

## Technical Specifications (In-Cash Procurement)

### System Engineering support for Launchers and EWs

The objective of this engineering contract is to provide system-engineering support in the framework of EC Upper and Equatorial Launchers and corresponding Ex-vessel Waveguides design finalization, qualification and manufacturing preparation.

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# 1 Purpose

The objective of this engineering contract is to provide system-engineering support in the framework of EC Upper and Equatorial Launchers and corresponding Ex-vessel Waveguides design finalization, qualification and manufacturing preparation.

## 2 Scope

### 2.1 Background

The EC system aims at delivering up to 20MW for plasma heating and current drive (H&CD) applications, with a capability of an additional 20 MW by future upgrade (40 MW in total). In order to achieve 20MW of delivered power, the EC system has an installed power of 24MW.

The EC system is comprised of seven main sub-systems:

- High Voltage Power Supplies (HV),
- High Power Microwave Sources (RF),
- Evacuated Transmission Lines (TL),
- Ex-vessel Waveguides (EW),
- Equatorial Launcher (EL),
- Upper Launchers (UL),
- EC Control system (CS).

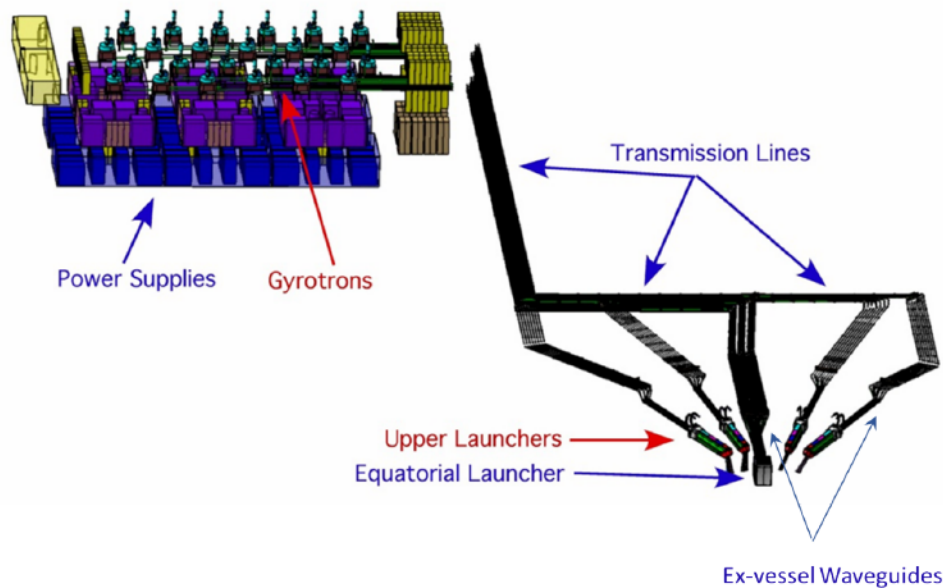


Figure 1: EC system main subsystems

The EC system is equipped with four upper launchers (UL) of 8 MW microwave power input capable each with the main aim to provide NTM control and assist in the plasma breakdown and burnthrough. It also contributes, together with the equatorial launcher (EL), to provide pure heating. The EC system is equipped with on EL able to inject up to 24MW microwave power mainly for central heating and current drive.

The four ULs are installed in upper ports 12, 13, 15 and 16 being, the last one used for first plasma. The EL is installed in equatorial port 14. See figure below.

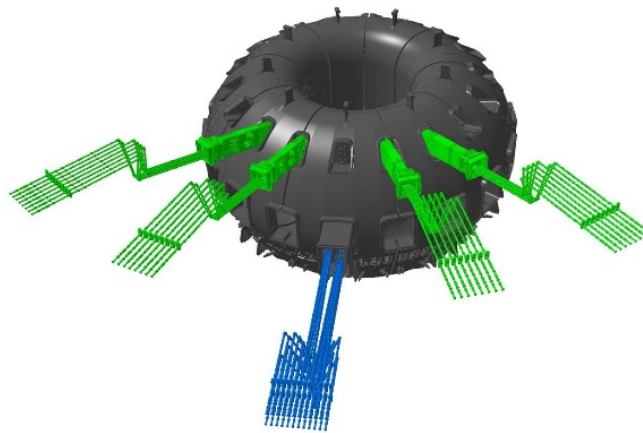


Figure 2: Location of EC launchers: UL12, 13, 15, 16 and EL14

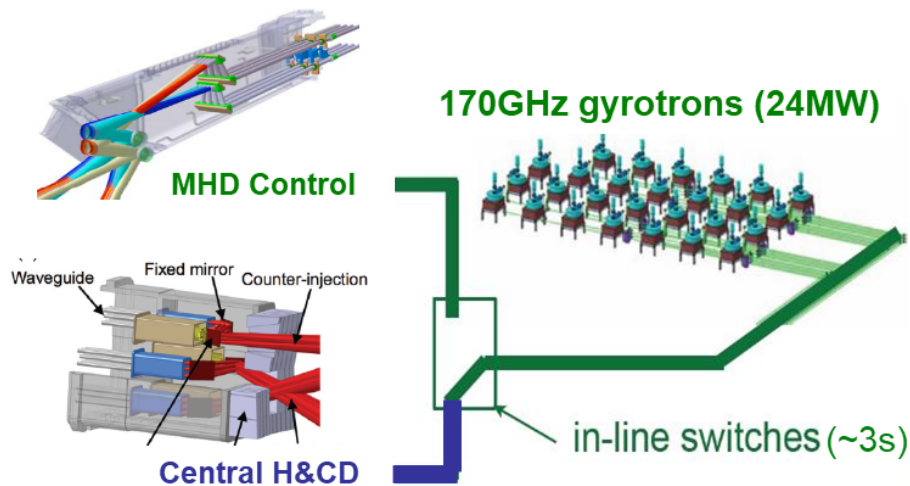


Figure 3: Overall view of power injection and functionality of EC launchers

The last portion of waveguides connecting to the launchers and forming part of the first confinement barrier mainly forms the Ex-Vessel Waveguides system. This system includes a series of RF components and the corresponding ancillaries. Being part of the first confinement barrier most of the EW components are PIC classified as SIC-1.

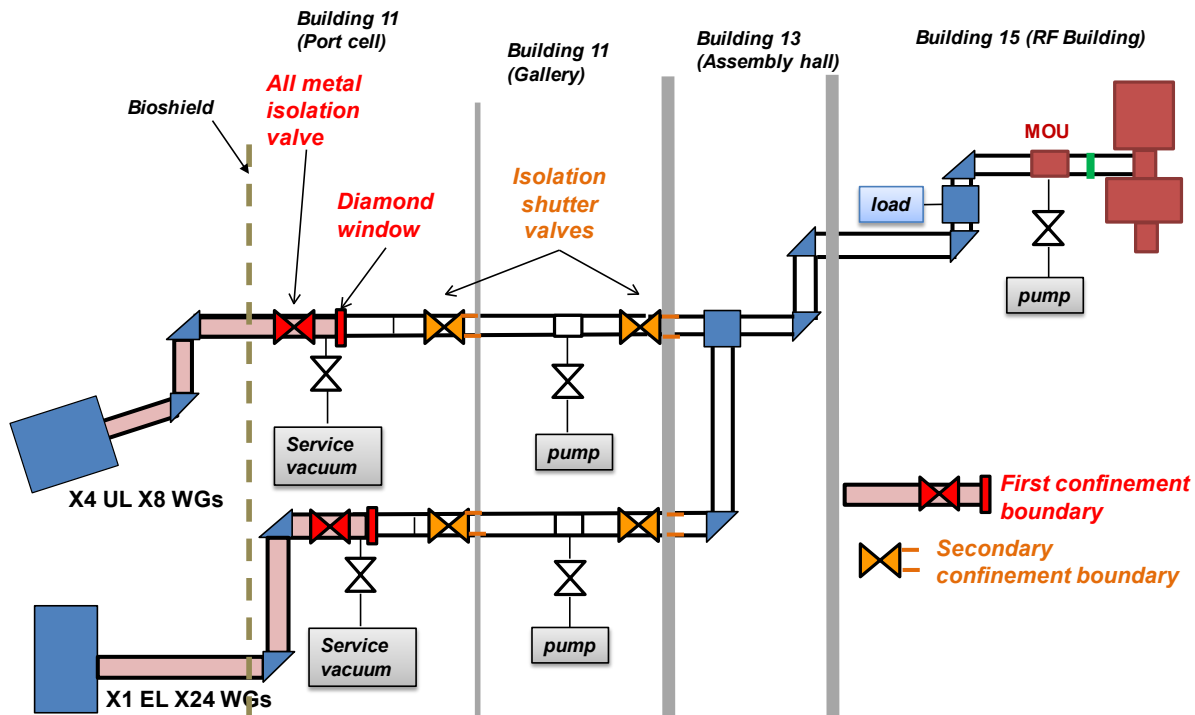


Figure 4: Overall layout and confinement strategy. First confinement barrier formed by EW system is highlighted in red. Note that there are two miter bends that form part of first confinement barrier (from port plug up to the diamond window), and therefore SIC-1. They are represented in blue in the figure.

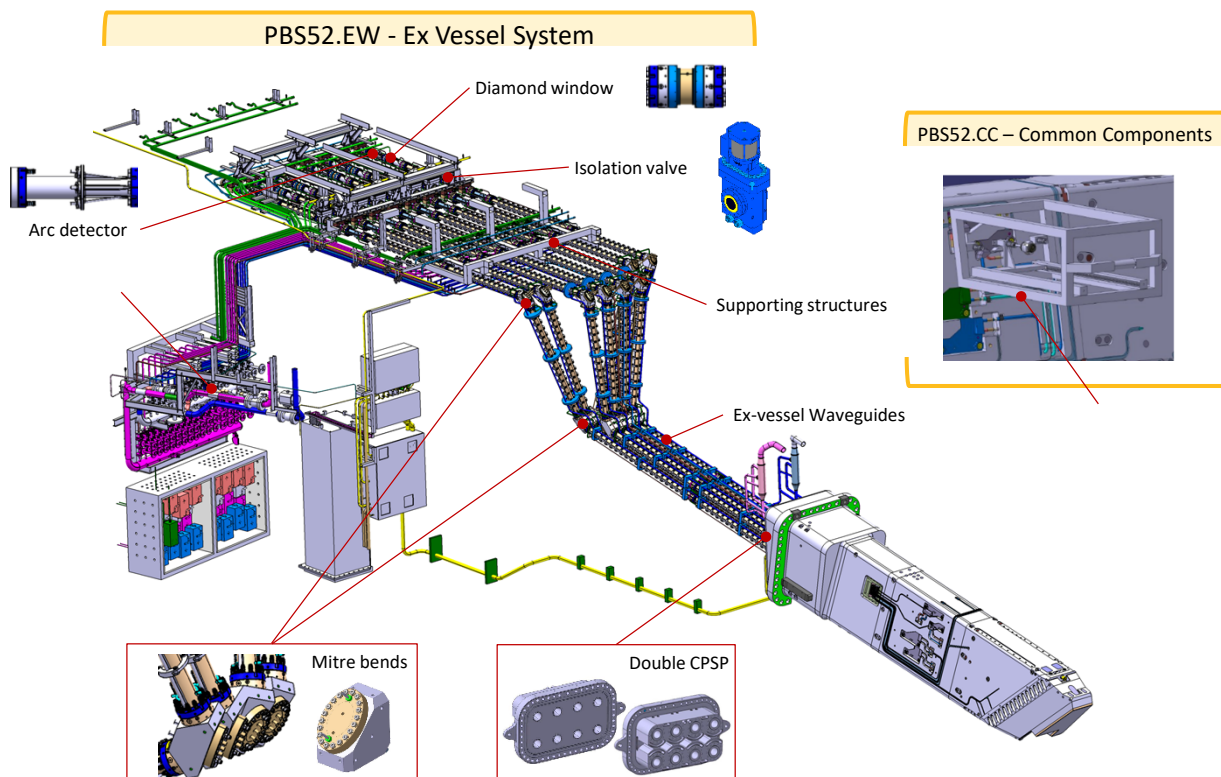


Figure 5: Overall architecture of EW and UL systems

More details about the design and status of development of different components can be found in the references [04][05][06].

## 2.2 Scope of work

The scope involves support to corresponding TROs and EC team for the subsystems described above (UL, EL and EWs) in the areas listed below (the detailed work description is given in section 6):

- Interface management, monitoring and update,
- Requirement management and propagation, management of design input with corresponding DAs,
- Optical design optimization,
- Engineering justification analysis in support of the design finalization, qualification, and preparation of manufacturing,
- Port Cell integration of PBS52 systems and components, including the implementation of transversal functions,
- Installation, commissioning and maintenance program development,
- EWP production coordination for FP components,
- Safety demonstration including implementation of ALARA principle,
- Metrology strategy from design phase to installation and commissioning phases.

The services provided under the contract are organised according to the following Work Packages:

- WP-A - Interfaces management and requirements propagation and verification control
- WP-B - Optical design optimization and alignment studies
- WP-C - Design finalization, optimization and justification (including qualification plan and manufacturing design),
- WP-D - Installation, maintenance and commissioning programs.

The detailed description is given in section 6.

## 3 Definitions

The list of acronyms used in this document are defined in Table 3.1. For a complete list of ITER abbreviations see: [ITER Abbreviations \(ITER\\_D\\_2MU6W5\)](#).

Table 3.1: Definition of acronyms used in this document.			
CAD	Computer-Aided Design	PIA	Protection Important Activity
CRO	Contract Responsible Officer	PIC	Protection Important Component
DA	Domestic Agency	QA	Quality Assurance
DCIF	Design Collaboration Implementation Form	QARO	Quality Assurance Responsible Officer
EC	Electron Cyclotron	RF	Radio Frequency
EW	Ex-Vessel Waveguides	SIC	Safety Important Class
FP	First Plasma	TL	Transmission Line
EWP	Engineering Work Package	TRO	Technical Responsible Officer
I&C	Instrumentation and Control	UL	Upper Launcher
IO	ITER Organization		
KOM	Kick Off Meeting		
PBS	Plant Breakdown Structure		
PBS52	EC System		
PBS 52.UL	Upper Launcher system		
PBS 52.EL	Equatorial Launcher system		
PBS 52.EW	Ex-vessel Waveguides system		
PC	Port Cell		
PCR	Project Change Request		
P&ID	Piping and Instrumentation Diagram		

## 4 References

[01]	<a href="#">SRD-52 (ECH&amp;CD) from DOORS (ITER_D_28B365 v5.4)</a>
[02]	<a href="#">sSRD-52-UL Sub SRD Upper Launchers (ITER-D_YEWRRM v1.5)</a>
[03]	<a href="#">Sub SRD Ex-vessel Waveguides (ITER_D_YPZPKZ v1.1)</a>
[04]	<a href="#">52.UL_DDD Upper Launcher Design Description Document (ITER_D_YSTY8W v1.4)</a>
[05]	<a href="#">Description of the input design of the Upper Launcher and Ex-vessel Waveguides systems (ITER_D_42CJSA v1.4)</a>
[06]	<a href="#">F4E_D_2MW3RK - Draft of the 52.EW DDD</a>

## 5 Estimated Duration

The duration of the Contract is up to 1 year. The contract would be subject to conformity with performance and quality of deliverables as per section 8. All work to be performed in collaboration with relevant TROs, involved parties and relevant departments. Partial presence on ITER site is required (2 days on site and 3 days off site).

## 6 Work Description

### 6.1 WP-A: Interfaces management and requirements propagation and verification control

- Maintain and update interfaces affecting 52.UL, 52.EL and 52.EW: engage with other PBSs and corresponding DAs, and update interface documents as per maturity level.
- Engage with Design Integration team regrading interfaces affecting multiple PBS, and transversal functions responsible to ensure its proper implementation.
- Support in ensuring requirements propagation along system, subsystem and components technical documentation developed by corresponding DAs and subcontractors.
- Review of Component Requirements Documents and Component Load Specifications.
- Contribute to the development and/or review of Design Compliance Matrix and verification.
- Control requirements propagation in Equipment Technical Specification documentation

WP-A Deliverables: WP-A - Interfaces management and requirements propagation and verification control status report every 12 months.

### 6.2 WP-B: Optical design optimization and alignment studies

- Support the optimization of the optical design of the Upper Launcher. Engage with the different stakeholders and contribute to design optimization with different geometrical and optical analysis.
- Support in the waveguide alignment studies and impact on wave propagation performances.

WP-B Deliverables: WP-B – status report every 12 months.

### 6.3 WP-C: Design finalization, optimization and justification

- Support on the determination and finalization of sLS for 52.EL
- Provide mechanical engineering support for the design finalization and manufacturing preparation of 52.UL, 52.EL and 52.EW.

- Support in the safety demonstration of PIC as well as in the implementation of ALARA principle. Engage with IO Safety Department and corresponding DAs. Support in the development of safety documentation.
- Support in the creation and implementation of PCRs as needed for the design finalization and integration of 52.UL, 52.EL and 52.EW.
- Provide support in developing and reviewing qualification plans for 52.UL, 52.EL and 52.EW components in collaboration with the DA and subcontractors.

WP-C Deliverables: WP-C – Design finalization, optimization and justification status report every 12 months.

## 6.4 WP-D: Installation, maintenance and commissioning programs

- Support in the development of installation, maintenance and commissioning plans for 52.UL, 52.EL and 52.EW in collaboration with EC team and the DA.
- Coordinate production of EWPs for FP installation Tendering Phase.
- Developing the metrology plan and strategy for installation of 52.UL and 52.EW systems in collaboration with the DA.

WP-D Deliverables: WP-D – Installation, maintenance and commissioning programs status report every 12 months.

# 7 Responsibilities

## 7.1 Contractor Responsibilities

The Contractor shall appoint a single Contact Responsible Officer (CRO) for all matters of the contract.

In order to successfully perform the tasks in these Technical Specifications, the Contractor shall:

- Provide suitably experienced and trained resources (an Engineer) to complete all aspects of deliverables and associated documentation;
- Strictly implement the IO procedures, instructions and use IO templates, where provided;
- Organise work in an efficient way according to the workload, commitments and objectives;
- Report to the TRO any issues during the performance of the Contract which require IO intervention or decision including potential delays in the submission of deliverables;
- 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;
- The Contractor acknowledges that all input information provided to perform the task remain property of IO and shall not be disclosed or used for any other activity than the one specified in this specification;
- The Contractor shall be in charge of the training and coaching of all its resources;
- The Contractor shall work in accordance with the QA plan accepted by IO;
- The Contractor shall perform the activities according to this specification taking into account all relevant additional documents and IO processes into account (hand books, export control, intellectual properties...);



- The Contractor shall use the ITER software platforms, for the management of all the documents, which are produced during the execution of this contract.

## 7.2 IO Responsibilities

The IO shall:

- Appoint a TRO for the Contract, who will be the point of contact for all technical matters, and a Procurement Responsible Officer (PRO) for all contractual and commercial matters.
- Organise periodic meetings with the Contractor on work performed.
- Provide offices at IO premises (when on-site).
- IO shall make available to the Contractor all technical data and documents which the Contractor requires to carry out its obligations pursuant to this specification in a timely manner. Should not all the needed input be available, the Contractor shall advise IO representative of the potential impact on the delivery of the Work Packages, to agree and define all the correction actions to take in place.

## 8 List of deliverables and due dates

The list of deliverable packages is described in Table 8.1.

Note: Content of deliverables and time schedules could be modified as a function of the project needs by mutual agreement between the IO and the Contractor.

Table 8.1: List of deliverable packages and their estimated due date.		
D#	Description	Due date
Interfaces management and requirements propagation and verification control		
A01	Interfaces and requirements management status report 01	T01+6m
A02	Interfaces and requirements management status report 02	T01+12m
Optical design optimization and alignment studies		
B01	Optical design optimization and alignment studies status report 01	T01+6m
B02	Optical design optimization and alignment studies status report 02	T01+12m
Design finalization, optimization and justification		
C01	Design finalization, optimization and justification status report 01	T01+6m
C02	Design finalization, optimization and justification status report 02	T01+12m
Installation, maintenance and commissioning programs		
D01	Installation, maintenance and commissioning programs status report 01	T01+6m
D02	Installation, maintenance and commissioning programs status report 02	T01+12m

T01: is considered the initial day when the resources as available in Iter premises to start the work.

## 9 Acceptance Criteria

The deliverables will be posted in the Contractor's dedicated folder in IDM, and the acceptance by the IO will be recorded by their approval by the designated IO TRO. These criteria shall be the basis of acceptance by IO following the successful completion of the services. These will be in the form of reports as indicated in section 8, Table of deliverables.

### Language

The official language of the ITER project is English. Therefore, all documentation relevant to this contract shall be in English.

### Format of deliverables

The contractor shall submit all deliverables to the ITER Organization in the following format:

- All reports shall be provided in native electronic format (MS Word, Excel, PNG, JPEG (high resolution), MS PowerPoint, MS Project or other), as well as in PDF format.
- The electronic version of all input data files for the execution of the supporting engineering analysis (CAD & FEM software) performed by means of software applications.
- For all deliverables submitted in electronic format the contractor shall ensure that the release of the software used to produce the deliverable shall be the same as that adopted by the ITER Organization.

The deliverables and their format shall also take into account any specific rules and guidelines specified by the ITER Organization in writing during the execution of the contract.

## 10 Specific requirements and conditions

The Contractor is expected to assign one professional to this project, for the entire duration of this contract. The professional will be delivered a desk, a phone and a computer with all required softwares when on-site. Computers, softwares and all data produced during the contract shall remain property of the ITER Organisation.

All work is to be performed in collaboration with relevant TROs, involved parties and relevant departments. Partial presence on ITER site is required (2 days on site and 3 days off site).

The Contractor's proposed profile shall meet the following requirements:

- High capability to understand and define tasks within complex environment liaising with different parties and departments (DA, other PBSs, IO design integration, IO construction, IO operation, etc);
- Sufficient experience (more than 15 years) to deliver the scope of work with independent autonomy;
- At least 12 years working experience in a relevant field with relevant experience in system engineering and design integration of complex systems;

- Experience in producing design requirements documents for a system combining several engineering disciplines (optical, mechanical, thermal, nuclear, maintenance, ALARA approach);
- Relevant expertise in interface management for complex systems;
- Experience in optical design, metrology and alignment;
- Experience in Mechanical Engineering of complex system in different phases (design, manufacturing, assembly and integration) including the implementation of different codes and standards;
- Knowledge and experience in nuclear safety, safety analysis and French Decree/European Directives, FMECA, RAMI;
- Sufficient knowledge and adequate understandings on ITER environment in terms of EC system development (Project requirements, defined requirements and load specifications to perform the works described in section 6.
- Knowledge in plasma facing components and specific requirements of the assemblies that installed in the ITER vacuum vessel.
- Adequate understandings of ITER Port Cell environment, in terms of irradiation, nuclear safety functions and inspection/maintenance requirements.
- Experience in management of ENOVIA environment is a requirement;
- Skills in use of CAD (CATIA), CAE (structural analysis using ANSYS highly desirable), scientific calculations;
- Expertise in writing technical documentation including installation relevant documentation;
- Master or equivalent degree, PhD would be advantageous;
- Fluency in English both verbal and written is required.

To be considered as an advantage the following:

- Experience in large international projects (ability to work in multi-cultural Environment);
- Experience working on the ITER project and more specifically in the EC systems or similar in PC environment;
- Contracted company is able to provide specific expertise and guidance on optical design.

## **11 Work Monitoring / Meeting Schedule**

The work monitoring will be performed by the deliverable packages of table 8.1, periodic meetings with the TRO and participation in project meetings to report as requested.

## **12 Delivery time breakdown**

The delivery schedule is specified in Table 8.1.

## **13 Quality Assurance (QA) requirements**

The organisation conducting these activities should have an ITER approved QA Program or an ISO 9001 accredited quality system. Alternatively the contractor may opt to follow the IO QA processes. In this case, the requirement to prepare a Quality Plan is not applicable. Specific training shall be provided by IO.

Documentation developed as the result of this Contract shall be retained by Contractor for a minimum of 5 years.

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, it should fulfil IO document on Quality Assurance for ITER Safety Codes

## 14 CAD Design Requirements (if applicable)

For the contracts where 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”).

Components and activities intended for ITER Basic Nuclear Installation shall observe French Regulation in application of 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].