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

# Technical specification for RPrS update

The purpose of this document is to describe the approach, the work scope and requirements related to the upgraded RPrS of ITER to be submitted to the regulator 2 years before ITER first plasma in accordance with the ASN technical prescription [INB no 174-02]

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# 1 Purpose

The purpose of this document is to describe the approach, the work scope and requirements related to the upgraded RPrS of ITER to be submitted to the regulator 2 years before ITER first plasma[1] and the safety file for ITER first plasma[2]. This includes to:

- Take stock of all technical and regulatory requirements as well as ASN guidance and international standards applicable to ITER regarding Nuclear Safety, Radiation and Beryllium Safety along with applicable emergency prospective,
- Perform the inventory of safety demonstrations and potential impacts as well as to identify loopholes and/or room for improvement in the light of the latest design evolution, updated assumptions, latest operation plan in adequacy with the latest regulatory requirements mentioned above,
- Capture the operational needs (including maintenance) of the future machine defining or redefining the limits and conditions for operation (LCOs) complying with regulatory and project requirements, optimizing flexibility and minimizing constraints for safe and enhanced operability of the machine.
- Capture all evolutions of the INB 174 configuration "(Project Changes") since 2010 that deserve to be properly integrated in the new RPrS.

This revision of the RPrS is also a Safety Review somehow (10 years after the initial version of the RPrS) and in this context, it is important, when following regulatory guidance, that the Licensee be performing a conformity check with the latest safety requirements and regulations applicable to the ITER facilities:

- Looking for and determining improvement needs,
- Improving the safety of the installation considering:
    - The experience feedback from operation or similar operation activities;
    - The evolution of knowledge and rules derived from similar installations and or similar situations.

The objective of the tender is to deliver a robust RPrS upgrade along with associated preliminary inputs in relation with operating rules for operation (RGE)[3] and emergency response parts (PUI parts) to secure safety cases or assumptions taken on board in the RPrS. Some preliminary inputs to develop the Emergency preparedness and response plan (PUI) parts should also be proposed in parallel. The objective is also to review engineering documents establishing nuclear safety performance when appropriate in adequacy with the latest maturity of the project and associated PBS.

As required by the INB Ministerial Order (7th February 2012) a graded approach is expected to be established (art. 1.1) and is to be proportionate to the risk posed by ITER to the public and the environment.

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[1] In accordance with the ASN technical prescription [INB no 174-02]

[2] 1st Plasma phase which could be considered part of the Commissioning. However, some topics have to be described: the level of radiation expected, the limit and condition for operations for this phase, the management of waste, the need of radiation zoning …

[3] According to the article R593-30 of the Environmental Code, RGE and PUI are requested for the authorization to Start-up. According to the article 3 of the ITER Licence (Decree no 2012-1248 of 9 November 2012), the start-up of the installation is the first plasma Deuterium-Deuterium. Parts of these documents are to be anticipated since there are linked to RPrS parts and inter-related especially to secure safety case assumptions and research plan activities of ITER.

The RPrS update includes an in-depth review to:

- Demonstrate compliance with the *Décret d'Autorisation de Création* (DAC) as well as all nuclear, radiation and Beryllium safety related regulations and ASN technical prescriptions. Clear distinction about what the provisions which deal with the Labour code and what fall in the Environment or Public Health regulations & legislation is to be established.
- Highlight modifications to previous safety cases and/or previous design assumptions for the protection of the interest of the article L593-1 of the environment legislation,
- Propose feasible modifications when needed including on ASN technical prescriptions and/or the DAC requirements if not substantial,
- Upgrade accident analyses with impact upon the public and environment considering the latest source term definition and associated safety analyses considering internal and external hazards listed in the INB Order and the ones specific to ITER,
- Update safety demonstrations following a graded approach commensurate to potential consequences. Over-specifications are to be avoided and safety loopholes are to be identified for a consistent and exhaustive review,
- Update the list of PICs and PIAs with their defined requirements,
- Update the normal operating domain and the associated limits and conditions for operations,
- Establish a preliminary emergency plan in the light of this RPrS review and taking into account the different stages of the project[4].

For information, the RPrS is expected to be a 5000-page document in French. Some preliminary RGE (General Operating Rules) or Pr-RGE parts will be prepared accordingly as mentioned above with the support of IO/SQD and IO/SCOP. Those Pr-RGE along with some PUI parts should be established and made available to the regulator (if requested) before submitting the RPrS upgrade to ASN 2 years before the first plasma. **Lastly, the RPrS, the RGE and some preliminary PUI parts will be written in French for some regulatory reasons though most engineering and safety related documents are in English and may have to be upgraded directly in English.**

# 2 Background and Objectives

As part of the ITER nuclear facility licensing and in compliance with the Licence, namely "the Decree authorizing ITER Organization (IO) to create a land-based nuclear facility called « ITER »[5] (*Décret d'Autorisation de Création de l'INB* n°*174 9 November 2012*), safety studies and demonstrations have to be submitted to the French Regulator (ASN: *Autorité de Sûreté Nucléaire*) as required by the Environmental Code and taking into account the 2012 INB Order. They shall cover all stages of the ITER facility lifecycle including design, construction, assembly, commissioning, every operation phases and decommissioning. This shall be performed with the objective to protect the interests specified in the article L.593-1 of the

[4] Please take into account the ASN technical prescription [INB n°174-68].
[5] Décret d'Autorisation de Création de l'INB no 174 en date du 9 novembre 2012

Environment legislation[6]. The RPrS scope is defined in the article R.593-18 of the Environment regulation.

In addition, the article 1.3 of the 2012 INB Order explains that the Safety demonstration is to be detailed in the RPrS and that revisions are to be performed at the different steps of the facility's life span. Regulatory requirements related to the safety demonstration are specified in the articles 3.1 to 3.10 of the 2012 INB Order. The ASN Resolution 2015-DC-0532 of 17th November 2015 defines the content of this RPrS. Lastly; the ASN requested an RPrS update two years before the first plasma (see technical prescription [INB n°174-02] of the ASN Resolution 2013-DC-0379 of 12 November 2013) for more details.

The safety demonstrations are to be based on:

- Safety technical and regulatory requirements, safety principles or standards along with ASN guidance when available,
- and cover the different states of the installation as well as the authorized domain envisioned taking into account the Operational needs (Scientific programme, inspection/maintenance needs…).

The normal operating domain with associated preliminary data to establish LCOs is to be reviewed and enhanced as appropriate. Then, accidental analyses (Postulated initiating events - PIEs, FMECA, external and internal hazard analyses…) are to be reviewed and enhanced to:

- Consolidate or establish additional accidental analyses with updated data (upgraded source term, updated layout and PBS designs, new data coming from Research…),
- Identify the means to prevent, detect and limit the consequences of all accidents (including new ones) in a graded manner,

In the context presented above, the licensing files, including the RPrS, rely on a number of specific nuclear safety studies and documents, covering various areas of expertise (e.g. fire analyses, human and organisational factors, external hazards …). These specific studies will be called "licensing support documentation" in this tender. Non-disclosure agreements (NDAs) will be established with non-IO stakeholders to share all necessary documentation.

IO has already set up a work plan to upgrade the RPrS based on the following phases:

1) Preparatory phase: Identification of the applicable regulatory framework, RPrS evolutions due to PCR/DR/NCRs and gap analysis, this work will be provided to the contractor;
2) Support phase: Delivery of updated and new descriptive documents and safety analysis documents; those data will aslo be made available to the contractor;
3) RPrS Update: the delivery of the updated RPrS will be performed in collaboration with the contractor with regular formal reviews.

[6] Public safety, health and sanitation, the protection of nature and of the environment.

Detailed status and content of the work done on these different phases will be provided to the Contractor at the beginning of the contract.

With regard to these 3 phases, the expected services as part of this contract cover the support of the IO teams for:

- the development of specific safety analyses and the drafting of corresponding reports used to demonstrate the adequate safety level of ITER facility;
- the assessment of changes[7] from design, construction, assembly, operation activities and their impact on the safety files supporting the 2012 RPrS to prepare their update;
- the qualification of the new protection important components (PICs) integrated in the up-to-date ITER configuration (by end of 2022);
- the conformity verification of the hypotheses used for the licensing support documentation, (under configuration management), and, the validity of the assumptions to establish the inventory of radionuclides which may be mobilized and the amount and isotopic composition of radioactive material released (or postulated to be released) from a nuclear facility, so called the "source term". This source term is used in modelling releases of radionuclides to the environment, in particular in the context of accidents located in the Tritium Building, the Tokamak Building or the Hot Cell Complex. The ITER source term does also include toxic substances and especially the Beryllium in the ITER case. The TAP building where all blankets (with Beryllium) will be stored is also a source of potential industrial accident which may affect the public and the environment for instance and should also be investigated.

# 3 Definitions

For a complete list of ITER abbreviations see: ITER Abbreviations (ITER_D_2MU6W5).

In the following table, denominations and definitions are given of all the actors, entities and documents referred to in this Specification, together with the acronyms used in this document.

[7] Taking into account the IO processes: Project Change Request, Non-Conformity Report, Deviation Request, Field Change Request and Review of Regulatory Files.

| Denomination | Definition | Acronym |
|---|---|---|
| ITER Organization (IO) | For this Contract the ITER Organization | IO |
| ITER Organization Responsible Officer | Person appointed by the ITER Organization with responsibility to manage all the technical and financial aspects of this contract | IO-RO |
| ITER Organization – Technical Responsible Officer | Person appointed by the ITER Organization with responsibility to manage all the technical of a system or sub-systems based on the Plant breakdown structure | IO-TRO |
| ITER Organization – Safety Responsible Officer | Person appointed by the ITER Organization with responsibility to manage the nuclear od radiation safety of a system or sub-systems based on the Plant breakdown structure | IO-SRO |
| ITER Organization – Safety and Quality Department – Environmental Protection and Nuclear Safety Division | Division within IO in charge of nuclear safety and environmental protection and licensing process | IO-DG/SQD/EPNS |
| ITER Organization – Safety and Quality Department – Security, Health and Safety Division | Division within IO in charge of occupational health and safety of workers emergency management and security | IO-DG/SQD/SHS |

| | | |
|---|---|---|
| ITER Organization – Safety and Quality Department – Radiation Beryllium Safety Group | Group within IO in charge of radiation and beryllium safety | IO-DG/SQD/RBSG |
| ITER Organization – Science and Operation Department – Operation Division | Division within IO in charge of Commissioning, preparation of Operations, Operations and Maintenance. | IO-SCOP/SCOD/OPD |
| Plant Breakdown Structure | Sub-organization in charge of a plant system | PBS |
| Contractor Responsible Officer | The person appointed (in writing) by the legally authorised representative of the Contractor, empowered to act on behalf of the Contractor for all technical, administrative legal and financial matters relative to the performance of this contract | C-RO |
| Autorité de Sûreté Nucléaire | French Regulator | ASN |

# 4 Contract approach

## 4.1 Introduction

The contract is divided in two parts:

- A firm part, where the Contractor has a key role as "an RPrS integrator[8]" (IO keeping the responsibility) and shall provide key inputs for the RPrS and the preliminary data to establish the RGE and PUI supporting IO efforts.
- An optional part based on "work assignement" to support IO on demands.

IO and existing contractors (ORANO, UNED and JACOBS) within IO will support and provide the RPrS Contractor with inputs and/or RPrS/RGE chapters on the following topics: Radiation protection (covering the safety function "Limitation of exposure" (Radiation zoning, ALARA, RGE associated), Beryllium Risks, Waste aspects. The role of the RPrS Contractor will be limited to an integration of those data in that case.

## 4.2 Approach for the firm part

The ultimate objective of the first part is to:

- **Write the RPrS chapters in French for the following chapters :**
  - *Chapitre II – FOH*
  - *Chapitre III – Maitrise des risques présentés par l'INB*
    - *Le confinement des substances radioactives*
    - *La maitrise des risques non radiologiques*

[8] "Integrator" means inhere that the contractor will take the lead to gather all IO information, assumptions and input to establish the draft new RPrS with a continuous review of IO RPrS stakeholders.

  - *Chapitre IV – Démonstration de la sureté nucléaire*
    - *Démarche de la démonstration de sureté*
    - *La défense en profondeur*
    - *Analyse des événements déclencheurs, incidents, accidents*
  - *Chapitre V – Activités et éléments importants pour la protection*

- **Check consistency of other RPrS chapters :**
  - *Chapitre I – Description de l'INB, de son environnement et de son fonctionnement (this chapter will be delivered by IO)*
  - *Chapitre III – Maitrise des risques présentés par l'INB*
    - *La protection des personnes et de l'environnement contre les rayonnements ionisants (this chapter will be established by IO)*
  - *Chapitre IV – Démonstration de la sureté nucléaire*
    - *Incendie (this will be written down by the contractor with the support of IO and existing work performed so far);*
  - *Chapitre VI – Gestion des situations d'incidents et accidents (this chapter will be established by the contractor in the light of existing analyses with iterative review done by IO)*
  - *Chapitre VII – Evaluation des conséquences potentielles des incidents et accidents (this chapter will be established by the contractor based on existing IO material including recent IO reviews of inventory and source term prospects);*
  - *Chapitre VIII – Etude du dimensionnement du plan d'urgence interne (this chapter will be established by the contractor based on existing IO material in close collaboration with IO emergency stakeholders);*
  - *Chapitre IX – Opérations particulières*
  - *Chapitre X – Dispositions complémentaires et spécifiques*
- **Write the preliminary RGE, PUI and Safety files for the first plasma**

The firm part is based on the following Work Packages:

- WP1 – Contract management
- WP2 – Familiarization of the context and validation of the integrated approach
- WP3 – Functional analysis of ITER and for the PBS playing a role for the confinement function & design verification with simulations
- WP4 – FMECA analysis
- WP5 – Identification and review of the accident scenario
- WP6 – Human and organization factor (HOF) analysis
- WP7 – Fire Analyses along with deflagrations or explosions
- WP8 – Integrated analysis
- WP9 – RPrS update
- WP10 – Preliminary General Rules for Operations (RGE)
- WP11 – Preliminary Emergency preparedness and response plan (PUI)
- WP12 – Safety files for the first plasma

The following steps shall be considered and consolidated when appropriate:

1. Collection of the inputs:
   - The overall description of ITER systems (buildings, premises, processes) has already been prepared and will be provided to the Contractor. Nevertheless, a review to check consistencies across descriptions and the interfaces between systems shall be performed to help start the RPrS upgrade process.
   - Safety functions definition and related requirements as well as identification of the systems and subsystems playing a role to perform those functions,
   - ITER and PBS operating states (operating conditions, maintenance needs) in normal conditions,
   - Load specifications based on accidental scenarios, external and internal hazards

2. Functional analyses of ITER and for the PBS playing a role for the confinement function,
   a. Safety requirements related to normal conditions
   b. Safety requirements related to hazards
   c. Identification of operating status (normal, abnormal)

3. Identification and review of accident scenarios
   a. Review existing events based on previous selection of PIEs, accidental analysis reports (AAR) and the RPrS,
   b. Identification of new events with IO support.

4. FMECA analysis Top-down (AAR review) and bottom up (based on PBS identification)
   a. Criticality matrix
   b. Identification and quantification of failures modes

5. Accident impact analyses
   a. Workers (under the labour code regulation)
   b. Public and environment (under the environment and public health regulations)

6. Specialties
   a. Human and organizational factors analyses
   b. Fire analysis
   c. Explosion risks ($H_2$, dust in the VV …)

7. Integrated analysis
   a. Compliance by combining components, operating states and loads
   b. Justified PIC classification based on safety functions propagations, FMECA and accidental scenarios and the related provisions to reach a safe state
   c. Verification of Define Requirements
   d. Consolidation or determination of the limits and conditions for the operating domain
   e. Validation of the AAR

8. Preparation of Safety files for the first plasma with its specific operational rules and procedures as well as emergency preparedness and response plan:
   a. Preparation of Safety file for first Plasma
   b. Preparation of General Operating Rules and procedures
   c. Preparation of Emergency preparedness and response plan (PUI)

This approach is iterative and may need on a case-by-case basis, several iterations between steps in order to converge to consistent safety cases and related requirements.

It is also under the responsibility of the RPrS Contractor to advise IO on the integration of those chapters and the impact of analyses associated with the work output packages.

Safety engineering should also be part of this work when appropriate with the support of IO teams. Safety functions (namely limitation of radiation exposure at the site fence and radionuclide confinement) should be properly dealt with, with adequate performance targets in line with the maturity of ITER design and subsequent PBS. Safety function supports will also be analyzed. Safety requirements, once properly identified, are to be allocated to systems and sub-systems with duly established justifications to be considered for design evolution gate reviews of every system or subsystem involved in those safety functions. In addition, the conformity between the revised safety requirements with the items already built or installed has to be checked.

## 4.3 Approach for the optional part

IO has to perform several reports, studies and analyses to support the RPrS update.

A support from the RPrS Contractor will be required. The deliverables concern all the following topics and should be part of the licensing documentation:

1. System or building designs,
2. Waste and effluents management,
3. ICPE list and associated risks,
4. Operations of the facility,
5. Control of the risks in the facility,
6. Human and Organisational Factors (HOF),
7. Protection Important Activities (PIAs) and Protection Important Components (PICs) (list, classification, qualification, Hardened Safety Core Components, …)
8. Management of radioactive and toxic materials (as beryllium) during normal or accidental situations,
9. Support studies for risks (hazards and consequences),
10. Commissioning operations and associated safety requirements,
11. Emergency planning and management requirements,
12. Specific operations (construction, internal transport, radioactive source management).
13. Environmental monitoring.

The Contractor shall provide the following:

- safety cases and operating procedures, at least RGE and PUI, to cover the relevant risks for the 1st Plasma Operations:
    - Activation (water, air, gases, materials) even if negligible,
    - Effluent and waste,
    - Beryllium and other hazardous materials that may affect the L.593-1 interests,
    - Hazards that may affect health and safety of workers as: cryogenics, electro-magnetic fields, hazardous materials,
    - Non radiological hazards as the ones derived from chemical material storage,
    - Non-radiological Emergency (fire, toxic or chemical risks, etc.)
- safety cases and proposals to modify the RPrS chapters for:
    - Activation (water, air, gases, materials),
    - Effluent and waste,

- Beryllium and other hazardous materials that may affect the workers, the Public and the Environment,
- Hazards (fusion facility specific) that may affect health and safety of workers such as: cryogenics, electro-magnetic fields, hazardous materials,
- Environmental monitoring,
- Review of the authorized operating domain and normal operations,
- Review of the accident safety studies including the lists of design basis and beyond design basis accidents and the probability of occurrence,
- Review of accidental scenarios derived from internal and external hazards,
- Review of the provisions ensuring the safety function Confinement and assessment of the retention efficiency in case of accidental or uncontrolled releases,
- Review of the radiation safety provisions for the different modes of the Machine: mode 0 – Plasma in operation, mode 1 – short term and long term maintenance and mode 2 – heavy maintenance with transport of highly radioactive components,
- Verification of the inventory of mobilizable radionuclides for the different states of the installation along with the source term for every accidental scenario,
- Emergency preparedness and response provisions covering radiological and non-radiological events.

The studies must comply with the French regulations and ASN decisions, requirements, guidance and basic fundamental safety rules applicable to ITER. A compliance matrix would be produced at least with the section IV of the ASN resolution 2015-DC-0532 of 17th November 2015, the section III of the 2012 INB Order, the Decree no 2012-1248 of 9th November 2012, the ASN Resolution no 2013-DC-0379 of 12th November 2013, radiation protection 2018 regulation and associated orders and regulation applicable to Beryllium exposure.

Reports need to be provided in accordance with the contract schedule.

This contract will be managed through work assignments (see §**Error! Reference source not found.**.2) that will provide the detailed specifications of the works to be performed, within the scope listed in this chapter.

# 5 Scope of work activities and work packages

## 5.1 Firm Part – Work Packages

### 5.1.1 WP1 – Contract management

The purpose of this WP1 is dedicated to management of the contract (Technical, budget, schedule) and reporting.

#### *5.1.1.1 Inputs*

- This technical specification
- All the references identified in the input package regarding the PBS and transverse activities

- Additional documents provided by IO during the contract updating initial input
- Project schedule
- IO procedures (MQP) applicable for the different stakeholders of the project: IO, DAs, contractors and/or external interveners.

#### *5.1.1.2 Activities*

- To define and update the contract management plan (including deliverables list, provide a compliance matrix with regards of the application regulation including the Ministerial Order 7th February 2012 applying to all the components important for the protection of the public (outside the fence) and the environment (PICs) and related activities (PIAs). This step is fundamental. The Contractor, based on his experience implementing Safety engineering processes in parallel, at the end of the appropriation phase, will define the integrated plan including all the WP processes, after WP2. The purpose will be to define the most efficient way to work amongst IO contractors and IO (core team, PBS) as an integrated team.
- Organize, follow up, report on all the contract activities (Planning, prioritization and detailed scope of work)
  *NOTA: A follow up and monitoring including notably: List of Deliverables, schedule, progress report needs to be done for each WP.*
- Advise IO on optimization of the current contract and recommendations to improve ITER project
- Organize and prepare the contract management meeting (monthly progress)
- Coordination of the contractors' activities and participation to key technical meeting
- Provide minutes of these meetings

#### *5.1.1.3 Output from the Contractor*

- Contract management plan versions (including integrated processes).
- Quarterly Status report (including planning and detailed scope of work schedule)
- Minutes of the Contract management meeting
- Minutes of Technical meeting involving several transverse activities
- Memos to advice, to warn, to make recommendations to IO

### 5.1.2 WP 2 – To establish an integrated approach

The purpose of this WP2 will be for the Contractor:

- to gather and become familiar with the inputs provided by IO to fully understand the environment and constraints,
- to define an integrated approach to deliver the RPrS update and associated RGE along with some PUI parts when applicable in a timely manner,
- To play the role of RPrS integrator and advisor to IO (IO keeping the responsibility)

IO proposes to have the following meetings for familiarization:

- Three Introduction meetings (4 hours each) in order to have:
  - an overview of the ITER project focusing on the Tokamak, as well as presentations on ITER specific licensing requirements,
  - Safety function "Confinement" and key hazards, main accidents and consequences
  - A specific meeting will be organized by IO/SQD/RBSG on radiation safety focusing on the protection of the public and the protection of the workers with radiation zoning aspects as well as the ALARA approach. In addition, RBSG will present the approach to write the radiation protection chapters and

associated RGE. A specific coordination will be set up on this topic to manage the interfaces and the coherence of the RPrS, the RGE and related PUI parts when applicable.

- Four Introduction meetings for key PBS (15, 26, 31, 32, 52, 53, 55, 56 and 62) playing a role on nuclear safety and radiation safety – (2 hours each) using CAD data (CATIA files), Virtual Room in order to have an overview of the main systems, a presentation of the current design, the main functions and the key associated documents. That will be an opportunity for an exchange between the contractors and the main PBS Technical Officers (TRO) and IO transverse function responsible officers for safety related transverse functions as established by the Engineering Domain of IO.

This set of meeting will complete the documents provided in order to freeze the inputs to be considered for the others Work Packages.

In order to have a common approach, the Contractor will present its safety engineering process and its integrated approach to fulfil the contract. IO/SQD will established some gate reviews when needed and will support the contractor with informal working groups gathering TROs and Transverse function stakeholders when appropriate.

This includes, amongst others: safety demonstration core process (hazard analyses, accidental analyses, Safety functions breakdown and verification of define requirements, graded approach, operating states definition, loading conditions verifications…), as well as specific considerations for external and internal hazards and especially the fire safety approach, the Human and Organization Factors approach and waste management.

Discussions through dedicated workshops will be organized between IO and the Contractor in order to: tailor this integrated approach according to ITER context; to present the processes that will be implemented for the contract including relationship amongst teams. In addition, technical visit of the nuclear site will be organized with objectives to discuss certain issues.

ITER Organization has prepared support descriptive documents presenting site, buildings, areas and PBS. The Contractor, with the role of the RPrS integrator, will gather this information and based on his experience on safety reports will propose the content of description chapters. The description chapters will be proposed by IO and reviewed for consistency by the Contractor who will propose the necessary updates based on the WP4, WP5, WP6 and WP7

#### *5.1.2.1 Inputs*

- This technical specification
- All the references identified in the input package regarding nuclear safety, PBS and transverse activities: RPrS, licensing related files sent to ASN, etc.
- Support descriptive documents,
- Normal and degraded operating conditions documents (SCOD and PBS)
- Inventory and Source term updates,
- Additional document provided by IO during the contract updating the initial inputs.

#### *5.1.2.2 Activities*

- Collect and assess the initial input data: RPrS, PBS (requirements, Engineering Work Packages (EWP) ) and transverse activities,
- Review the inventory of all the safety requirements applied to ITER (General regulations: radiation protection, *code de l'environnement, code du travail*,…, specific to ITER regulation (DAC, RPrS, ASN requests..) and maintain a database showing how those requirements are considered, allocated and justified.

- Technical assumptions for data not provided are to be submitted to IO for approval,
- Input package review and validation per safety functions, area (multi PBS and integrated approach)
- Review the support descriptive documents based on generic description needs
- Request update of support descriptive document and RPrS chapters based on WP4, WP5, WP6 and WP7
- Analyze the source term update to be used for accidental analysis
- Co-organize, and co-prepare with IO the meetings
- Provide minutes of these meetings
- Provide nuclear engineering processes based on Contractor's training and guidelines, then propose customization of these processes for the contract and nuclear facility visits

#### *5.1.2.3 Output from the Contractor*

- Memos, mails based on Question & Answer approach
- Input data review
- Workshops organization to develop integrated approach (PPT, minutes)
- Integrated approach procedure
- Regulation inventory database and compliance matrix associated
- Updated planning based on introduction meeting and workshops
- Formal review of the support descriptive documents
- Generic content of description RPrS volume of ITER, its environment, and its operating phases
- A review of the description chapters based on WP4, WP5, WP6 and WP7
- RPrS chapters describing the source term for every accident analysis

### 5.1.3 WP 3 – Functional analysis of ITER and PBS playing a role for the confinement function & design verification through simulations

The Contractor will gather the functional analysis available in ITER and from the PBS TROs playing a role for the confinement function. The objective will be to have a functional analysis performed for confinement function and detailed ones for PBS.

The analysis will consider the stage approach:

- First plasma
- PFPO-1 and PFPO-2 with specific attention on Beryllium risks
- DT phase (Tritium, beryllium, dust risks and additional identified source term risks)

In addition, the different modes of operation shall be considered: mode 0, 1 and 2 and the transition between phases (e.g.: from high vacuum to pressure to negative delta P with outside as appropriate).

PBS playing a role for the confinement function are the following:

- Static confinement:
  - PBS 15: Vacuum vessel
  - PBS 18: Fueling and wall conditioning systems
  - PBS 24: Cryostat & VVPSS
  - PBS 26: Cooling water systems
  - PBS 51: ICH
  - PBS 52: ECH
  - PBS 53: NB systems

    - PBS 55: Diagnostics
    - PBS 56: TBM
    - PBS 62: Building
    - PBS contributing to the last confinement barrier (PBS 34: cryogenics…)
- Dynamic confinement:
    - PBS 31: Vacuum systems
    - PBS 32: Tritium plant
    - PBS 62: HVAC as appropriate
    - PBS 24. VP (accident scenarios)
- Controls:
    - PBS 64: REMS
    - PBS69: Access controls and security

SYLVIA simulations on selected configurations and representative scenarios to justify the performances are to be envisioned.

#### *5.1.3.1 Input*

- RPrS
- ITER and PBS functional analysis from TROs
- Project requirements
- Safety related documents provided by IO
- Accident analyses
- Detailed system descriptions and documentation
- And other documents IO deems necessary for this work

#### *5.1.3.2 Activities in collaboration with other existing IO contracts*

- Perform the ITER confinement functional analysis (integrated a multi PBS approach) for all the different operating states (modes and phases)
    - Functional breakdown structure
    - Main sub-systems
    - Elementary components
- Support IO PBS so that they deliver the detailed functional analyses of the PBS playing a role in the confinement function
- Define all the operating states of confinement functions and PBS associated
- Review accidental conditions (design basis and beyond design basis accidents) and more as appropriate
- SYLVIA simulations as appropriate for all modes, incidents or accidents

#### *5.1.3.3 Output from the Contractor*

- Functional analysis of ITER confinement function
- Support and review the PBS Functional analysis
- One Plant Functional Description (PFD) for all the operating modes ($PFPO_i$, different modes)
- One calculation note (SYLVIA simulations)
- Design compliance matrix for relevant PBS (e.g.: 31, 32 and 62) identifying all the confinement related requirements, checking for coherence across PBS and providing high level guidance on when & how to substantiate compliance with the requirements

### 5.1.4 WP 4 – Identification and review of the accident scenario

This WP4 is one of the main WP of the contract with integrated approach and RPrS integration.

This approach is a top-down approach based on ITER RPrS that identifies a list of Accident Analysis Reports (AAR):

- 2DPVGT - Accident Analysis Report (AAR) Volume I - Event Identification and Selection
- 2DJFX3 - Accident Analysis Report (AAR) Volume II - Reference Event Analysis
- 2E2XAM - Accident Analysis Report (AAR) Volume III - Hypothetical Event Analysis

It will be completed by meetings with PBS TROs who are concerned by the confinement function to ensure consistency and completeness of data and assumptions.

The Contractor will analyze the existing RPrS and the Accident Analysis Reports (14 AAR in reference event analysis (Design Basis Accidents) and 7 AAR in hypothetical event analysis (Design Extended Conditions)).

Based on up-to-date data in the WP3 and WP5, the Contractor will review the AARs. Specific workshops will be organized with IO stakeholders (Safety, SCOD, ENG domain with PBS concerned) in order to analyze the previous AAR and to identify the necessary update. The Contractor will be in charge to propose the actions and to coordinate the activity for the update as the main integrator of the RPrS under IO supervision.

It is important to mention that a graded approach shall be implemented. This means that the Contractor with justified arguments could present different conclusions for any updated AAR compare to previous version. It will be the IO responsibility to approve the AAR to be used for the RPrS update.

#### *5.1.4.1 Inputs*

- RPrS
- All AARs and associated documents
- Other hazard studies or safety analysis performed by ITER (IO or DA)
- Impact analysis

#### *5.1.4.2 Activities*

- Analyze the RPrS and AAR considering updated input
- Organized workshops with stakeholders
- Update and perform AAR according to the different hazards (internal, external, specific loads)
- Following all analyses and based on experience, make recommendations to IO to implement prevention, detection and limitation of consequences to mitigate the harmful effects of accidents.
- If necessary, propose further optimization such as redundancy, diversity, optimized defence in depth and more,
- Based on updated AAR, the Contractor will assess the impact on workers, public and environment (against relevant pieces of regulation) with a continuous review of IO RPrS stakeholders.

#### *5.1.4.3 Output from the Contractor*

- Updated AARs (identification of defense in depth means: prevention, detection, limitation of consequences) with impact analysis
- Specific RPrS chapter on AAR updated

### 5.1.5 WP 5 – FMECA analysis

FMECA analysis is proposed for the PBS playing a role in the safety confinement function in order to have a detailed analysis of systems and to bring consistency over all updated AARs in WP4.

As a reminder FMECA is a *"logical, structured analysis of a system, subsystem, device or process"*. The Contractor will establish "Risk matrix" and "Risk ranking categories". A risk matrix will be used to prioritize the action items associated with each potential incident.

The Contractor will list and rank hazards due to the system in order to share safety efforts and means to mitigate consequences.

The Risk Matrix "C" will be defined by the combination of the frequency F (probability to have a potential unsafe situation) with the severity S of the event.

$$C = f(F, S)$$

C is to be determined:

- To identify "hazardous sources" that can cause a threat (assimilation to the potential effect generated by this source)
- To assess severity S for each event
- To assess the frequency F to have this potential unsafe situation

The effects of the failure modes is to be classified by criticality levels in relation to criteria defined at system level according to the objectives (operation, safety, etc.). The failure modes of a function will be gathered by criticality levels in relation with their effects. It is important to note that when a given entity is considered in a given failure mode, all other entities are assumed to be in nominal operating conditions.

The Contractor, based on his experience will propose this FMECA approach along with the tools, the rating scale and the associated criticality matrix. This approach is to be an engineering analysis done by a cross-functional team of experts that thoroughly analyzes processes; therefore, the Contractor will propose the FMECA and will set up meetings with stakeholders to validate the FMECA. Other approach such as HAZOP for instance may be appropriate too as long as the contract applicant explains all the approach with concrete examples.

The FMECA will be performed on the PBS playing a role on confinement function with a stage approach considering operating conditions, transitions based on WP3 analyses.

#### *5.1.5.1 Input*

- Description of the system – WP2
- Functional analysis – WP3
- Operating conditions – WP3

#### *5.1.5.2 Activities*

- Propose FMECA approach and tool
- Perform FMECA of the PBS playing a role on confinement function
- Analysis of the FMECA with all AAR

#### *5.1.5.3 Outputs from the Contractor*

- FMECA reports

### 5.1.6 WP6 – Human and organization factor (HOF) analysis

Human & Organizational Factors (HOF) analysis based on ITER HOF program [2WBVKU]. The HOF programme will follow the two levels approach:

- **General analysis**: the objective of this analysis will be to have an overview of the needs for operations (including during maintenance), the constraints generated by the working environment (hazards management and individual protections needed, accessibility issues – in line with technical environment, performance requirements, etc.). The experience feedback from other facilities with similar working situations shall be included (the Contractor with the design/operation experience on the installations representing similar characteristics, especially in terms of hazards management, is preferred).
- **Specific analysis** will consist in elaborating and analysing the maintenance/inspection scenarios (representative for the future probable activity in the port cell areas-necessary to ensure facility's safety objectives. The Task Analysis method will be based on operation scenarios analysis covering all normal operation conditions that may occur. In particular, for the analysis of the working situations (workstations) which are the most penalized in terms of environmental and physical constrains, especially for the radiological/beryllium zones, and that cover protection important activities [PIAs] to address the human and organizational reliability issues.

These studies will be preceded by the review of existing ITER guidelines for the design of local workplaces (on site) and the complementary standards review.

The HOF analyses will be performed in line with the priority topics identified in RPrS, WP4 WP5, WP6 and in particular, the Safety Sensitive Activities (SSA), which are any human intervention on PIC components and/or human work performed in radiation/contamination controlled areas, necessary to ensure facility's safety objectives. The analyses will identify the most representative working situations in ITER with the goal to cover all normal operation conditions, and the most penalized cases in terms of risk severity and operational complexity.

Based on those analyses, the verification of HOF consideration into ITER project and the validation by IO, the Contractor will propose the RPrS HOF chapter.

#### *5.1.6.1 Inputs*

- RPrS
- Output of WP 3, 4, 5
- ITER HOF requirements documents
- ITER HOF studies

#### *5.1.6.2 Activities*

- Identification and analyses of input
- Elaborate HOF analysis following ITER requirements
    - Identification of major accident scenarios with human intervention (failure or line of defense)
    - Description of the safety system (organization, information provided, treatment of information, actions to be performed)
    - Description of the human behavior and the HOF mitigations proposed
- Verify the HOF requirements consideration into the design and the operation
- Elaborate the HOF chapters of the RPrS

#### *5.1.6.3 Outputs from the Contractor*

- HoF reports focusing on activities and systems identified in WP4 and 5
- Deliver the HoF RPrS chapter "*Aspects organisationnels et humains*"

### 5.1.7 WP7 – Fire analysis

The purpose of this activity is to support the safety demonstration and the Accident Analysis Reports with a systematic assessment of the fire risk within the Tokamak and Tritium buildings. In particular, the fire analysis shall consider locations where dangerous material and/or radioactive materials are located, as well as room with fire sensitive PIC and protected corridors. In addition, fire events from surrounding areas shall be considered.

This activity will have to be performed within the framework defined by the *Order of 20 March 2014 approving the decision n° 2014-DC-0417 of the Nuclear Safety Authority* and the *Order of 11 January 2016 approving decision n° 2015-DC-0532 of the Nuclear Safety Authority*. As such, the related task will be PIA.

In particular, this activity related to the fire risk analysis shall allow identifying and/or confirming:

- The PIC systems that have to be protected from the fire (i.e. fire sensitive components)
- The protected corridors within the buildings
- The fire risks within the different rooms
- The fire prevention, detection, suppression and mitigation measures
- The consequences of the fire regarding the release of nuclear material

#### *5.1.7.1 Inputs*

- RPrS
- All AARs and associated documents
- Other hazard studies or safety analysis performed by ITER (IO or DA)
- Impact analysis
- Fire loads inventory for Tokamak and Tritium building
- Identification of fire sensitive systems
- 3D model

#### *5.1.7.2 Activities in agreement with the IO fire transverse function leader and IO-SQD fire safety stakeholders*

The option shall cover for the scope of work the following tasks:

- Definition of the fire analysis methodology,
- Assessment of regulatory compliance with the fire regulation related to the *Order of 20 March 2014 approving the decision n° 2014-DC-0417 of the Nuclear Safety Authority* and the *Order of 11 January 2016 approving decision n° 2015-DC-0532 of the Nuclear Safety Authority* as well as any applicable ICPE (*Installation Classée pour la Protection de l'Environnement*). Labour Code compliance is not requested unless impact on the previous ones.
- Assessment of the implementation of the fire protection strategy based on prevention, detection and mitigation provisions
- Feedback analysis of similar fire risks / fire events
- Buildings vulnerability assessment (i.e. Preliminary fire safety analysis) defining the fire safety strategy and identifying the situation / location that could impact the nuclear safety
- Description of available fire protection measures

- Detailed fire analysis of the referenced fire scenarios:
    - Identification of the representative fire scenarios, accidental sequence (e.g. events tree) and applicable barriers
    - Assessment of the robustness of the fire protection measures
    - Quantification of the fire scenario (fire modelling)
    - Assessment of the consequences
    - Assessment of the fire scenario with aggravating factor (e.g. cumulative events, failure of fire protection measures)
    - Assessment of consequences related to generalized fire events
    - Fire safety demonstration

#### *5.1.7.3 Outputs from the Contractor*

- Assessment on the compliance of the fire protection strategy with regulatory requirements
- Gap analysis on the implementation of the fire protection strategy for the nuclear buildings
- Methodology of the fire analysis
- Tokamak and Tritium buildings fire analysis
- Verification and validation report(s) for the fire modelling tool(s)
- Fire computations for the fire scenarios and the generalized fire
- Summary of the fire analysis for the RPrS

### 5.1.8 WP8 – Integrated analysis

The purpose of this WP8 is to gather all the output of the previous work Packages in order to crosscheck the exact status of the nuclear safety performance “Confinement” of ITER project according to the maturity of the project and PBS.

Based on previous WP, the Contractor will check the PIC list with associated requirements and will confirm them or will propose an update following a graded approach proportional to the consequences (impact analysis results).

This WP8 is FUNDAMENTAL to enhance rationalization of PIC/PIA according to a justified graded approach where graduated nature of requirements, which must be defined proportionally to the potential consequences of the inconveniences and risks generated by ITER.

#### *5.1.8.1 Input*

- RPrS
- Output of W3 to WP7
- Initial PIC list with defined requirements

#### *5.1.8.2 Activities*

- Justified and propose a PIC & PIA classification based on updated lists of design basis accidents and beyond design basis accidents relying on AAR updated and FMECA in accordance with safety demonstration principles and following a graded approach
- Identification, validation, update based on WP of the defined requirements. Verification of feasibility of those defined requirements (meeting with PBS concerned and report by PBS)
- Proposal of classification of the PIC importance according to nuclear safety

- Identification and proposal with PBS of the PIC requirements for qualification and commissioning
- Consolidation or determination of the limits of operating domain (input for WP9: RGE)
- Validation of the AAR based on justified cases to be studied according to the accident impact analysis. Verification of the general objectives are met.

#### *5.1.8.3 Outputs from the Contractor*

- Updated PIC/PIA list, classification of PIC according to importance, with defined requirements
- PIC/PIA review report
- Updated operating domain of the PBS
- Validated AARs to be used in the RPrS chapters

### 5.1.9 WP 9 – RPrS integration

The purpose of this WP9 is to write RPrS chapters in French and to integrate the others in order to have a full consistent RPrS.

Important: the chapters on radiation protection and beryllium risk will be an input. It is therefore important to have a verification of those inputs on the others parts of the RPrS and to identify what could be the impact on other chapters.

#### *5.1.9.1 Input*

- RPrS
- WP output
- Radiation protection chapters

#### *5.1.9.2 Activities*

- Write the RPrS chapters in French:
  - *Chapitre II – FOH*
  - *Chapitre III – Maitrise des risques présentés par l'INB*
    - *Le confinement des substances radioactives*
    - *La maitrise des risques non radiologiques*
  - *Chapitre IV – Démonstration de la sureté nucléaire*
    - *Démarche de la démonstration de sureté*
    - *La défense en profondeur*
    - *Analyse des événements déclencheurs, incidents, accidents*
  - *Chapitre V – Activités et éléments importants pour la protection*
- Review other RPrS chapters :
  - *Chapitre I – Description de l'INB, de son environnement et de son fonctionnement (this chapter will be delivered by IO)*
  - 
  - *Chapitre III – Maitrise des risques présentés par l'INB*
    - *La protection des personnes et de l'environnement contre les rayonnements ionisants (this chapter will be established by IO)*
  - *Chapitre IV – Démonstration de la sureté nucléaire*
    - *Incendie (this will be written down by the contractor with the support of IO and existing work performed so far);*

- *Chapitre VI – Gestion des situations d'incidents et accidents (this chapter will be established by the contractor in the light of existing analyses with iterative review done by IO)*

- *Chapitre VII – Evaluation des conséquences potentielles des incidents et accidents*
  *(this chapter will be established by the contractor based on existing IO material including recent IO reviews of inventory and source term prospects);*

- *Chapitre VIII – Etude du dimensionnement du plan d'urgence interne (this chapter will be established by the contractor based on existing IO material in close collaboration with IO emergency stakeholders);*

- *Chapitre IX – Operations particulières*

- *Chapitre X – Dispositions complémentaires et spécifiques*

- Conformity with RPrS content (ASN resolution 2015-DC-0532) and if issues, proposals of mitigation actions
- Identify the potential inconsistencies and propose mitigations

#### *5.1.9.3 Outputs from the Contractor*

- RPrS update chapters (French)

### 5.1.10 WP 10 – Preliminary data to establish next General Operating Rules

The General operating rules (RGE) is the main document presenting the normal operating domain of ITER based on the authorized domain (RPrS). In coherence with RPrS, the RGE shall present the operating means or provisions implemented to stay or come back into the normal operating domain.

The role of the Contractor is to support IO in the delivery of the RGE in coherence with

#### *5.1.10.1 Inputs*

- ITER concept of operations
- Systems concepts of operations
- ITER Research plan
- Facility operating definitions
- ITER maintenance plan
- PBS maintenance plan
- Operations management plan
- Maintenance management plan
- OHS/RBSG/NS management plan
- WP4 – Accidental scenarios (DBAs, BDBAs)
- WP8 – Integrated analysis (PIC classification, AARs, operating domain)

#### *5.1.10.2 Activities*

- Review the input documents and make recommendations
- Review the RGE to be prepared by IO and make recommendations
- Consider RGE feedback for RPrS update

#### *5.1.10.3 Outputs from the Contractor*

- Formal review of RGE
- Update of RPrS in coherence with RGE

### 5.1.11 WP 11 – Emergency preparedness & response plan parts - PUI

The role of the Contractor is to support IO in the delivery of the emergency preparedness and response plan (PUI) taking into account the steps of the project and the stages of the operations as well as the upgraded RPrS and the RGE to be envisioned.

#### *5.1.11.1 Inputs*

- All existing PUI related documents, data on onsite source term established by IO
- ASN guidance and current regulations
- International standards

#### *5.1.11.2 Activities*

- Review the input documents and make recommendations for emergency preparedness and response
- Draft some PUI parts when necessary to support the RPrS content in collaboration with IO-SQD/SHS

#### *5.1.11.3 Outputs from the Contractor*

- PUI parts and/or contingency plan for the workers

### 5.1.12 WP 12 – Safety file for the First plasma

The role of the Contractor is to support IO in the delivery of the safety file for the first plasma:

#### *5.1.12.1 Inputs*

- All inputs of all work packages
- Presentation of the staged approach
- Presentation of the configuration of the Machine and the PBS for the first plasma
- The definition of the commissioning tests, the commissioning tests procedures, instructions, records and results expected before the first plasma,
- The presentation of the operations in the framework of the first plasma phase, the operating rules and instruction for the first plasma phase,
- The organisation foreseen to be implemented for the first plasma.

#### *5.1.12.2 Activities*

- Review and assess the hazards on workers and public as well as any detrimental effects on the environmental protection related to the operations during first plasma phase:
    - activation phenomenon
    - effluent production
    - waste management
    - hazard due to magnetic field
    - hazard due to cryogenics
    - hazard due to high voltage
    - hazard due to PE or high energy pipes
    - hazard due to the storage or the use of hazardous substances

- Establish provisions to prevent, to detect and to mitigate the hazards mentioned above and their consequences in accordance with the relevant regulation and following a graded approach
- Write the Safety file presenting the hazards and the provisions mentioned above
- Review the operating rules and instruction to cover the operations during first plasma
- Write a safety file presenting the Operating feedback experience of IO as a Licensee based on the commissioning tests for first plasma dealing with OHF, among other things.

#### *5.1.12.3 Outputs from the Contractor*

- A safety file written in French:
  - to demonstrate safe operations for first plasma in compliance with relevant regulations including activation phenomenon, effluent and waste management, industrial hazards for workers and public as well as detrimental effects on the environmental protection
  - to present the provisions to prevent, to detect and to mitigate these hazards and their consequences
  - the results of the commissioning tests and their analyses.
- Safety file, written in French, presenting the Operating feedback experience of IO as a Licensee based on the commissioning tests for the first plasma
- A report presenting the review of the operating rules and instruction to support operations during the first plasma phase.

## 5.2 Scope of work – Optional part

The Contractor could be asked to provide additional support to the IO for the topics identified in chapter 33. The option 1 will be organised using "*Work assignment technical specifications"*.

For each type of Contractor's staff that the Contractor will estimate to be potentially needed to execute a requested specific work among the above-mentioned ones and to deliver the corresponding final report on scope, agreed schedule and quality, a unit price for the hourly rate will be provided by the Contractor in its bidding offer.

A communication protocol for both the firm part and the optional part of this contract between the Contractor and the ITER Organization Contract Responsible Officer will be established based on the IO internal organization as below:

- PBS TRO for the Systems or Buildings design,
- PBS TRO and SRO for Waste and effluents management,
- SRO for the ICPE list and risks,
- OPD and SQD entities (EPNS, SHS, RBSG) for the Operation of the facility,
- OPD and SQD entities (EPNS, SHS, RBSG) for Human and Organisational Factors,
- PBS TRO and SQD entities (EPNS, SHS, RBSG) for the Protection Important Activities and Protection Important Components (List, classification, qualification, Hardened safety Core Components...),
- SQD entities (EPNS, RBSG) for the Management of radioactive during normal or accidental situations,

- RBSG and SHS for the Management of toxic materials and beryllium during normal or accidental situations,
- RBSG for the inventory of radionuclides and the source term,
- RBSG for the activation calculations,
- RBSG and PBS TRO for the radiation safety provisions,
- SQD entities (EPNS, SHS, RBSG) and CIO Transverse Function for the Support studies for hazards risks,
- OPD and SQD entities (EPNS, SHS, RBSG) for the Commissioning operations and associated safety requirements, General operating rules of the facility,
- SQD entities (EPNS, SHS, RBSG) for the Emergency planning and crisis management requirements.

Within the scope detailed in chapter 4.3, the following types of deliverables are expected as part of this option 1:

1. Reports related to ITER systems, structures or components,
2. Reports on results of modelling and calculations,
3. Analysis and synthesis of regulatory texts and their impact on the ITER safety demonstration,
4. Analysis and synthesis of literature reviews (R&D results with impact on the ITER safety demonstration),
5. Assessment of changes from design, construction, assembly, operation activities and their impact for the safety files update
6. Verification of the conformity of the assumptions used in licensing documentation, (conformity with assumptions under configuration management),
7. Synthesis of the licensing information used which needs to be propagated in the baseline documents.

Each time the need of specific support activities from the Contractor will be expressed by the IO RO, the IO CRO will issue a *work assignment technical specification* defining:

- the list of deliverables to be provided,
- their technical content (input data, the detailed specification),
- the schedule and deadline,
- the necessary meetings for the follow-up of the works,
- the need for the works to be performed on the ITER site, or not.

The Contractor will have to provide an offer to IO within two weeks including:

- proposed profiles existing within the Contractor staff able to perform the specified works (see also chapter **Error! Reference source not found.**),
- confirmation of its ability to meet the schedule,
- an offer indicating the firm price for delivering the required documents, based on the hourly rates featured in the contract.

Upon agreement with the Contractor, a formal work assignment will be issued by IO mentioning the technical request, the deliverables, the deadline and the firm price.

The input data needed to perform the work will be provided by ITER Organization. General work plan and guidelines will be established by IO.

The Contractor shall provide written deliverables in French dealing with the scope described in this document for the first Plasma Operations and, separately, topics dealing with the DT phases with all safety cases and RPrS upgrade proposals.

The IO can terminate the contract, after duly notification each time and justification of the non-compliance, if work appear to be insufficient when assessed against the work plan, guidelines and agreed methodology and processes and/or when IO directions are not complied with by the Contractor, without compensation.

# 6 Estimated Duration

The estimated starting date of the contract shall be after contract signature. Implementation of the activities shall only start after the Kick off Meeting (T0). The expected duration of contract is for the firm part **T0 + 24 months**. Tokamak Complex (Buildings B11, B74, B14), Hot Cell Complex and TAP Building (for provisional Beryllium storage) are part of this contract framework regarding source term prospects.

# 7 Specific requirements and conditions

The official language of the ITER project is English and therefore all input documentation relevant for this Contract will be mainly in English. However, since the licensing documentation is to be submitted in French, all final output documents are requested in French. The required language for each deliverable will be defined on a case-by-case basis. Therefore, it is required that only persons fully fluent in French can be selected for the writing of the deliverables. Evidences and tests can be required.

Therefore, the Contractor shall ensure that all the professionals in charge of the Contract have an adequate knowledge of English and perfect French proficiency in writing, to allow easy communication and adequate drafting licensing documents.

The following skills are mandatory to perform the contract:

- Established safety engineers who have a substantiated experience in writing safety reports to ASN/IRSN. Those collaborators will lead Work Packages.
- Demonstrated and practical experience for participants in nuclear and radiation safety with substantiated experience in Hazard analysis, nuclear safety report integration and coordination.
- Senior Nuclear safety engineer or technical experts in following areas:
    - Confinement and HVAC/detritiation systems design
    - Radiation protection
    - Safety demonstration including FMECA, identification of PIEs, accident analysis, classification of PIC, definition of defined requirements
    - Fire analysis
    - Human and Organizational Factors integration

This will be part of the selection criteria.

## 7.1 Place of performance for core team

The work may require the presence of the Contractor’s personnel at the site of the ITER Organization, Cadarache, 13108 St Paul-lez-Durance, France.

This will be defined according to the Contractor organization and on a case-by-case basis through the work assignments for what concerns the option part.

### 7.2 Logistics support

The IO will provide the following support for the team who will be on site (free of charges):

- A working place, Supply (electrics, water, IT…),
- Connections/ capacity/ bandwidths,
- Office furniture,
- Computer/work-station,
- IO-configured hardware,
- IO-configured software & licenses,
- Phone line, e-mails,
- Meeting rooms with visio-conference capabilities.

The contract collaborators supporting the onsite team will perform the activities in the contractors' premises. The contracting organization shall have fully licensed versions of all relevant codes and the computer resources to carry out the required analyses and activities. In the case of offsite work, the Contractor shall be required to propose and implement a suitable connection scheme.

## 8 Responsibilities

IO shall assign one IO representative, to work as sole Contractor interface.

The IO representative will assess the performance and quality of the work. The main criteria will be:

- Mobilization of a team based on skills as expected and described in chapter 8 (including proper back office for expertise), as well as capacity to be integrated with IO and to enhance safety engineering approach between Contractor/IO team.
- Technical content, quality, of the deliverables based on Contractor's skills as expected and described in chapter 8 and capability to enhance integrated approach (coherency between documents, in the approach…)
- Milestones and deliverables provided according to schedule

The IO representative shall be responsible for checking the deliverables against requirements, schedule the processes (including CAD).

IO shall make available to the Contractor all technical data and documents that the Contractor requires to carry out its obligations pursuant to this specification in a timely manner. For delays of more than two weeks in making them 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 launch immediately.

### 8.1 Contractor's responsibilities

The Contractor shall ensure that he complies with the following:

- The Contractor shall guarantee that all input information provided to perform the task remain property of IO and shall not be used for any other activity than the one specified in this specification;
- The Contractor shall have access to a fully documented set of processes and procedures in its own Quality Management System to execute the service tasks in case the process in not yet available in IO;

- The Contractor shall be in charge to provide evidence of the competence of its personnel and provide its personnel with the training & coaching to the level of competence required;
- The Contractor shall provide an organization suitable to perform the work as described in this specification;
- The Contractor shall work in accordance with the QA plan approved by IO;
- The Contractor shall perform the activities accordingly to this specification taking into account all relevant additional documents and IO processes into account (hand books, export control, intellectual properties, …);
- The Contractor shall be responsible to produce and manage, using the ITER software platform, all the documents listed in chapter 11.
- The Contractor shall provide to the IO representative full access to its work premises and related documentation, to permit to follow up the progress of the work
- The Contractor shall guarantee that all input information provided to perform the task remain property of IO and shall not be used for any other activity than the one specified in this specification.
- The Contractor shall be in charge of the training & coaching of all its resources. Identification and change of Contractor's core team on IO approval.
- The Contractor shall provide an organization suitable to perform the work as describe in this specification;

Prior to the start of work on each activity, the Contractor shall review the input technical information provided to it by IO for completeness and consistency, and shall advise the IO representative of any deficiencies it may find. The Contractor shall not be responsible for errors in the input technical information, which could not be reasonably detected during such a review; duration of this review will be agreed between the Contractor and IO representatives and will have no impact on the delivery schedule.

During the execution of its contract, the Contractor shall be responsible to:

- Before starting the task propose and agree with the IO-representative the solutions intended to be put in place or developed to respond to the problem,
- During the task, alert and come to the IO-representative to find out any missing information, late input delivery, difficulty in controlling its work, and more generally be pro-active in providing solutions and resolving issue.

# 9 Acceptance Criteria

All deliverable shall be reviewed in the IO system: IDM for relevant output, ENOVIA for relevant output.

An IDM folder to store the input and related output will be specified at the kick-off of each activity.

The process of acceptance is driven by IO internal process of approval, until this process is completed, modifications can be requested of the Contractor. The IO approval process involves all the interfacing system concerned.

The form of deliverable is according to the formalized in Section 11. Any deviations, if not previously agreed, may lead to the deliverable being refused.

The maximum time for IO acceptance / comments is 15 working days after the storage (+IDM email) of the deliverables in IDM. After this period if no action has been performed by the IO, the deliverable shall be considered as accepted.

Non-CAD deliverables (Graphics, PowerPoint Documents, etc.) will be reviewed upon delivery by the IO RO/RE and will be accepted if compliant with the requirements advised by the RO at the start of the task, all these documents shall follow an IDM workflow.

In case of non-compliance / conformity of a deliverable or a set of deliverables, the Contractor shall correct them and re-submit them for review and acceptance; resubmission shall be at Contractor's cost.

In case of non-compliance / conformity of a deliverable or a set of deliverables, the Contractor shall correct them and re-submit them for review and acceptance; resubmission shall be at Contractor's cost.

Once the deliverable is submitted by the Contractor in IDM, the deliverable may be considered as accepted if there is no comment from IO with 15 working days.

# 10 Work Monitoring

The WP shall be launched after the Kick off Meeting where the Contractor will present the work plan, including the main milestones (meeting, deliverables…). For what concerns the option part, specific schedule will be prepare for each Work Assignment Technical Specification. Tasks associated will be integrated to the global schedule. That will be IO responsibility to integrate those specific tasks to the global schedule as appropriate.

The parties will interact as much as possible regarding technical matters using telephone, emails. In all the exchange, the IO RO and the Contractor RO will be in copy of all the exchanges.

Quarterly contract management meetings shall be conducted between the Contractor and the IO RO, if needed other meeting may be needed after mutual agreement. This progress meeting could be organized the same days of preparation and technical meetings.

Section 11 below sets out the proposed IO delivery schedule for the Work Package. The Contractor shall review and provide to IO for approval, within two weeks following contract entry into force a detailed schedule to meet the delivery requirements.

The Contractor has to deliver the documents/database at the due date as summarized in the table here after. The required input data is given to the Contractor at least 2 weeks in advance of the delivery date.

# 11 List of Deliverables

## 11.1 Firm Part

The contract will start at T0 (kick-off meeting date).

IO proposes (the deliverables could be updated based on the Contractor proposal and experience but the logic shall be maintained) following milestones as shown in the following table:

| Deliverable description | Due date |
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| **WP1 – Contract management** | |

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| Minutes of Kick off meeting | T0 + 1 week |
| Contract Management Plan | Version A: T0 + 3 weeks |
| | Version B: T0 + 3 months |
| Quarterly Status report | Every 3 months |
| Minutes of the Contract management meeting | Every 3 months |
| Input data review & completion report | T0 + 2 months |
| **WP 2 – Familiarization of the context and validation of the integrated approach** | |
| Minutes of Introduction meeting #1 – ITER Nuclear Safety | T0 + 2 weeks |
| Minutes of Introduction meeting #1 – Confinement | T0 + 3 weeks |
| Minutes of Introduction meeting #2 – Limitation of external exposure (Radiation safety) | T0 + 4 weeks |
| Minutes of Introduction meeting #3 – PBS set 1 | T0 + 5 weeks |
| Minutes of Introduction meeting #4 – PBS set 2 | T0 + 6 weeks |
| Minutes of Introduction meeting #5 – PBS set 3 | T0 + 7 weeks |
| Minutes of Introduction meeting #6 – PBS set 4 | T0 + 8 weeks |
| Integrated approach Workshops | 1st: T0+1 month<br>2nd: T0+1,5 months |
| Input data review & completion report | T0 + 2 months |
| Integrated approach procedure | T0+2 months |
| Regulatory inventory database and compliance matrix associated | Va: T0+2 months<br>Vb: T0+12 months<br>Vc : To+24 months |
| Generic content of description RPrS volume of ITER, its environment, and its operating phases | T0+3 months |
| Formal review of the support descriptive documents | Batch 1: T0+3 months<br>Batch 2: T0+6 months<br>Batch 3: T0+9 months<br>Batch 4: T0+12 months<br>All batches: T0+18 months |
| **WP 3 – Functional analysis of ITER and for the PBS playing a role for the confinement function & design verification with simulations** | |
| Functional analysis of ITER confinement function | Va: T0+3 months<br>Vb: T0+6 months<br>Vc : T0+12 months |
| Support and review the PBS Functional analysis (14 main PBS – see the list) | Va: T0+3 months<br>Vb: T0+6 months<br>Vc : T0+12 months |

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| One PFD for all the operating modes (PFPO, mode 0, mode 1)<br>One calculation note (SYLVIA simulations) | Va: T0+6 months<br>Vb : T0+12 months |
| **WP 4 - Identification and review of the accident scenario** | |
| AAR updated - Event Identification and Selection | Update T0+3, To+12 months, To+18 months |
| AAR updated - Reference Event Analysis | Update T0+6, To+15 months |
| AAR updated – Hypothetical Event analysis | Update T0+8, To+17 months |
| **WP 5 – FMECA analysis** | |
| FMECA reports on PBS "1st barrier (static confinement)" | Va: T0+6 months<br>Vb: T0+12 months |
| FMECA reports on PBS "Dynamic confinement" | Va: T0+6 months<br>Vb: T0+12 months |
| FMECA report on PBS "Controls" | Va: T0+6 months<br>Vb: T0+12 months |
| **WP6 – Human and organization factor (HoF) analysis** | |
| HoF report | Va: T0+8 months |
| HoF RPrS chapter (French) | Va: T0+12 months<br>Vb : T0+18 months |
| **WP7 – Fire analysis** | |
| Methodology of the fire analysis | T0+2 months |
| Tokamak and Tritium buildings fire analysis | Va: T0+6 months<br>Vb: T0+12 months<br>Vb: T0+18 months |
| Verification and validation report(s) for the fire modelling tool(s) | Va : T0+15 months<br>Vb: T0+19 months |
| Fire computations for the fire scenarios and the generalized fire | Va: T0+6 months<br>Vb: T0+12 months |
| Summary of the fire analysis for the RPrS | Va: T0+12 months<br>Vb: T0+18 months |
| **WP8 – Integrated analysis** | |
| Updated PIC/PIA list, classification of PIC according to importance, with defined requirements | Va: T0+13 months<br>Vb: T0+16 months<br>Vb: T0+18 months |
| PIC/PIA summary report "*Dossier de synthèse de la qualité* » | Va : T0+12 months<br>Vb : To+18 months<br>Vc : To+24 months |
| Updated operating domain of the PBS | T0+14 months |
| AAR validated to be used in the RPrS chapters | T0+14 months |
| **WP 9 – RPrS integration** | |

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| RPrS update chapters | Va: T0+6 months<br>Vb: T0+12 months<br>Vc: T0+18 months<br>Vd: T0+24 months |
| **WP 10 – (Preliminary) General Operating rules** | |
| Formal review of RGE | Va: T0+6 months<br>Vb: T0+12 months<br>Vc: T0+18 months<br>Vd: T0+24 months |
| Update of RGE in coherence with RPrS | RGE Vb: T0+14 months<br>RGE Vb: T0+20 months<br>RGE Vc: T0+24 months |
| **WP 11 – PUI** | |
| PUI parts and/or contingency plan for the workers especially for radiation and Beryllium risks | Va: T0+21 months<br>Vb: T0+24 months |
| **WP 12 – Safety file for the First plasma** | |
| First Plasma Safety File | Va: T0+6 months<br>Vb: T0+12 months<br>Vc: T0+18 months<br>Vd: T0+24 months |
| Safety file presenting commissioning for First plasma | Va: T0+18 months<br>Vb: T0+24 months |
| Report presenting operating rules and instruction to support operations during the first plasma phase | Va: T0+18 months<br>Vb: T0+24 months |

### 11.2 Option part

For what concerns the option part, specific schedule will be prepare for each Work assignment technical specification with a Ti and due date to finish the activities. **Tasks associated will be integrated (The Contractor is the RPrS integrator) to the global schedule**. The latest Work assignment technical specification shall be integrated to the global schedule to be properly integrated into the Firm part deliverables.

## 12 Quality Assurance (QA) requirement

The Contractor should have ISO 9001 accredited quality system. Otherwise, the Contractor shall have QA Programme approved by the IO.

The general requirements are detailed in ITER_D_22K4QX - ITER Quality Assurance Program (QAP) and ITER Procurement Quality Requirements (ITER_D_22MFG4).

Prior to commencement of the work, a Quality Plan which complies with Procurement Requirements for Producing a Quality Plan (ITER_D_22MFMW) shall be submitted to IO for approval with evidence of the above. The Contractor's Quality Plan shall describe the

organisation for tasks; roles and responsibilities of workers involved in; any anticipated sub-contractors; and giving details of who are the independent checkers of the activities.

Where any deviation is requested or non-conformity has happened from the Technical Specification, Contractors Deviations and Non Conformities the ITER Requirements Regarding Contractors Deviations and Non Conformities (ITER_D_22F53X) shall be followed.

Documentation developed as the result of this task shall be retained by the Contractor of the task for a minimum of five (5) years and then may be discarded at the direction of the IO.

IO will monitor implementation of the Contract's Quality Plan. Where necessary, IO will assess the adequacy and effectiveness of the quality system specified in the Quality Plan through surveillance or audit. Where condition adverse to quality is found during monitoring, IO may request to the Contractor to take corrective action.

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). Where applicable, Software Qualification Policy (KTU8HH v1.2) shall be taken into consideration to ensure quality and integrity of software prior to application.

Neutronic analyses have to be performed following the ITER QA requirements for analyses and calculations: ITER_D_22MAL7 - Analyses and Calculations and ITER_D_R7XRXB - Instructions for Nuclear Analyses.

# 13 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.

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).
- 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. (Please refer to ITER_D_4EUQFL - Overall supervision plan of external interveners chain for Protection Important Components, Structures and Systems and Protection Important Activities).

The scope of this contract includes Protection Important Activities. In that case, the PIA will be identified in the work assignment, with the associated defined requirements. In addition, the Contractor will have to demonstrate compliance with ITER_D_SBSTBM - Provisions for Implementation of the Generic Safety Requirements by the External Actors/Interveners

In practice, and according to, the calculations to be carried out in the scope of this contract are a PIA. The defined requirements associated to this PIA are defined below:

| Defined Requirement | Provisions to be implemented in this contract |
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| The input data shall be:<br>- Up to date<br>- Validated<br>- Consistent with safety demonstration<br><br>For undefined input data:<br>- Clearly identified and referenced assumptions<br>- Sensitivity study to assess the impact of the range of assumptions or use of non-arguable conservative assumptions<br>- Formally validated baseline or conservative input data in the document in support of the safety analysis | - Input data to be provided by IO to ensure that the input is formally validated baseline or conservative input data in the document in support of the safety analysis.<br>- The contractor shall apply the instructions for verification of input for radiation transport calculations.<br>- The contractor shall apply the instructions for nuclear analysis.<br>- The contractor shall clearly define and identify the assumptions taken. |
| The calculation model used shall always be equally or more conservative than the Configuration Management Model (CMM). | Input data to be provided by IO to ensure that the input is formally validated baseline or conservative input data in the document in support of the safety analysis |
| The method and code shall be qualified | The contractor shall apply the instructions for nuclear analysis. |
| The method and code shall be used within its qualification domain. | The contractor shall apply the instructions for nuclear analysis and the requirements stated in this specification. |
| The uncertainties associated with the methods shall be estimated, or additional margins shall be added and substantiated, through sensitivity studies. | The contractor shall apply the instructions for nuclear analysis where the estimation of uncertainties is part of the output data and acceptance criteria. |
| The parameters (including input data) that have strong impact on the results shall be identified. | As part of this contract, the contractor shall identify the parameters (including input data) that have strong impact on the results and provide it in the final report. |
| All input data, methods codes and their validity domain and uncertainties shall be included in the report. | The contractor shall apply the instructions for nuclear analysis and the requirements stated in this specification. |
| Intermediate and final results shall be expressed in international units. | Intermediate and final results shall be expressed in international units. |

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| A sensitivity studies shall be performed for covering uncertainties or additional safety factor in the results and the results shall be integrated in the report. | The contractor shall apply the instructions for nuclear analysis where the estimation of uncertainties is part of the output data and acceptance criteria. |
| The acceptance criteria shall be included in the report; all margins and safety factor shall be expressed in safety limits. | All margins and assumed safety factors shall be given in the final report. |