IDM UID
**TX82V9**

VERSION CREATED ON / VERSION / STATUS
**04 Nov 2016 / 1.0 / Signed**

EXTERNAL REFERENCE / VERSION

**Technical Specifications (In-Cash Procurement)**

# Technical Specification - Hot Cell Complex - Mechanical Engineering

This document aims at specifying four types of transverse activities to be performed for the Hot Cell Complex design activities:
1 – Study of the Hot Cell configuration before the nuclear phase, identifying part of the procurement which could be delayed, and identifying temporary means to be considered for the Beryllium phase,
2 – Technical recommendations aiming at reducing cost and limit the complexity of:
The Civil Work structure, The Stainless Steel liner, The Heating, ventilation and ...

# Table of Contents

# 1 Purpose

This document aims at specifying four types of transverse activities to be performed for the Hot Cell Complex design activities:

1 – Design of mechanical building systems such as lifting platforms, shock absorber, local air coolers, transfer trolleys, confinement and shielding doors, cranes,

2 – Changes of mechanical systems within the Hot Cell Complex (building, the Radwaste and the Remote Handling system scope), in order to minimize the overall cost and to improve safety,

3 – Specification of mechanical engineering activities for preliminary and detailed design stages,

4 – Review of deliverables issues by a third party (consortium in charge of the Hot Cell Engineering contract for the conceptual design stage), proposing in parallel design improvements.

# 2 Scope

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 Facility is described in ITER_D_L9V43M - Functional description of the Hot Cell Building. The Radwaste facility is described in ITER_D_L5G67Y - HCC TF - Functional description of the Radwaste Building. The Personal Access Control Building is described in ITER_D_L5G8Z5 - HCC TF - Functional description of the Personnel Access Control Building.

To be noted that the Hot Cell layout has changed in 2016 (see figure below and ITER_D_TVL52W - 2016 HCC - General Arrangement - In work).

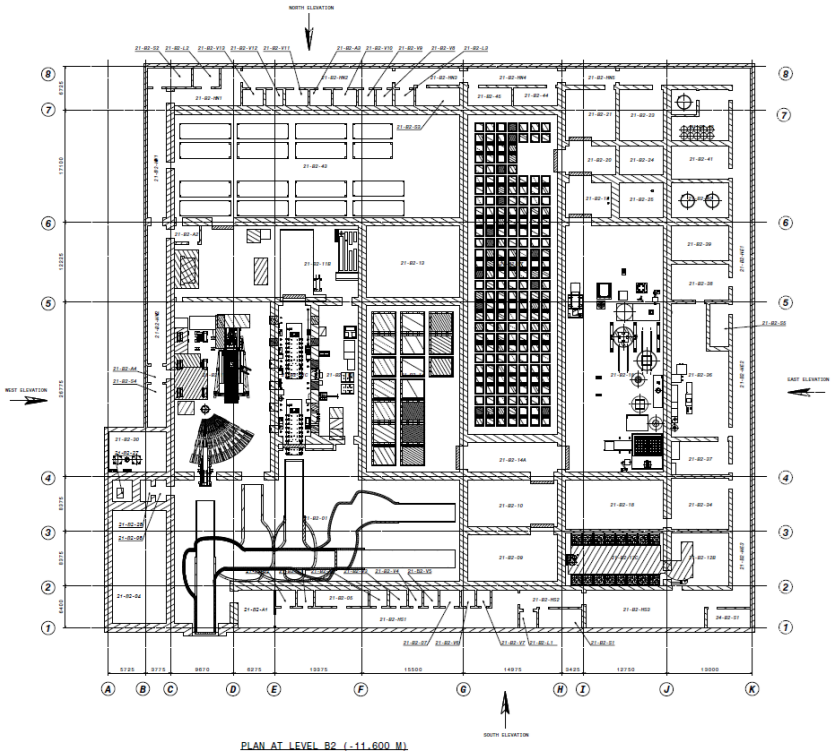



Figure 1 Level B2 of the 2016 Design of the Hot Cell Complex

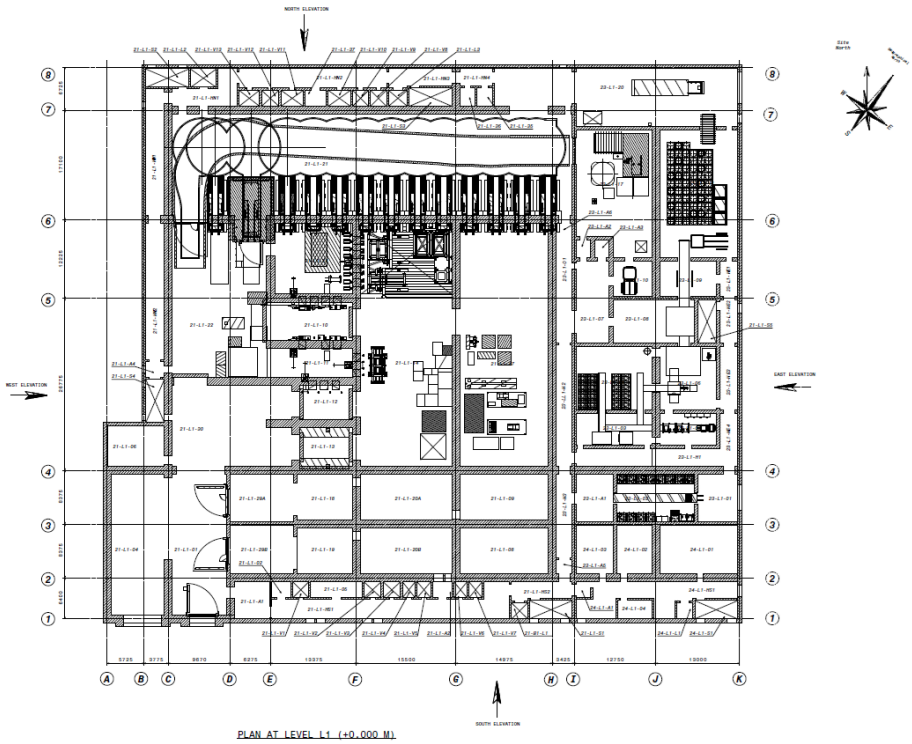



Figure 2 Level L1 of the 2016 Design of the Hot Cell Complex.

The table in appendix 1 summarizes main features of the Hot Cell Complex, illustrating the level of complexity and the required skills for this contract.

# 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.

# 6 Work Description

## 6.1 Context

Three types of activities are being performed in 2016 / 2017 aiming at designing the Hot Cell Complex (HCC) and answering to the French regulator:

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

One major contract has been placed for the Hot Cell building engineering activities (technical specification at the link ITER_D_SW5UFF - Technical Specification Hot Cell Complex - Building Engineering Contract), 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 design activities, cost and safety optimization.

Goal is also to prepare documents for the tender phase for the Hot Cell Engineering contract (preliminary and final design stages).

## 6.2 Objective of the contract

The objective of the contract is broken down into 12 deliverables which correspond in fact to four types of activities as described below.

### *6.2.1 Design of the building systems*

Based on the skills and experience of the contractor, the requirements shall be gathered at first in order to make a preliminary sizing and simplified 2D drawings of the following building systems:

- lifting platform for vertical transfer of heavy loads: 2 representative examples,
- shock absorber in red zones: 2 representative examples,
- Local Air Cooler or cooling panels: 1 representative for each of them,
- transfer trolleys: 2 representative examples,
- confinement doors: 2 representative examples,
- shielding doors: 2 representative examples,
- nuclear cranes: 2 representative examples,

This activity is performed in two steps:

1- Preliminary sizing and 2D sketches (Deliverables D1 and D2),

2- Sizing and 2D drawings (Deliverables D10 and D11),

The design shall be refined up to a level of details corresponding to the illustrations given in appendix 2.

### *6.2.2 Cost and safety improvement*

A three stage approach is considered for cost and safety improvement of the the Radwaste process, the Remote Handling System and the building system:

1. Identification of 20 potential improvements: Deliverable D3,
2. Change proposal for the 10 most promising ones: Deliverable D6,
3. Implementation of the 10 changes (at conceptual level): Deliverable D8.

The topics shall be different than the ones defined in section 6.2.1.

Such improvement and changes shall be justified, in particular versus cost and safety. IO agreement is requested between the different steps.

### *6.2.3 Specification of expected deliverable for Engineering design activities*

The objective is to write a technical specification, detailing the expected deliverables of mechanical systems, for the preliminary and final design of the Hot Cell Facility, keeping in mind that the scope includes the Radwaste process, the Hot Cell Remote Handling systems and the building (mechanical systems and civil work).

This specification shall be in line with the IO procedures and it shall take into account the TKM feedback regarding building design activities.

It shall establish:

- The list of expected deliverables,
- The scope and boundaries of each deliverable,
- The preliminary table of content of each of the expected deliverables,
- The expected detail of information for each deliverables, using clear criteria and illustrations,
- The expected added value between:
    - the input data which will be provided (conceptual design stage) and the outcome of the preliminary design stage,
    - the preliminary design stage and the outcome of the final design stage,
- The requirements aiming at reducing cost whenever possible, without jeopardizing the safety.

This activity corresponds to the deliverables D5 and D12.

The Technical Specification shall be clear enough to prevent the risk of having the engineering company focusing on Civil Work only, pushing the preliminary and detailed design into the procurements packages, which ends up with a major risk of later change of the building Civil Work with associated consequences in term of cost and schedule..

### *6.2.4 Review and proposed improvement of deliverables elaborated by a third party*

As explained in section 6.1, an engineering activity is on-going regarding the HCC building design and it is broken down into 3 Work-Packages and many deliverables.

The contractor is asked to review the mechanical aspects of the deliverables within 2 calendar weeks after reception of the documents. Each comment of the comments shall suggest a way to improve the design or the document itself.

This activity corresponds to the deliverables D4, D7 and D9.

# 7 Responsibilities

## 7.1 Contractor's Responsibilities

In order to successfully perform the tasks in these Technical Specifications, 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 | Collect of requirements, preliminary sizing and 2D-drawings of mechanical systems, such as :<br>- lifting platform for vertical transfer of heavy loads: 2 representative examples,<br>- shock absorber in red zones: 2 representative examples,<br>- Local Air Cooler or cooling panels: 1 representative for each of them,<br>Evidence shall be given that the proposed design is based on proven and existing solutions. | T0 + 1 month |
| D2 | Collect of requirements, preliminary sizing and 2D-drawings of mechanical systems, such as :<br>- transfer trolleys: 2 representative examples,<br>- confinement doors: 2 representative examples,<br>- shielding doors: 2 representative examples,<br>- nuclear cranes: 2 representative examples,<br>Evidence shall be given that the proposed design is based on proven and existing solutions. | T0 + 2 months |

| D # | Description | Due Dates |
|---|---|---|
| D3 | Proposal of about 20 improvements of the mechanical systems within the scope of the Radwaste process, the Remote Handling System and the building (not already covered by D1 nor D2):<br>- to reduce the cost,<br>- to simplify the maintenance activities,<br>- to removes as much as possible the need of complex remote handling operations,<br>- to improve safety, in particular versus mechanical risks, dust management, minimizing the spread of dust and reducing the dose rate of maintenance activities (ALARA). | T0 + 3 months |
| D4 | Review of the deliverables WP01 produced by a third party in the frame of ITER_D_SW5UFF - Technical Specification Hot Cell Complex - Building Engineering Contract regarding mechanical topics, with associated recommendations. Review and recommendations shall be documented using drawings of existing systems, reference to nuclear facilities, code of practices, standards, etc. | T0 + 4 months |
| D5 | Preliminary version of the technical specification, detailing the expected deliverables for the preliminary and final design of mechanical systems located with the Hot Cell Facility, including the building mechanical systems, the Radwaste process and the Hot Cell Remote Handling systems. See section 6.2.3. | T0 + 5 months |
| D6 | Based on the most promising recommendations (Deliverable D3), proposal of about 10 design changes (at pre-concept level) to improve mechanical systems within the scope of the Radwaste process, the Remote Handling System and the building:<br>- to reduce the cost,<br>- to simplify the maintenance activities,<br>- to removes as much as possible the need of complex remote handling operations,<br>- to improve safety, in particular versus mechanical risks, dust management, minimizing the spread of dust and reducing the dose rate of maintenance activities (ALARA). | T0 + 6 months |

| D # | Description | Due Dates |
|---|---|---|
| D7 | Review of the deliverables WP02 produced by a third party in the frame of ITER_D_SW5UFF - Technical Specification Hot Cell Complex - Building Engineering Contract regarding mechanical topics, with associated recommendations. Review and recommendations shall be documented using drawings of existing systems, reference to nuclear facilities, code of practices, standards, etc. | T0+7 months |
| D8 | Based on the agreed pre-concept (Deliverable D3 and D6), design changes at concept level, aiming at improving the mechanical systems within the scope of the Radwaste process, the Remote Handling System and the building,:<br>- to reduce the cost,<br>- to simplify the maintenance activities,<br>- to removes as much as possible the need of complex remote handling operations,<br>- to improve safety, in particular versus mechanical risks, dust management, minimizing the spread of dust and reducing the dose rate of maintenance activities (ALARA),<br>- to solve issues that could have been raised during the CDR planned in 2017 (issues are formalized by chits). | T0 + 8 months |
| D9 | Review of the deliverables WP03 produced by a third party in the frame of ITER_D_SW5UFF - Technical Specification Hot Cell Complex - Building Engineering Contract regarding mechanical topics, with associated recommendations. Review and recommendations shall be documented using drawings of existing systems, reference to nuclear facilities, code of practices, standards, etc. | T0 + 9 months |
| D10 | Final sizing and 2D-drawings of mechanical systems, such as :<br>- lifting platform for vertical transfer of heavy loads: 2 representative examples,<br>- shock absorber in red zones: 2 representative examples,<br>- Local Air Cooler or cooling panels: 1 representative for each of them,<br>Evidence shall be given that the proposed design is based on proven solutions.<br>Detail level of the 2D drawings shall correspond to the illustration given in appendix 2 | T0 + 10 months |

| D # | Description | Due Dates |
|---|---|---|
| D11 | Final sizing and 2D-drawings of mechanical systems, such as :<br>- transfer trolleys: 2 representative examples,<br>- confinement doors: 2 representative examples,<br>- shielding doors: 2 representative examples,<br>- nuclear cranes: 2 representative examples,<br>Evidences shall be given that the proposed design is based on proven solutions.<br>Detail level of the 2D drawings shall correspond to the illustration given in appendix 2 | T0 + 11 months |
| D12 | Final version of the technical specification, detailing the expected deliverables for the preliminary and final design of mechanical systems located with the Hot Cell Facility as a whole, including the building mechanical systems, the Radwaste process and the Hot Cell Remote Handling systems. | T0 + 12 months |

The 2D-drawings shall correspond to front views and plan view. They can be performed using a CAD tool (2D or 3D) but this is not mandatory. Indeed, handmade drawings, such as the ones presented in Appendix 2 are sufficient, as long as the provided information are sufficient to be able to create later on a 3D model.

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.

# 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,
- Design of doors, lifting platform, trolleys, cranes,
- Commissioning of heavy handling means in nuclear facilities,
- Commissioning of Radioactive Waste process.

At least 20 years' experience is required in these fields of expertise.

In the offer, the contractor shall present in the offer:

- 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, CTROs, 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 (if applicable)

It is highlighted that the design activities can use CAD design tools, in 2D or 3D but it is not a mandatory requirement. Indeed, the 2D drawings which are requested can be “handmade” sketches such as the ones given in appendix 2 for illustration.

If CAD design tasks are involved, 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.

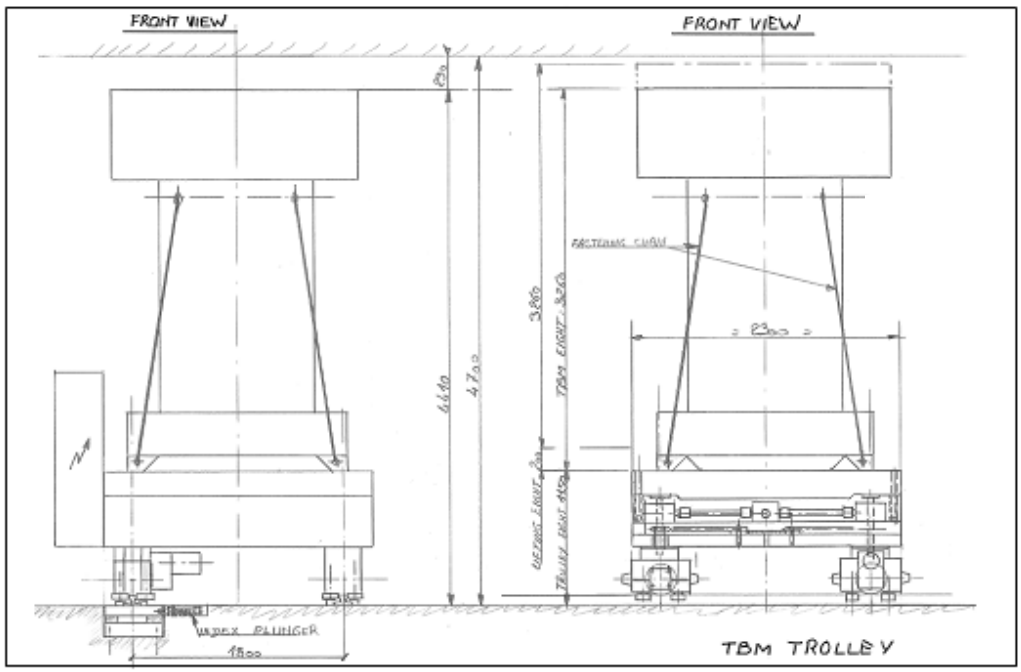
For the Protection Important Components, structures and systems of the nuclear facility, and Protection Important Activities the contractor shall ensure that a specific management system is implemented for his own activities and for the activities done by any Supplier and Subcontractor following the requirements of the Order 7th February 2012 [20].

# 16 Appendix 1: Main features of the Hot Cell Complex

| | Requested 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, 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. |
| | Engineering/design | Design and overall integration of :<br>- Building structure. Volume about 300,000 $m^3$ nuclear concrete building<br>- Approximately 600 rooms within the Hot Cell Complex,<br>- Building systems, e.g. Heating, Ventilation, and Air Conditioning (HVAC), fire protection, electrical distribution, Instrumentation & Control (I&C), liners, red zone cooling, piping,<br>- Mechanical heavy handling, e.g. cranes, doors, trolleys |
| Hot Cells expertise | 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 components | Contact dose rate = 250 Sv/h due to activation in the Tokamak.<br>Contamination of tritiated and activated dust on In Vessel components and IRMS<br>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 (Derived Atmospheric Contamination) in red zones<br>Red zone / C4 areas fully covered by stainless steel liner, with a gap between the concrete wall and the liner. This gap is maintained under air Detritiation System. |
| | Nuclear maintenance | 10 different hot workshops, 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:<br>– Equatorial Port Plug (50t, 3.5m length x 2.4 m x 2m),<br>– Upper Port Plug (25t, 6 m length),<br>– Divertor (9t, 3.5m length, 2m high, 0.8m wide),<br>– Vacuum Cryopump (2.9m length, 1.7m diameter), |

| | Requested experience | Main features of the Hot Cell Complex facilities |
|---|---|---|
| | | – Oversized Neutral Beam components up to 8m length, 3m high and 3.3m wide<br>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 Handing Transfer Cask, large size docking door: 2m x 2.4m, between the TKM and the HCC, and within the Hot Cell Building. |
| Radwaste management | Treatment of radioactive solid waste | Orders of magnitude during 20 years operation:<br>– 1000 tons of MAVL waste<br>– 100 tons FMA-VC<br>– 100 tons purely tritiated waste<br>– 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) and with in situ remote maintenance or hands-on maintenance after remote decontamination. |
| Hot Cell Remote Handling | Complex remote operation | Port Plug refurbishment, example of tasks to be performed fully remotely:<br>– tilting 90° of 50t port plugs,<br>– removal of subcomponents,<br>– welding and control,<br>– testing. |
| | Hot Cell Remote Handling | Design and integration of:<br>– Tens of heavy duty long range manipulators, fully powered by electrical motors,<br>– Few telescopic power manipulators,<br>– Shielded windows,<br>– Lighting and viewing systems,<br>– Frames and handling tools,<br>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 |

# 17 Appendix 2: Illustration of 2D drawings



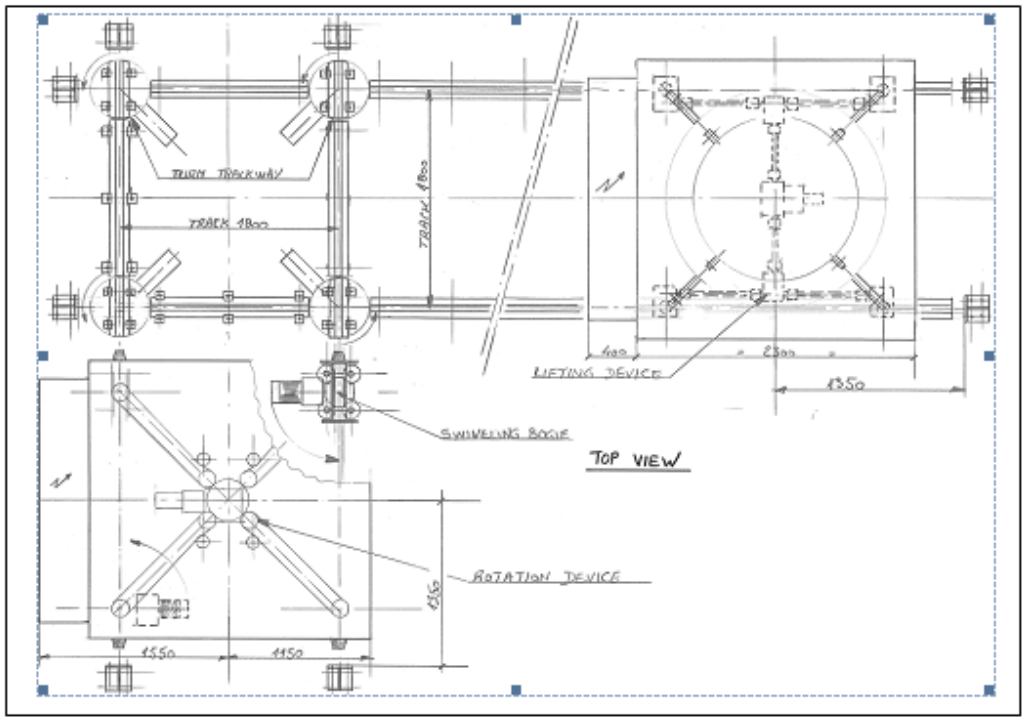




Illustration of 2D drawings of mechanical system