

Design, Manufacturing, Integration, Commissioning and Maintenance of ITER Control System

Call for Nomination

Ref. IO/24/CFT/70001203/LLU

1 Purpose

The purpose of this Contract is to provide the technical services required for the design and manufacturing of "in-fund" plant system instrumentation and control (I&C), the integration and commissioning of ITER integrated control systems comprising plant system I&C, and the central control system, as well as the maintenance of the ITER integrated control systems during temporary operation.

Services primarily focus on control system software including all layers from controllers interfacing actuators and sensors to operational Human Machine Interface (HMI) using selected ITER technologies as specified in the Plant Control Design Handbook (PCDH) and satellite documents.

This Contract is a framework contract, where each task order (TO) is a free-standing engineering activity with its own budget.

2 Background

The ITER Instrumentation and Control (I&C) System is the term encompassing all hardware and software required to operate the ITER machine.

The ITER I&C System has two levels of hierarchy; the Central I&C Systems and the Plant Systems I&C, and three segregated vertical tiers; conventional control (CODAC), machine protection (interlocks) and safety. The Central I&C Systems are "in-fund", i.e. procured by the ITER Organization (IO). The Plant Systems I&C are generally delivered "in-kind", i.e. procured by the seven ITER Domestic Agencies (DAs) but some have been retained or transferred back to the IO.

There are 171 Plant Systems I&C with associated sensors and actuators. The primary goal of the ITER I&C system is to provide the fully integrated control of the ITER machine. Standardization of Plant System I&C is a pre-requisite.

Mandatory requirements and recommendations for the Plant System I&C development lifecycle and component selections are documented in the Plant Control Design Handbook

(PCDH) and satellite documents (publicly available at

<u>https://www.iter.org/mach/codac/PlantControlHandbook</u>). To complement and to enforce the standards, the IO has developed software frameworks targeting the standard controllers platforms, e.g. PLC libraries and code generation tools, FPGA libraries, and CODAC Core System software distribution. These frameworks are used to interface and support the development of every ITER plant system to ensure homogeneity and maintainability by the IO during integrated commissioning and operations.

The selected technologies are Siemens S7 PLC slow controllers, Step7 and TIA portal, WinCC OA, PCIe based fast controllers, RedHat Linux, C/C++, Java, Python, open-source software (Experimental Physics and Industrial Control System – EPICS, Control System Studio, etc.).

Figure 1 illustrates the physical architecture of the integrated ITER I&C system. A plant system I&C is a unit, which interfaces to CODAC and which includes a set of tightly coupled controllers, with one and only one, Plant System Host (PSH) implementing a set of plant-specific and generic (common) functions. A control group, or subsystem, is an assembly of plant system I&Cs and central coordination.

Based on the function and requirements pertaining to the plant system I&C, it would additionally interface with the Central Interlock System (CIS) and the Central Safety Systems (CSS).

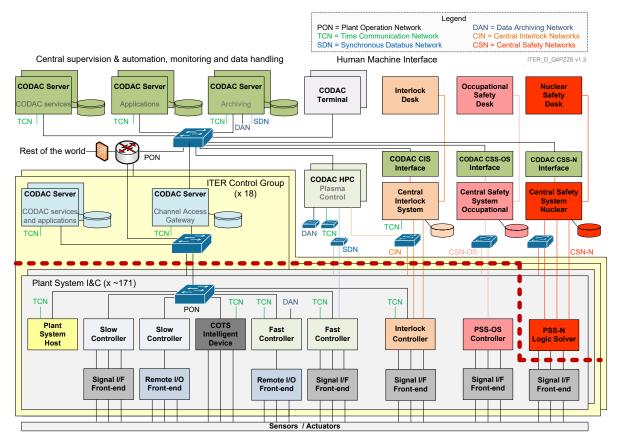


Figure 1: Physical architecture of ITER integrated control system

Plant system software delivered by third party contains signal input/output configuration, possible device drivers for COTS intelligent devices, controller applications (process control) executing on slow and/or fast controllers, interface configuration to central system, plant system specific HMI operator screens and configuration of central services such as archiving and alarm definitions. Software is grouped in units and are delivered and versioned in the software repository.

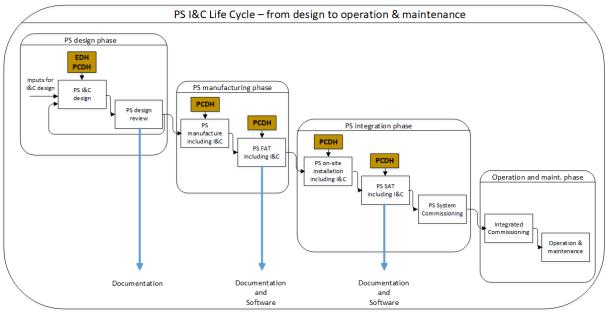


Figure 2: Lifecycle of Plant System I&C

I&C integration with central control system is performed after delivery of the Plant System I&C hardware, software and documentation, and is pre-requisite for Plant system commissioning.

During site acceptance testing, integration and commissioning many problems are discovered and corrective actions are required. This is particular true for software. Figure 2 illustrates the established configuration control process for software versioning, deployment and testing. Off-line test facilities provide tools to debug issues without accessing the target system.

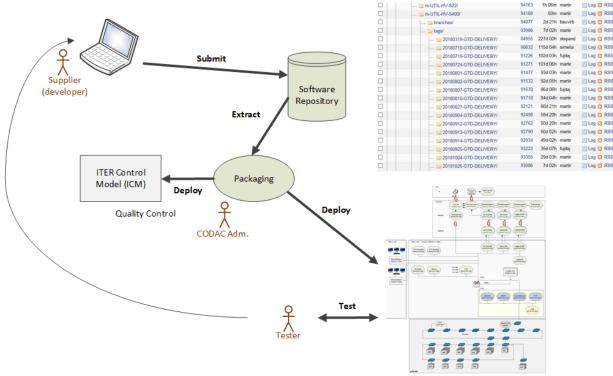


Figure 3: Software versioning, deployment and testing

To keep track of defects and enhancements ticketing systems are used (Bugzilla, Jira).

3 Scope of Work

This summary covers the technical services to be provided to IO along the complete lifecycle of ITER Plant Systems I&C. The service scope covers the conventional controls, interlock controls and occupational safety controls.

These services cover the following topics:

1. **Design and Manufacturing:** Provide engineering expertise for the design of "in-fund" Plant System I&C, deliver design documentation, substantiate design elements through prototypes or Proof of Concept (POC) demonstrators, deliver documentation for design gate reviews, implement I&C software and manufacture I&C cubicles, define and execute Factory Acceptance Tests (FAT), provide all I&C deliverables identified in the PCDH at each phase of the design and manufacturing lifecycle.

Services may be provided anywhere; design gate reviews or prototypes tests may require limited on-site presence.

2. **SAT and Integration:** Support the preparation of integration by reviewing deliverables (documentation, hardware and software) from plant system supplier. Perform off-line software testing using test facilities in the lab. Dry run the integration package on the ITER Control Model (ICM). Support the deployment on the target. Participate in site acceptance testing of the plant system. Identify and document control system issues. Propose and implement solutions. Use test facilities in the lab to verify solutions before deployment on the target.

Services are required to be provided on-site with potential back-office support.

3. **Commissioning:** Participate in the commissioning of the plant system. Identify and document control system issues. Propose and implement solutions. Use test facilities in the lab to verify solutions before deployment on the target.

Services are required to be provided on-site.

4. **Operation and Maintenance:** Implement corrections and enhancements as requested by Operation. Use test facilities in the lab to verify solutions before deployment on the target. The services include obsolescence management activities as well, and cover e.g. partial replacement of hardware components and the corresponding adaptation and requalification of the running control system software.

Services are required to be provided on-site with possible off-site back-office support.

5. **Technical Support:** Design and implement different solutions and/or new features as identified during any lifecycle phase. Such cases will be identified as stand-alone projects. Use test facilities in the lab to verify solutions before deployment on the target.

Services are required to be provided on-site with possible off-site back-office support.

4 Duration of Services

The contract will be carried out over an initial firm period of four (4) years firm and an optional period of two (2) years. The contract is scheduled to come into force in November 2025.

5 Timetable

The tentative timetable is as follows:

Call for Nomination	November 2024
Prequalification issuance	January 2025
Call for Tender issuance	April 2025
Contract Signature	November 2025

6 Experience

The candidate entities shall have adequate experience for the work and activities as detailed below.

- Capability to design I&C systems, manufacture hardware cubicles and corresponding software components using the IO selected technology
- Capability to develop, debug, maintain and improve plant system controller software using the IO selected technology

- Capability to develop, debug, maintain and improve interfaces to actuators and sensors using the IO selected technologies
- Capability to develop, debug, maintain and improve Human Machine Interfaces using the IO selected technologies
- Capability to develop, debug, maintain and improve integrated supervision and automation using the IO selected technologies
- Capability to develop, debug, maintain and improve communication and networking using the IO selected technologies

7 Candidature

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.

The Plant System I&C lifecycle identified above (considering also on-site presence requirements) naturally identifies three lots for the services:

- Lot 1 Plant system I&C Design and Manufacturing Services
- Lot 2 I&C Integration and Commissioning Services
- Lot 3 I&C Maintenance Services

Candidates must be qualified for all the lots under the scope of work of this call for tender; if that is not the case they need to form a consortium.

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.

8 Reference

Further information on the ITER Organization procurement can be found at: <u>http://www.iter.org/org/team/adm/proc/ Pages/Welcome.aspx</u>