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Report

Summary of Technical Specifications for Final design of PCS for 1st Plasma Operations

Summary of Technical Specifications for Final design of PCS for 1st Plasma Operations For Call for Nomination This document summarizes the scope of work and requirements for the framework contract to be placed for the final design of Plasma Control Systems (PCS) for 1st Plasma Operations. The purpose of this contract is to prepare the final design of the ITER Plasma Control System (PCS) PBS-47 for 1st Plasma Operation. A Final Design Review will assess the design before it will be implemented and tested by PBS-45 CODAC. Further information including final technical specifications and draft contract will be sent with the Call for Tender.

<i>Approval Process</i>			
	<i>Name</i>	<i>Action</i>	<i>Affiliation</i>
<i>Author</i>	De Vries P.	24 Jan 2017:signed	IO/DG/COO/SCOD/SCD/STCO
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<i>Reviewers</i>	Snipes J.	24 Jan 2017:recommended	IO/DG/COO/SCOD/SCD/STCO
<i>Approver</i>	Campbell D.	25 Jan 2017:approved	IO/DG/COO/SCOD
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<i>RO: De Vries Peter</i>			
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Change Log

Summary of Technical Specifications for Final design of PCS for 1st Plasma Operations (U8TR8H)

<i>Version</i>	<i>Latest Status</i>	<i>Issue Date</i>	<i>Description of Change</i>
v1.0	Signed	19 Jan 2017	
v1.1	Approved	24 Jan 2017	Adopted changes suggested by J. Snipes



Summary of the Technical Specification for Final design of PCS for 1st Plasma Operations

Call for Nomination

Purpose

This document summarizes the scope of work and requirements for the framework contract to be placed for the final design of Plasma Control Systems (PCS) for 1st Plasma Operations.

The purpose of this contract is to prepare the final design of the ITER Plasma Control System (PCS) PBS-47 for 1st Plasma Operation. A Final Design Review will assess the design before it will be implemented and tested by PBS-45 CODAC. Further information including final technical specifications and draft contract will be sent with the Call for Tender.

Background

The ITER schedule foresees, after the first phase of construction has been completed, a period of integrated commissioning accumulating with generation of first plasma. The requirements for first plasma are to show the fully integrated use of the plant, but not yet to operate a full plasma discharge. The target plasma current is at least 100kA for 100 ms duration, possibly up to 1MA lasting up to a few seconds. It basically consists of only the ITER plasma initiation phase. At this phase of the ITER construction, not all systems will have been completed. The blanket and divertor will not have been installed yet and a provisional set of limiters will be in place to protect the vacuum vessel from the interaction with the plasma. There will be only electron cyclotron (EC) auxiliary heating, to assist the plasma initiation. Only a limited set of diagnostics will be available, some for control and others to monitor the plasma development. Nevertheless, this and the preceding first utilization of the power supplies, poloidal field coils, gas fuelling and EC heating systems will be the first integrated use of the ITER PCS.

The aim is to prepare the final design of the ITER PCS for this operational phase, building on the preliminary design that was carried out previously. The final design needs to be complete, properly assessed, verified, validated and documented, including procedures for its implementation, testing and commissioning. Hence, the development of controllers needs to be accompanied by documented assessment and simulations that verify and validate the design. For this, ITER approved formats, such as the ITER PCS PCSSP and the ITER PCS database will be used, which are also planned to aid the implementation of the design. Close collaboration with the ITER Control System Division is required during the final design phase to optimally prepare for the subsequent implementation. Moreover, procedures need to be developed for the integrated commissioning of the PCS, jointly with the commissioning of the other operational systems. This needs to be done jointly with the ITER operations management section (OMA) to coordinate this work. The ITER CIS is responsible for the protection of the device, but the PCS will provide the first line-of-defence by aiming to avoid interlock events and also acts as an actuator for the CIS to ramp down the plasma and the PF/CS/CC currents.

Many of the tasks within the scope of this design project are linked to multiple ITER systems and thus require an integrated management of the development, documentation and planning for the first utilization of the ITER PCS. The design needs to be ready to allow

ample time for implementation and testing prior to the start of integrated commissioning, presently foreseen about one year prior to first plasma.

Acronyms

CC	Correction Coils
CS	Central Solenoid
CIS	Central Interlock System
ECH	Electron Cyclotron Heating
IO	ITER Organization
PCS	Plasma Control System
PCSSP	Plasma Control System Simulation Platform
PF	Poloidal Field
PS	Power Supplies

Scope of work

The study shall include

- The final design for the ITER PCS architecture and exception handling, required for the full (not only 1st plasma) scope of PCS.
- Develop a set of controllers, delivered in PCSSP, assessed, verified and validated, for:
 - All power supplies and poloidal field coils to generate 1st plasma up to 1 MA for several seconds, as well as use-cases for the commissioning of these systems. Provide first line of defence in protecting the PS and PF/CS coils. At first plasma, the coil and power supply systems should be capable of providing loop voltage and prepare and control, the magnetic null, for an efficient plasma initiation and if necessary burn-through.
 - ECH power between 0.8 MW and 6.7 MW into the plasma to assist with the plasma initiation but importantly avoid unabsorbed power affecting in-vessel components.
 - Gas fuelling to provide pre-fill for plasma initiation, including the feedback control of the pre-fill pressure, and influence the further development of the plasma for burn-through and ensure no slide-away discharge will develop.
 - Detailed descriptions, test and commissioning procedures for all required controllers.
 - Assistance with the further completion of the interface description (interface sheets and required real-time data-exchange (signal list) for all systems necessary up to 1st plasma operations.
- Provide expert assistance in utilizing PCSSP.
 - All controllers, actuator and diagnostic models should be delivered as ITER PCSSP modules in Matlab/Simulink.
 - All controllers should be assessed and validated, using the PCSSP, on a set of use-cases, determined by system commissioning and 1st plasma operations scenarios provided by the IO.
- Provide PCS database assistance on a complete description of the final design
 - PCS architecture required for 1st plasma including all required exceptions and exception handling schemes.

- Description of all necessary interfaces.
- Description of all controllers, including testing and commissioning procedures.
- Determine the requirements for the pulse schedule and schedule editor.
 - Determine what PCS parameters should be visible and tuneable
 - How to select/deselect actuators or sensors and tune controllers and exceptions.
 - How to properly validate schedule against the plant state.
- PCS integrated commissioning procedures up through 1st plasma
 - Procedures for open-loop PCS commissioning and for closed-loop integrated commissioning, including schemes to avoid interlock events and as the first line of defence to protect the device.
 - List the PCS use-cases for integrated commissioning of other systems.
 - Development of a plan for 1st plasma operations, including tests that may benefit the subsequent operational phases. Determine and perform the predictive modelling necessary to carry out 1st plasma operations efficiently.
 - Prepare procedures to validate actuator and diagnostic models.
 - Prepare and test instructions and procedures to update the PCS during operations.
- Provide support to prepare the documentation and presentations for the Final Design Review and present the design at the review.

Timetable

The tentative timetable is as follows:

Tender submission	June 2017
Contract placement	August 2017
Kick-off meeting	September 2017
Completion of Contract	March 2020

Experience

The contractor and its personnel shall have adequate experience in the development of control systems and their implementation for tokamak operations. This includes experience with:

- simulating and assessing plasma control systems,
- commissioning and operations of tokamaks,
- developing and managing, commissioning procedures,
- Enterprise Architect systems engineering databases.

Candidature

Participation is open to all legal persons participating either individually or in a grouping (consortium) which is 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, which 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 groupings shall be presented at the pre-qualification stage. The tenderer's composition cannot be modified without the approval of the ITER Organization after the pre-qualification.

Legal entities belonging to the same legal grouping are allowed to participate separately if they are able to demonstrate independent technical and financial capacities. Candidates (individual or consortium) must comply with the selection criteria. The IO reserves the right to disregard duplicated reference projects and may exclude such legal entities from the pre-qualification procedure.