

Technical Specifications (In-Cash Procurement)

Technical specification - Mechanical design Hot Cell Complex

This document aims at specifying the design and engineering activities to be performed for the Hot Cell Complex (HCC) conceptual studies.

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1 Purpose

This document aims at specifying the design and engineering activities to be performed for the Hot Cell Complex (HCC) design proposal studies:

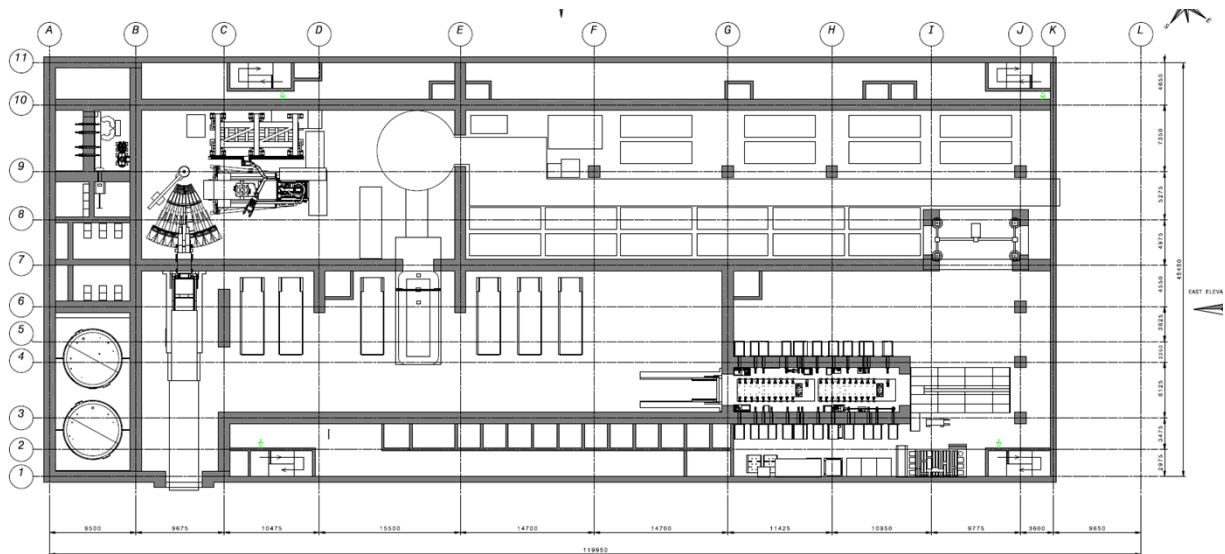
- 1 – In-vessel components and remote handling systems refurbishment,
- 2 – Cleaning and decontamination cells
- 3 – Hot Remote Handling Test Facility
- 4 – Radwaste type B treatment and storage

2 Scope

2.1 Hot Cell Complex

The scope includes the overall Hot Cell Complex, including the building and the processes, in particular the Hot Cell Complex building, the Radwaste process and the Hot Cell Remote Handling System.

The Hot Cell Complex is described in [ITER_D_X932PF - Description of Hot Cell Complex - Option 2](#). Hereunder are a few extracts of layout drawings [ITER_D_WDYC63 - HCC - Option 2 - 2D drawing BUILDING#21](#) and [ITER_D_WKF4X6 - HCC - Option 2 - 2D drawing BUILDING#23](#).



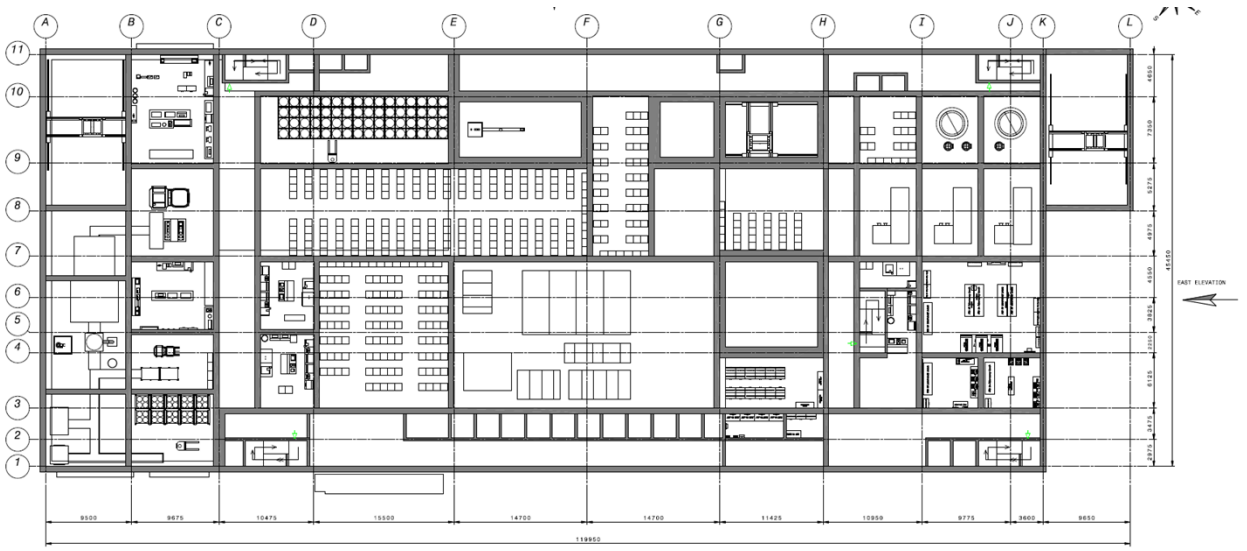
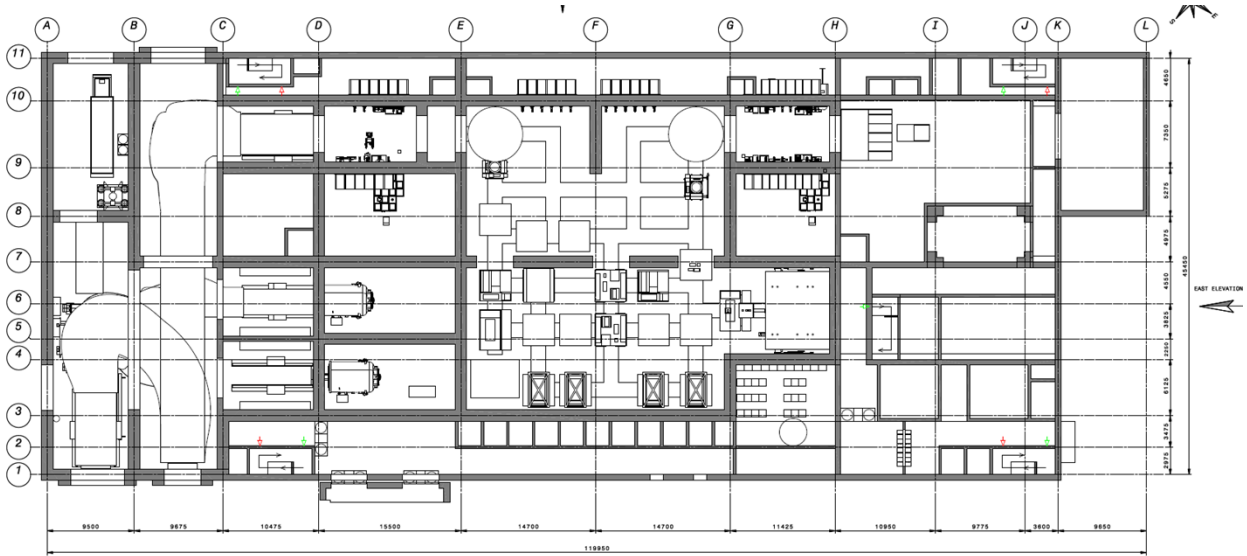


Figure 1 Building 21: B2, L1, and L2 levels (pre-concept)

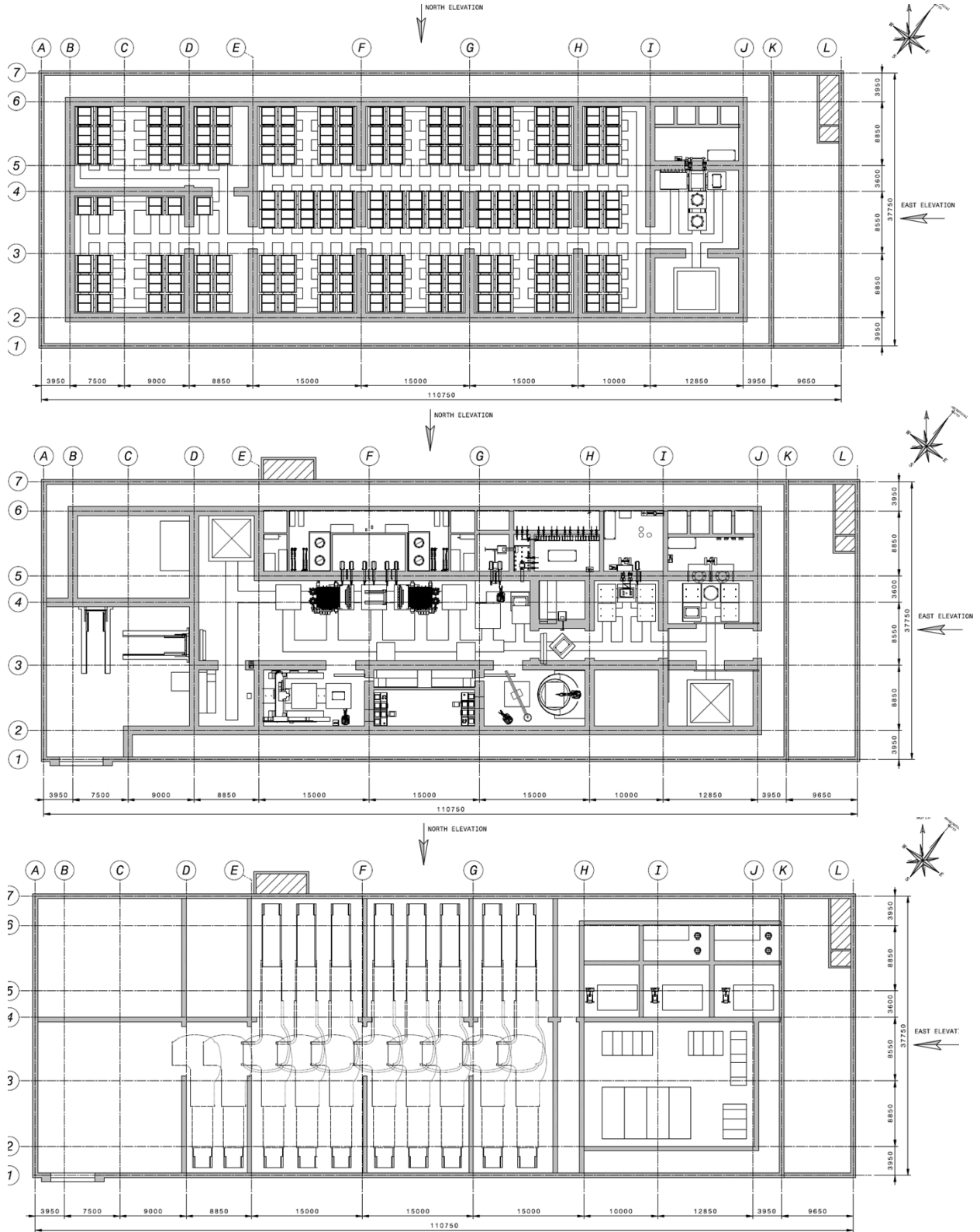


Figure 2 Building 23: B2, L1, and L3 levels (pre-concept)

The table in appendix summarizes main features of the Hot Cell Complex, illustrating the level of complexity and the required skills for this contract.

2.2 Refurbishment cell

This area is designed to perform the refurbishment and maintenance tasks of the irradiated In Vessel components and Remote Maintenance Systems from the Tokamak. These components are activated/contaminated at a level that requires most maintenance activities to be remotely handled. It shall also perform some auxiliary operations like transfer to Radwaste or Buffer Storage.

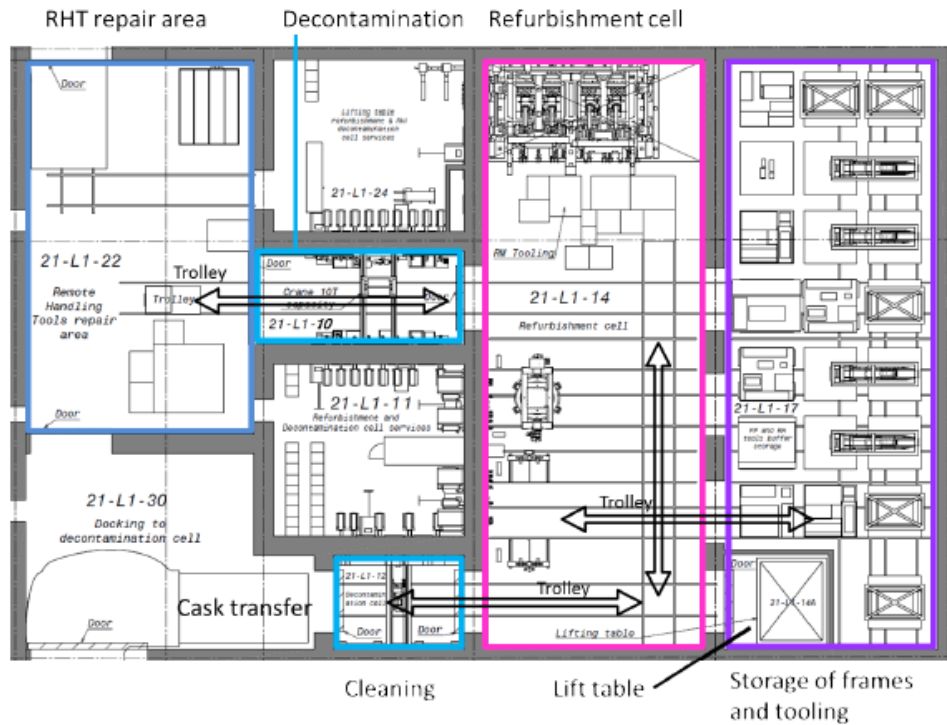


Figure 3: extract of the reference layout (2017)

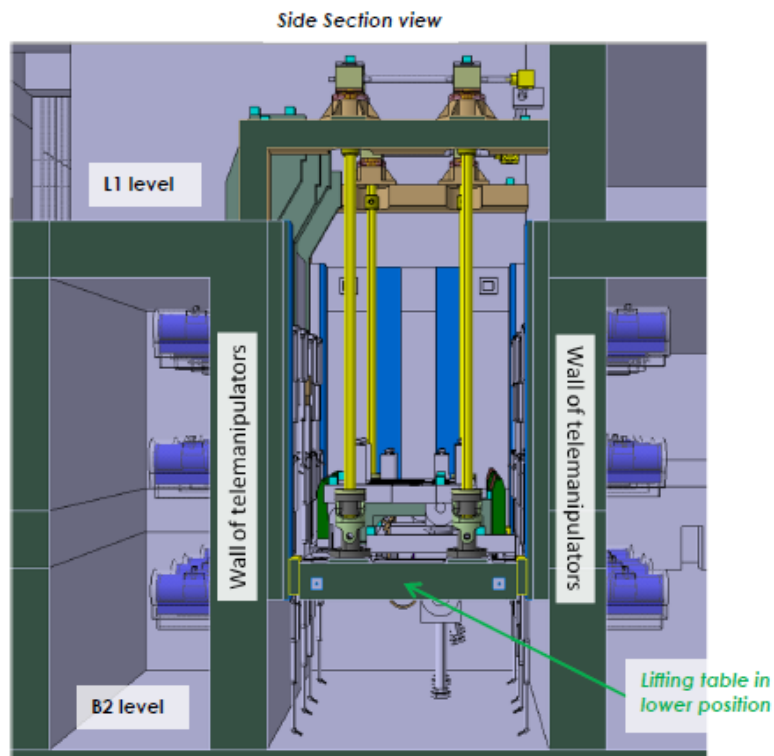


Figure 4: Maintenance pit and lifting table for the in-vessel components

2.3 Cleaning and decontamination cells

In the cleaning cell, the activated dust is removed by mean of vacuum cleaner, as much as possible, from the VV components in order to limit its spread through the other cells. The decontamination cell is used for remote decontamination and control of equipment used in HCC red zones, before hands-on maintenance operation in the RH tools repair area. For the transfer of new sub-components or equipment into the refurbishment cell, this cell is used as a material airlock.

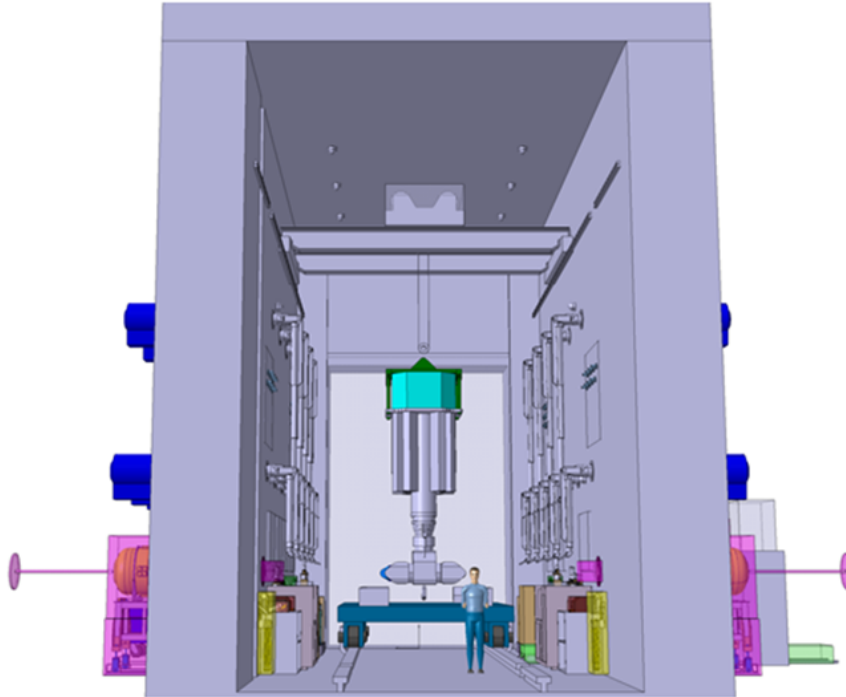
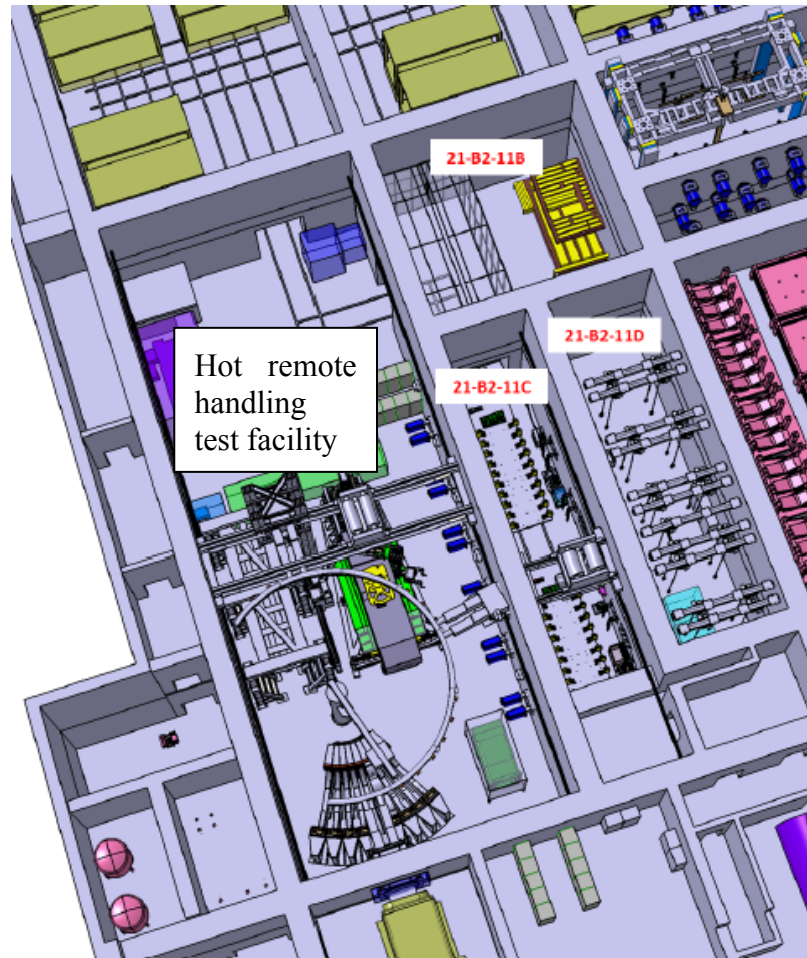


Figure 5: Decontamination cell

2.4 Hot Remote Handling Test Facility

This room is dedicated to the tests and the requalification after maintenance on remote handling systems (IRMS) used in the Tokamak. It is located at the basement of the facility, on 2 levels.



2.5 Radwaste type B treatment and storage

The refurbishment of the In-Vessel components generates MA-VL Radwaste. Some components are simply replaced with a new component rather than refurbished. The discarded component is transferred in the buffer storage area, prior to being treated as a waste.

The Radwaste cells are divided in several sub-functions:

- Treatment of solid Radwaste:
 - Remote cutting in order to reduce the size of the components to be treated as waste. This operation is mandatory for large components with two cutting stations to cut them in order to fit the size of the container,
 - Heating in order to reduce the Tritium content in waste and to recover the Tritium, by means of a large furnace called Tritium Recovery System (TRS),
 - Characterization of samples in order to precisely define the radwaste content, in a shielded cell chain called Hot Cell Laboratory,
 - Packaging, decontamination and conditioning in cemented container for storage,
- Import/Export:
 - The transfer of cemented container characterized as FMA-VC to ANDRA,
 - The transfer of TBM shipping flask to the TBM parties,
 - The transfer of new components to be installed in the Tokamak machine.

- Storage of MA-VL waste: ITER is supposed to store its MA-VL waste during ITER operation and deactivation phase, in a dedicated area. At the end of ITER operations, the responsibility of the waste storage is transferred to the host country,
- Purely Tritiated Wastes are produced on ITER site, mainly by the Tritium Plant (TP). The HCC hosts the purely tritiated waste storage in a dedicated area, during all ITER lifetime. Afterwards the responsibility of the waste storage is transferred to the host country.

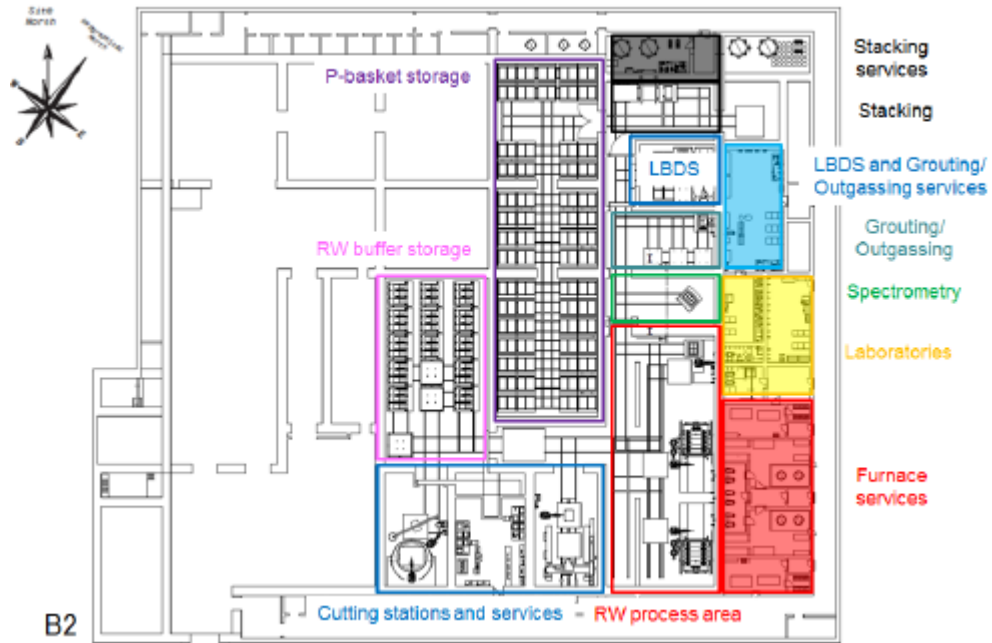
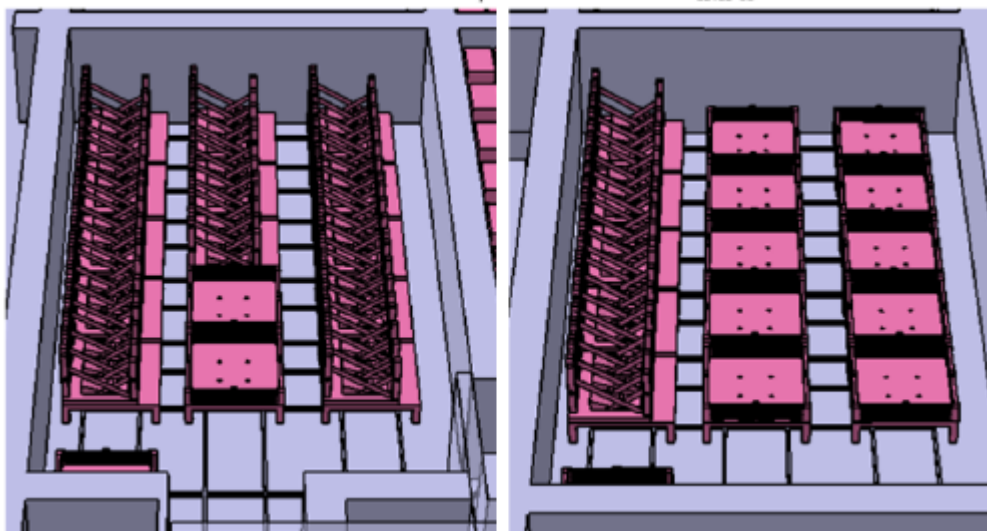


Figure 6: RW type B process overview



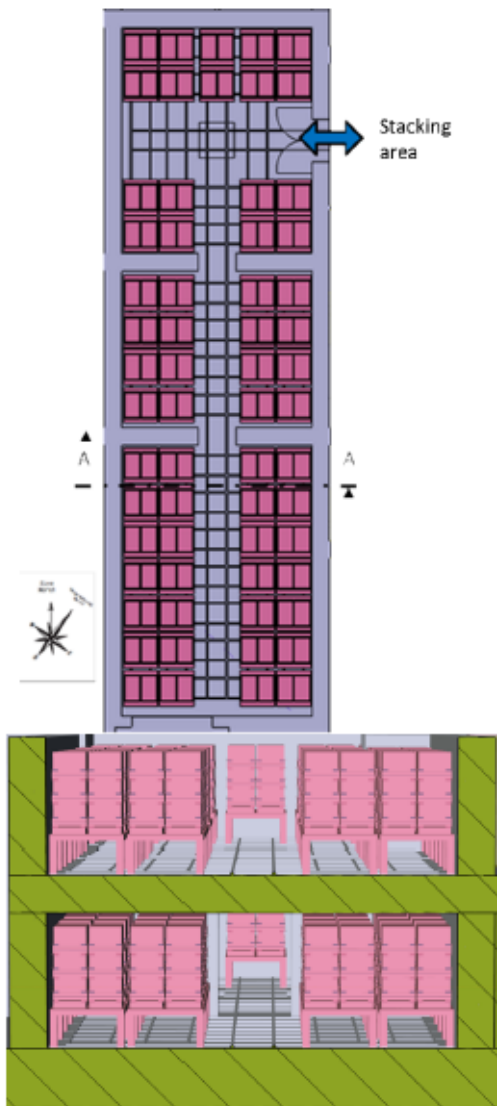


Figure 7 buffer storage and long term storage for type B

3 Definitions

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

4 References

Acronyms:

- C-R: Contractor Responsible. See Contract specifications for definition of duty.
- C-TRO: Contractor Task Responsible Officer. See Contract specifications for definition of duty.
- IO-RO: ITER Organization Responsible Officer. See Contract specifications for definition of duty.
- IO-TRO: ITER Organization Task Responsible Officer. See Contract specifications for definition of duty.

- PBS: Project Breakdown Structure

5 Estimated Duration

The contract duration shall be one year and shall commence after the official start date and upon the mutual agreement of both parties. The services shall be performed on-site at IO, either full time or a 2 days per week basis.

6 Work Description

6.1 Context

6.1.1 HCC

The pre-conceptual design of the Hot Cell Complex (HCC, cf. Figure 1 and Figure 2) is being developed by IO. It is based on the existing conceptual design which was performed in 2017 in the frame of an engineering contract, and which outcome was to have one single building.

The main change is now to host radwaste processing and components maintenance functions in two separate buildings.

Therefore, the following activities are being performed:

- Design activities of the HCC buildings,
- Design activities of the Radwaste and Remote Handling System located within the HCC,
- Safety analysis based on the Hot Cell Complex design.

A contract for the conceptual design of the Hot Cell Complex buildings and services will be started in Q2 2019, while series of contracts have been launched in order to study the Radwaste and Remote Handling Systems located within the Hot Cell Complex. The requested work is focused on the refurbishment, cleaning and decontamination and radwaste process design activities, safety and cost optimization.

6.2 Objective of the contract

The objective of the contract is broken down into 6 deliverables which correspond in fact to four types of activities as described below.

6.2.1 *In-vessel components and remote handling systems refurbishment*

The refurbishment cell technical concept for the in-vessel components has been changed from the use of an overhead crane over a pit in the reference design to an extract tower in the alternative design. The whole layout of the refurbishment area is thus reconsidered.

On the basis of this alternative design, the contractor shall produce a design proposal, defining the interfaces that will drive the building design (e.g. the layout of loads, the need for embedded plates), ensuring the best integration of this area within the HCC and the compliance to safety and project requirements.

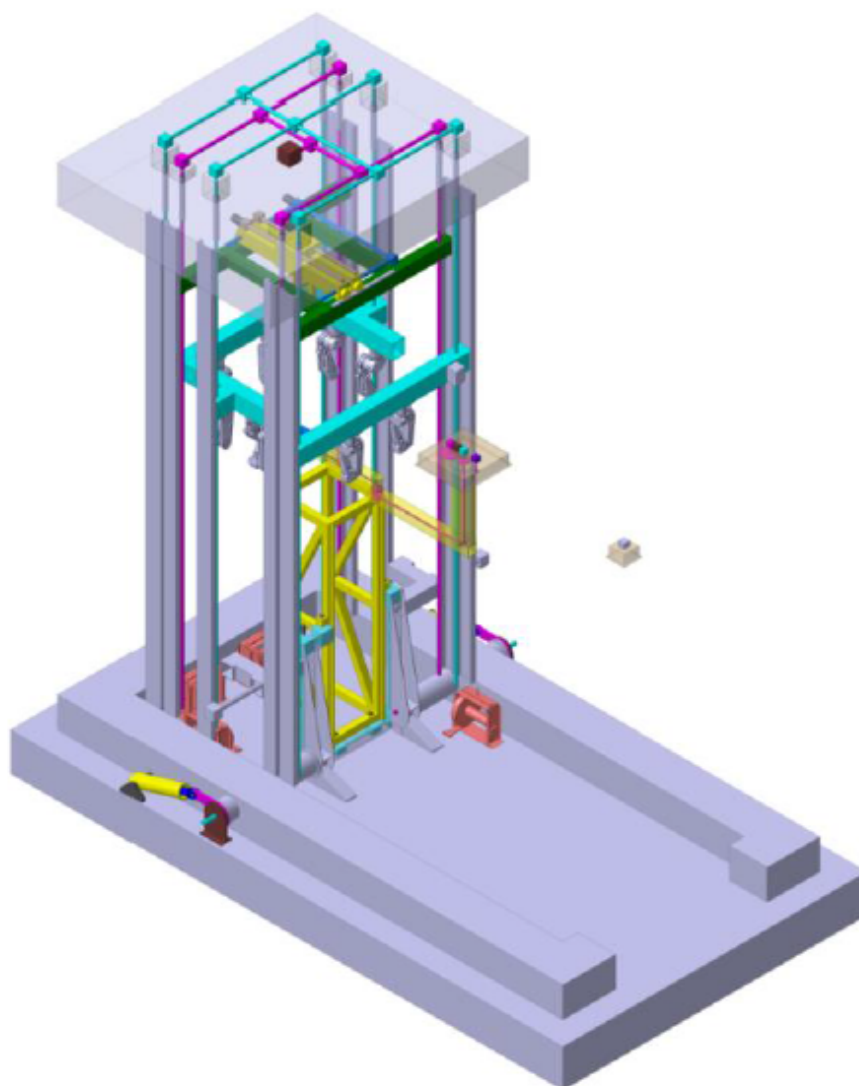


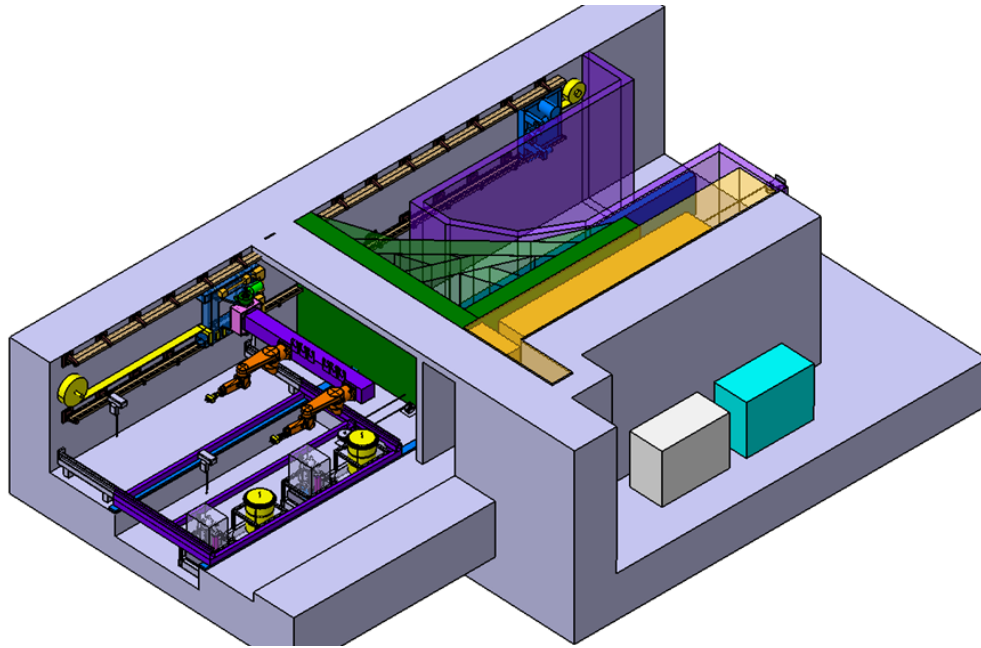
Figure 8 extract tower pre-concept

This activity corresponds to the Deliverables D1 and D4.

6.2.2 *Cleaning and decontamination cells*

Following the change of the concept for the refurbishment process, the cleaning and decontamination cells will, as much as possible, get rid of overhead cranes. Through the wall robotic arms or gantry crane system shall be implemented for these cleaning operations.

On the basis of this alternative design, the contractor shall produce a design proposal, defining the interfaces that will drive the building design (e.g. the layout of loads, the need for embedded plates), ensuring the best integration of these cells within the HCC and the compliance to safety and project requirements



This activity corresponds to the Deliverable D1, D2, D4 and D5.

6.2.3 Hot Remote Handling Test Facility

On the basis of the HCC alternative design, the contractor shall produce a design proposal, defining the interfaces that will drive the building design (e.g. the layout of loads, the need for embedded plates), ensuring the best integration of the RHTF within the HCC and the compliance to safety and project requirements.

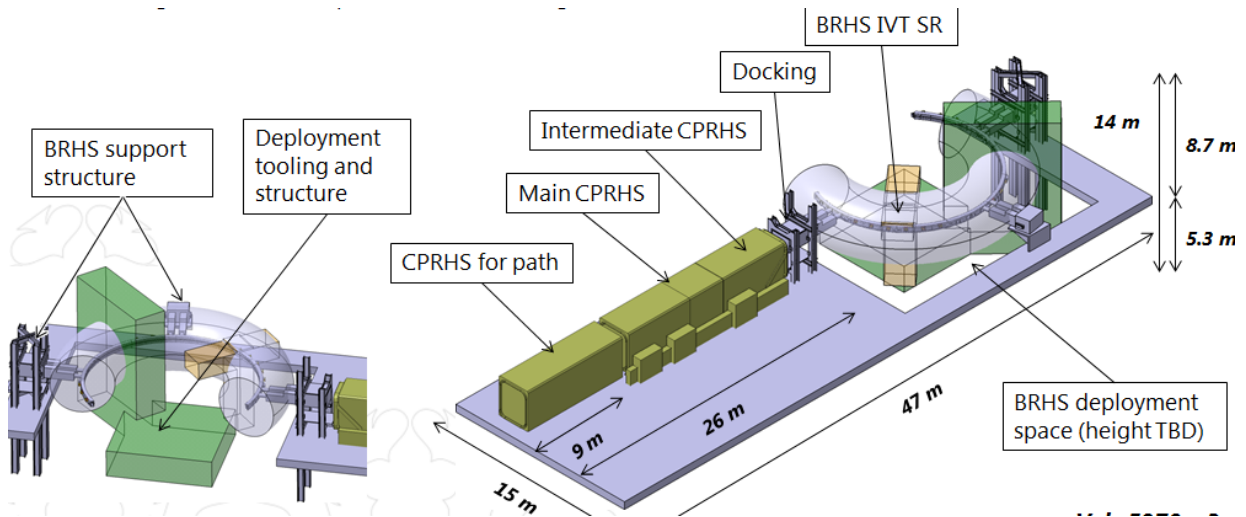


Figure 9 IRMS deployment for requalification

This activity corresponds to the Deliverables D2 and D5.

6.2.4 Radwaste type B treatment and storage

Two systems are particularly being refined in the new type B pre-design: the volume reduction system and the tritium recovery system. As defined in chapter 2.5, the remote cutting is needed

in order to fit the size of the container, but as well to fit the size of the TRS: the existing design is mainly composed of two furnaces with large dimensions and difficult maintenance.

The alternative design is a smaller oven, with enhanced remote operability and maintenance.

On the basis of this alternative design, the contractor shall produce a design proposal, defining the interfaces that will drive the building design (e.g. the layout of loads, the need for embedded plates), ensuring the best integration of the cutting and tritium reduction systems within the HCC and the compliance to safety and project requirements.

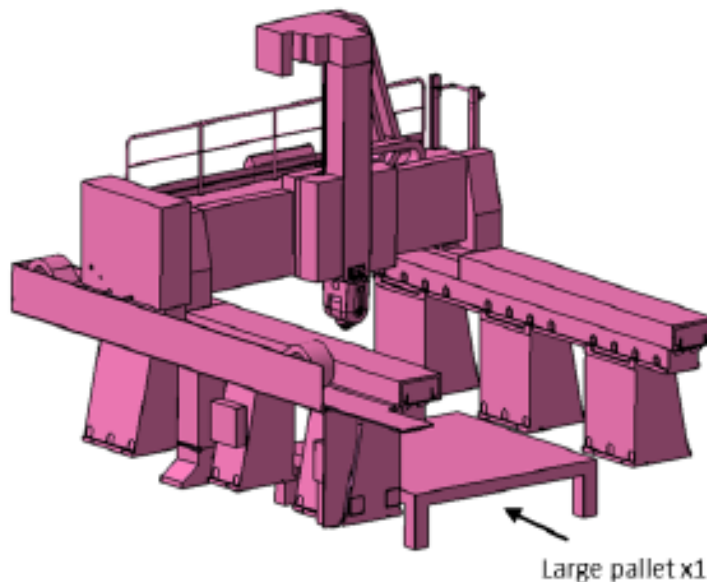


Figure 10 Example of a milling machine for RW

This activity corresponds to the deliverables D3 and D6.

7 Responsibilities

7.1 Contractor's Responsibilities

In order to successfully perform the tasks in this Technical Specification, the Contractor shall:

- Strictly implement the IO procedures, instructions and use templates;
- Provide experienced and trained resources to perform the tasks;
- Contractor's personnel shall possess the qualifications, professional competence and experience to carry out services in accordance with IO rules and procedures;
- Contractor's personnel shall be bound by the rules and regulations governing the IO ethics, safety and security IO rules.

7.2 IO's Responsibilities

The IO shall:

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

- Provide a standardized IT working environment (laptop, screen, keyboard, webcam and headset).

8 List of deliverables and due dates

D #	Description	Due Dates
D1	<p><u>Preliminary version of the design proposal of the refurbishment and cleaning cells.</u></p> <p><u>To include</u></p> <ul style="list-style-type: none"> • <u>2D / 3D (as appropriate) CAD Design Proposal Drawings,</u> • <u>Preliminary sizing and scoping calculations – including structural design & material assessments,</u> • <u>Identify technical risks (register),</u> • <u>Preparation and presentation of T0+3 Design Review</u> 	T0 + 3 months
D2	<p><u>Preliminary version of the design proposal of the decontamination cell and the hot RHTE</u></p> <p><u>To include</u></p> <ul style="list-style-type: none"> • <u>2D / 3D (as appropriate) CAD Design Proposal Drawings,</u> • <u>Preliminary sizing and scoping calculations – including structural design & material assessments,</u> • <u>Identify technical risks (register),</u> • <u>Preparation and presentation of Design Review</u> 	T0 + 5 months
D3	<p><u>Preliminary version of the design proposal of the radwaste type B:</u></p> <ul style="list-style-type: none"> - Cutting process - Tritium removal system <p><u>To include</u></p> <ul style="list-style-type: none"> • <u>2D / 3D (as appropriate) CAD Design Proposal Drawings,</u> • <u>Preliminary sizing and scoping calculations – including structural design & material assessments,</u> • <u>Identify technical risks (register),</u> • <u>Preparation and presentation of Design Review</u> 	T0+6 months

D #	Description	Due Dates
D4	<p><u>Final version of the design proposal of the refurbishment and cleaning cells</u></p> <p><u>To include</u></p> <ul style="list-style-type: none"> • <u>Updated Design requirements & specifications compliance, Safety Assessment and justification of proposed design document,</u> • <u>Updated 2D / 3D (as appropriate) CAD Design Proposal Drawings,</u> • <u>Clarified sizing and scoping calculations – including structural design & material assessments,</u> • <u>Residual risks technical register,</u> • <u>Mass & loading calculations & drawings</u> • Approximate order of cost estimate • Principals of control system design, logic, requirements and any further supporting function requirements to the proposed design, • Maintenance and recovery scenarios proposal document • <u>Preparation and presentation of Design Review</u> 	T0 + 9 months

D #	Description	Due Dates
D5	<p><u>Final version of the design proposal of the decontamination cell and the hot RHTF</u></p> <p><u>To include</u></p> <ul style="list-style-type: none"> • <u>Updated Design requirements & specifications compliance, Safety Assessment and justification of proposed design document,</u> • <u>Updated 2D / 3D (as appropriate) CAD Design Proposal Drawings,</u> • <u>Clarified sizing and scoping calculations – including structural design & material assessments,</u> • <u>Residual risks technical register,</u> • <u>Mass & loading calculations & drawings</u> • Approximate order of cost estimate • Principals of control system design, logic, requirements and any further supporting function requirements to the proposed design, • Maintenance and recovery scenarios proposal document • <u>Preparation and presentation of Design Review</u> 	T0 + 10 months

D #	Description	Due Dates
D6	<p><u>Final version of the design proposal of the radwaste type B:</u></p> <ul style="list-style-type: none"> • Cutting process • Tritium recovery system <p><u>To include</u></p> <ul style="list-style-type: none"> • <u>Updated Design requirements & specifications compliance, Safety Assessment and justification of proposed design document,</u> • <u>Updated 2D / 3D (as appropriate) CAD Design Proposal Drawings,</u> • <u>Clarified sizing and scoping calculations – including structural design & material assessments,</u> • <u>Residual risks technical register,</u> • <u>Mass & loading calculations & drawings</u> • <u>Approximate order of cost estimate</u> • Principals of control system design, logic, requirements and any further supporting function requirements to the proposed design, • Maintenance and recovery scenarios proposal document • <u>Preparation and presentation of Design Review</u> 	T0 + 12 months

To be noted that the priorities between the different Deliverables to be issued could be changed at the KoM or during the duration of the contract, as per IO request and in agreement with the contractor, but this will not affect the overall duration or the cost of the work.

9 Acceptance Criteria

These criteria shall be the basis of acceptance by IO following the successful completion of the services. These will be in the form of monthly progress reports as indicated in section 8, table of deliverables and further detailed below:

- Report and Document Review criteria.
- Reports as deliverables shall be stored in the ITER Organization's document management system, IDM by the Contractor for acceptance.
- Technical Responsible Officer is the Approver of the delivered documents.
- The Approver can name one or more Reviewers(s) in the area of the report's expertise.
- The Reviewer(s) can ask modifications to the report in which case the Contractor must submit a new version.
- The acceptance of the document by the Approver is the acceptance criterion.
- The acceptance criteria of the document correspond to:
 - Justified and documented comments,

- Lessons learned of existing nuclear facilities,
- Reference to existing technologies and proven solutions used in nuclear field,
- Reference to existing and applicable Norms and Standards,

10 Specific requirements and conditions

Significant experience in:

- Design of mechanical systems operating in irradiated and contaminated environment,
- Design of Radioactive Waste process,
- Flow analysis of refurbishment and radwaste processes,
- Commissioning of heavy handling means in nuclear facilities,
- Experience of adaptation and installation of automated robots in nuclear areas (including radiation hardening)
- Commissioning of Radioactive Waste process
- CAD design with ENOVIA.

At least 15 years' experience is required in these fields of expertise.

The contractor shall present in the offer:

- two options for the workload: full time or 2 days per week on IO site,
- a resource loaded schedule, in line with the delivery dates given in section 8,
- a resource estimate for each of the Deliverables,

11 Work Monitoring / Meeting Schedule

The work will be managed by means of Progress Meetings and/or formal exchange of documents transmitted by emails which provide detailed progress. Progress Meetings will be called by the ITER Organization, to review the progress of the work, the technical problems and the planning. It is expected that Progress Meeting will be held weekly or biweekly. Progress meetings will involve C-R, C-TROs, IO-RO and IO-TROs.

The main purpose of the Progress Meetings is to allow the ITER Organization/RHRM Division and the Contractor Technical Responsible Officers to:

- a) Allow early detection and correction of issues that may cause delays;
- b) Review the completed and planned activities and assess the progress made;
- c) Permit fast and consensual resolution of unexpected problems;
- d) Clarify doubts and prevent misinterpretations of the specifications.

In addition to the Progress Meetings, if necessary, additional meetings to address specific issues to be resolved may be requested by the ITER Organization.

For all Progress Meetings, a document (the Progress Meeting Report) describing tasks done, results obtained, blocking points and action items must be written by the Contractor. Each report will be stored in the ITER IDM in order to ensure traceability of the work performed.

12 Delivery time breakdown

See Section 8 – Deliverables and Due Date

13 Quality Assurance (QA) requirements

The organisation conducting these activities should have an ITER approved QA Program or an ISO 9001 accredited quality system.

The general requirements are detailed in [ITER Procurement Quality Requirements \(ITER_D_22MFG4\)](#).

Prior to commencement of the task, a Quality Plan must be submitted for IO approval giving evidence of the above and describing the organisation for this task; the skill of workers involved in the study; any anticipated sub-contractors; and giving details of who will be the independent checker of the activities (see [Procurement Requirements for Producing a Quality Plan \(ITER_D_22MFMW\)](#)).

Documentation developed as the result of this task shall be retained by the performer of the task or the DA organization for a minimum of 5 years and then may be discarded at the direction of the IO. The use of computer software to perform a safety basis task activity such as analysis and/or modelling, etc. shall be reviewed and approved by the IO prior to its use, in accordance with [Quality Assurance for ITER Safety Codes \(ITER_D_258LKL\)](#).

14 CAD Design Requirements

The following shall apply:

The Supplier shall provide a Design Plan to be approved by the IO. Such plan shall identify all design activities and design deliverables to be provided by the Contractor as part of the contract.

The Supplier shall ensure that all designs, CAD data and drawings delivered to IO comply with the Procedure for the Usage of the ITER CAD Manual ([2F6FTX](#)), and with the Procedure for the Management of CAD Work & CAD Data (Models and Drawings [2DWU2M](#)).

The reference scheme is for the Supplier to work in a fully synchronous manner on the ITER CAD platform (see detailed information about synchronous collaboration in the ITER [GNJX6A](#) - Specification for CAD data production in ITER Contracts.). This implies the usage of the CAD software versions as indicated in CAD Manual 07 - CAD Fact Sheet ([249WUL](#)) and the connection to one of the ITER project CAD data-bases. Any deviation against this requirement shall be defined in a Design Collaboration Implementation Form (DCIF) prepared and approved by DO and included in the call-for-tender package. Any cost or labour resulting from a deviation or non-conformance of the Supplier with regards to the CAD collaboration requirement shall be incurred by the Supplier.

15 Safety requirements

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

For Protection Important Components and in particular Safety Important Class components (SIC), the French Nuclear Regulation must be observed, in application of the Article 14 of the ITER Agreement.

In such case the Suppliers and Subcontractors must be informed that:

- The Order 7th February 2012 applies to all the components important for the protection (PIC) and the activities important for the protection (PIA).
- The compliance with the INB-order must be demonstrated in the chain of external contractors.
- In application of article II.2.5.4 of the Order 7th February 2012, contracted activities for supervision purposes are also subject to a supervision done by the Nuclear Operator.

For the Protection Important Components, structures and systems of the nuclear facility, and Protection Important Activities the contractor shall ensure that a specific management system is implemented for his own activities and for the activities done by any Supplier and Subcontractor following the requirements of the Order 7th February 2012.

16 Appendix: Main features of the Hot Cell Complex

	Demonstrable skills and experience	Main features of the Hot Cell Complex facilities
Nuclear civil engineering of complex large scale project	High technology project	First-of-a-kind or research construction projects
	Strong links with industry and potential Plant manufactures	Wide range of disparate leading edge/high-tech systems and equipment to be designed for in the Preliminary and Construction Design stages in order to avoid risk of change during suppliers manufacturing design.
	International projects	ITER stakeholders are China, the European Union, India, Japan, Korea, Russia and the United States. It corresponds to 35 different nations. The project language is English and safety documentation to be delivered to the French safety authority shall be in French and English.
	Engineering/design	Design and overall integration of : <ul style="list-style-type: none"> - Building structure. Volume HCC 290,000 m³ nuclear concrete building (B21 and B23) - Approximately 600 rooms within the HCC, - Building systems, e.g. Heating, Ventilation, and Air Conditioning (HVAC), fire protection, electrical distribution, Instrumentation & Control (I&C), liners, red zone cooling, - Mechanical heavy handling, e.g. cranes, doors, trolleys,
	HVAC and fire protection	2 air change per hour in accessible areas, switch to Detritiation System if tritium above threshold detection (safety function) Management of heat loads, fire loads, air conditioning, fire protection and mitigation
	Network routing (e.g. cabling, piping, HVAC), management of penetrations and anchorage	About 400 Control Cubicles and 100 Electrical Distribution Boards located in the HCB and RWB. Routing of HVAC, cable trays, DS piping in peripheral corridor. Segregation of routing for PIC functions (e.g. power supply, instrumentation)
Hot Cells	Numbers of hot cells / red zones	15 different hot cells in HCB, in total volume of red zones / C4 ventilation class = 26,000 m ³
	Management of irradiated and contaminated	Contact dose rate = 250 Sv/h due to activation in the Tokamak. Contamination of tritiated and activated dust on In Vessel components and IRMS

	Demonstrable skills and experience	Main features of the Hot Cell Complex facilities
	components	Constant efforts to prevent spread of dust in red zones (from design stage to operational procedures), ALARA
	Tritiated environment	High level of tritium concentration > 4000 DAC in red zones Red zone / C4 areas fully covered by stainless steel liner, with an gap between the wall and the liner
	Nuclear maintenance	10 different hot workshop, 300 m ² average each, dealing with hands-on maintenance on components after remote decontamination, ALARA
	Remote heavy handling in red zone	Handling of various heavy components, non-exhaustive list: <ul style="list-style-type: none"> – Equatorial Port Plug (50t, 3.5m length x 2.4 m x 2m), – Upper Port Plug (25t, 6 m length), – Divertor (9t, 3.5m length, 2m high, 0.8m wide), – Vacuum Cryopump (2.9m length, 1.7m diameter), – Oversized Neutral Beam components up to 8m length, 3m high and 3.3m wide Two lines of defence: high reliability of heavy transfer systems and mitigation means in case of unexpected load drop.
	Docking of transfer casks	Transfer and docking of Remote Handling Transfer Cask, large size docking door: 2m x 2.4m
Radwaste management	Treatment of radioactive solid waste	Orders of magnitude during 20 years operation: <ul style="list-style-type: none"> – 1000 tons of MAVL waste – 100 tons FMA-VC – 100 tons purely tritiated waste – 10 tons TFA
	Treatment of radioactive liquid effluent	Orders of magnitude: 200 m ³ / year
	Radwaste process remotely controlled	Type B radwaste process located in the red zones / C4 areas shall be fully remotely controlled (no man access).
Hot Cell Remote Handling	Complex remote operation	Port Plug refurbishment, example of tasks to be performed fully remotely: <ul style="list-style-type: none"> – tilting 90° of 50t port plugs, – removal of subcomponents, – welding and control, – testing.
	Hot Cell Remote Handling	Design and integration of: <ul style="list-style-type: none"> – Tens of heavy duty long range manipulator, fully powered by electrical motors, – Few telescopic power manipulators, – Shielded windows, – Lighting and viewing systems,

	Demonstrable skills and experience	Main features of the Hot Cell Complex facilities
		<ul style="list-style-type: none"> – Frames and handling tools, Buffer storage, remote decontamination, hands-on maintenance.
	Centralized control system	Functions such as ventilation management, remote transfers, remote refurbishment of In Vessel Components, remote waste treatment, shall be controlled from a centralized control room located in the Personal Access Control Building
	Seismic requirement	High seismic requirement (2 to 3 g acceleration in different dimensions) on building structure and part of the building system and process which is seismic classified according to the safety analysis
Safety	Safety demonstration	<p>Full traceability of safety requirement, from the “high level” safety requirement to the detailed safety requirement and the related reference documentation</p> <p>Exhaustive list of prevention, detection and mitigation means for each internal and external safety hazard (deterministic approach).</p>
	ALARA	Implementation of the “As Low As Reasonably Achievable” approach into design activities, in particular regarding shielding calculation and hot workshops.
	Human Factor	Human factor integration, definition and tracking of Human Factor requirements, development of virtual mockup and Human Machine Interfaces for the centralized control room.
	French Nuclear Regulator licencing process	Safety analysis of the HCB and RWB based on the outcome of the consolidation / value engineering phase. Then continuous support to the licencing process: answer to ASN request, data and safety analysis for the update of the RPrS.

17 Example of drawing (expected level of detail)

