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Technical Specifications (In-Cash Procurement)

2024-10 - CFE - PLC frameworks extension and Magnetics diagnostics I&C integration support

Call for Expertise - Technical specification of work to be performed related to future proofing of PLC frameworks and tools, and for Diagnostics I&C Integration with Central I&C systems. 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 following activities:

- The future proofing of Programmable Logic Controllers (PLC) framework and tools, i.e. the Unified Control Library (UCL) and Code Generation Tool (CGT), covering design improvements for scalability and expandability, additional library support, integration of EPICS components and functional testing
- 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), covering automated procedures, configuration workflows and data archiving.

2 BACKGROUND

Each of the 55+ ITER diagnostic Instrumentation and Control (I&C) systems are developed by the IO-CT and the Domestics 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).

2.1 Update of the Code Generation Tool

The ITER Code Generation Tool (CGT) [RD4] has been developed to support the use of a standardized uniform component library (UCL) [RD5] in order to perform validation actions, self-consistency checks to generate PLC code and other critical project resources. The CGT thus facilitates troubleshooting and maintenance activities, as well as enhancing the projects quality with the benefit of managing ever improving consistency with documentation.

The existing CGT now requires updates to support:

1. An additional electrical system code library, including new generated resources such as code and HMI resources.
2. Additional EPICS record support, including record-level verification and validation checks.
3. Functional tests that use the existing PLC development infrastructure [RD6], to improve the quality assurance and confidence in the generated code.

2.2 Integration Support for Magnetics Diagnostics

The magnetics diagnostic plant system [RD7] is critical to the successful operation of ITER plasma pulses, produces large volumes of sensor data that is used to calculate critical plasma parameters in real time. In addition to being used for real-time plasma diagnostic and control, the data must also be archived.

The magnetics diagnostics component will soon be integrated into the ITER operational infrastructure. This integration process will require the development, qualification and integration of:

1. Plant I&C configuration workflows and interfaces, incl. support for interfacing to OPC UA servers.
2. SUP automation, using the Sequencer infrastructure.
3. Data archiving adapters.

3 SCOPE

The Call for Expertise (CFE) aims at securing access to additional relevant technical competences to contribute to the development of identified plant system software components.

Unless specified otherwise in this document, the principles laid out in [RD8] are applicable to this technical specification.

The services are compatible with, and preferably performed, offsite with the exception of deployment and verification of magnetics diagnostics software which require onsite presence.

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

[RD4] Code Generation Tool Design (5JDH9E v2.0)

[RD5] Unified Control Library (iter.org)

[RD6] TIA Portal Tools (https://git.iter.org/scm/coa/tia-portal-tools.git)

[RD7] 55.A0 Design Description Document (2K9Y6N v1.1)

[RD8] ITER_D_82MXQK - General Management Specification for Service and Supply

6 ESTIMATED DURATION

The contract duration is 12 months.

7 WORK DESCRIPTION

The work is partitioned into two task areas as follows:

- To extend the Code Generation Tool to:
  - Improve data storage handling.
  - Support the “electrical” library component.
  - Integrate EPICS records, including verification support.
  - Support functional tests using the TIA Portal resources.
- To support the integration of the magnetics diagnostics component, as follows:
  - Examine, update and develop configuration interfaces support SUP automated configuration operations.
  - Examine, update and develop sequencer components to support SUP automated sequences.

Examine, update and develop data archiving components to interface to CODAC data archiving infrastructure.

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 by IO-CT 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 go through static analyses, 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	Date
1.1 CGT Design update 1	Improved storage performance design	22/12/24
2.1 MagDiag, Design 1	Configuration interfaces design	15/01/25
1.2 CGT Implementation 1	Updates for design, phase 1	16/02/25
1.3 CGT Design 2	Electrical library support design	02/03/25
2.2 MagDiag, Implementation 1	Configuration interfaces impl.	26/03/25
2.3 MagDiag, Design 2	Sequencer stakeholder consultation	09/04/25
1.4 CGT Implementation 2	Updates for design, phase 2	27/04/25
1.5 CGT Design 3	EPICS record support design	18/05/25
2.4 MagDiag, Implementation 2	Sequencer component implementation	18/06/25
2.5 MagDiag, Design 3	Archiving stakeholder consultation	02/07/25
1.6 CGT Implementation 3	Updates for design, phase 3	13/07/25
1.7 CGT Design 4	Integrated testing design	03/08/25
2.6 MagDiag, Implementation 2	Archiving component implementation	10/09/25
1.8 CGT Implementation 3	Updates for design, phase 4	28/09/25
2.7 MagDiag, Implementation 3	Finalised implementation	05/11/25
1.9 CGT Implementation 4	Finalised implementation	09/11/25

7.2 List of Deliverables and Due Dates

Deliverable	Description	Type (TDFC)	Due date
D1	• Updated I&C software • Verification report • Consolidated activity report	Software V&V Report Report	T0 + 4 months

D2	• Updated I&C software • Verification report • Consolidated activity report	Software V&V Report Report	T0 + 8 months
D3	• Updated I&C software • Verification report • Consolidated activity report	Software V&V Report Report	T0 + 12 months

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 create clean and maintainable code;
- 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. Quarterly reports are defined and used as a vehicle to track acceptance of detailed activity deliverables for payment purposes.

9.2 Report and Document Review criteria

Refer to section 6.2 of [RD8].

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

The services are compatible with hybrid onsite and offsite activities, with the exception of deployment and re-qualification after software change which require onsite presence.

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

Considering the collaborative nature of the contributions, together with members of the ITER Control System team, and the objective for the produced software to be used on the production-level ITER control system, the Quality Assurance requirements described in the CODAC Software Engineering and Quality Assurance document [RD1] for Software Integrity Level 1 (SWIL-1) components shall apply to all deliverables.

13 SAFETY REQUIREMENTS

See section 5 of [RD8].

The work covered by this technical specification does not include PIC/PIA.