IDM UID

YDQMW2

VERSION CREATED ON / VERSION / STATUS

04 Apr 2019 / 1.4 / Approved

EXTERNAL REFERENCE / VERSION

Technical Specifications (In-Cash Procurement)

Technical Summary for Conceptual design HCC Staged Approach

The purpose of this document is to provide a high level definition of the scope of works and required Contractor competences for the HCC Conceptual design Activities.

The document describes the overall configuration of the Hot Cell Complex, summarises the scope of the Contract, and identifies the essential expertise, experience and skills required of the performing Contractor.

Table of Contents

1 Purpose

ITER is a first of a kind mega-project with a wide range of disparate leading edge/high-tech systems to be assembled and installed into buildings at its site in Saint Paul lez Durance, Cadarache, in the south of France.

The ITER Organization (IO) is the nuclear operator, complying with the relevant French Laws and regulations, authorization, codes and standards applied to Basic Nuclear Installation (INB). IO is responsible for integrating the activities from the early stage of design, to the procurement, the assembly, commissioning and operation.

IO and Fusion For Energy (F4E) have been charged with the design and the procurement of the Hot Cell Complex, with the Radwaste process for the management of very low, low and medium radioactive waste, and the Remote Handling system of the Hot Cell. About 10% of the building floor surface is used for miscellaneous systems which will be designed and procured by other participant countries (Domestic Agencies), in particular the Detritiation System (DS) and the Port Plug Test Facility (PPTF).

In addition to design activities being performed on the process and mechanical systems, building design activities are needed, knowing that the Hot Cell Complex is a nuclear building, therefore it is “Protection Important Component” (PIC).

Design activities shall be performed for the Civil Work structure and the building systems (e.g., ventilation system, Liquid and Gas, Electrical). The design effort corresponds to a conceptual detailed level and will end up to a formal design review process.

It must be noted that part of the expected documentation may be used as support documentation to answer to the French nuclear regulator.

This Call for Nomination is to seek companies or consortia interested in participating in the Call for Tender for the Conceptual Design of the Hot Cell Complex Building– Civil works and Building Systems.

Abbreviations are given in appendix 1.

2 Requirements, main features of plant and buildings

2.1 Maintenance and Radwaste process

The Hot Cell Complex shall provide the following functions:

- **Refurbishment and storage of In-vessel components**: It means that the Hot Cell will be the place where activated and/or contaminated In-vessel components go after their removal from the Tokamak. These In-vessel components will be refurbished, maintained, and for some of them buffer stored in this facility.
- **Test of In-vessel components after refurbishment**: Thermal cycling and functional tests are required on the repaired/refurbished Port Plugs (PP) using PP test facilities located in the HCB,
- **Port Cell equipment storage and maintenance**;
- **IRMS storage, decontamination and maintenance**: IRMS equipment will be decontaminated, maintained, refurbished, tested and stored between the shutdowns in the HCB,
- **Radwaste processing and storage of**:
    - o Solid Radwaste type B, also called “MAVL” (corresponding to “Medium Activity, Long Life Radionuclide”), which are mainly the discarded part of the In Vessel component,
    - o Solid Purely Tritiated Waste,
    - o Solid Radwaste type A, also called FMA-VC (corresponding to “Low and Medium Activity, Short Life Radionuclide”):
    - o Solid Radwaste TFA (corresponding to Very Low Level Waste),
    - o Buffer storage and treatment of radioactive effluent after accidental event in TKM,
    - o Liquid Radwaste,
    - o Suspect liquid effluents from radiological controlled zones that turn out to be radioactive,
- **Characterization, chemical analysis, packaging and export of Radwaste.**
- **Health physics facilities, access control of personnel, changing rooms** for personnel working in radiological controlled areas of the Tokamak Complex (TKM), the HCB or RWB,
- **Control rooms**

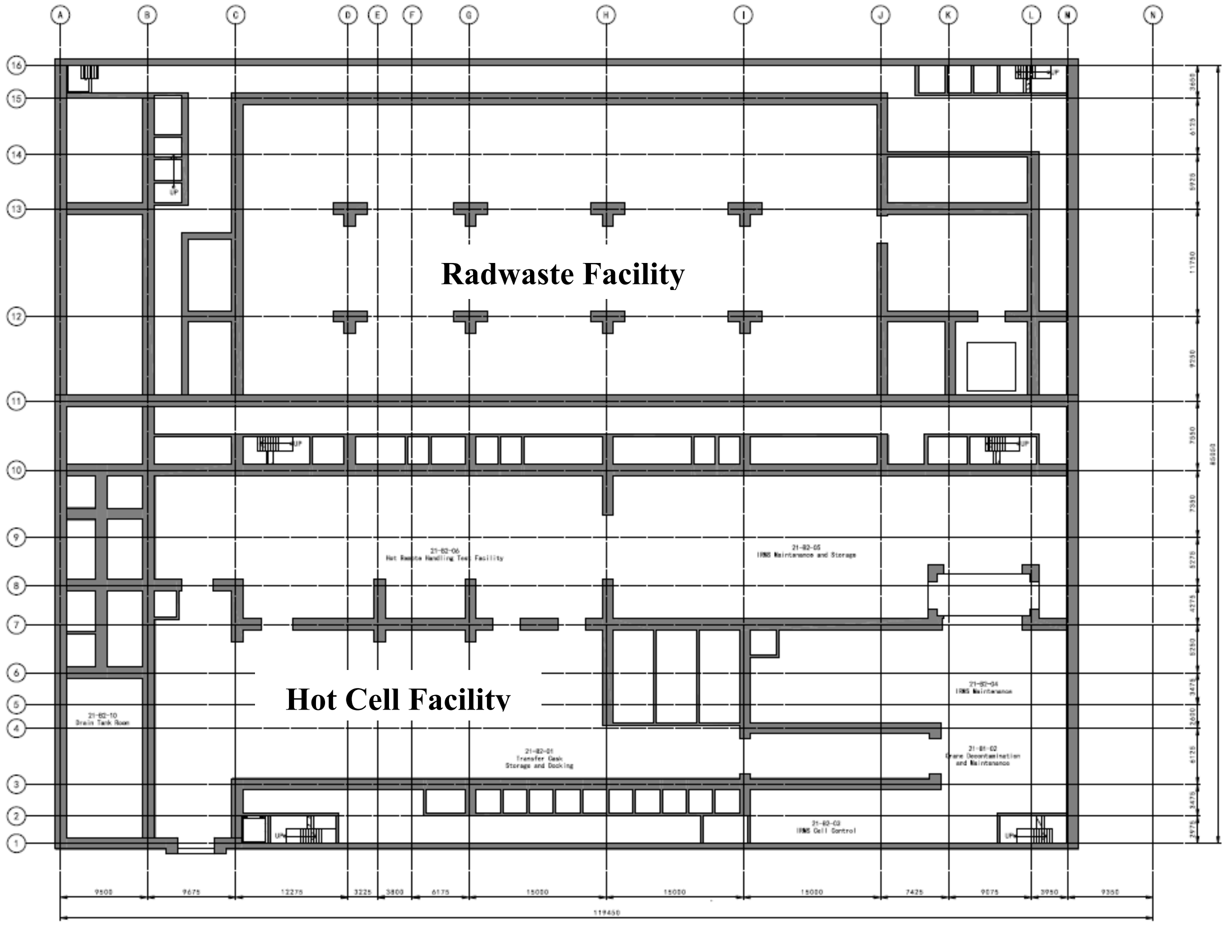
2.2 ITER project lifecycle

The design of the Hot Cell Complex, shall accommodate different phases of operations, with related constraints and objectives:

- The operational phase where plasma will be performed in TKM, with very low activation but production of Beryllium dust,
- The operational phase with Deuterium-tritium Plasma producing activated and contaminated components, in particular with activated dust and tritium,
- The deactivation phase for which the HCB and RWB shall support, in particular, the removal, the treatment and the buffer storage of In-vessel component,
- The decommissioning of the TKM and later the decommissioning of the HCC.

2.3 Main building features

The HCC is located adjacent to the Tokamak Complex, north side. It is connected to the Tokamak through a cargo lift located in the TKM Complex for the transfer of equipment, through a personal access corridor for operators and through pipes between the 2 complexes.



B2 Level

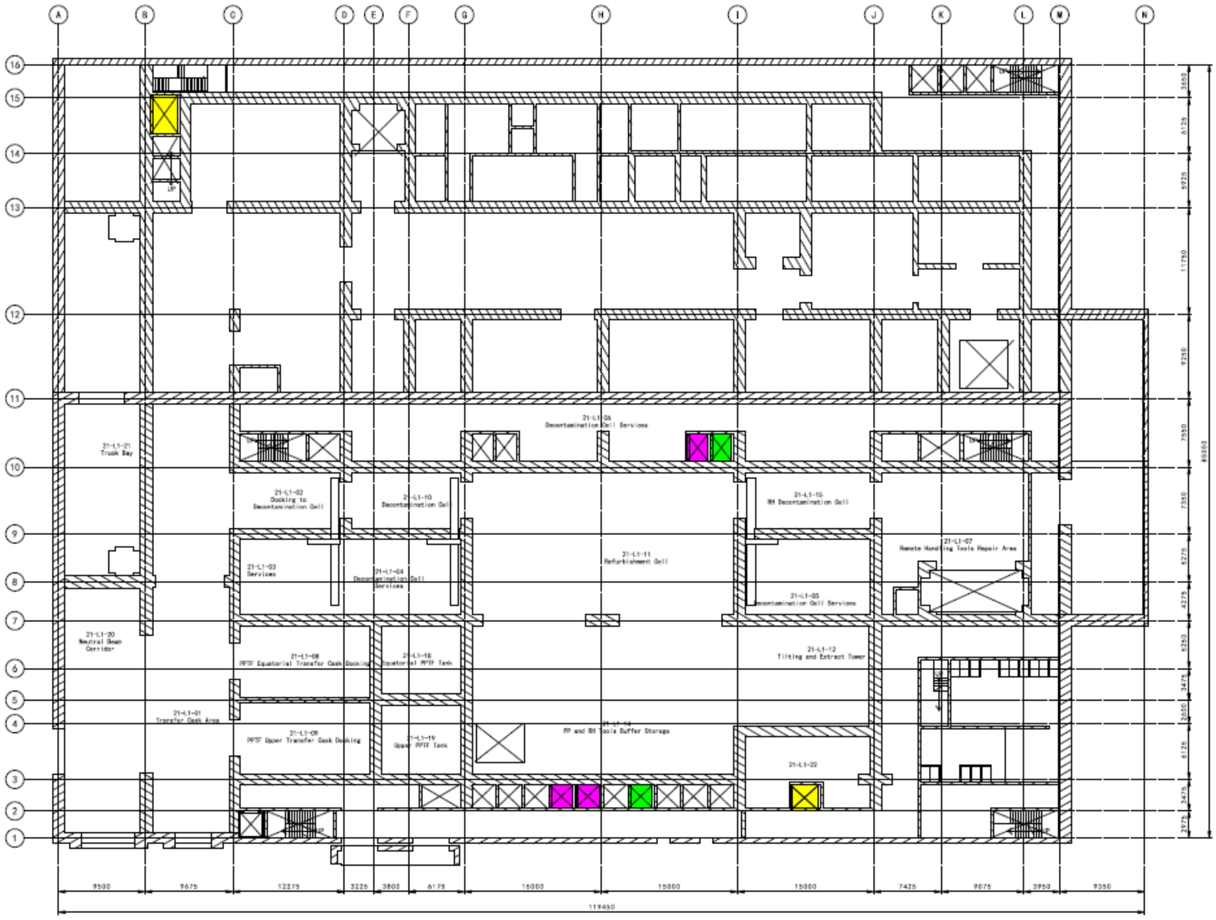
The Complex is a single concrete structure, 85m wide, 110 m long, 11m underground with two basement levels and 23m above ground on 3 levels, but the segregation between the different functions is maintained.

The HCC is sub-divided into a southern part that needs to be ready in December 2028 in order to support the TKM at PFPO (Pre Fusion Plasma Operation) and at the early stage of the FPO (Fusion Plasma Operation) phase and a second northern part of the building that will be fully completed and commissioned at a later date yet to be determined, for the treatment and storage of Type B waste (also called MAVL corresponding to "Medium Activity, Long Life Radionuclide").

B1 Level

LEGEND

- HVAC Exhaust
- HVAC Supply
- HVAC Additional
- Space Reservation Interfaces


21-L1-21
Truck Bay
21-L1-06
Decontamination Cell Services
21-L1-02
Docking to
Decontamination Cell
21-L1-10
Decontamination Cell
21-L1-15
RH Decontamination Cell
21-L1-03
Services
21-L1-04
Decontamination Cell
Services
21-L1-11
Refurbishment Cell
21-L1-07
Remote Handling Tools Repair Area
21-L1-05
Decontamination Cell Services
21-L1-20
Neutral Beam
Corridor
21-L1-08
PPTF Equatorial Transfer Cask Docking
21-L1-18
Equatorial PPTF Tank
21-L1-12
Tilting and Extract Tower
21-L1-01
Transfer Cask Area
21-L1-09
PPTF Upper Transfer Cask Docking
21-L1-19
Upper PPTF Tank
PP and RH Tools Buffer Storage
21-L1-22
9500
9675
12275
3225
3800
6175
15000
15000
15000
7425
9075
3950
9350
119450

L1 Level

L2 Level

L3 Level

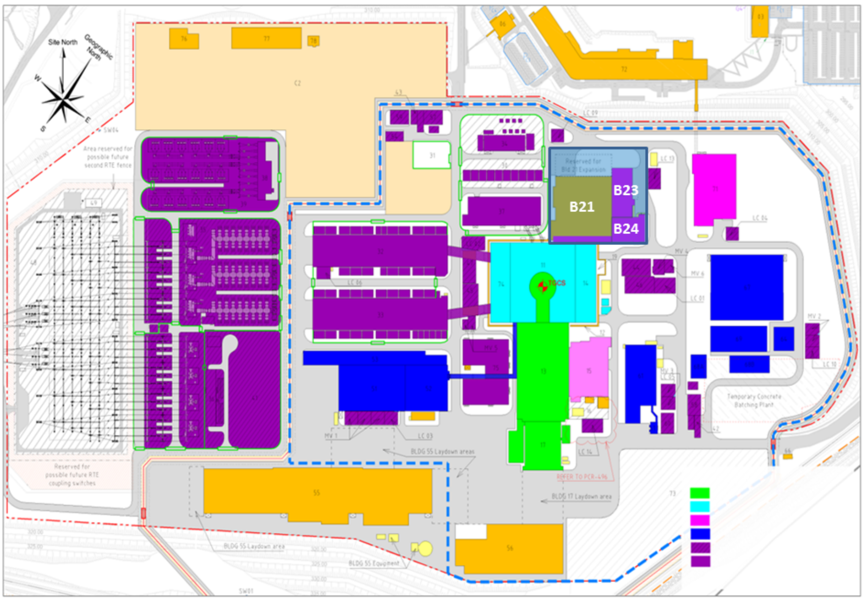
Figure 1 : Current overview of the Hot Cell Complex

This design is at a pre-conceptual design stage. It takes into account the staged approach strategy considering one building incorporating the functions described in section 2.1 but foreseen to be commissioned at different stages of the building's life cycle (PFPO1, PFPO2, FPO phase) to adjust the real needs of the IO, it's therefore foreseen to:

1. Erect and commission the civil work for the whole building
2. Adjust the process and services installations to the ongoing needs considering the project phases and associated risks

This design frame has been selected considering the former design features and taking into account the TKC feedback in terms of services architectures.

It must be noted that the construction of the building will occur whilst the construction of the TKM and the adjacent buildings is on-going, or at least, during the assembly phase of the TKM Complex. is a strong constraint which shall be considered at an early stage of design, in terms of technical feasibility, cost, functional and physical interfaces.



1 Tokamak Basic Machine (incl. Bldg 13, Bldg 17 & Sub-Assembly)	3 Control Bldgs 23, 24, 71 and RF Heating Bldg 15	5 Electrical and Power Supplies Buildings
2 Tokamak Complex Bldg 11, 14 and 74	4 Cryoplant (including Bridge) and Site Services Buildings	6 Site Works (Works Access and Area Management)

Figure 2 : Site master plan

3 Scope

The conceptual design contract will cover the Civil Works and the building systems, such as:

- Heat Ventilation and Air conditioning systems specific for nuclear buildings
- Potable water network
- Drainage networks (condensate, fire water)
- Liquid waste drainage networks (active, suspect)
- Chilled water network
- Demin water network
- Low pressure hot water network
- Nitrogen supply network
- Firefighting dry riser network
- Compressed and breathing air networks
- Fire detection
- Electrical, Instrumentation and control
- Hydrogen detection

Many analyses and related documents already exist, but at the start of the contract, the IO will provide a new “functional” layout for the HCC. The civil work structure will have to be adjusted to ensure the strength of the building and reduce its final design as well as construction cost. Design activities on the building systems will have to be adapted and refined in order to have a sufficient level of confidence for the internal arrangement, the Civil Work structure and to have the proper input data for the safety requirements.

The scope does not include design activities of the Remote Handling, the Radwaste, the Port Plug Test Facility and the Detritiation System. Nevertheless, the skills of the contractor in Remote Handling, Waste management and Tritium management will be an advantage as it will help the integration work and the decision making.

4 Schedule outline and task summary

ITER is a Nuclear Facility identified in France by the number-INB-174 (“Installation Nucléaire de Base”). As a consequence, the Contractor 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) leading to the definition of Defined Requirements for these PIC/PIA which shall be propagated to the suppliers chain.
- The compliance with the INB-order must be demonstrated, including through the chain of external contractors, if any.

To be noted that:

- The key personnel forming the core of the contractor team will be permanently located at ITER through the duration of the contract in order to integrate the design with other stakeholders and ensure an efficient design process which meets requirements. This shall include the overall design manager and discipline design leads.
- Where possible, technical solutions shall be based on existing and proven techniques, aimed at reducing risks and minimizing cost.

- The sequence of activities corresponds approximately to the schedule below:

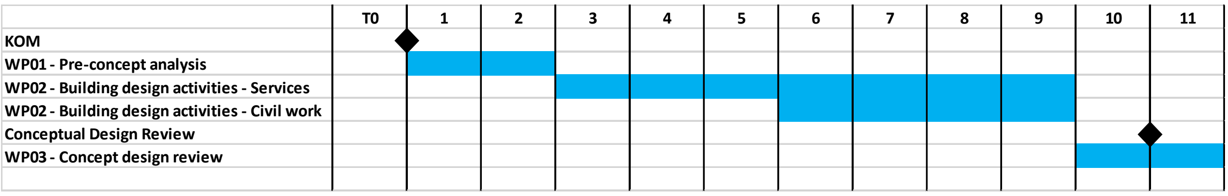


Figure 3 : Illustration of the sequence of activities – illustration only

At T0 + 9 months, the level of design and related justification shall be sufficient to be able to freeze the layout of the Hot Cell Complex: the documents delivered will constitute an input data package for the Conceptual Design Review, which will be the formal step before the authorization to proceed with the preliminary design.

4.1 Description of the study phases

It is expected to have 3 sequential phases, as illustrated in Figure 3 above:

4.1.1 Pre-concept analysis:

This first phase will establish the collection of the loads, based on the analysis of the requirements and the interface data provided by the IO.
In the meantime, this phase will provide/confirm the main design options to comply with safety and functional requirements.
A preliminary version of the design justification plan shall be issued at this stage.

4.1.2 Building design activities:

These design activities are meant to support the concept design review of the building. All the building systems listed in section 0 shall be included. The compliance of the design with Safety Requirements must be demonstrated, during the Be phase and the FPO phase.

4.1.3 Conceptual Design Review:

At the end of the conceptual studies, the input data package documents issued during the design activities will be gathered by the Contractor and serve as the reference description of the buildings and associated systems for the Design Review. The Contractor will make the presentations for this review and then work on solving the potential issues raised at this point.

4.2 Example of the main deliverables

Hereunder are examples of typical deliverables that will be expected.

4.2.1 Pre-concept analysis:

- Design Justification Plan
- Support to ICD and IS update
- Review of civil work pre-concept
- Load collection report
- Technical assumptions approval for data not provided
- Safety requirements propagation to systems and associated compliance matrixes
- Architectures for Services/Utilities

- Main components design justifications (Services/Utilities)

4.2.2 *Building design activities*

Documents shall consider the staged approach in terms of PFPO1/2 and FPO and also in terms of systems' installation (Hot-Cell and Radwaste facilities).

For the Civil works:

- Civil Work Design description
- Update of the Civil Work – Basis of Design Concrete outline drawings
- Fire sectors and escape routes drawings
- Reaction forces for heavy loads
- Update of the construction and installation methodologies
- Civil Work - GA drawings
- Civil Work - Layout of loads
- Civil Work - FE analysis (static and dynamic)
- Civil Work - Floor response spectra
- Civil Work - Anchorage calculation
- Load drop analysis
- Design and construction schedule

For the Building Systems:

- Buildings Systems Design Description
- Pressure gradients drawings
- Building systems load specifications
- Update of the Electrical, I&C, cable trays - Basis of design
- Electrical, I&C, cable trays: schematics, GA drawings
- Update of the Fire and explosion protection - Basis of Design
- Fire protection – PFD, GA drawings, calculation notes
- Update of the HVAC, LAC, Cooling Red Zones - Basis of design
- HVAC, LAC: Cooling Red Zones - architecture diagram, PFD and schematics, heat and aeraulic balance calculation
- L&G: Basis of design, PFD and schematics, GA drawings
- Utilities /Services – Operation description considering PFPO1&2, FPO phase
- Bill of Materials

Other deliverables:

- 3D model
- Compliance matrix and refined List of Defined Requirements
- Risk and opportunities analyses
- Support to ICD and IS update
- Commissioning strategy

4.2.3 *Conceptual Design Review:*

- Input data package constitution,
- Preparation of the presentations
- Presentation of the design at the Review
- Chit resolution report

5 Contractor's Expected Competencies

The Hot Cell Complex Contractor shall provide a well-organized, highly skilled team, with in-depth knowledge and experience of ALL the following topics:

	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 : - Building structure. Volume HCC 350,000 m^3 nuclear concrete building - 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. 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 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	Contact dose rate = 250 Sv/h due to activation in the Tokamak. Contamination of tritiated and activated dust on In Vessel

	Demonstrable skills and experience	Main features of the Hot Cell Complex facilities
	contaminated components	components and IRMS 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
	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	Full traceability of safety requirement, from the "high level" safety requirement to the detailed safety requirement and the related reference documentation Exhaustive list of prevention, detection and mitigation means for each internal and external safety hazard (deterministic approach). –
	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.

Table 1: Demonstrable skills and experience

6 Conflict of Interest

There is no conflict of interest between this contract and the next phases of design activities (preliminary, final or manufacturing design), nor later the procurement of the Hot Cell Complex itself (building and systems).
The outcome of this contract will be a part of the engineering package that will be shared between the tenderers for the next phases.

7 Appendix: Abbreviations

ALARA	*As Low As Reasonably Achievable*
ASN	*« Autorité de Sûreté Nucléaire » - French Safety Authority*
Be	*Beryllium*
C4	*Ventilation Classification C4 according to ISO 17873*
CDR	*Conceptual Design Review*
DAC	*Derived Atmospheric Contamination*
DS	*Detritiation System*
F4E	*Fusion For Energy, European Domestic Agency*
FMA-VC	*Low and Medium Activity, Short Life Radionuclide*
GA	*General Arrangement*
HCB	*Hot Cell Building*
HCC	*Hot Cell Complex*
HVAC	*Heating, Ventilation, and Air Conditioning*
I&C	*Instrumentation & Control*
INB	*« Installation Nucléaire de Base » - Nuclear Facility*
LAC	*Local Air Cooler*
L&G	*Liquid & Gas*
MAVL	*Medium Activity, Long Life Radionuclide*
PACB	*Personal Access Control Building*
PFD	*Process Flow Diagram*
PIA	*Protection Important Activity*
PIC	*Protection Important Component*
PP	*Port Plug*
PPTF	*Port Plug Test Facility*
RPrS	*« Rapport Préliminaire de Sûreté » - Preliminary Safety report*
RWB	*Radwaste Building*
TFA	*Low Level Waste*
TKM	*Tokamak*