apply appropriate qualification methods in accordance with [745]
4. Demonstrate that qualification activities address the defined safety functions and conditions
5. Produce all required qualification deliverables in accordance with [745].

A3.4. Use of Standard Components

Where Tritium Plant Standard Components are used, the Contractor may credit existing qualification provided that:

- The application is bounded by the qualified envelope; and
- The configuration is demonstrably equivalent to the qualified configuration baseline.

Any deviation shall be identified and addressed through additional qualification activities

A3.5. Integration with Project Execution

Equipment Qualification shall be integrated into project execution, including:

- Detailed design and equipment selection;
- Procurement and interaction with suppliers;
- Alignment with project gate reviews (DDR, MRR);

- Planning of qualification activities to support the project schedule.

The Contractor shall identify EQ-related risks and implement appropriate mitigation measures.

A3.6. Qualification Deliverables

The Contractor shall produce qualification deliverables in accordance with [745], including (as applicable):

1. Equipment Qualification Strategy
2. Component Qualification Plans
3. Qualification execution records (analysis, testing, or equivalent evidence)
4. Qualification Summary Reports
5. Qualification Preservation documentation.

All deliverables shall be:

1. Traceable to safety functions and design inputs
2. Consistent with the defined qualified configuration
3. Suitable for IO review and acceptance.

A3.7. Preservation of Qualification

The Contractor shall ensure that qualification validity is maintained throughout:

1. Manufacturing and procurement
2. Storage, transport, and installation
3. Commissioning.

Changes that may affect qualification validity (e.g. configuration, materials, suppliers, or conditions) shall be assessed and addressed as required.

A3.8. Environmental Conditions

The MUS equipment is installed within the Tritium Plant environment and is subject to project-specific environmental conditions which shall be considered as inputs to Equipment Qualification.

These conditions are defined in the Modular Utility Skids - Load Description Document [262], including environmental specifications and component lists, and include (as applicable):

1. Temperature, pressure, and humidity conditions
2. Seismic loads
3. Fire and accident conditions
4. Static magnetic field (SMF) levels within the installation areas.

The Contractor shall ensure that all qualification activities and justifications are based on these defined conditions.

Where environmental conditions are location-dependent (e.g. SMF), the Contractor shall consider the applicable values for the installed position of each component.

Appendix A4. Human Factors

Human factors (HF) requirements shall be considered for all phases of the Plant lifecycle (i.e. fabrication, assembly, commissioning, operation, maintenance and decommissioning). The HF requirements for the Plant design are:

1. The Plant design shall minimise reliance on human actions to ensure or maintain safe conditions.
2. The physical layout, equipment access, lighting, and manual handling provisions shall support good ergonomics and reliable task performance (e.g. operation and maintenance), taking into account human perceptual and physical characteristics and environmental influences on human performance
3. Risks to workers shall be avoided or, where this is not possible, minimised (e.g. electrical hazards, contamination, work at height, exposure to hazardous materials).
4. The Plant shall be designed to prevent errors, e.g. through the use of positive confirmation of valve positions, logic-based layout, use of colours and labels, easy-to-read instrumentation.
5. Communication of important information shall be optimised to support correct decision-making, in particular through the design of the control system HMI and audible alarms. Requirements for alarms and HMIs are defined in the ITER HMI Design Process , ITER Alarm System Development Process, and Human Factors for HMI Development, as described in the Modular Utility Skids - Control & Instrumentation Technical Specification [23].
6. The Control System shall be able to record and track any operating event during the whole operational life of the Plant as described in the Control and Instrumentation Technical Specification[23].
7. The requirements of Safe Access for Maintainability [524] shall be implemented into the Plant design in order to comply with French regulations for safety related to work areas and accessibility of equipment. The equipment design and layout shall ensure sufficient accessibility for safe and efficient planned operations and maintenance tasks, including the planned replacement of components and decommissioning.
8. All signage shall be standardised, and important information shall be provided in English and French as detailed in the ITER Signage & Graphics Standards [523].
9. When the Plant is identical in appearance (e.g. train A and train B), signage and labelling shall be colour-coded to enable workers to distinguish between them and reduce the risk of errors during operation and maintenance tasks. Further details of this requirement are given in the General Mechanical, Piping & Structural Specification [18].
10. Plans, manuals and procedures for commissioning, operating and maintenance shall be written in a clear, organised and consistent fashion to improve comprehension and reduce errors of interpretation.

Throughout the Contract, the Contractor shall work with the IO to identify human factors issues and shall establish a process to record and track them to resolution. Human factors issues may be recorded in the overall Project Issues Register (see Project Management & Quality Requirements [4]), provided that they are clearly identified as such.

The Issues Register shall record how the human factors issues have been implemented in the design; for example by updates to the layout, equipment specifications, signage, or by implementation in operating & maintenance manuals or procedures.

Appendix A5. Use of Halogenated Materials

Halogenated materials may adversely affect the performance of the ITER Atmospheric Detritiation System and are therefore not permitted in rooms served by the system. This requirement applies to all components, regardless of their size, location within the room, or function, and covers all halogens (fluorides, chlorides, bromides, and iodides)

Halogens may be present as core constituents of materials such as poly-vinyl chloride (PVC), as additives such as brominated flame retardants in acrylonitrile butadiene styrene (ABS), or as function-enhancing materials such as polytetrafluoroethylene (PTFE) for bearings. They may also be present as residual fabrication materials, for example chloride deposits on metals used in catalysts, and in materials such as printed circuit board laminates, paints, adhesives, cables, and moulded plastic housing.

The Contractor shall select suitable materials and components that do not contain halogens. Certification of materials as 'halogen-free' or 'low-halogen' is not sufficient to provide compliance with the requirement. Following standards such as IEC 61249-2-21, 'halogen-free' only means that the chlorine and bromine content is below a certain concentration, which is not the same as non-halogenated.

The Contractor shall provide evidence demonstrating compliance with this requirement. No specific evidence is required for materials that clearly contain no halogens. Where materials or components may contain halogens, confirmation shall be provided by the Contractor's Subcontractors regarding their presence or absence.

In order to demonstrate this requirement is met, the Contractor shall provide a Halogens Quantity Assessment Report with a collective estimate of the halogens in the rooms for review at the Detailed Design Reviews. In most cases, suitable non-halogenated materials are readily available.

In cases where no suitable components or materials are available to meet this requirement, the Contractor shall submit a Deviation Request to the IO for review and approval before using the material. The Deviation Request shall include details of the halogen content of the materials and a justification demonstrating that suitable non-halogenated components or materials are not available. Compliance with standards such as IEC 61249-2-21 may be checked as a means to confirm the maximum halogens content of materials.

There is no requirement to limit halogens for the equipment located in the cubicle rooms.

Appendix A6. Process Engineering Deliverables

This appendix provides explanations, description and requirements of process engineering deliverables.

a. Components in Component Sizing Calculation Reports

Initial sizing of the components has been performed by the IO. Major changes to the sizing of the components is not expected (for example, changes to Component sizing that challenges the feasibility of the layout), however at the start of the Contract the Contractor shall assess the IO design to confirm the sizing, and implement any updates or changes that result from the normal course of detailed design.

The studies that the Contractor shall perform to finalise and/or substantiate the design and sizing of the components are detailed in the specific Equipment Technical Specifications. The Contractor shall document the sizing and selection of components in Component Sizing Calculation Reports.

b. Equipment Technical Specifications

The IO has provided technical specifications for each of the main Plant items. The Contractor shall work with Subcontractors to develop the detailed specifications and to select the makes and models of all components. The Contractor shall define all details necessary for the complete and correct specification of the components, including ensuring that all design conditions are correctly reflected in the specifications and resolving any items identified as 'Vendor to Confirm' or 'Vendor to Decide' in the Document Package. The Contractor shall update the Equipment Technical Specifications to include the data for the final selected components

c. Datasheets

The Contractor shall provide datasheets for all tagged components, which will include the data of the final selected components. The datasheets templates shall be agreed with the IO.

d. Pressure & Temperature Analysis

The IO has determined the operating and design temperatures and pressures across the Modules based on the IO design, as documented in the Pressure & Temperature (P&T) Analysis. The P&T Analysis defines the operating pressures (PO), operating temperatures (TO), maximum allowable pressures (PS), and other conditions that are defined in the Tritium Plant Section Guideline – Pressure and Temperature Analysis [657].

e. Cause & Effect Matrix

The IEC 62881 Cause & Effect Matrix [708] describes both the functions that are executed through the IO central safety system (CSS) and the functions that are executed through the Plant control system.

f. Control Scheme

The Control Scheme documents is a process engineering document that is the main input to the I&C design. It lists input and output devices connected to the control systems. The Control Scheme documents shall be provided by IO as part of the Input Document Package in accordance with Section 4.4.

g. Line and valve sizing calculation report

The Line & Valve Sizing Calculation Report provides the calculations used for sizing lines and valves. It is supported by sketches illustrating circuits and by performance data on the selected components. The report shall cover all isolation valves (manual and automatic) and control valves in the Scope of Supply.

The Contractor shall not reduce the sizes (diameters) of any lines without approval from the IO.

h. Flowmeter Sizing Report

The Flowmeter Sizing Report covers all of the flowmeters in the scope of supply. The report shall include the following:

a. Details of selected flowmeters
b. Calculations and detailed characteristics of the flowmeters, demonstrating the suitability of the selected instruments
c. Flowmeter measurement accuracy calculations

i. Overpressure Protection Report

An overpressure protection assessment is used to verify that all isolatable sections, up to the battery limits, are protected from overpressure.

The technical specifications listed in Section 7.1 Table 3 Section 1 define the preliminary list of overpressure scenarios to be considered and specifies the requirements for the related calculations and relief device sizing. The Contractor shall review this list and update it as necessary.

An Overpressure Protection Report shall include:

a. Results of the assessment
b. Calculation notes for all relief devices and upstream/downstream lines to demonstrate that the sizing covers all overpressure scenarios
c. Datasheets for all relief devices.

The Contractor shall design vent lines for overpressure devices discharging into the room such that the discharge is directed to a safe location.

j. Heat Exchanger Thermal Design

Thermal design reports for heat exchangers shall be produced for all heat exchangers within the Scope of Supply.

The reports shall include the results of the specified modelling and calculations, including the calculation and definition of:

a. Heat transfer coefficient in clean and dirty conditions
b. Exchange area required and the design area
c. Pressure drop on both flow sides for the range of flow conditions.

k. Liquid Seal Design & Sizing Report

Liquid seals are used on the drain lines to prevent process gas flowing into the drain lines, and to ensure no gas backflow from the drain lines into the process lines as illustrated on the P&IDs.

In the detailed design, the Contractor shall confirm the sizing of the seals (i.e. pipe size and height) to ensure safe and reliable operation, meaning the liquid seal remains effective under all operating scenarios and the liquid level remains below the maximum height for the connected equipment.

The Contractor shall size the liquid seals and integrate them into the design and 3D model. Their sizing shall take into account the range of pressures at the battery limits as given in the process basis of design in the technical specifications listed in Section 7.1 Table 3 Section 1, and the range of operating pressures within the Plant.

The Contractor shall produce a Liquid Seal Sizing Report to document the calculations and demonstrate the suitability of the design.

l. Thermal Insulation Calculations and Specifications

Thermal insulation is used on the Plant for the following purposes:

1. Heat conservation (HC)
2. Cold conservation (CC)
3. Personnel protection (PP)
4. Anti-condensation (CP)
5. Passive fire protection (PFP).

The IO has performed a preliminary assessment of the piping and the components where thermal insulation is required and the type of insulation required (HC, CC etc.) as shown in the P&IDs [17]-[17D] and the Technical Specifications (Section 7.1 Table 3 Section 1). The general requirements for thermal insulation are given in the General Mechanical, Piping and Structural Specification [18].

For all types of thermal insulation (excluding passive fire protection insulation), the Contractor shall:

1. Perform process calculations to determine the required insulation material and thickness. This also involves identifying any other locations (piping or equipment) where insulation is required, and updating the design accordingly. This includes:
   a. HC and CC insulation to meet the process requirements
   b. PP protection to limit the external surface temperature (see ref. [18] for the maximum allowable surface temperature)
   c. HC insulation to limit the heat loss to the room (see the Utilities Data Book [15] for the requirements)
   d. CP insulation to prevent condensation on piping or equipment.
2. Produce procedures for the installation of the thermal insulation. These procedures shall be used by both the Contractor and by the future installation contractor for the thermal insulation that will be installed at the IO site.
3. Produce a Thermal Insulation Calculation Report to present the results of the calculations and the datasheets of the selected insulation.
4. The Contractor shall design the attachments or supports for fixing the insulation to the equipment or piping.
5. The Contractor shall update the insulation thickness and locations in the 3D model and P&IDs, and ensure that the final thickness does not create clashes or any access difficulties within the room.

m. Heat Load Calculation Report

There are limits on the thermal heat load that equipment can emit to the Plant Process and EI&C Cubicles Rooms. The limits are provided in the Modular Utility Skids - Utilities Databook [15].
The Contractor shall design the Plant equipment to ensure that it does not exceed the heat rejection limits while running at maximum heat generation conditions, using insulation where necessary to reduce the heat rejection.

The Contractor shall perform heat load calculations to confirm and demonstrate that the total heat rejection to the rooms does not exceed the limits, and shall provide a Heat Load Calculation Report to present the results. The heat load shall be calculated based on the ambient temperature of 25°C.

n. Utilities Consumption Calculation Report

The Plant operates with the following fluid utilities:

1. Compressed Air
2. Chilled Water
3. Demineralised Water
4. Nitrogen

Details of the fluid utilities such as composition, the flow, pressure and temperature conditions, and maximum return temperatures for the Chilled Water are given in the Modular Utility Skids - Utilities Databook [15].

The Contractor shall design the Plant to operate within the limitations of the provided utilities under all operating conditions, including maximum demand conditions. The Contractor shall consider the utilities properties and conditions in the detailed design and selection of the components to ensure that they function correctly and within the limits.

The Contractor shall perform process calculations to confirm and demonstrate that the Modules operate within the limits of the utilities supply. The Contractor shall provide a Utilities Consumption Report which presents the results of the calculations, and describes the maximum demand conditions considered.

Appendix A7. Instrumentation and Control

A7.1. I&C nuclear safety functions

The nuclear safety classification of all I&C functions (i.e. whether a function is classified as PIC/SIC-1A; PIC/SIC-2C or non-SIC) and the components that carry out the functions is the responsibility of the IO. During the detailed design, the Contractor shall review and if necessary update the I&C functions list, however the IO shall remain responsible for assigning the nuclear safety classifications. The safety classifications of the functions based shall be provided to Contractor as part of Input Document Package, see Section 4.4.

A7.2. RAMI Requirements

The Contractor shall ensure that the I&C design and components selection supports the reliability, availability and maintainability targets given in Section 5.2. Specifically:

1. The Contractor shall identify the functions that require high reliability and availability to meet the overall Plant targets, and shall design the system and select components to meet these requirements and demonstrate that they are met.
2. The Contractor shall identify where redundant instruments and voting need to be introduced in order to meet reliability, availability or maintainability targets. For example the Contractor shall assess the need for implementation of redundant instruments, for instance:
    a. To meet reliability requirements (to achieve the required probability of failure on demand or reduce spurious trip rate).
    b. To allow maintenance activities such as calibration of instruments while keeping the Modules on-line.

A7.3. Instruments

The Contractor shall specify and select Instruments in accordance with the Modular Utility Skids - Control & Instrumentation Technical Specification [23] and the process and technical requirements. The Contractor shall provide detailed Instrument specifications and datasheets, updating any aspects of the IO design necessary to align with updates or changes resulting from the detailed design. Datasheets shall be provided using the template agreed with the IO.

The Contractor shall produce all required design Deliverables relating to the detailed design of the Instruments including specifications, data sheets, hook-up diagrams and loop diagrams.

A7.4. Cables & Junction Boxes

The Contractor shall define the quantity and location of the Junction Boxes, and shall produce the cabling schematics that show which Instruments are connected to which JB. The requirements for JBs are given in the Modular Utility Skids - Control & Instrumentation Technical Specification [23].

A7.5. Actuated Valves

In the detailed design, the Contractor shall develop the air supply solenoid valve configuration for the actuated valves depending on the Plant of the control system and valve selection.

Appendix A8. Operation and Maintenance Manual

During the detailed design, the Contractor shall provide a preliminary Operating and Maintenance Manual for the Plant to cover all operating activities and procedures. The final Manual shall be issued in Phases 2 and shall include instructions and vendor documentation for all components within the Plant. The format and the contents of the Operating & Maintenance Manual shall be agreed with the IO.

The Operation and Maintenance Manual shall (as a minimum) contain the following sections and sub-sections:

1. General Description of Facilities and Processes

   This section provides the operating context of the facilities and equipment, with a general description of all processes and key equipment within these processes. The section should contain a high level overview of key operating & maintenance considerations for the facilities in order to ensure maximum Plant availability for continuous operation.

2. Procedures

   The Manual shall provide procedures for the start-up, operation, shutdown, preparation for maintenance (i.e. decontamination and isolation) and maintenance and inspection down to the components.

3. Equipment Lifting & Maintenance Requirements

   This section provides the equipment listing in tabular form with details on the main design and operating parameters for each asset, e.g. capacities, flowrates, pressures, temperatures, speeds, etc. Recommended routine servicing, predictive maintenance, preventive maintenance and scheduled inspection requirements. Equipment lifting weights shall be provided for any equipment that requires rigging for maintenance purposes.

   a) Static equipment (i.e. Vessels / Valves etc.)
   b) Rotating equipment (i.e. Pumps / Blowers etc.)
   c) Electrical equipment (i.e. Electric motors / Switchgear / Distribution Panels etc.)
   d) Instrumentation equipment (i.e. I&C Cubicles / Control Valves / Transmitters / Sensors / Controllers / Junction Boxes. etc.)
   e) Other Equipment (i.e. any other equipment not previously mentioned).

   Maintenance requirements shall include descriptions on the task to be performed, the recommended interval of these tasks (i.e. days, months, years, etc.), manpower skill requirements and (where applicable) all necessary consumables/spare parts required to perform each maintenance task.

4. Periodic Inspection & Test Schedule

   This schedule shall include all Periodic Inspection & Tests required during the Design Life of the Plant starting from final acceptance of the installed Plant until final shutdown and decommissioning of the Plant, including in particular, but not limited to:

   f) Regulatory Periodic Inspections and Tests (such as pressure equipment inspections, pressure tests, lifting equipment load tests, recalibration of instruments)
   g) Other Periodic Inspections to be performed according to the Contractor and/or Subcontractors and recommendations and following best practices.
   h) Periodic routine operating tests
   i) Details of requirements for involvement of other parties such as Notified Bodies.

5. Details of temporary equipment, utilities or consumables required for performing maintenance or inspections.
6. Details of design characteristics which are important to the service life of the equipment, such as:
    a) For fatigue, the theoretical number of cycles
    b) For creep, the theoretical number of hours at determined temperatures
7. Details of how in-service inspections shall be performed.
8. Lubrication requirements

    Lubrication requirements shall be detailed in a separate lubrication schedule.

Appendix A9. Transportation to ITER Site

After completion of the Delivery Readiness Review (see Section 3) and following instruction from the IO, the Contractor shall transport all of the equipment to the ITER site following the Procedure for Transportation of components to ITER site [628] under the Incoterms DAP (Delivery at Place). This procedure defines the following transportation loads:

1. Conventional Truck Loads (CTL)
2. Conventional Exceptional Loads (CEL)
3. Highly Exceptional Loads (HEL)

As described in the technical specifications the Contractor shall ensure HEL deliveries are avoided, and shall verify with the IO before increasing the dimensions of any of the equipment skids.

In the event that HEL deliveries are required, the Contractor shall subcontract the transportation of all HEL loads to the IO site to the logistics service provider DAHER. Other logistics service providers are not authorised to transport HEL loads to the IO site. The contact details for DAHER are:

DAHER TECHNOLOGIES
Ines BOLLINI email address: i.bollini@daher.com
Sébastien DECEGLIE email address: s.deceglie@daher.com
ST PAUL LEZ DURANCE - FRANCE

The Contractor may select other logistics service providers for the transportation of all other (non-HEL) loads under the Incoterms DAP (Delivery at Place).

The Contractor shall provide any special lifting equipment required to handle the delivered equipment and accelerometers on the packaging as described in the General Mechanical, Piping & Structural Specification ref. [18].

The Contractor shall as far as practical consolidate the deliveries of equipment to reduce the number of deliveries.

Requirements for the transportation & delivery documentation are given in Project Management & Quality Requirements [4].

The Contractor shall provide support to the delivery of the equipment at the IO site, in particular:

1. The Contractor shall review the IO procedures for unloading and handling of packages, and storage and preservation of the equipment.
2. The Contractor shall oversee the unloading of the equipment from the delivery trucks and the manoeuvring into the storage area to ensure that the equipment is handled in accordance with the requirements specified by the Contractor.
3. The Contractor shall provide checklists and procedures for inspecting the materials upon delivery to the IO, and shall participate in the Material Receiving Inspections of the delivered equipment.

Appendix A10. Gate Reviews

There are several types of Gate Reviews in the Scope of the Contract. Payment milestones as well as progressing to following steps of the project are linked to the successful outcome and completion of the Reviews. The Contractor shall describe the plan for the Reviews in the Project Execution Plan and shown in the Contract Implementation Schedule as described in ref. [4].

The following Sections describe the Gate Reviews in the Scope of the Contract.

A10.1. Detailed Design Reviews

It is envisaged that Detailed Design Reviews could be performed on specific Work Packages to optimise project delivery.

For each Detailed Design Review, the Contractor shall provide a list of specific Deliverables that are required to complete the review, this shall be subject to review and agreement by IO.

The Reviews are not intended to be the primary mechanism for reviewing and accepting Deliverables produced by the Contractor, though act as a milestone once Deliverables have been accepted to confirm the work is complete and consistent at the end of the Detailed Design (for the specific scope of the Review).

A10.1.1. Readiness for Review

All Deliverables within the scope of the Review shall be complete and accepted by IO, after which written formal Notification of a Review can be sent by the Contractor to IO. The Notification shall be sent 2 working weeks prior to the proposed date of the Review by the Contractor to IO. The Review Notification Template (to be provided by the IO) shall be used that includes the proposed Agenda.

IO shall review the Notification information within 1 working week of its receipt and confirm or reject acceptance of the Review and Agenda in writing using the Review Notification Acknowledgement Template (to be provided by the IO).

It should be noted that Deliverables shall be sent for review and acceptance by IO in-line with the Contract Implementation Schedule and not all as one package before the Review.

In general, the Reviews shall be conducted using design deliverables or 3D models rather than summaries in PowerPoint presentations. The Contractor shall add a reference of the deliverable where the item is developed. IO shall reserve the right to review all deliverables in the Review.

A10.1.2. Location and Administration

Reviews shall be held in person at the IO Headquarters in Saint-Paul lez Durance (France) unless other arrangements are agreed by IO and the Contractor.

The Contractor Lead Presenter is a mandatory member during Reviews and must attend in person. Other members of the Contractor's organisation shall attend as required to ensure the design is presented thoroughly at the Review. IO reserves the right to confirm the selection of which technical representatives of the Contractor shall attend the Review.

Reviews shall be performed during normal working hours of the IO Headquarters (8:00 am to 6:00 pm Central European Time).

The duration of the Review shall be sufficient to complete the Agenda, extra time shall be permitted to complete all items. The Review may be paused and reconvened at the request of the Review Chair.

A10.1.3. Review Meeting

The Agenda shall be followed and key discussions recorded using Review Outcome Report template. Issues requiring actions shall be recorded in the Action Plan (in the Review Outcome Report). Issues raised during the Review shall be described clearly in easy to understand English, categorised per priority and importance and shall include a proposed corrective action including criteria for closure. Where an issue is raised that impacts scope outside of the Review, this shall be recorded in the Project Action Tracker.

A10.1.4. After the Review Meeting

The Review Outcome Report will be sent to the Contractor for review and comment. Comments shall be returned back to the IO within 1 working week. As part of this review the Contractor shall confirm or propose alternative corrective actions and provisional closure dates of each action. The closure date of the actions shall ensure the Contract Implementation Schedule is maintained. Closure dates and alternative corrective actions shall finally be accepted by IO in the approved Review Outcome Report.

A10.1.5. Tracking and Closing Actions

Tracking of progress against actions and their closing shall be performed and reported by the Contractor as part of the Monthly Reporting (see Project Management & Quality Requirements [4]). Closure of actions shall be evidenced by the Contractor submitting updated deliverables or other deliverables justifying closure to the IO. The IO shall review the deliverables and once the IO has confirmed that the action has been addressed adequately by the submitted deliverable(s) the Action Plan shall be updated with reference to the corresponding deliverable(s) (including version) and the action shall be closed.

Once all Category 1 issues are closed the Design Review shall be completed and closed.

A10.2. Manufacturing Readiness Reviews

Manufacturing Readiness Reviews are the Gate Reviews which will confirm and close out the Manufacturing Design. The successful completion of the Manufacturing Readiness Reviews is required before beginning fabrication of components.

In a similar way to the detailed design, the Contractor shall organise the work and the MRRs into Work Packages in order to optimise the Project delivery. The Contractor shall describe the MRR plan and schedule in the Project Execution Strategy.

The MRRs shall cover all of the fabrication in the Scope of the Contract, including fabrication of components at Subcontractors, and the fabrication activities at the Contractor workshop to fabricate and assemble the equipment skids and other loose items prior to delivery to the IO.

The Contractor shall carry out the MRRs in accordance with the Working Instruction for Manufacturing Readiness Reviews [676]. At the end of the MRR the Contractor shall issue a Manufacturing Readiness Review Report.

A10.3. Factory Acceptance Tests

Factory Acceptance Tests (FATs) are the Gate Reviews which confirm and close out the fabrication and testing activities to confirm that that the fabricated components meet the specified requirements. Requirements for FATs are given in the requirements of technical specifications [18], [42], [42A], [42B], [42C] and [42D].

A10.4. Delivery Readiness Reviews

Delivery Readiness Reviews (DRRs) are the Gate Reviews which are held prior to shipment of equipment from the Contractor to the IO site.

At the DRRs, the following documentation shall be reviewed:

1. Fabrication documentation including test reports, completed MIP, and Fabrication Completion Dossier
2. Contract Release Note (see ref. [4])
3. Transportation & Delivery Documentation (see ref. [4])

Other key aspects that are checked at the DRR:

1. That all delivered equipment has unique identifiers (tag numbers and PNI number) and that these are identified in the documentation (drawings, BOMs, Contract Release Note, Delivery Report and Packing List); and that equipment is physically tagged and marked.

   The Contractor shall provide evidence (i.e. photographs or inspection reports) to confirm that equipment is correctly tagged, marked and labelled. Requirements are given in ref.[4].
2. That the equipment has been packaged in accordance with the approved procedures.
3. That all Packages to be delivered are labelled with Shipping Labels. Requirements for Shipping Labels are given in ref. [18]
4. That any Category 1 issues (see Section 8.4) raised at the FAT have been closed out.
5. That preservation and storage requirements are specified.

The DRR is a hold point and shall be fully completed with all Category 1 issues closed before transportation to the ITER site begins.

The Contractor shall carry out the DRRs in accordance with the Working Instruction for Delivery Readiness Reviews [678]. The DDR may be performed by document review but may be performed in a dedicated meeting if requested by either the IO or the Contractor.

A10.5. Material Receiving Inspections

The purpose of Material Receiving Inspections (MRI) is to inspect the condition of the goods after delivery to the IO. After successful completion of the MRI, the ownership of the goods will transfer to the IO.

The IO shall assign a Receipt Inspection Level (RIL) to each delivery. The MRIs shall be performed by the IO in accordance with the Procedure for Reception of Components at the ITER Site [530]. The Contractor may attend the MRIs to support the inspection.

Appendix A11. Manufacturing Dossier

A11.1. Purpose

This appendix defines the minimum content of the Manufacturing Dossier (MD) to be prepared and submitted by the Contractor for each deliverable item within the Scope of Supply. The Manufacturing Dossier constitutes the formal record of manufacturing, inspection, testing, and conformity of the supplied equipment and documents the as-built condition at the time of release.

A11.2. General Requirements

The Manufacturing Dossier shall be:

1. Compiled and submitted after completion of fabrication and factory acceptance testing (where applicable) and prior to delivery readiness.
2. Fully traceable to the delivered equipment, including serial numbers, tags, and revision status.
3. Reviewed, approved, and signed in accordance with the Project Management and Quality Requirements.
4. Structured in accordance with the table below, unless otherwise agreed with the IO.

The level of detail and applicability of individual documents shall be commensurate with the scope, quality class, and safety classification of the deliverable.

A11.3. Content Description

The Manufacturing Dossier shall include, as a minimum, the following categories of documentation:

a. As-Built Records

Final drawings, documents, and data reflecting the as-manufactured configuration, endorsed by authorised signatures.

b. Manufacturing and Quality Documentation

Manufacturing and Inspection Plans, Quality Plans, manufacturing procedures, and process specifications demonstrating compliance with contractual and technical requirements.

c. Inspection, Testing, and Verification Records

Factory test reports, testing procedures, inspection reports, and non-destructive testing documentation, as applicable.

d. Material Control and Traceability Records

Raw material lists, certificates, inspection records, and concessions ensuring full traceability of materials to the final product.

e. Deviation and Non-Conformance Management

Lists and reports of non-conformities, deviation requests, and their approved dispositions.

f. Logistics and Release Documentation
g. Package lists and the Contractor Release Note confirming readiness for delivery.
h. Certificates of Conformity

Declarations and certificates demonstrating conformity with contractual, regulatory, and applicable CE requirements, where applicable.

A11.4. Applicability

Not all documents listed in this appendix may be applicable to every deliverable. The Contractor shall identify applicable items for each Manufacturing Dossier and justify any omissions. Any deviation from the structure or content defined herein shall be subject to prior agreement with the IO.

Table 1: Contents of the Manufacturing Dossier

Deliverable	IDM link
As-Built Records (with signatures): 1. Drawings 2. Documents a. Manufacturing and Inspection Plan b. List and Report of Non-Conformities and Deviation Requests c. List and Report of Raw Materials d. Factory Test Report 3. Data a. Package list	
Contractor Release Note	
Quality Plan	
Testing Procedures, Specifications and Reports	
Material Control Reports: 1. Certificates 2. Inspections 3. Concessions	
Manufacturing Documentation: 1. Manufacturing procedures 2. Non-Destructive Testing (NDT) Procedures 3. Process specifications	
Certificates of conformity 1. CE Declaration of conformity 2. Product certificate of conformity	