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ITER Plant Simulator platform - Technical Summary

This document provides the summary of the technical specificationfor the production and delivery of the ITER Plant Simulator platform.

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1 Purpose

This document provides the summary of the technical specification for the production and delivery of the ITER Plant Simulator (IPSi) platform, including the licensees of the codes used, the training and the production of specific system level models.

2 ITER Plant Simulator

ITER Organization has initiated the development of the ITER Plant Simulator with the main objective to deploy it for the Operator Training.

Since the construction and operation of ITER is performed in four phases, the ITER Plant Simulator will evolve from the first to the fourth phase to adapt its configuration and functionalities to the one of the actual ITER Plant. Because of that, the ITER Plant Simulator shall be designed and built in a flexible and modular manner.

As shown in Figure 1, the ITER Plant Simulator architecture will include:

- The models of the systems with relevant local control (I&C), in light blue in Figure 1;
- The simulation or emulation of the central control systems and the human machine interface, in orange in Figure 1;
- The platform able to synchronize all models, to configure the initialization of scenarios and to run them, to store data and to manage the interaction between instructor and IPSi through the instructor desk, in green in Figure 1.

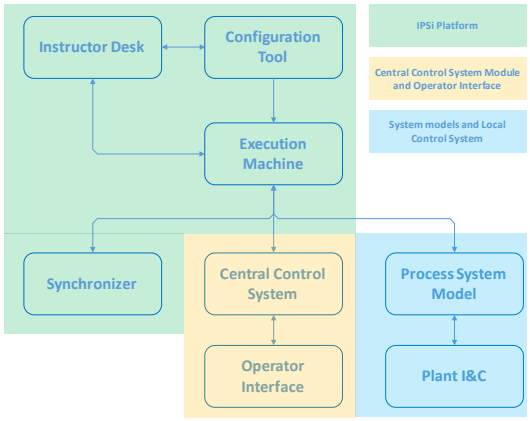

Figure 1 – ITER Plant Simulator: overall architecture

3 Acronyms

FP	First Plasma
IPSi	ITER Plant Simulator
KoM	Kick off Meeting

For a complete list of ITER abbreviations see: ITER_D_2MU6W5 - ITER Abbreviations

4 Definition

For the purposes of this document, the following definitions are introduced in the frame of the ITER Plant Simulator production and deployment.

Control system The control system is intended as the set of hardware and control loops that monitor and regulate the process system acting on variables.
Control system can be local or centralized:
- Local control system acts on local system variables (internal variables);
- Central control system acts on central variables (external variables).

Internal variables are necessary to run a module with the relevant control system. External variables are necessary to synchronize modules running in parallel.

Emulation Emulation of control system is intended as an imitation of the actual control system. This imitation runs on a generic CPU and operates in a virtual environment instead of the real world. The virtual environmental is typically the one of a Simulator.

Module A module is a set of logic and equations executing specific functions and representing a (sub-)process system or a (sub-)control system (local or centralized). Module(s) run on dedicated machine(s) to simulate or emulate the response of a control system or a process system, in dynamic mode. Internal variables are defined for each module with the goal to define initial configuration and compute the transient scenarios. External variables are defined for each module in order to synchronize it with other modules. All modules shall be connected to an execution machine or to another module.

Process system model Model of a system including key equipment performing active functions, such as
- Pipes or cables to transfer fluid or electrical current
- Valve to modulate or stop the flow
- Pumps to provide head to the fluid
- Heat exchanger to exchange power.

Process system includes all type of processes, e.g. fluid and electrical ones.
The equipment characteristics introduced in the model are the ones delivered by the manufactured and verified by test.

Simulation Simulation of control system is intended as rewriting of the control logic specification for reproducing the behavior of the actual control system.
This reproduction can be done in the same model simulating the process system or using an independent model.

5 References

[R1] ITER_D_2DY7NG - Project Specification (PS)
[R2] ITER_D_24QSG6 - ITER Research Plan Level - 1
[R3] PCR-738 - Establishment of the 2016 ITER Baseline

6 Standards

S.1. ANSI/ANS-3.5-2009 «Nuclear Power Plant Simulators for used in Operator Training and Examination»

7 Required expertise

The candidates shall have demonstrated capabilities and experience through various projects in the fields of real time plant simulator development, maintenance and deployment for operator training. The specific experience and qualities sought by IO include:

- Supplying and maintaining Plant Simulator platform(s) for operator of electrical, chemical or other relevant facilities;
- Developing and maintaining preparatory code for the production of Plant Simulator;
- Adapting the code and the Plant Simulator platform architecture to the operator (client) needs, e.g. modularity and flexibility requirements;
- Integrating system model provided by third party and/or by the clients into the Plant Simulator platform;
- Providing methods and tools to simulate multi-phase, multi-component physics with fast transient, in real time;
- Integrating third party control systems within the Plant Simulator platform(s), based on both simulated and emulated approach;
- Providing commercial software/hardware interfaces between the preparatory code and platform and other modules representing the process systems and the control systems;
- Demonstrated capability to develop new software/hardware interface(s), if any need;
- Demonstrated capability to cope with multi-years cooperation for the production of highly evolutionary Plant Simulator, and deployment of resources at client's premises.

Given the very broad scope of experience needed, the IO would like to encourage interested parties to form consortia to achieve a solid coverage of the complete spectrum.

The working language of ITER is English, and a fluent professional level is required (spoken and written) by all staff working under the Framework Contract and Task Orders.

8 Scope of Work

The scope of work of this summary includes the following:

- The production the ITER Plant Simulator platform, in green in Figure 1;
- Licensing and maintenance of the code(s) used for ITER Plant Simulator platform;
- Delivering of training of users;
- Supplying specific module(s) constitutive of ITER Plant Simulator, such as the ones simulating the electrical systems;
- Any technical support for the specification and integration of:
    - Production and delivery of software and/or hardware interfaces, among the platform and other item of the Simulator (such as third party modules simulating process systems);
    - Integration of third party modules (such as third party modules simulating process systems) and central control systems within IPSi;
    - Deployment of IPSi for operator training, including preparation of operator training.

The work not included in the scope of this summary is listed below:

- Development of module using third party code, including licensing of third part code;
- Hierarchical specification of Control Systems and relevant implementation in IPSi;
- Drafting of the operating procedures;
- Licensing of third party code;
- Development of module using third party code;

- Hardware for running IPSi, based on the assumption that IPSi platform does not require any special hardware and that standard CPU and computer can be used;
- Post First-Plasma configuration.

The contract will be organized in task order with a contract ceiling value established in the frame of the procurement process.

The scope related to post-First Plasma is not included in this summary. IPSi extension will be deemed necessary to align it with post-First Plasma configuration, beyond the scope of this technical specification. The future involvement of the Contractor for IPSi extension is a key success factor and it will be realized through later contract(s). In the frame of this Contract, IO intends to establish a long term partnership with the Contractor and to define preliminarily the mechanisms for later contract(s) extension, e.g. market price index for planning fair evolution of price.

9 Quality Assurance Requirements

As a Nuclear Operator, IO requires that for the entire duration of the Framework Contract, Contractors shall hold, and maintain, as a mandatory requirement, a valid ISO 9001 (or an equivalent QA program approved by the IO). Failure to do this may lead to a potential termination of such contract.

The missions and tasks executed under this Framework Contract shall be carried out in compliance with the applicable IO Quality Requirements.

10 Contract organization

The contract will be organized in task order with a contract ceiling value established in the frame of the procurement process.

Following the contract award, Task Orders will be issued for the execution of the contract.

All the services requested in the frame of the contract will be detailed in the Technical Specification, and the scope of the Task Order will refer to it. The cost of the Task Order will be defined based on the financial aspects agreed at the contract awarding.

The work execution will be on a deliverable basis.

The first task order will be finalized at the KoM soon after the contract awarding and the first task is planned to be completed by end of 2020.

The ITER Organization will award the Contract for a total period of 48 months.

11 Tender timeline

The tentative timetable for setting up the contract is as follows:

- Call for nomination sent: July 2020
- Pre-Qualification launch: September 2020
- Call for Tender launch: October 2020
- Award of the Contract: February 2021

12 Candidature

Participation is open to all legal entities established in an ITER Member State, which is:

- European Union including Switzerland (EURATOM Members),

- Republic of India,
- Japan,
- People's Republic of China,
- Republic of Korea,
- Russian Federation,
- United States of America.

On 31 January 2020, the UK left the EU and EURATOM with a transition period from 1st February to 31 December 2020 to be used to determine the conditions of their future relationship. EURATOM is the ITER Member and the withdrawal of the UK from EURATOM leads to the fact that UK is not anymore party to the ITER project.

Until the 31 December 2020, current end date of the transition period, UK entities retain the right to participate in IO procurement procedures.

After the end of the transition period, when the EURATOM Treaty ceases to apply to and in the UK, any UK entities bidding as a prime contractor or consortium partner will be rejected from the IO procurement procedures. UK entities will no longer be recognised as entities of an ITER Member and will no longer have the right to participate in IO procurement procedures, unless the UK has entered into an agreement with EURATOM. Where UK entities can demonstrate a unique and specific competence in a certain field the IO, with approval of the ITER Council, may also allow them to participate in a procurement procedure.

Participation is open to all legal persons participating either individually or in a grouping (consortium). All legal persons including all consortium members should be established in an ITER Member State. A legal person cannot participate individually or as a consortium partner in more than one application or tender. A consortium may be a permanent, legally established grouping or a grouping that has been constituted informally for a specific tender procedure. All members of a consortium (i.e. the leader and all other members) are jointly and severally liable to the ITER Organization. The consortium cannot be modified later without the approval of the ITER Organization.

In the event of a consortium, a draft of the Consortium Agreement, or letter of intent and Power of Attorney signed by all the consortium members shall be submitted together with the tender. Legal entities belonging to the same legal grouping are allowed to participate separately if they are able to demonstrate independent technical and financial capacities. Bidders (individual or consortium) must comply with the selection criteria. IO reserves the right to disregard duplicated references and may exclude such legal entities from the tender procedure.

13 Contractor's responsibilities

Further information on the ITER Organization procurement can be found at:

http://www.iter.org/org/team/adm/proc/overview.