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Technical Specifications (In-Cash Procurement)

Engineering support in IC H&CD system on Development of IC-PSC prototype & Fast controller Phase 2

The contract scope is to provide expert support to carry design from preliminary design to final design phase. This requires expertise support on following subjects: Development & test of IC-PSC prototype phase 2 in collaboration with CODAC Preparation of contract for the development of IC Plant System Controller fast controller and slow controller programs. It should be noticed that Fast and Slow controller softwares are defined but not fully drafted. They are partly drafted and loaded on CODAC test facility for validation. Support to DAs for their own I&C development in order to check the implementation of CODAC standards and interface with IC-PSC

Approval Process			
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Engineering support in IC H&CD system on Development of IC-PSC prototype & Fast controller Phase 2

Contract Technical Specifications

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1 Background and Objectives

IC H&CD is one of Heating and Currents Drive (H&CD) systems foreseen in ITER. The IC H&CD shall provide radio-frequency (RF) heating and current drive to the ITER plasmas in the frequency range [40 MHz to 55 MHz]. A total of 20 MW of RF power in plasma is initially required from the system. The ITER IC H&CD system is composed of two antennas in port plugs, matching systems, transmission lines, RF power sources (09), HVPS (High Voltage Power Supply) (18), plant control system (IC-PSC) and test facilities (2 RF dummy loads, port plug test facilities).

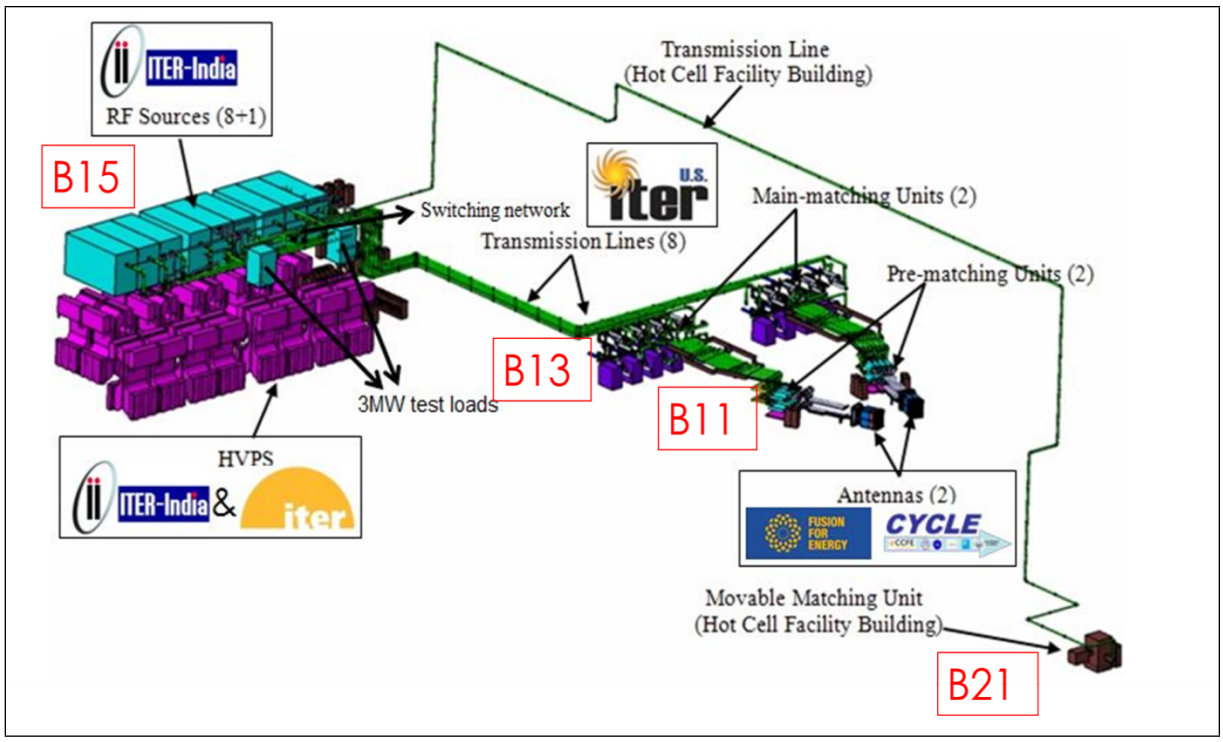

Figure 1: IC H&CD system

HVPS, RS sources, TL & MS and antenna subsystems shall be procured by different procurement arrangements with different domestic agencies. HVPS, RS sources, TL & MS and antenna shall have dedicated local controllers.

IC-PSC, the plant system controller of IC H&CD shall control & synchronize all local controllers.

The functional architecture scheme of the IC H&CD control system consists of a Main Controller (IC-PSC) controlling local/subsystem Control Units. The Main Controller provides the functional/operational interface with CODAC and the Plasma Control System, while the local Control Units controls individual subsystems (HVPSs, RF Sources, TL & MS and antenna) as illustrated in Figure 2.

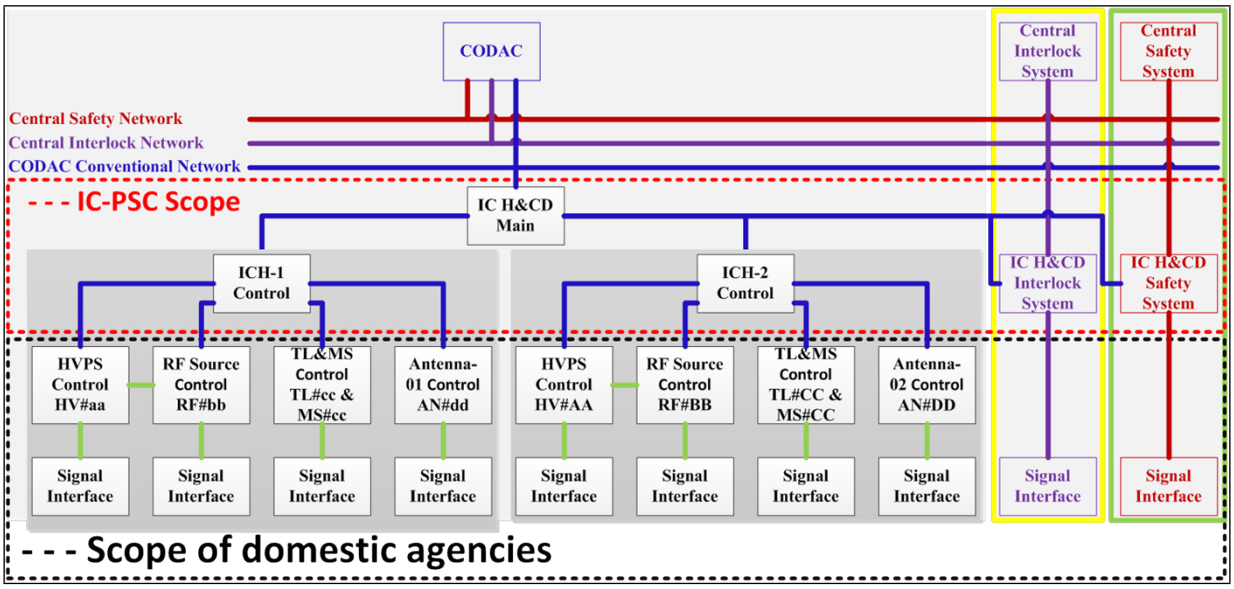

Figure 2: IC H&CD I&C Functional Architecture showing Control Hierarchy

ITER I&C systems shall use CODAC infrastructure & CODAC standards defined in PCDH. The PCDH document defines standards for all ITER plant system instrumentation and control (I&C). Main CODAC standards are briefed below. The expert shall have access to these documents especially CODAC PCDH & relevant documents.

The CODAC Core System is a software package that is distributed by the ITER CODAC Section for the development of the plant system I&C. It includes the software for Mini-CODAC and PSH and it provides the plant system I&C developers with the environment required to develop and test the software in a way that complies with the ITER requirements.

The software is based on EPICS. The software of PSH and fast controllers is based on the EPICS framework and utilities. The Mini-CODAC software is based on EPICS tools, developed within the EPICS community and extended by ITER.

ITER Organization has selected PCI Express as the base I/O bus technology for use in ITER Instrumentation and Control System fast controllers. The main recommended items of the ITER Instrumentation and Control System fast controller catalogue are the PXI, Compact PCI and PXI Express I/O boards. A PXI Express chassis is used to carry the I/O boards. PXI Express I/O chassis is separate from the CPU chassis which will be a standard industrial computer.

ITER Organization has selected Siemens S7 PLC technology for use in ITER Instrumentation and Control System as slow controllers.

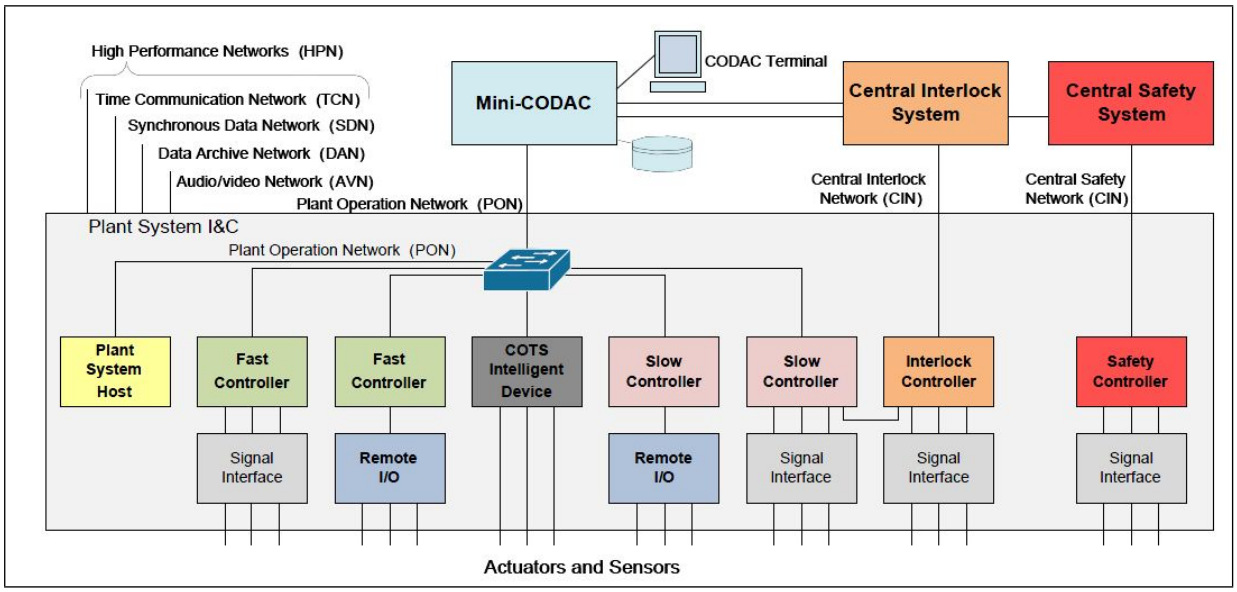

Figure 3: ITER Plant System I&C Physical Architecture (courtesy: ITER CODAC)

IC-PSC, the main controller of IC H&CD shall be procured by IO. IC-PSC has preliminary design done in January 2014, which defined functional and hardware architecture. It reflected as well the work done within the frame of the first external expert contract in the development if the IC-PSC.

The contract scope is to provide expert support to carry design from preliminary design to final design phase. This requires expertise support on following subjects:

- Development & test of IC-PSC prototype phase 2 in collaboration with CODAC
- Preparation of contract for the development of IC Plant System Controller fast controller and slow controller programs. It should be noticed that Fast and Slow controller softwares are defined but not fully drafted. They are partly drafted and loaded on CODAC test facility for validation.
- Support to DAs for their own I&C development in order to check the implementation of CODAC standards and interface with IC-PSC

2 Scope of Work

The scope of this contract includes the supply of specialised engineering services to perform the following activities:

The expert shall work in collaboration with IC H&CD team and CODAC support engineer The expert needs to work independent to provide the deliverables.

2.1 Development & test of IC-PSC prototype in collaboration with CODAC

IC H&CD is carrying out IC-PSC prototype with ITER CODAC help. The purpose of this prototype is to check & implement the functional architecture to hardware & software. It has been first developed during a first contract, but need further development in order to fully implement all IC-PSC interfaces and test the new tools developed by CODAC.

So, for IC-PSC prototype the expert needs to use CODAC core system tools & IC H&CD fast controller functional requirements. IO provide prototype functional specification.

This prototype needs programming of FPGA card and Siemens PLC. Core system uses EPICS as middleware for fast controller & slow controller input/output process variable access. The EPICS IOC shall be running on Red Hat Linux OS platform.

This provides essential experience of CODAC core system and its subsequent evolutions

2.2 IC Plant System Controller - fast controller Performance, Operation, Configuration specification.

IC H&CD I&C requirements like configuration of IC H&CD system controller as per operation mode transition, changing threshold value for interlock & alarms to get sufficient & necessary fast protections & fast feedback functions shall be used for specifying the fast controller performance and operation specification.

RF Systems are somewhat different from conventional system for data acquisition & feedback control aspects. It requires some additional knowledge on the system designs. Knowledge on the digital signal processing is an added advantage for RF system designs.

3 Estimated Duration

The contract will have an initial firm period of 12 months (220 working days). There shall be option to extend the contract for one further period of 12 months.

4 Work description

The expert shall provide the deliverables in the form of reports. IO shall review the reports. The expert shall perform all the necessary modifications or iterations to the reports and submit a revised version.

4.1 Deliverable-1: Development & test of IC-PSC prototype in collaboration with CODAC

- Further develop fast controller part of IC-PSC prototype. Essentially providing software development part & his/her expertise on the PXIe form factors. Programming FPGA cards

- Further develop state machine for different modes of IC H&CD. Other major functions like to operation mode transition within IC H&CD.
- Implement required interface with slow controller and signal & status reporting.
- Provide technical report on the prototype

4.2 Deliverable-2: IC Plant System Controller Technical specification (Performance, Operation, Configuration Requirements)

For this deliverable the expert recollect the IC H&CD I&C requirements coming from fast protections, fast feedback loop and set point passing to the RF Source and communication with PCS during the operation. It shall as well finalize with DA the definition of all interfacing functions:

- Recompile specifications of IC H&CD I&C fast and slow controllers
- Finalize real time fast feedback control specifications of IC-PSC.
- Compile configuration, operation, control specifications

5 Responsibilities (including customs and other logistics)

5.1 Responsibility of ITER

ITER has the responsibility of providing detailed technical specifications when required during the execution of the work described as deliverables.

ITER has the responsibility of timely communicating to the contractor any change in requirements, specifications, planning and budget that might affect the contract development.

Access will be granted to IDM folders to perform the tasks.

5.2 Responsibility of the contractor

The contractor has the responsibility of regularly submitting to ITER the progress of the contract, for ITER approval as per deliverables.

6 List of deliverables and due dates (proposed or required by ITER)

The deliverables are made of monthly reports describing both calendar of worked days and actions carried out during the month.

7 Acceptance Criteria (including rules and criteria)

This criteria shall be the basis of acceptance by IO following the successful completion of the services.

These will be in the form of progress reports in accordance with section 6 (monthly reports) of the technical specification.

Report and Document Review criteria:

Reports as deliverables shall be stored in the ITER Organization's document management system, IDM by the Contractor for acceptance.

A named ITER Organization's Contract Technical Responsible Officer is the Approver of the delivered documents.

The Approver can name one or more Reviewers(s) in the area of the report's expertise.

The Reviewer(s) can ask modifications to the report in which case the Contractor must submit a new version.

The acceptance of the document by the Approver is the acceptance criterion.

8 Specific requirements and conditions

The activities shall be driven by the IO responsible officer in the IC & LH section. The contractor's staff will work exclusively at the IO site for the duration of the contract.

- At least Bachelor degree in the control and instrumentation area.
- At least 5 years' relevant experience in technical I&C design;
- Experience in control system design, development and implementation;
- Experience in fast data acquisition and real time control
- Experience in Linux OS; C/C++, FPGA & PLC programming
- Experience in large experimental device commissioning and operation would be an advantage.

Up to five missions per years are planned which will be reimbursed under ITER Organization conditions.

9 Work Monitoring / Meeting Schedule

The work will be managed by means of Progress Meetings and/or formal exchange of documents transmitted by emails which provide detailed progress. Progress Meetings will be called by the ITER Organization, to review the progress of the work, the technical problems, the requirements, the interfaces and the planning.

The main purpose of the Progress Meetings is to allow the ITER Organization/IC&LH Section and the Contractor Technical Responsible Officer to:

a) Allow early detection and correction of issues that may cause delays;

b) Review the completed and planned activities and assess the progress made;

c) Permit fast and consensual resolution of unexpected problems;

d) Clarify doubts and prevent misinterpretations of the specifications.

In addition to the Progress Meetings, if necessary, the ITER Organization and/or the Contractor may request additional meetings to address specific issues to be resolved.

For all Progress Meetings, a document describing tasks done, results obtained, blocking points shall be written by the engineer.

All reports will be stored in the ITER IDM in order to ensure traceability of the work performed.

10 Payment schedule / Cost and delivery time breakdown

Interim monthly payments.

11 Quality Assurance (QA) requirement

The organisation conducting these activities should have an ITER approved QA Program or an ISO 9001 accredited quality system. The general requirements are detailed in ITER document ITER_D_22MFG4 - ITER Procurement Quality Requirements.

Prior to commencement of the task, a Quality Plan ITER_D_22MFMW - Procurement Requirements for Producing a Quality Plan must be submitted for IO approval giving evidence of the above and describing the organisation for this task; the skill of workers involved in the study; any anticipated sub-contractors; and giving details of who will be the independent checker of the activities.

Prior to commencement of any manufacturing, a ITER_D_22MDZD - Requirements for Preparing and Implementing a Manufacturing and Inspection Plan must be approved by ITER who will mark up any planned interventions.

Deviations and Non-conformities will follow the procedure detailed in IO document ITER_D_22F53X - Contractors Deviations & Non-conformities Procedure.

Prior to delivery of any manufactured items to the IO Site, a Release Note must be signed ITER_D_22F52F - ITER Requirements Regarding Contractors Release Note.

Documentation developed as the result of this task shall be retained by the performer of the task or the DA organization for a minimum of 5 years and then may be discarded at the direction of the IO. The use of computer software to perform a safety basis task activity such as analysis and/or modelling, etc shall be reviewed and approved by the IO prior to its use, it should fulfil IO document on Quality Assurance for ITER Safety Codes ITER_D_258LKL - Quality Assurance for ITER Safety Codes Procedure.

12 References / Terminology and Acronyms

AVN	Audio-Video Network
CIN	Central Interlock Network
CODAC	COntrol, Data Access and Communication
DAN	Data Archive Network
EPICS	Experimental Physics and Industrial Control System
FPGA	Field Programmable Gate Array
HPN	High Performance Networks

HVPS	High Voltage Power Supply
I&C	Instrumentation and Control
IC H&CD	Ion Cyclotron Heating & Current Drive
IC-PSC	IC H&CD Plant System Controller
IDM	ITER Document Management
IO	ITER Organization
I/O	Input / Output
IOC	Input / Output Controller
ITER	International Thermonuclear Experimental Reactor
LCU	Local Control Unit
PCDH	Plant Control Design Handbook
PCI	Peripheral Component Interconnect
PCS	Plasma Control System
PLC	Programmable Logic Controller
PON	Plant Operation Network
PSH	Plant System Host
PXIe	PCI Express Extensions for Instrumentation
RF	Radio Frequency
SDN	Synchronous Databus Network
TCN	Time Communication Network
TL & MS	Transmission Line & Matching System
TRO	Technical Responsible Officer