

Technical Specifications (In-Cash Procurement)

**2021-07 - CFE - Magnetics diagnostics I&C integration
support**

Call for Expertise - Technical specification of work to be performed related to Diagnostics
I&C Integration

No PIC/PIA and PE/NPE involved

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1 PURPOSE

This document provides the technical specification for the work to be performed under a Call For Expertise (CFE) for the preparation of ITER magnetics diagnostics plant controller (PBS 55.A0) integration with central I&C systems, i.e. Control, Data Access and Communications (CODAC) system and Central Interlock System (CIS), for configuration purposes.

2 BACKGROUND

Each of the 55+ ITER diagnostic Instrumentation and Control (I&C) systems are developed by the IO-CT and the Domestic Agencies (DA) according to their responsibilities for the supply of the various diagnostics.

The diagnostics I&C systems are integrated with central I&C systems to form part of the ITER integrated control system and take part in the integrated and automated operation of ITER from the Main Control Room (MCR).

In the context of the ITA C45TD16FE (*Supporting control system infrastructure for the commissioning and operation of complex plant systems*), F4E and IO-CT are collaborating in the development and evaluation of components related to Plant System Supervision and Automation (SUP) - amongst other activities.

3 SCOPE

The Call For Expertise (CFE) aims at securing access to additional relevant technical competences to participate to the successful conclusion of the ITA C45TD16FE Sub-task 4 (*Evaluation of CODAC software components manufactured in view of ITER commissioning support*) by contributing to the finalisation of SUP configuration software components and their application in the context of ITER magnetics diagnostics plant controller.

4 DEFINITIONS

CODAC	Control, Data Access and Communications
CVVF	Configuration Verification and Validation Framework
EPICS	Experimental Physics and Industrial Control System
SRS	System Requirements Specification
SDS	System Design Specification
SMS	System Manufacturing Specification
STR	System Test Report
STP	System Test Plan
SUP	Supervision and Automation component

5 REFERENCES

- [RD1] SEQA-45 - Software Engineering and Quality Assurance for CODAC ([2NRS2K](#))
- [RD2] [ITER_D_BHUMA6 - Supervision and Automation - Software Requirements Specification](#)
- [RD3] [ITER_D_28NSQS - Supervision and Automation - Configuration - Software Architecture and Design Description](#)

5.1 Inputs to be provided at the start of activities

- [RD4] 55.A0 Design Description Document ([2K9Y6N v1.1](#))
- [RD5] 55.A0 Enterprise Architect Model ([2KA8RL v1.1](#))

6 ESTIMATED DURATION

The contract duration is 12 month

7 WORK DESCRIPTION

From the complex plant system perspective, there are two main SUP features that play a decisive role in the plant system architecture so that the data loading into the plant is, as far as possible, near to its final form (e.g. transferring transformed coefficients, as opposed to sending complex time-dependent machine information):

- The possibility of loading and validating en-bloc structured configuration parameters, and
- The delegation of parameter transformation and validation to the central control system services.

The development process for both features is similar:

- Review of the current proposed design (together with the developed ITA prototypes – that have supported and validate the idea);
- Proposal of a detailed design (using UML);
- Implementation of the actual design, leveraging the already existent C++ common framework that exists in IO-CT;
- Continuous testing and validation of the development; and
- Production of user-documentation.

These activities are expected to be executed following an *agile* approach, with weekly technical meetings involving all the key actors (namely, one dedicated developer from F4E; one dedicated developer by IO-CT; and the ITA F4E and IO-CT representatives), with additional support from the CODAC SUP TRO and development team, when necessary.

The development work will be broken down into chunks of activities that allow for a fast release cycle (e.g. 3 weeks' time). The components will be unit-tested and assessed against relevant software quality assurance metrics through Continuous Integration (CI), and (as soon as technically feasible) the releases will be validated in the scope of the magnetics plant controller I&C development.

7.1 Activity breakdown

Title	Outputs/Features	Weeks	Date
Review SUP/CVVF design	Updated SRS and SDS (if needed)	1	13/09/21
SUP design	Component detailed design (focus on SUP)	2	27/09/21
SUP/CVVF design	Component detailed design (full)	2	11/10/21
SUP release 0.1	SUP loading protocol (bridge pattern)	2	25/10/21
SUP release 0.2	SUP loading protocol - PVA personality	2	08/11/21
SUP release 0.3	SUP read input parameters from JSON file in console	2	22/11/21
SUP release 0.4	SUP demonstrated to load from file all parameters (transformed in advance) to 55.A0	2	06/12/21
SUP release 0.5	CVVF bare C++ service	6	17/01/22
SUP release 0.6	CVVF C++ service with common validation (math expressions, etc.)	2	31/01/22
SUP release 0.7	CVVF service demonstrated to validate 55.A0 algorithms	4	28/02/22
SUP release 0.9	SUP and CVVF integrated to load dummy plant	2	14/03/22
SUP release 1.0	SUP and CVVF integrated to 55.A0	3	04/04/22
SUP release 1.1	SUP read input parameters from machine parameters database	4	02/05/22
SUP release 1.2	SUP CVVF MATLAB support	4	30/05/22
SUP release 1.3	SUP CVVF Python support	4	27/06/22
SUP release 2.0	User-documentation with practical use-cases and best practices	6	08/08/22

8 RESPONSIBILITIES

IO will nominate a Technical Responsible Officer for this contract.

The contractor will provide specialist resources on a long-term permanent basis for the duration and at the location as required under this scope of work. The contractor undertakes that:

- The personnel will possess the qualifications, professional competence and experience to carry out such services in accordance with best practice within the industry;
- The personnel will be bound by the rules and regulations governing ITER safety and security when present at ITER premises;
- The required safety clearance deliverables will be provided and maintained accurate during period of execution of the services.

8.1 Experience and Specific Skills

Education:

- Master degree or equivalent in Physics, Control Engineering or Computer Science.

Professional experience:

- At least 10 years' experience working as Control Software Engineer in designing, installing, commissioning or operation of large-scale scientific control systems;
- Familiarity with fusion machines, plasma physics and tokamak diagnostics is considered most advantageous.

Technical Competencies and demonstrated experience in:

- Using, designing, implementing and verifying control system distributed automation software frameworks and applications;
- Executing integration and commissioning of heterogeneous I&C systems, including identifying and resolving issues;
- Using Linux, virtualization environments, real-time operating systems and application frameworks;
- Using C++, Matlab and python programming languages and environments;
- Applying high-integrity software quality assurance processes;
- Following agile software development processes;
- Delivering high quality technical reports and documentation in English;
- Using EPICS7 Channel Access and pvAccess communication protocols and EPICS7 ecosystem tools is considered most advantageous;
- Familiarity with the ITER integrated control system architecture, tools and techniques is considered most advantageous given the tight schedule.

Behavioural competencies:

- Ability to create and sustain a mutually supportive team work environment;
- Ability to analyse multiple and diverse sources of information to understand problems accurately before moving to proposals.

9 ACCEPTANCE CRITERIA

The following criteria shall be the basis of the acceptance of the successful accomplishment of the Work.

9.1 Delivery date criteria

On-time delivery of deliverables according to the milestone dates defined in Section 7.

9.2 Report and Document Review criteria

Reports and design documentation as deliverables shall be stored in the ITER Organization's document management system, IDM by the Contractor for acceptance. The IO Technical Responsible Officer for this contract 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 an acceptance criterion.

9.3 Software delivery criteria

Software source code shall be delivered in the ITER Organizations software repository (GIT) by the Contractor for acceptance. The IO Technical Responsible Officer for this contract is the Approver of the delivered software source code.

The acceptance is based on CI reports, source code and quality peer reviews performed with each GIT pull requests, and when technically achievable, release verification reports pertaining to the magnetics plant controller I&C development project.

10 SPECIFIC REQUIREMENTS AND CONDITIONS

None identified.

11 WORK MONITORING / MEETING SCHEDULE

The work will be managed by means of weekly planning and progress meeting and/or formal and informal exchange of documents which provide detailed information. Planning meetings will be organized by the ITER Organization to plan the upcoming activities, review the progress of the work, discuss, and resolve the technical problems.

The main purpose of the weekly meetings is to allow the ITER Organization and the contractor to:

1. Allow early detection and correction of issues that may cause delays;
2. Review the completed and planned activities and asses the progress made;
3. Permit fast and consensual resolution of unexpected problems;
4. Clarify doubts and prevent misinterpretations of the specifications.

On a quarterly basis, the contractor shall submit to ITER Organization an activity report with references to software deliveries and documentation produced during that period.

On request and by agreement, additional special subject meetings will be organized.

12 QUALITY ASSURANCE (QA) REQUIREMENTS

The recommendations that are described in the CODAC Software Engineering and Quality Assurance document [RD1] shall apply to the deliverables.

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.

In such case the External Contractors (Suppliers and Subcontractors, and their 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.