THEMATIC WORKSHOP

Controls & integrated commissioning program

System commissioning & Control command system architecture

David GRILLOT

ITER Controls & Integrated Commissioning Program Manager

Process engineer with more than 30 years of experience, David Grillot joined the ITER organization 10 years ago as Cryogenic Section Leader.

In his current role, together with the project leaders, he has the responsibility to execute and deliver the design and implementation of the entire ITER control, interlock and nuclear safety system.

He is also responsible to plan and pilot the commissioning and operation activities, toward the integrated commissioning of the ITER machine and plant systems.

Before 2016, he worked for Air Liquid advanced Technologies, from commissioning engineer, project engineering to Technical Director of the division in charge of low temperature cryogenic and cooling system.

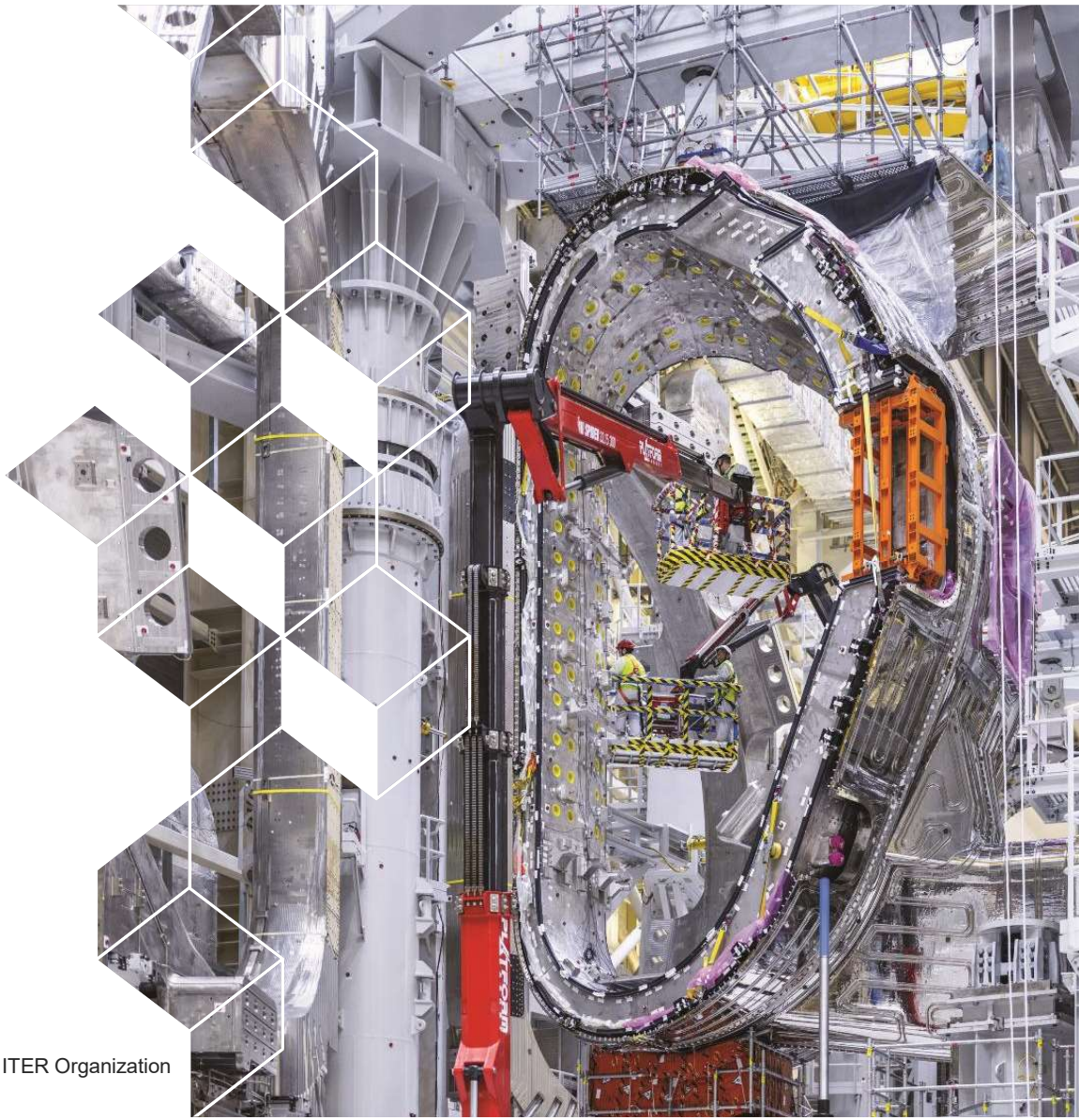
He published many papers and own few patents in the field of large cryogenic system design and application.

Chairperson:

José Antao
Head of Public Innovation
Policy Management
ILO Portugal

IBF/25
INTERNATIONAL ITER BUSINESS FORUM

ITER - Control System & Commissioning progress



David GRILLOT

Head of Control & commissioning program

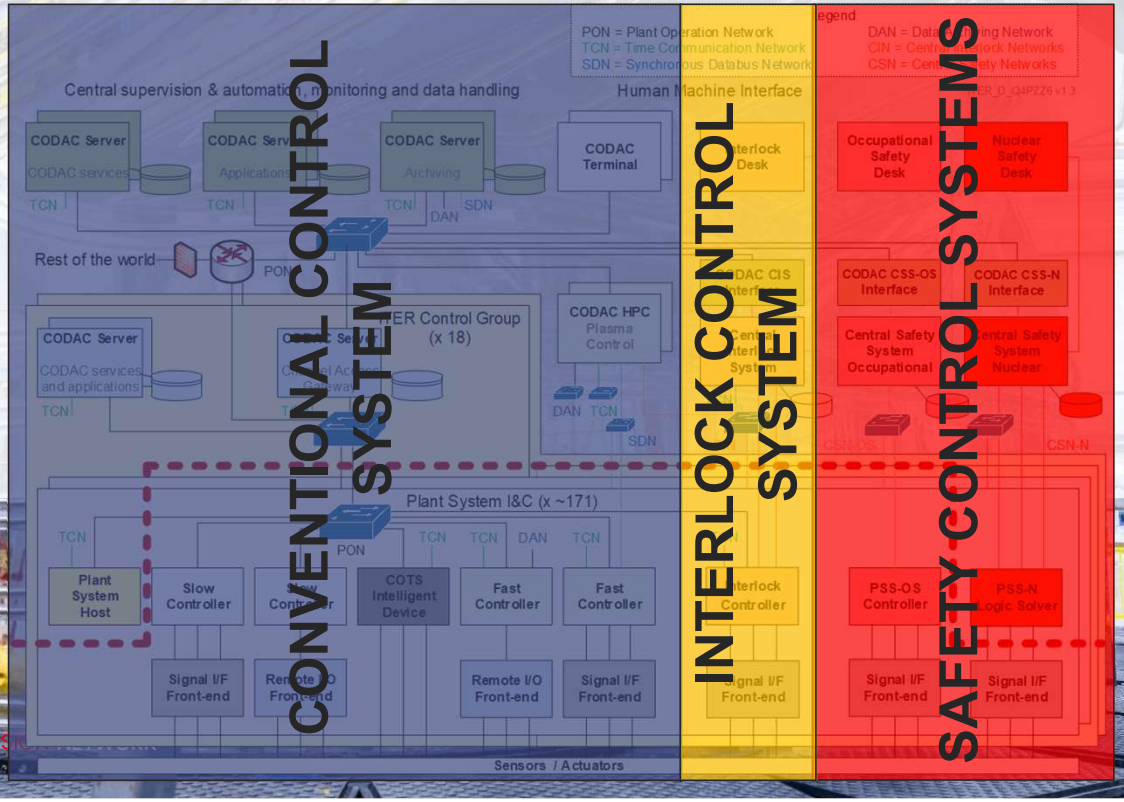
APRIL 24th,

Content

1 ITER I&C Architecture

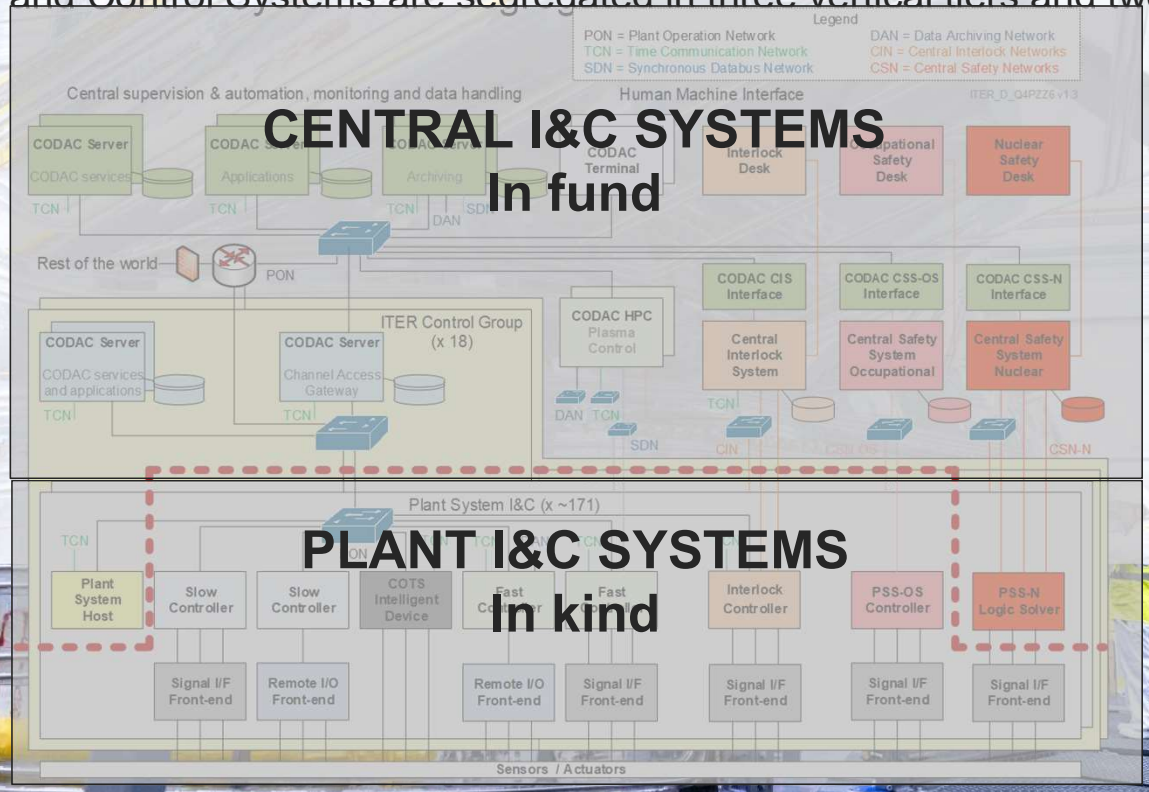
ITER I&C Architectures

ITER Instrumentation and Control Systems are segregated in three vertical tiers and two horizontal layers.



ITER I&C Architectures

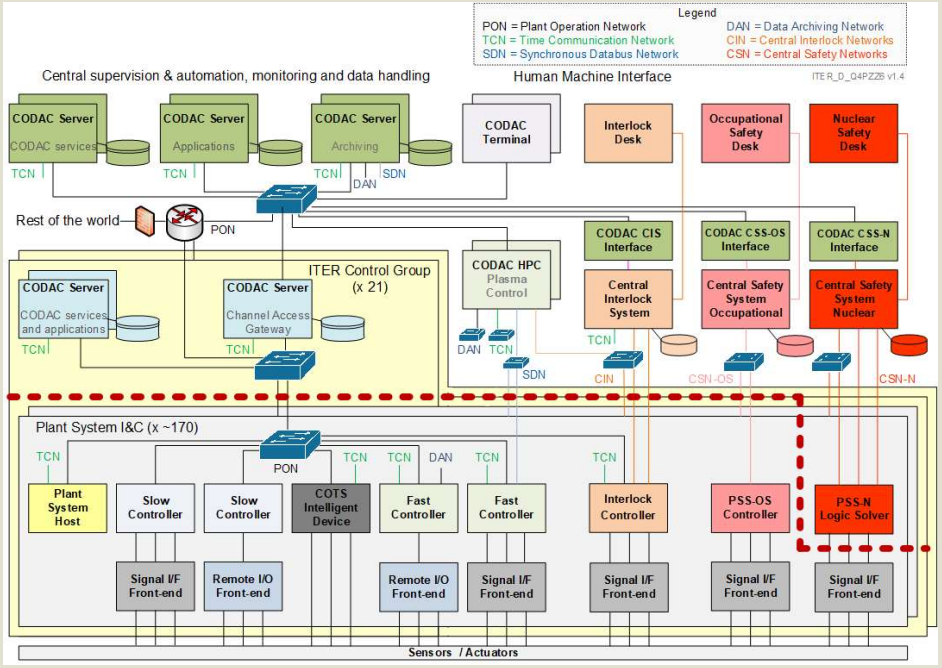
ITER Instrumentation and Control Systems are segregated in three vertical tiers and two horizontal layers.

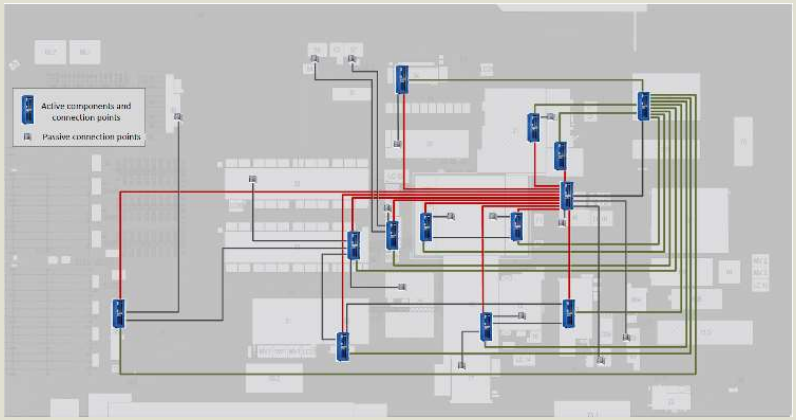


ITER CONTROLS BASICS

ARCHITECTURE AND INFRASTRUCTURE

- Hierarchical with 21 subsystems and 170 local control system (in-kind)
- Vertical segregation of (1) conventional control and operation, (2) protection and (3) safety
- Dedicated networks for (1) control and monitoring, (2) time synchronization, (3) distributed real-time control, (4) high throughput data acquisition, (5) protection and (6) safety
- Redundant dual star network cable infrastructure
- Virtualized central servers for supervision, automation, configuration, plasma control and data handling
- Data streamed to HDF5 back-end storage accessible on the intranet





ITER CONTROLS BASICS

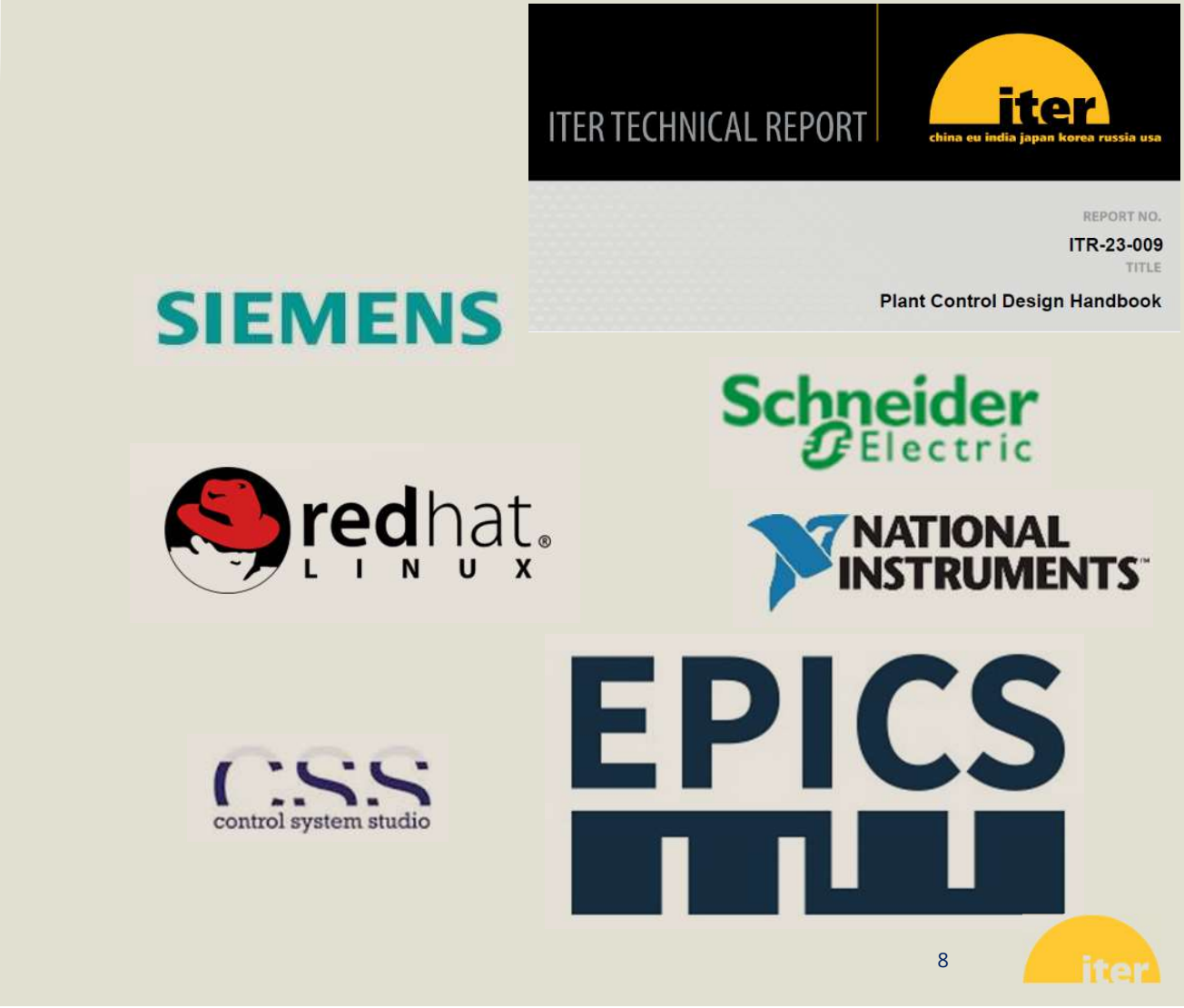
Mitigation actions to address challenge of integrating 205 local control system delivered in-kind established more than ten years ago

- Definition of standards (Plant Control Design Handbook)
- Distribution of software tool kit based on EPICS (CODAC Core System)
- Distribution of hardware integration kit
- Training and hands-on workshops
- Active outreach

Continues evolution and updates to address obsolescence and return of experience

These actions have been effective

Without them there would have been total chaos now



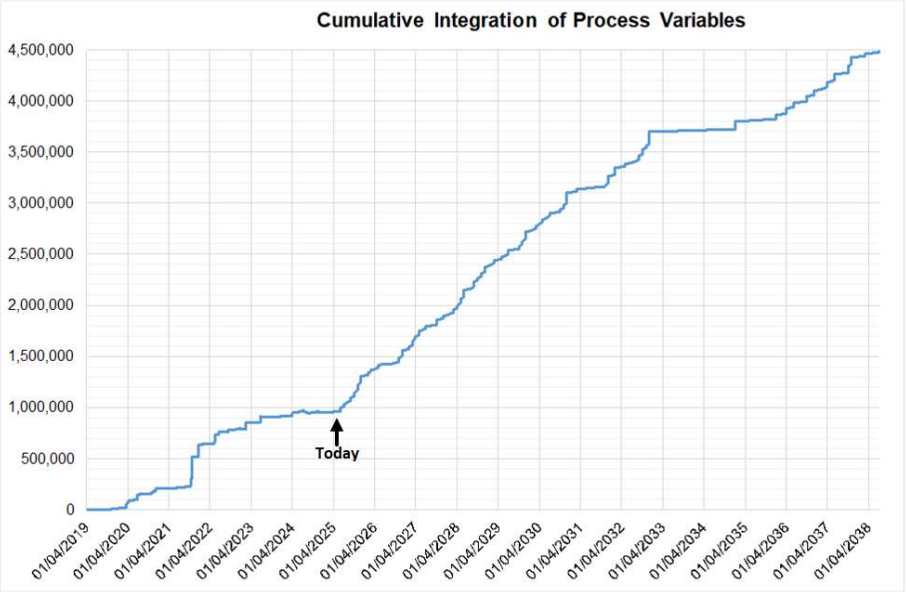
METRICS

Number of integrated process variables easy to obtain from the software repository

Can be predicted for future systems based on design data and system complexity

Commissioning schedule gives timeline as racks must be energized and process variables integrated before commissioning can start

Curve to the right indicates about 25% of integration towards start of research operation (SRO) has been achieved today

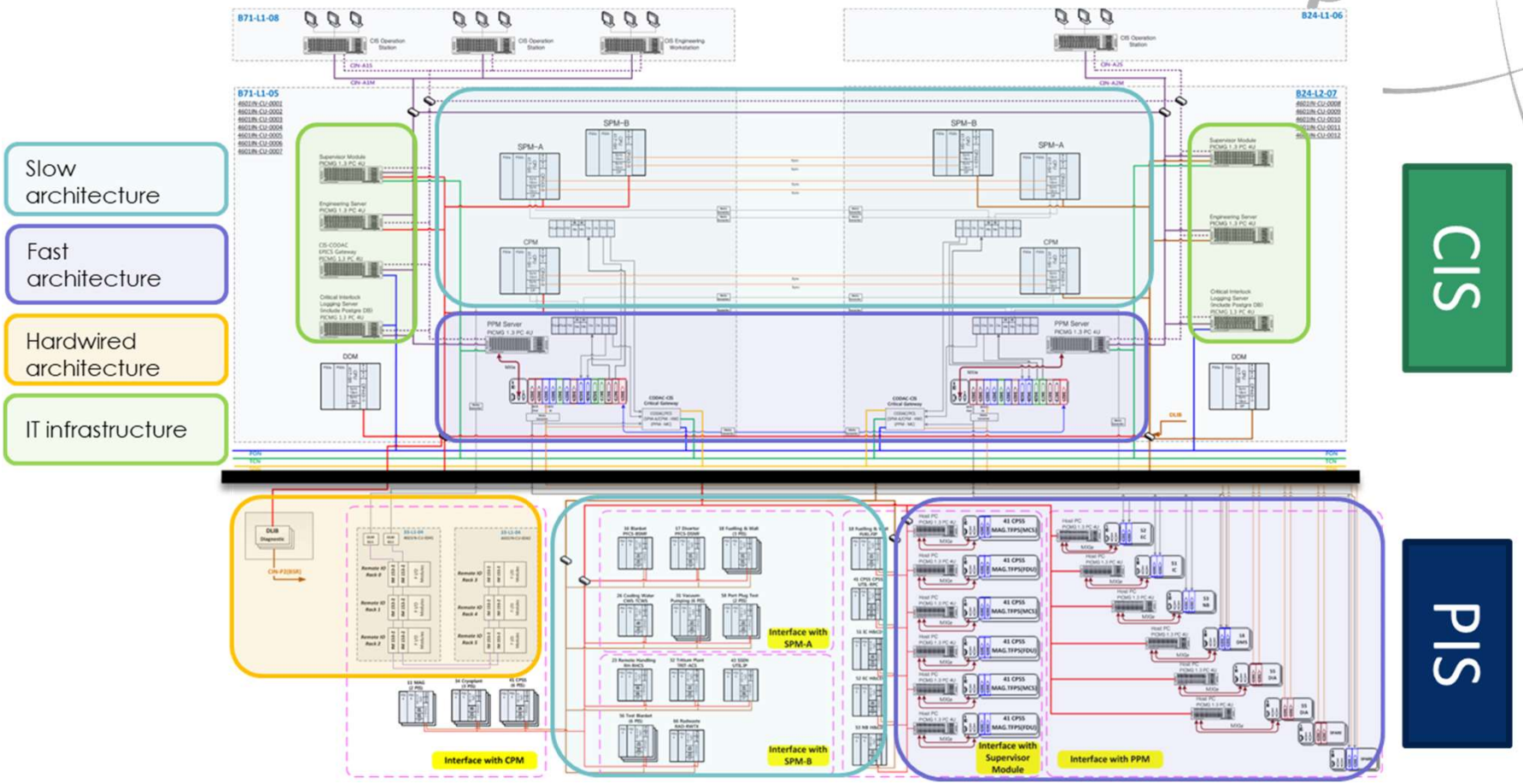


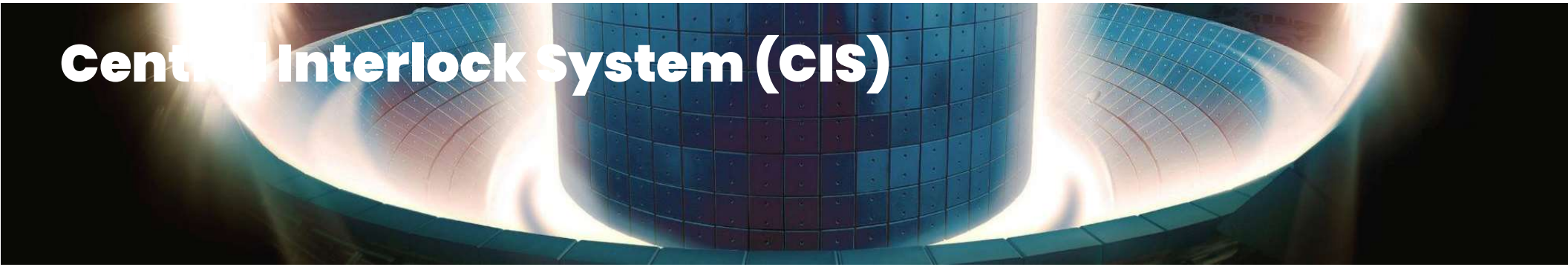
2- The Central interlock system

Central Interlock System (CIS)

- The Interlock Control System (ICS) is formed by the central coordinating layer (Central Interlock System – CIS) and the detection/actuation local protection layer (Plant Interlock Systems – PIS).
- It protects the ITER investment by ensuring that **no failure** of a key system or component, or incorrect machine operation, can degrade **machine integrity** or its **availability**
- It automatically executes the Investment Protection Functions and monitors its status

Interlock Control System architectures





Central Interlock System (CIS)

Many different technologies, with combination of:

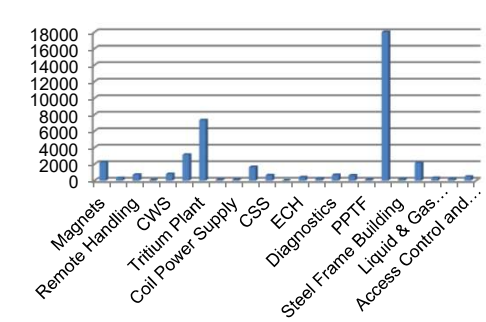
- State of the art SCADA system powered by Siemens WinCC-OA
- COTS controllers (Siemens failsafe-redundant PLC, National Instrument cRIO, FPGA)
- Ad-hoc design (DLIB – electronics to interface magnet and CPSS subsystems through hardwired loops)
- Customization of COTS (V&V and continuous improvement of fast architecture to ensure compliance with integrity levels required)
- High level IT services (servers & networks)

3- The Central Safety system

Central Safety Systems

2 Safety I&C Control Systems

- Nuclear Safety
  - To protect the people and environment against nuclear hazards
  - Complying with nuclear safety I&C standards (IEC 61513)
  - 300 functions; 23 PBSs; > 40,000 signals
  - Subject to licensing by the French Nuclear Safety Authority (ASNR)

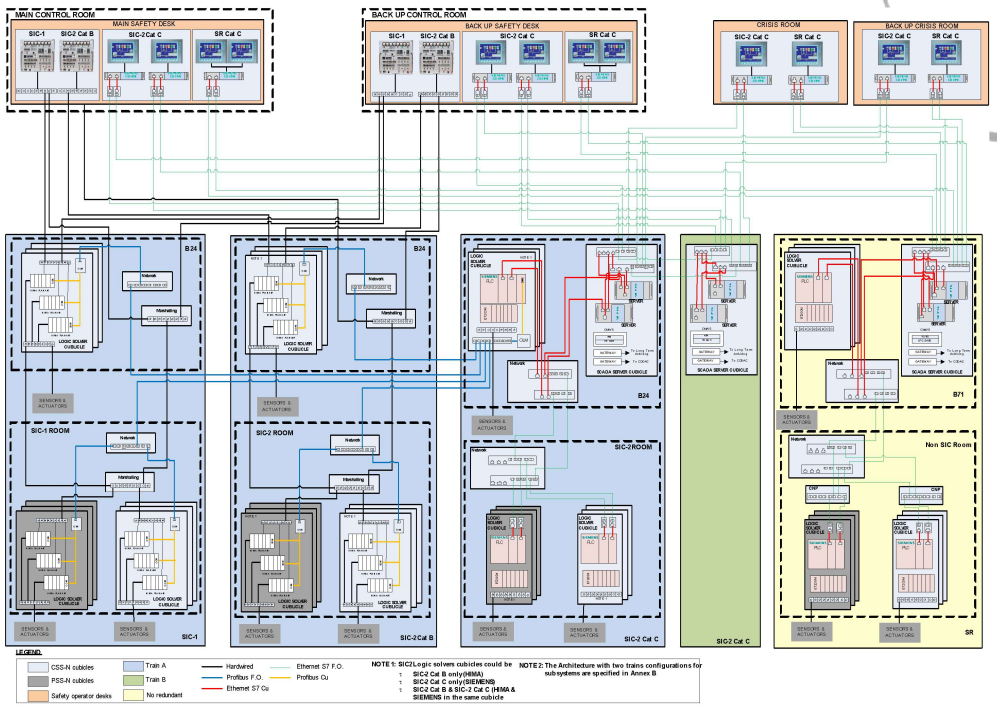


- Occupational Safety
  - In charge of the protection of people against non-radiological hazards
  - System designed according to functional safety standard (IEC 61511), able to implement high integrity functions

Safety I&C Control System architectures

System made 100 % of COTS (commercial off the shelf)

- Hardwired and computerized Human Machine Interfaces
- Solid state controllers (HIMA Planar 4) and High availability Siemens PLC, depending of the system class
- Redundant architectures implemented in different trains
- Qualified components for the usage in nuclear safety application



4. The Access control & Security System

Access Control & Security systems

- Participates in the safety of personnel by ensuring access to hazardous is possible only if certain protective conditions are satisfied, and by limiting such access to suitably qualified personnel

- Ensures the security and protection of the ITER plant from sabotage and from access by unqualified personnel.

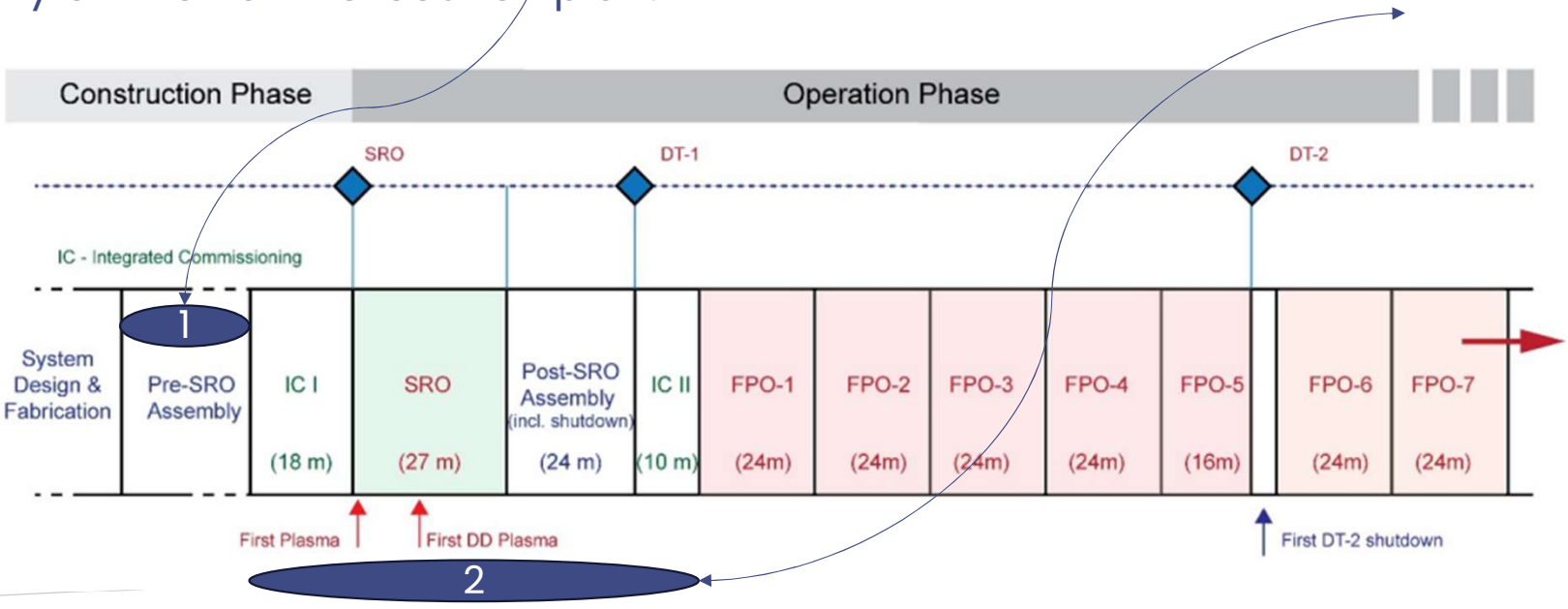
Access control system : Key facts

- 11 sub systems, 6 being nuclear Safety classified (PIC), some SIIV, physical protection fence
- Access Control, Intrusion detection, Video Surveillance, Emergency phones, Public Address, Site sirens, Crisis management communication means, Site high security fence…
- All different technologies
- Around 5000 devices in all buildings and outdoors
- Some devices in galleries, exposed to strong magnetic field and radiations (including PIC)
- Interfaces with ITER site legacy systems

5 Systems Commissioning

Positioning of the Systems commissioning

- Systems commissioning aims at validating that the system meets its design and safety requirements and bringing it to an operating mode
- A key milestone will consist of achieving the readiness of systems required at the Integrated commissioning start (1)
- However, some systems are required at a later stage of the ITER Project. They will carry on their own execution plan.

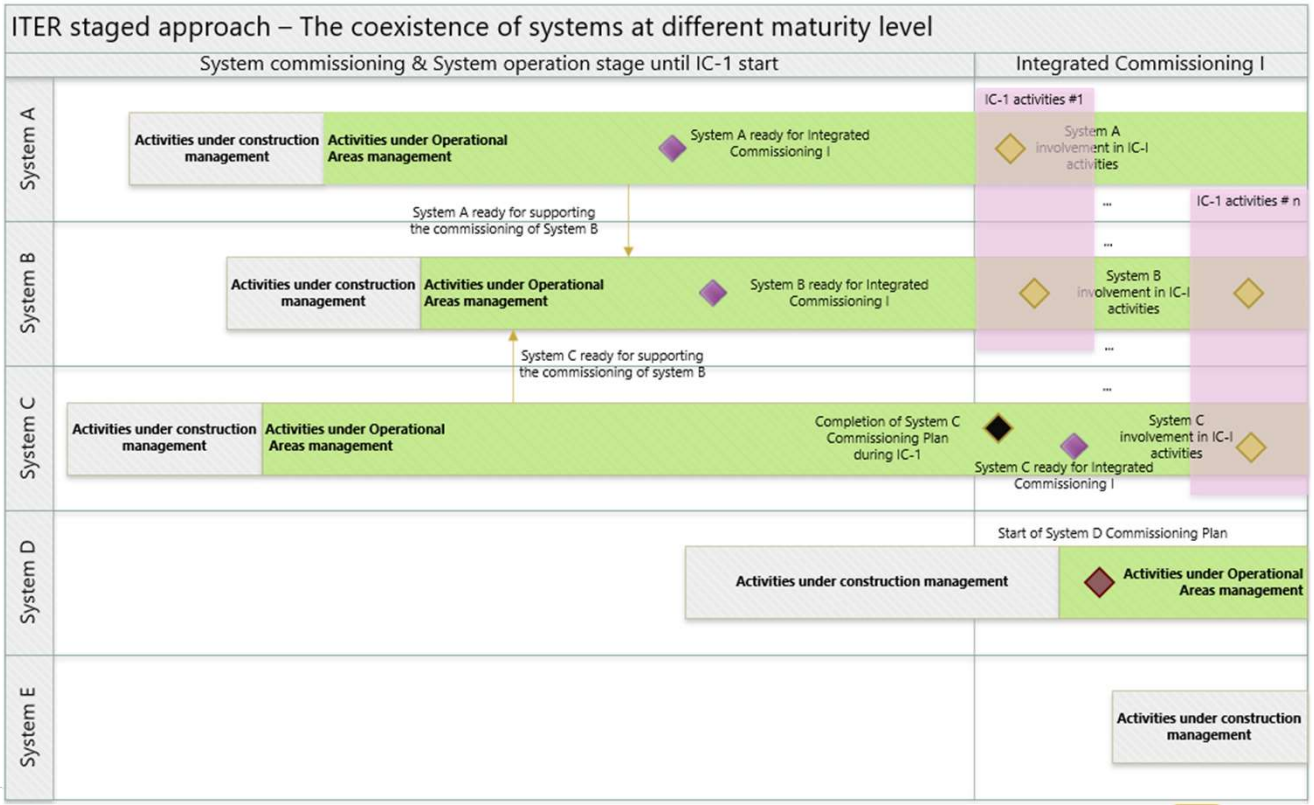


The ITER operational areas

- The ITER construction schedule results in the simultaneous execution of construction, system commissioning and (in the future) integrated commissioning activities

The operational areas organization has been set-up to:

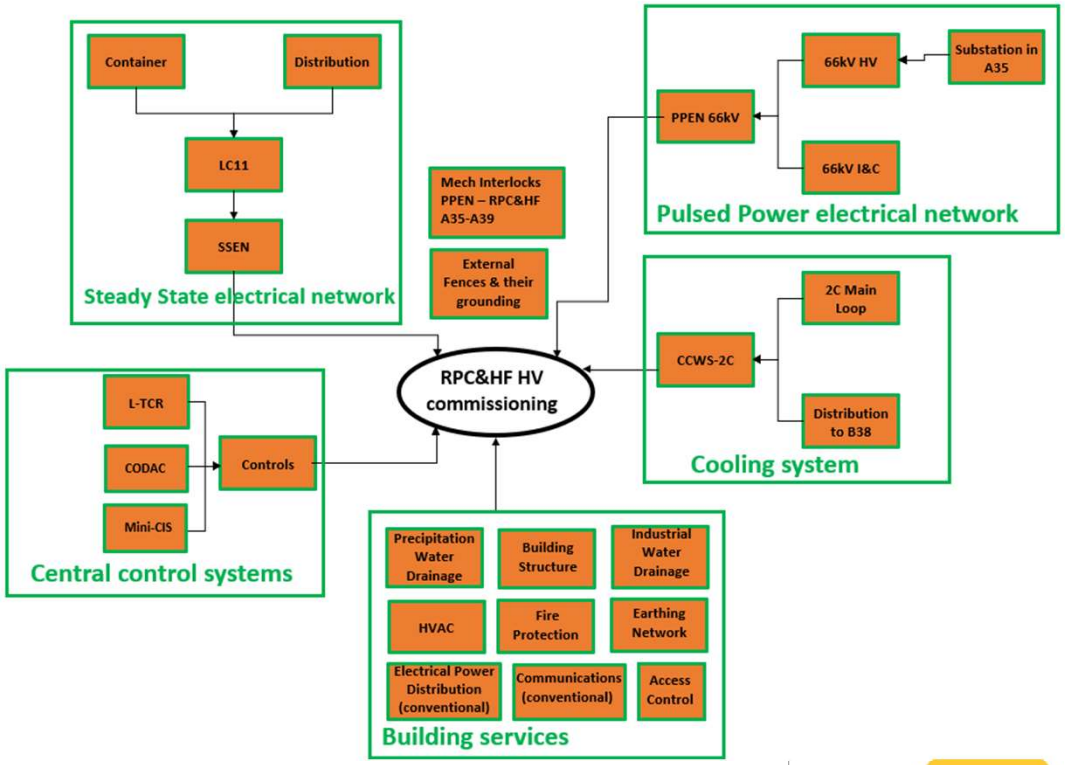
- Cope with the **additional risks** generated by commissioning & operation activities
- Assure the **timely availability** of "supporting" systems for both "client" systems & integrated commissioning activities



The integrated systems commissioning

- The commissioning of systems requires both an **integrated time schedule** to make sure "suppliers" are ready on time to support their clients and a **day-to-day coordination** at execution time to manage co-activities and unexpected events:

- Illustration of the dependencies for the commissioning of the Reactive Power Compensation & Harmonics Filtering system:



Control system :

INTEGRATION AND COMMISSIONING STATUS

First local control system delivered in 2018. Over the last 7 years systems have been integrated incrementally, followed by commissioning and (temporary) operation.

<u>In-kind local control systems integrated</u>

- Steady state electrical network
- Buildings and site services
- Cooling water
- Cryoplant
- Pulsed power electrical network
- Reactive power compensation and harmonic filtering

<u>In progress or imminent</u>

- Electron Cyclotron Heating
- Coil Power Supplies
- Magnet Cold Testbed
- First Diagnostics

<u>Central functions</u>

- Supervision
- Data archiving and data access
- Orchestration and sequencing
- Configuration

Temporary Main Control Room in operation since 2021

Inauguration of Main Control Room in December 2024

Commissioning: Supporting Systems

Heat Rejection and Cooling Water Systems

- **Steady-state electrical distribution (c.a. 50% of the final asset), heat removal with cooling water, chilled water, demineralized water, compressed air are in operation to support commissioning of other systems**

Compressed / breathing air production statio

Chilled water systems (condensers & evaporators):

22kV steady state electrical distribution sub-station

Demineralized water production statio

IBF/25

COOLING WATER

- Started integration and commissioning in 2021
- Provides heat rejection through cooling towers, component cooling, chilled water and blowdown
- Today heat rejection, chilled water and 2 component cooling loops are in commissioning or operation
- Top level HMI giving geographical overview over cooling water and distribution
- Equipment status and flows in pipes are animated using color coding

Commissioning: Reactive Power Compensation

- **The Pulsed Power Electrical network (PPEN) is in operation; supplied by two 400kV lines connected to the French grid (RTE)**
- **High voltage tests are completed, and system has entered its maintenance phase until tests with magnet converters take place**

Pulsed Power Electrical Network 66/22 kV

Filtering channels and Thyristor Controlled Reactors

Water cooled Thyristor Banks

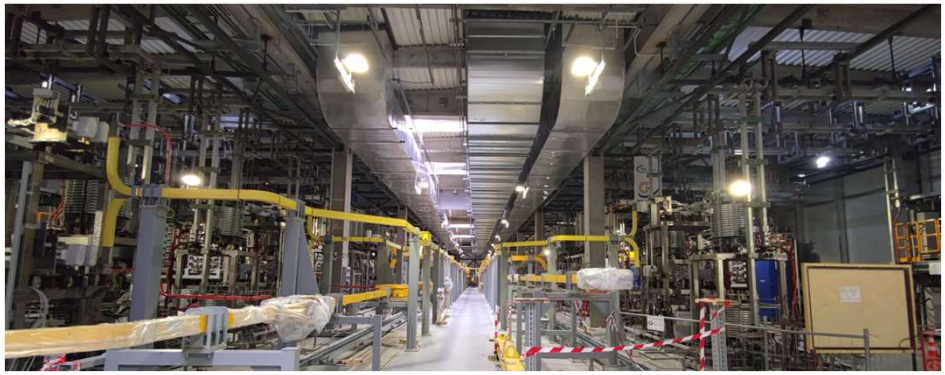
ELECTRICAL NETWORK

- Started integration and commissioning in 2018
- Four 400 kV/22 kV transformers feed medium and low voltage load centers distributed over the site
- Today more than 50 % of total system in 24/7 operation
- Top level CS Studio Human Machine Interface (HMI) gives geographical overview and instant power consumption
- Electrical components and high voltage cables animated using color coding

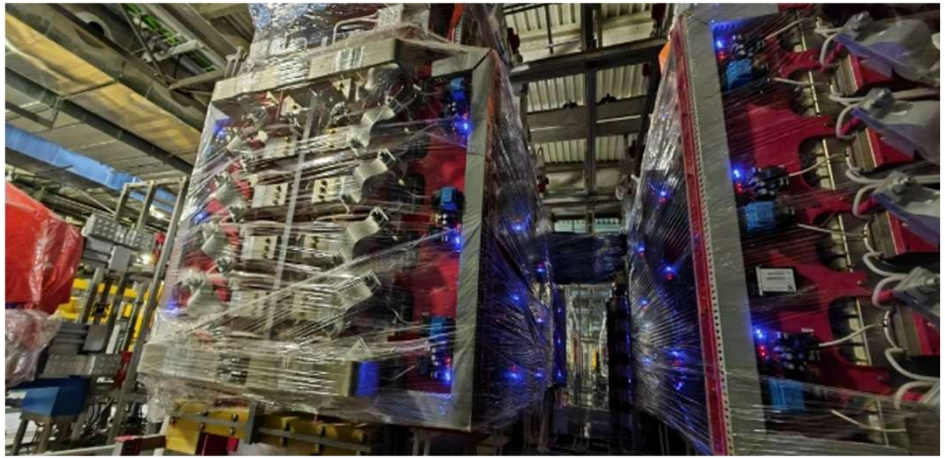
Commissioning: magnet power supply

Power Converters in B33

- The **1st low voltage energization of the PF Power Converter** was started from 13th Sep. 2024



Power Converters and Busbars in B32

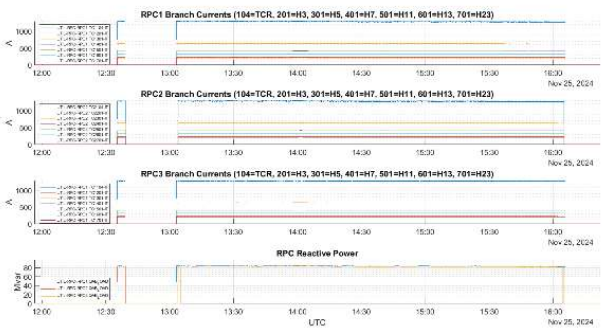


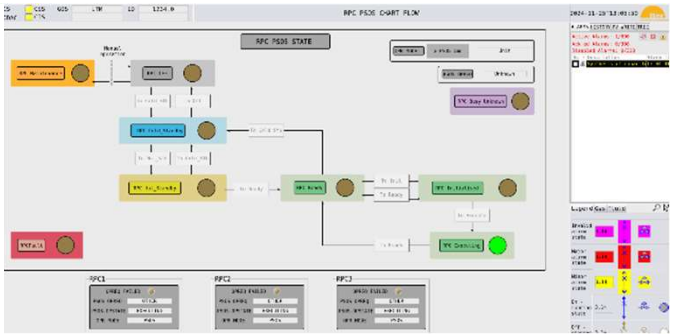
PF Power Converter Low Voltage 1st Energization

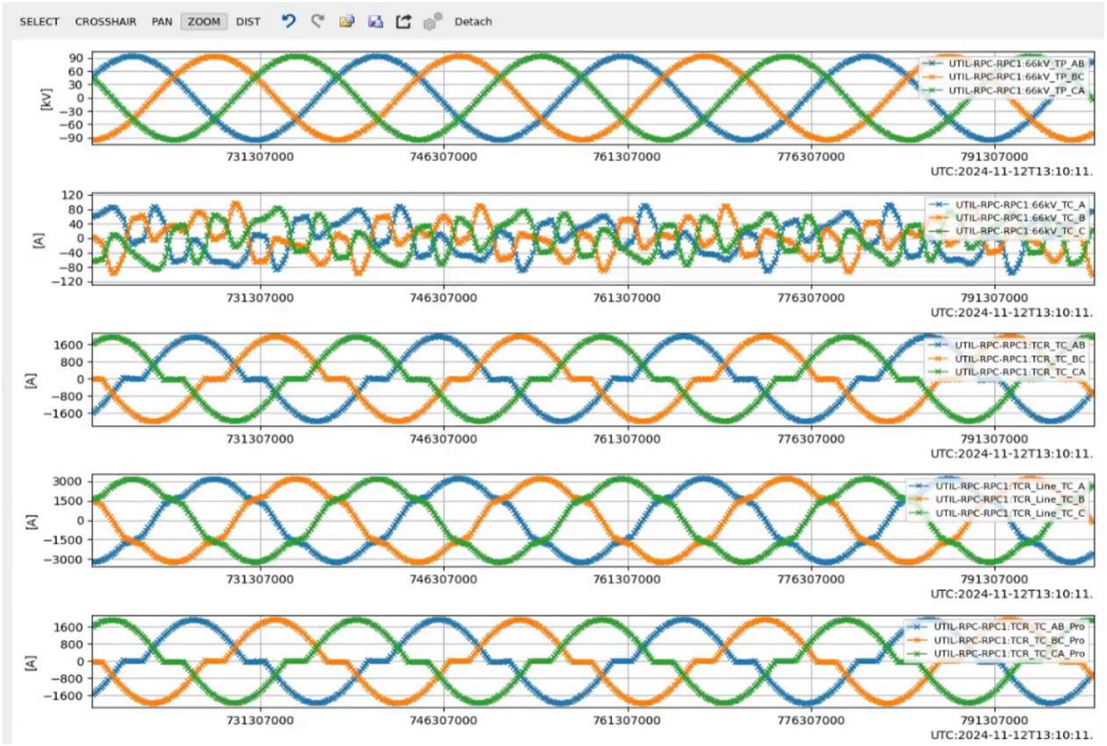
KODA PA Master Control System 1st Energization

PULSED POWER AND REACTIVE POWER COMPENSATION

- Started integration and commissioning in 2022
- Three 400 kV/66/22 kV transformers feed RPC, Coil Power Supplies and Additional Heating
- SAT completed on November 25, 2024 with three hours energization of all three RPC units
- CS Studio Human Machine Interface (HMI) gives view of the top-level state machine
- Fast data acquisition (DAN) and real-time control (SDN) at 6 kHz







Commissioning: Cryoplant

He Plants – Warm Compressor Station (WCS):

- All 18 screw compressors individual performance tests completed [≈ 21 MW total]
- **Compressor station overall acceptance tests completed**

He Plant – Cold Boxes:

- Static POS average & **dynamic operation for 1800s pulse profile acceptance tests completed for 1st Plant**
- Max **refrigeration capacity >25kW** demonstrated for 1st Plant

N_2 Plants:

- 2 x 5 MW centrifugal compressors commissioning completed
- 1st Cool Down of LN_2 Plants completed, with performance testing campaign to start

2025 MAIN OBJECTIVE:

- **1st Cryoplant SAT completion**

→ start of pre-operation to support MCTB

- **LN_2 Plants acceptance tests** completed
- **He Plants acceptance tests** completed
- Start-up of **He centrifugal compressors** [first of a kind]

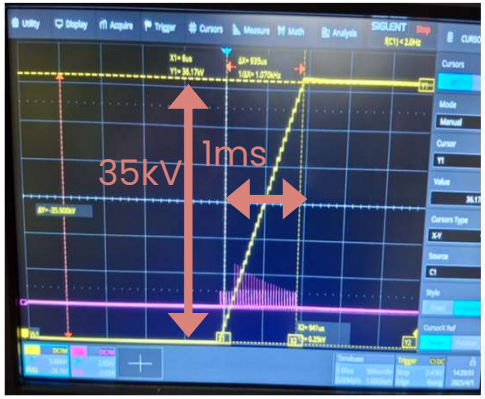
IBF/25

Commissioning: Electron Cyclotron Heating

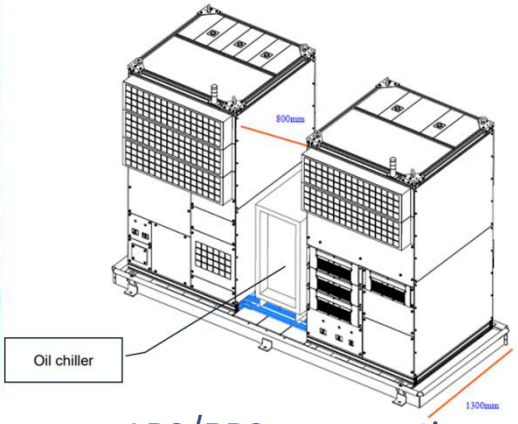
- Successful **1st energization of x4 Gyrotron Instrumentation and Control Cabinets** in L2 with the support of JA-DA, these cabinets integrate the different auxiliary systems as a pre-requisite for the commissioning of the two first gyrotrons;
- Successful **1st energization of Ampegon Power Supply BPS#1 and BPS#2**; the **first pulses 35kVdc-few mA** done on dummy load, commissioning progressing well;
- Preparation for the **1st energization of the MHVPS05**, Electrical non-conformities fixed (pending final inspection), compliance dossier issued, next step is High Voltage Insulation Test;
- Modification of the APS/BPS#1 and #2 (JA-DA) to accommodate additional oil chiller and resolution of electrical non-conformities (pending final inspection)

- All those activities will contribute to the commissioning start of the **first Gyrotron** (out of 24 needed for IC-I) from this summer

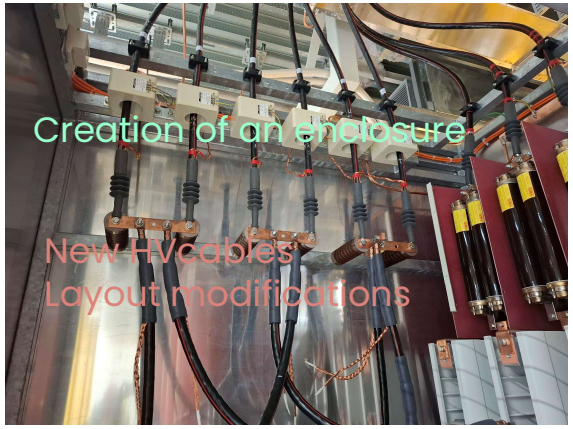
Gyrotron



BPS Commissioning
First Pulses on Dummy Load

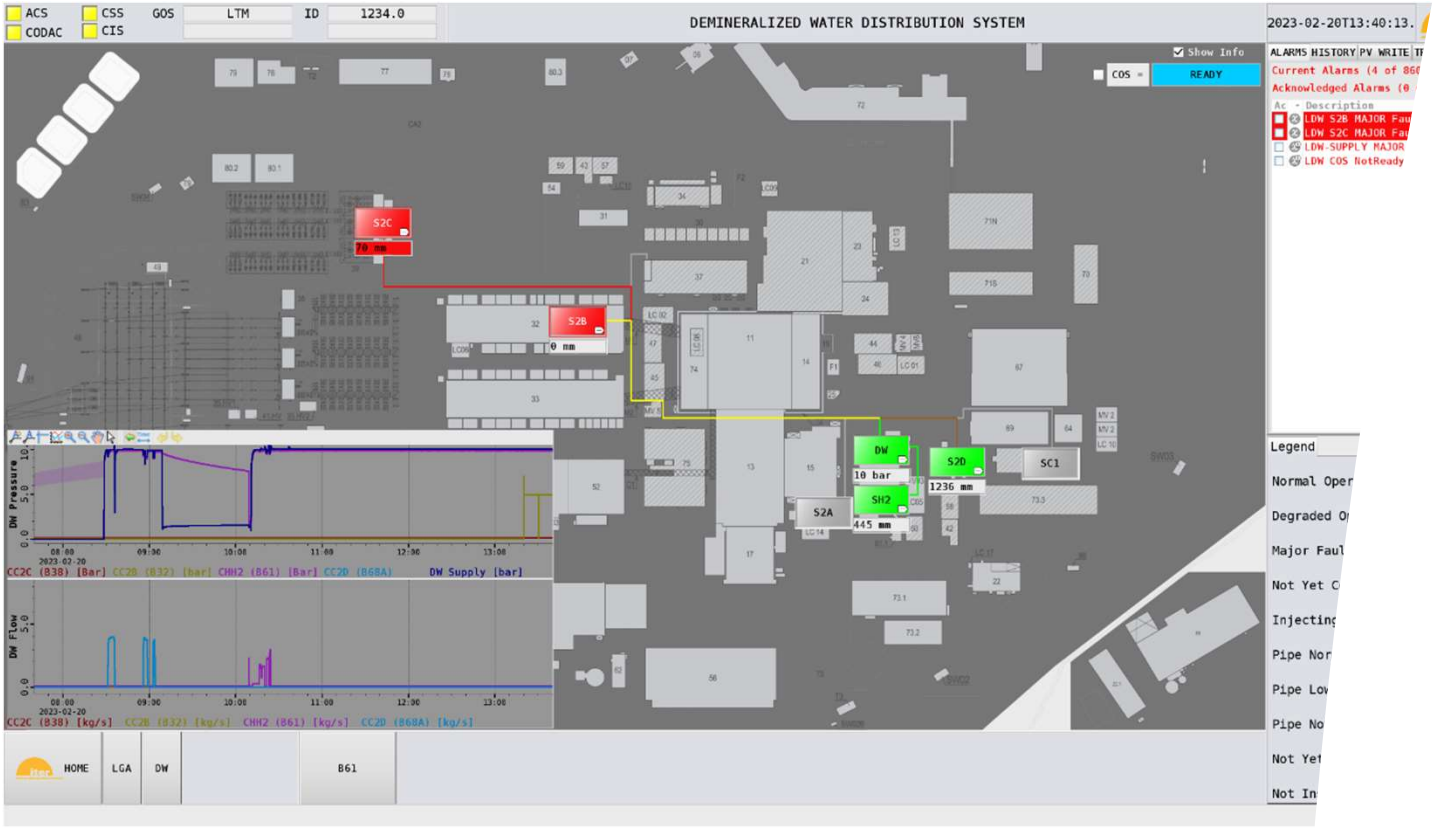


APS/BPS preparation
Oil Chiller Integration



Preparation 1st Energization MHVPS05
Modifications Step-Starter

Gyrotron Instrumentation Cubicles
1st energization

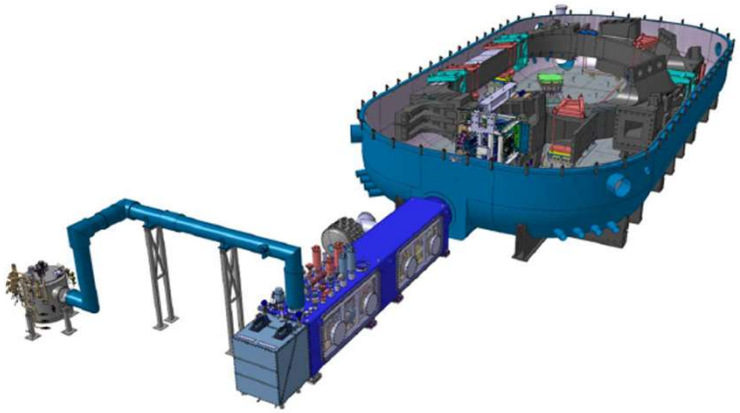


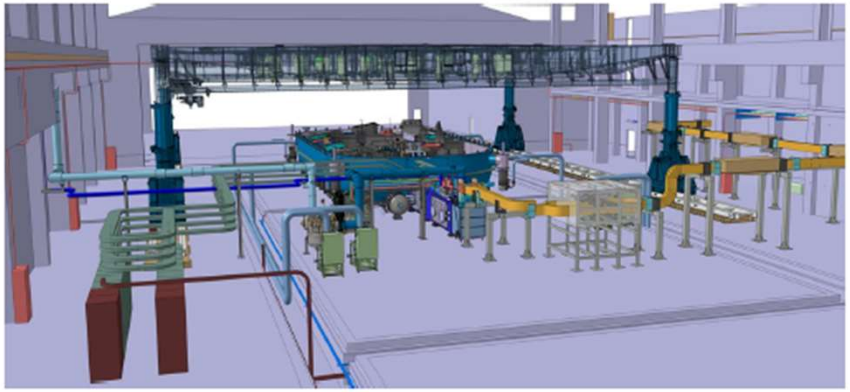
BUILDINGS AND SITE SERVICES

- Started integration and commissioning in 2019
- Provides environmental conditions, fire protection and distribution of liquid and gas services
- Today 50 % of auxiliary buildings and 20 % of distribution of services in 24/7 operation
- Example of top level HMI giving geographical overview over demineralized water production and distribution
- Clients status and flows in pipes are animated using color coding and a six hours trend shows pressures and flows at various points

Commissioning preparation : Magnet Cold Test Bench

- The objective is to test a sub-set of superconducting magnets at 4K and with current before their installation on site
- The test bench is made up (or make use) of a representative array of systems used to operate magnets in a Tokamak
- It will be the first opportunity on ITER to commission those systems in an integrated manner and then operate the MCTB when testing the coils
- Lessons learnt will be key for the preparation of the Integrated commissioning I phase
- System commissioning activities are planned from this summer, and the first TF coil will undergo its testing program by end of 2025

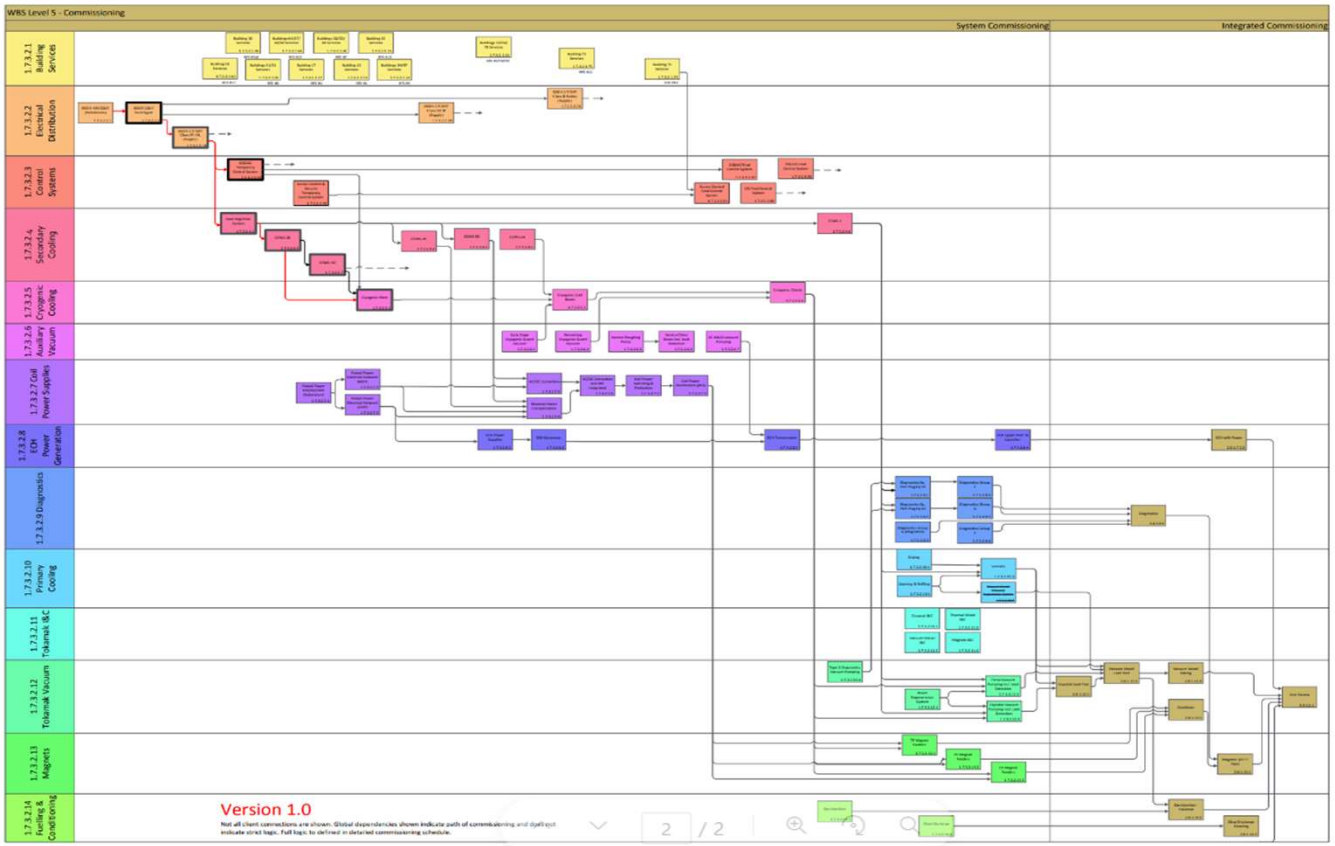




System commissioning activities leading to ITER machine
Integrated commissioning

To date Roughly 15% of the system commissioning done to IC-1

We have 8 years left to get to 100%!! Our mission will be done on time



IBF/25
INTERNATIONAL ITER BUSINESS FORUM

THANKS

TO BE PART OF THE WORLDWIDE **FUSION** NETWORK

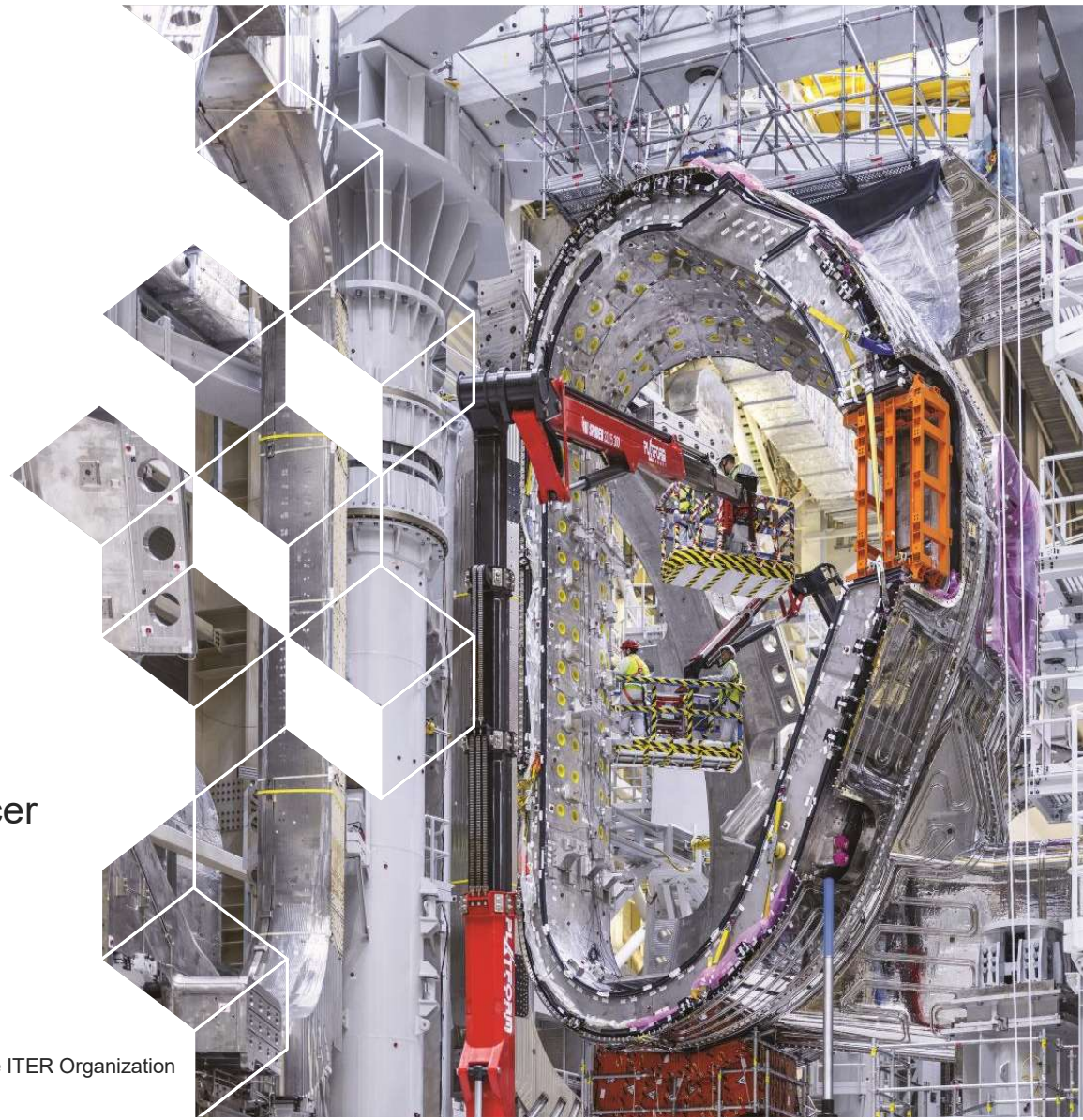
IBF/25

INTERNATIONAL ITER BUSINESS FORUM

Business Opportunities (Controls & integrated commissioning program)

Lijun LIU

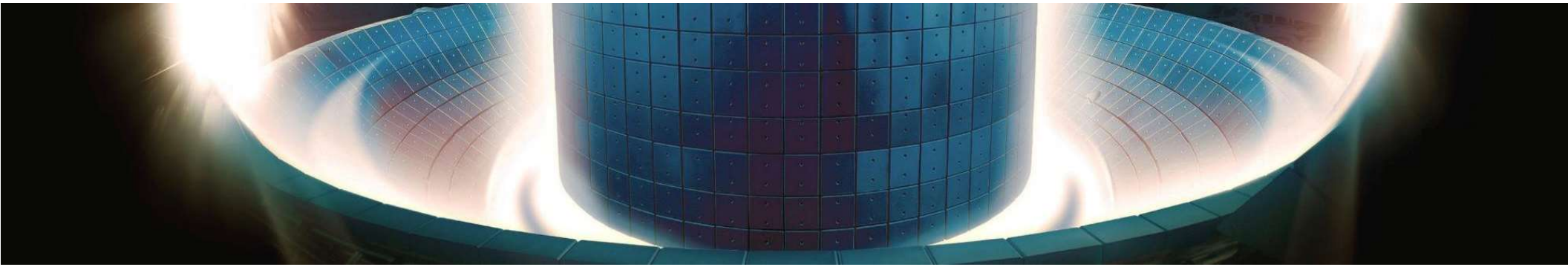
ITER Procurement Responsible Officer



WEDNESDAY APRIL 23rd

Summary

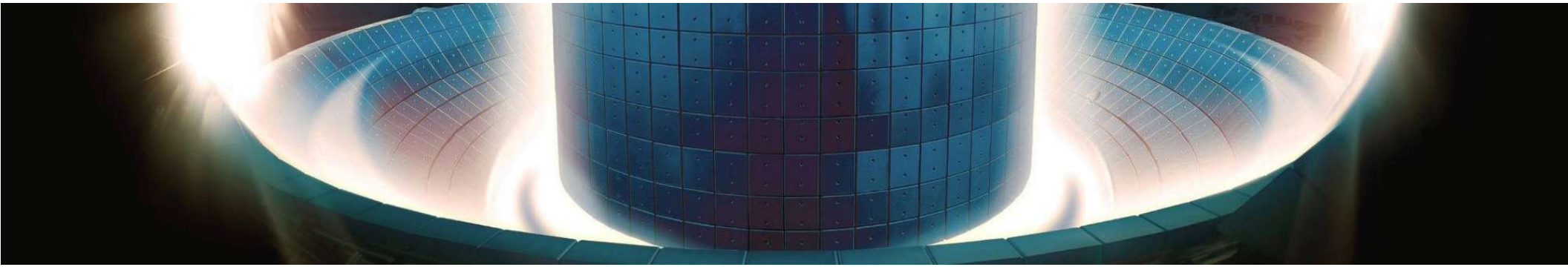
1. Control, Data Access and Communication (CODAC) Core System User Support
2. Control, Data Access and Communication (CODAC) Core System Software Maintenance
3. ITER Data Handling
4. Control, Data Access and Communication (CODAC) Operation Application Engineering Service
5. Maintenance of RedHat Enterprise Linux (RHEL)
6. New support service contract for CIS
7. CSS engineering and commissioning support services
8. Central Safety System for Nuclear (CSS-N) supply contract for Start of Research Operation (SRO)



1. Support Helpdesk for the users of our CCS (CODAC Core System) software distribution

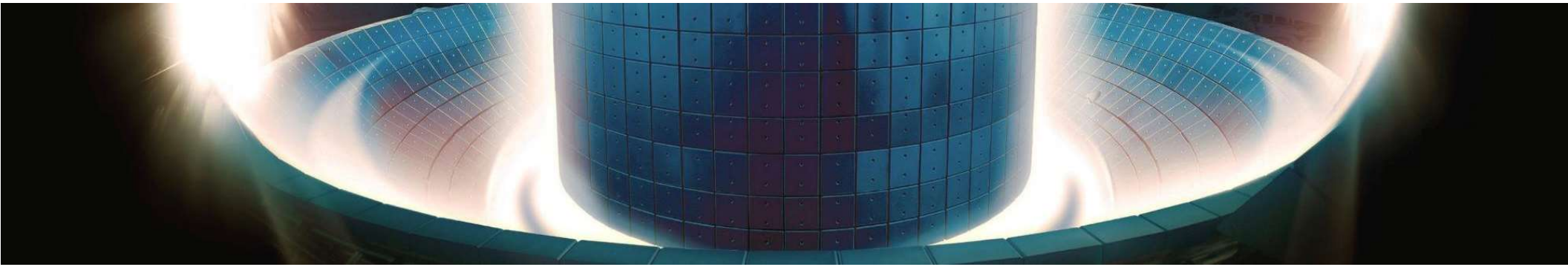
- **Scope**:
  - provide email-based helpdesk service for users, including first-level support & problem analysis
  - provide occasional multi-day hands-on training courses at the ITER headquarters
  - provide software Quality Assurance services (run specific test plans as part of the release process)
  - (The scope will be for remote work except for the hands-on training)

- **Solicitation**: Open Tender
- **Contract Type**: Service Framwork Contract
- **Indicative time to launch**: Q4-2025
- **Contract Value Range**: **A**



2. Assistance in maintenance of IO CCS (CODAC Core System) software distribution

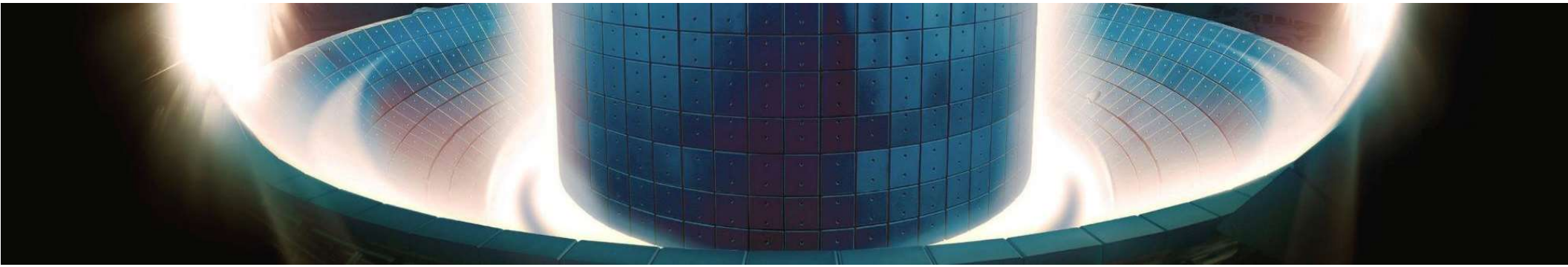
- **Scope**:
  - maintenance (fixes, improvements, tests) of configuration management applications (Java, Eclipse, PostgreSQL)
  - maintenance (fixes, improvements, tests) of kernel drivers and low-level software (C++, RedHat Linux)
  - maintenance (fixes, improvements) of the existing suite of automated software tests (Maven, C++, Python)
  - provide software QA services (run specific test plans as part of the release process)
  - (The scope will be for remote work)
- **Solicitation**: Open Tender
- **Contract Type**: Service Framework Contract
- **Indicative time to launch**: Q1-2027
- **Contract Value Range**: **A**



3. ITER Data Handling

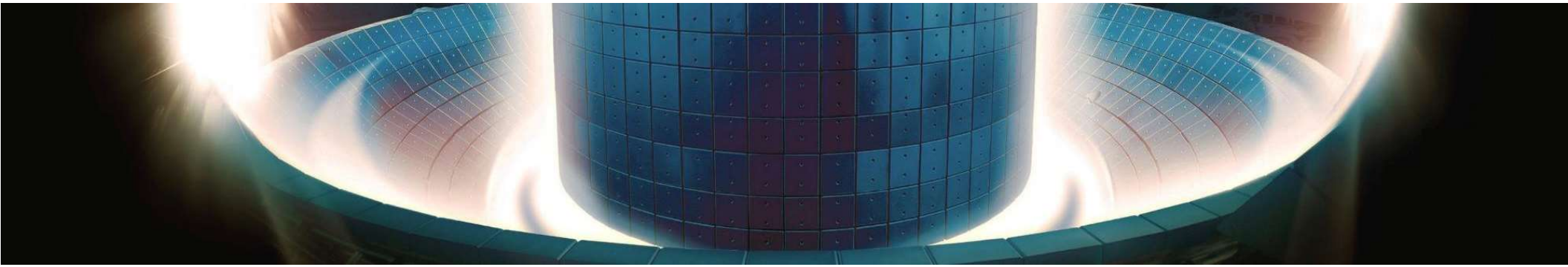
- **Scope**:
  - Maintenance of the data archivers, on the enhancement of the data access and inclusion of new components if necessary to cope with new needs in terms of data analytics.
  - Data visualization: it includes maintenance and enhancements of existing tools. Depending on the project needs it could also imply development of new utilities.

- **Solicitation**: Open Tender
- **Contract Type**: Service Framework Contract
- **Indicative time to launch**: Q2-2025
- **Contract Value Range**: **A**



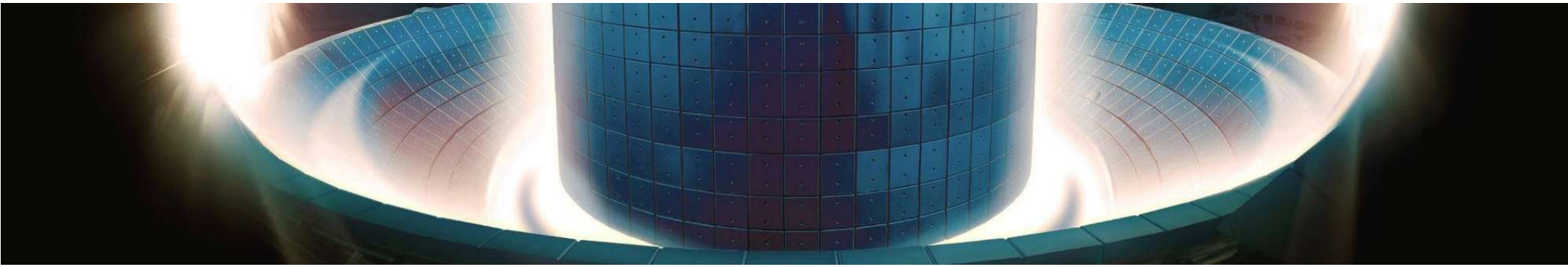
4. Control, Data Access and Communication (CODAC) Operation Application Engineering Service

- **Scope**:
  - Maintain on the ITER Real Time Framework (RTF) software including debugging, enhancing existing functions and implementing of new functionality; release on demand of RTF new version; and provide technical support activity.
  - Maintain PCS (Plasma Control System) application under supervision of IO; elaborate PCS components software package and utilities; and technical support PCS operation and system integrated commissioning toward the ITER Start of Research Operation.
  - Required technical expertise : C/C++, Python, Linux system engineering, RTF, EPICS, Maven, Matlab/Simulink Coder, Electron, React Flow, XML-Json file handling.
- **Solicitation**: Open Tender
- **Contract Type**: One Service Framework Contract
- **Indicative time to launch**: Q4-2026
- **Contract Value Range**: **A**



5. Maintenance of Red Hat Enterprise Linux (RHEL)

- **Scope**:
  - This Framework Contract allows CODAC to purchase Red Hat licenses in order to support the Plant Systems I&C commissioning and to prepare the Plant Operation Zone infrastructure, providing RHEL (Operating System supporting the Control System) RHV (Virtualization Platform hosting the Control System), RHS (Storage Solution), CEPH (Domain Storage used by the Virtualization Platform) and Satellite server (System Deployment Engine). The Central Control System is a set of servers, storages, and applications, themselves gathering, processing, recording, and displaying the data collected from the slow and fast controllers to the operators.
  - It additionally includes, the maintenance of operating system (RHEL) used by CODAC Operator Terminals to display ITER HMI (Human-Machine Interface) in the Main Control Room.
- **Solicitation**: Open Tender
- **Contract Type**: Service Framework Contract
- **Indicative time to launch**: Q3-2027
- **Contract Value Range**: **A**

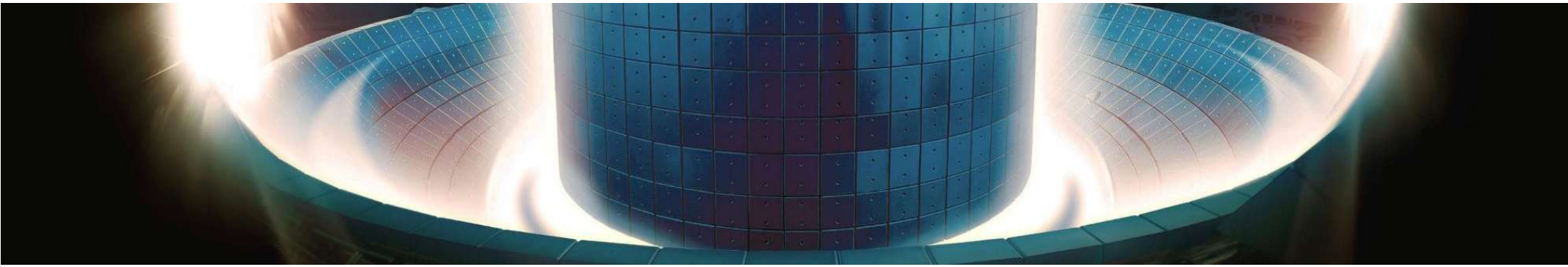


6. New support service contract for Central Interlock System (CIS)

Scope:

- Engineering services covering the participation in the design, development, installation, commissioning, testing and V&V (validation and verification);
- Development and integration of software modules and functions for slow controllers and fast controllers;
- Support the development of the CIS SCADA (Supervisory Control and Data Acquisition) under WinCC-OA framework, and its integration with the different Plant Interlock systems.

- **Solicitation**: Open Tender
- **Contract Type**: Service Framework Contract
- **Indicative time to launch**: Q2-2025
- **Contract Value Range**: **B**

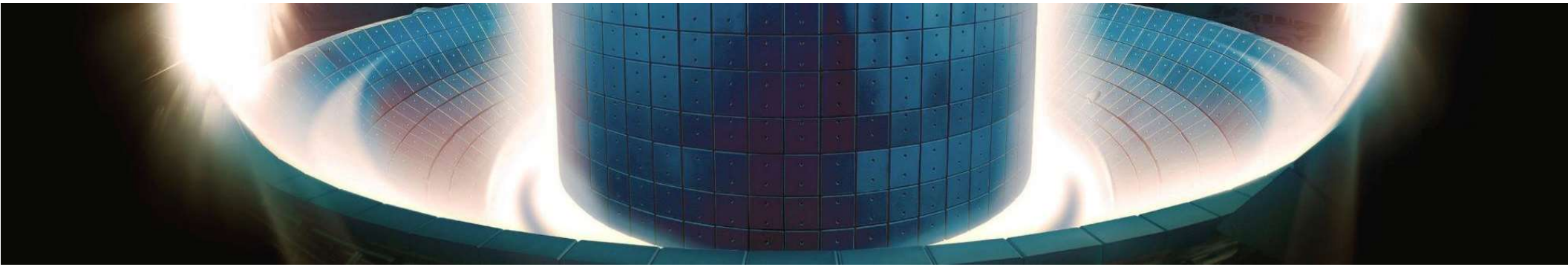


7. Central Safety System (CSS) engineering and commissioning support services

- **Scope**:

  The purpose of the contract is to provide technical services to support the design and integration of ITER safety control systems. It will cover topics such as engineering services, interface and infrastructure, prototyping and software development activities and commissioning preparation and execution. The contract may be split in lots.

- **Solicitation**: Open Tender
- **Contract Type**: Service Framework Contract
- **Indicative time to launch**: Q4-2025
- **Contract Value Range**: **B**



8. Central Safety System for Nuclear (CSS-N) supply contract for Start of Research Operation (SRO)

- Scope:

  A first version of the Nuclear Safety Control System is currently under manufacturing, including the backbone of the architecture and the implementation of safety controls of the first ITER systems to be commissioned. The purpose of the contract is to extend the nuclear safety control system to cover all ITER plant systems necessary for the Start of Research Operation.

  The contract includes the design, qualification, procurement, manufacturing, testing and delivery of the corresponding systems. The supply may be split in batches. The contract may as well include the modification of systems already delivered.

- **Solicitation**: Open Tender
- **Contract Type**: Service and Supply Contract
- **Indicative time to launch**: Q4-2025
- **Contract Value Range**: **D**

IBF/25
INTERNATIONAL ITER BUSINESS FORUM

THANKS

TO BE PART OF THE WORLDWIDE **FUSION** NETWORK

PLATINIUM SPONSOR SILVER SPONSOR SILVER SPONSOR BRONZE SPONSOR

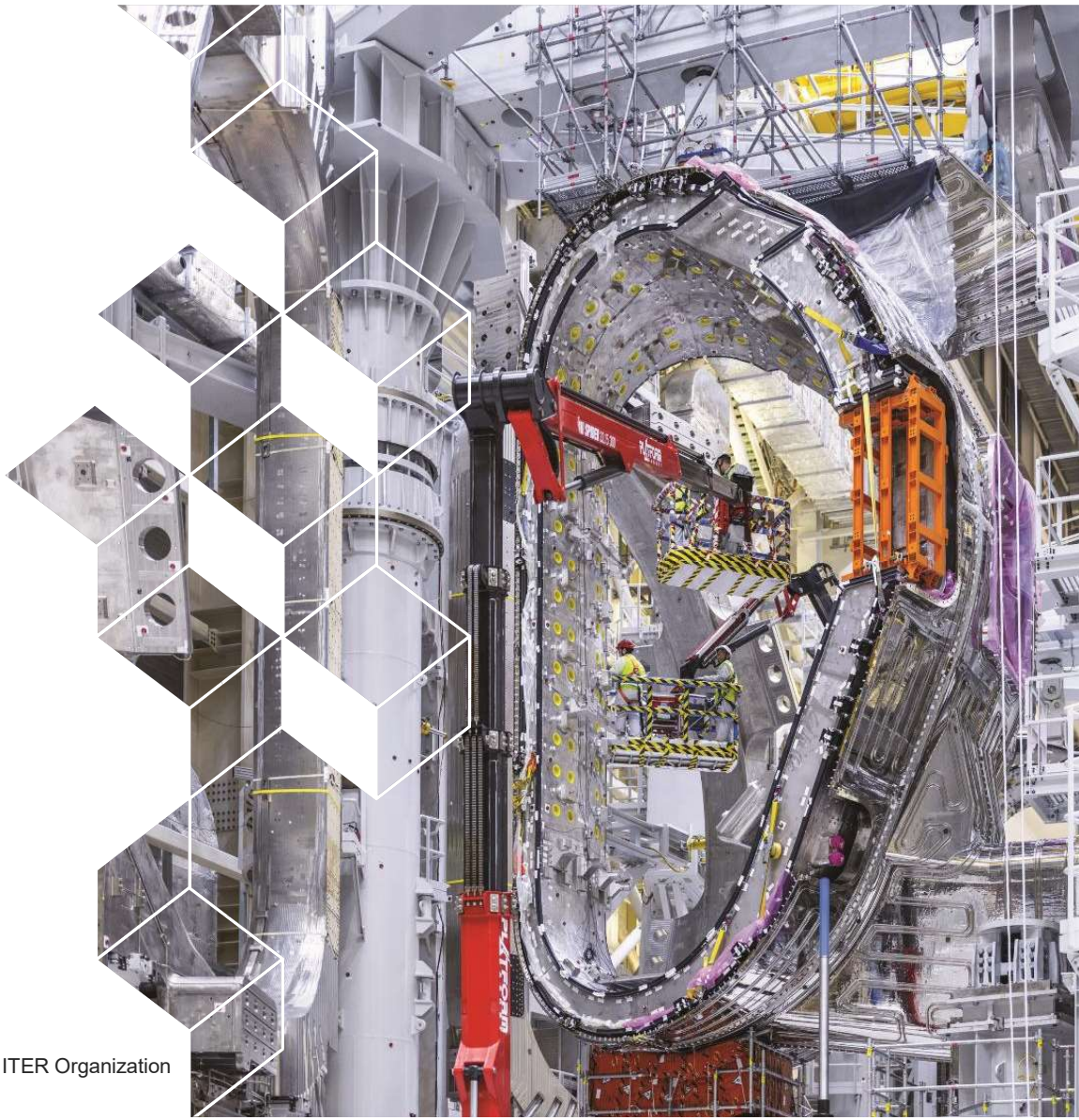
IBF/25

INTERNATIONAL ITER BUSINESS FORUM

ASSYSTEM perspective on Work with ITER

Romain BUISSON

I&C Business Manager



WEDNESDAY APRIL 23rd

Agenda

1. General presentation
2. Assystem activities
3. Assystem know-how
4. Assystem delivery model
5. Assystem work localisation
6. Perspectives

1. General presentation.

Assystem expertise.

WORKING ON THE TASK OF THE CENTURY: SWITCHING TO LOW-CARBON ENERGY.

Assystem assists governments, owners, contractors and OEMs to develop, deliver, and operate critical and complex infrastructures in the low carbon energy, industries, transportation, and defence sectors.

ENGINEERING EXPERTISE CENTERS

- France, India and Saudi Arabia for complex infrastructure engineering
- Türkiye & Central Asia for environmental & geotechnical services
- France, UK & India for transportation engineering
- France & UK for safety, risk, human factors, operation, regulation and compliance
- Uzbekistan for grid engineering
- France for balance of plant

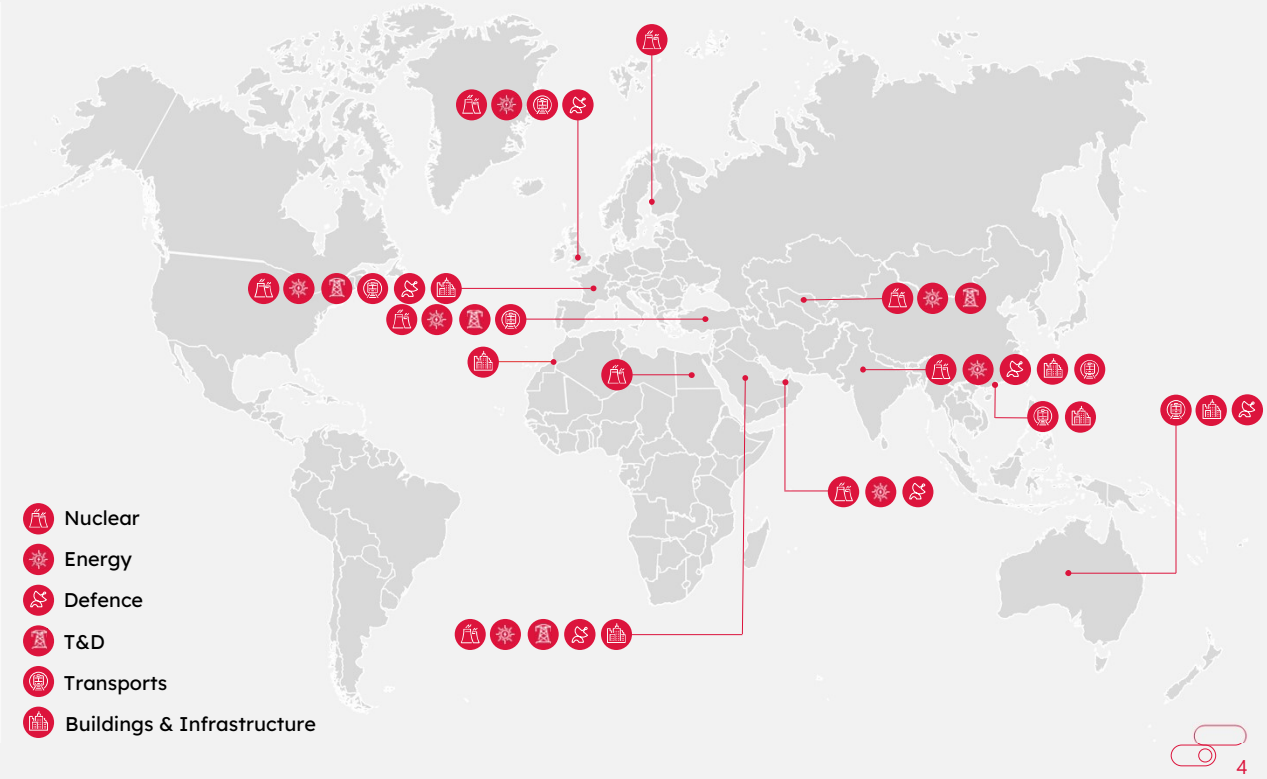
ENGINEERING PLATFORMS

60 years of expertise

8,000 experts

A local presence in 12 countries around the world

Assystem can be local everywhere



Assystem's positioning in Industrial Information Systems.

Taking advantage of the digitalisation of industrial systems, we intervenes in **Instrumentation & Control (I&C), Building Management Systems (BMS) and physical protection systems** of complex infrastructures in highly regulated international multi-sector environments.

Nuclear

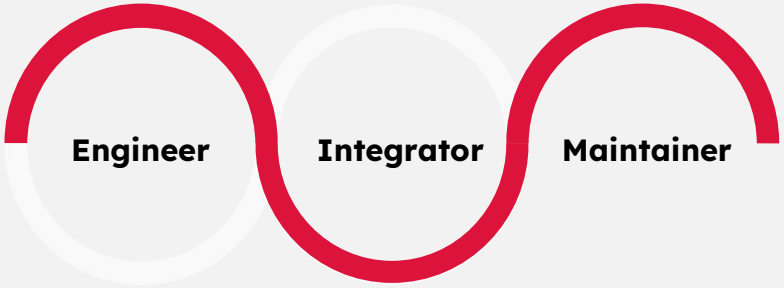
Energy

Infrastructure buildings

Transport

Defence

The Industrial Information Systems activities benefit from a triple positioning:



2. Assystem activities.

ASSYSTEM'S JOURNEY THROUGH ITER

2006

Nuclear Safety engineering for ITER Organization

"For the past five years, I've contributed to the ITER project, now coordinating teams to design tritium production systems—essential for fusion. Without tritium, there's no fusion; without fusion, there's no ITER.

This unique project relies on innovation, collaboration, and dedicated people building the energy of tomorrow."

Benoit CARNUS
Project manager and technical coordinator

"My role is to use advanced simulations to ensure the robustness and reliability of the structural elements and components on the ITER site. Taking part in a project of this scale and contributing to the energy of the future is a source of motivation and pride every day."

Alice BERTHOLOT
Mechanical and fluid calculations engineer

2008

Support for the design of all equipment for ITER Organization

2010

Architect Engineer 1 for ITER Buildings and Civil Infrastructures for F4E with ENGAGE joint venture (SNC)

2013

Preventive and corrective **maintenance of Instrumentation & Control cubicles** in operation for ITER Organization

2014

Divertor Remote Handling System development for F4E

Central Safety Systems Support services to support the design and integration for ITER Organization safety control systems

2016

Construction Management Agent for ITER Organization with MOMENTUM joint venture (SNC)

"Working on ITER, at the heart of a major international project, gave me invaluable experience that opened the door to a rewarding career in the nuclear industry, from HPC in the UK to EPR projects in France."

Coline LARCHER
PM technical manager

2019

Test Blanket Module design and analysis for ITER Organization

2020

Design Office Framework Contract Mechanical & Plant services for ITER Organization

Integration and Commissioning of ITER Control System

assystem

Contributing to ITER's Tritium Breeding Blanket Systems is a unique challenge, and I'm proud to develop solutions that enhance safety and support the future of fusion energy.

Jayant SOMVANSHI
Expert in thermohydraulic simulations and tritium transport

2021

System Engineering Framework Contract for F4E

My role is to ensure the conformity of instrumentation and automation systems for utilities while guaranteeing compliance with ITER standards, safety requirements, and French regulations—a crucial responsibility for the success of the test and commissioning phases.

Jérémy LO FASO
ANC Test & Commissioning Supervisor

2022

Design of the **Charge eXchange Recombination Spectroscopy** for F4E

Engineering for Design Development of the first confinement components of ITER Diagnostics Framework Contract for ITER Organization

Commissioning Support Framework Contract for ITER Organization

2023

Configuration Management Data for ITER Organization

Instrumentation & Control design lifecycle activities for the Diagnostic systems for ITER Organization

Working on ITER is a rewarding experience: we are contributing to an international collaboration whose impact can benefit the whole world.

Maxime OCTAVE
Realtime development Engineer

2024

Architect Engineer 2 for ITER Buildings and Civil Infrastructures for F4E with b.NEXT joint venture (SNC)

Proud to design key tools like the Unified Control Library and Code Generation Tool, simplifying automation and ensuring efficient management of ITER's control systems.

Matthieu SIMONIAN
Technical Lead of software development

Safety
2011~2026

- Library development
- PLC and IHM development
- Electrical wiring control
- Provision and review of interface documentation
- Tests

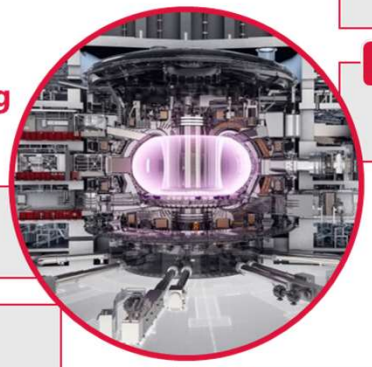
Integration & commissioning
2021~2027

Design, réalisation & FAT
Automation (PLC and Fast controller)
HMI

Integration
SAT (unit tests)
Implementations
Scripting (automatisation and correction)
Development

Commissioning
SAT (functionnal tests)
Documents review
Visual inspection

Maintenance
Script (automatisation and correction)
Development (IHM, Epics, PLC...)



Maintenance hardware I&C
2023~2026

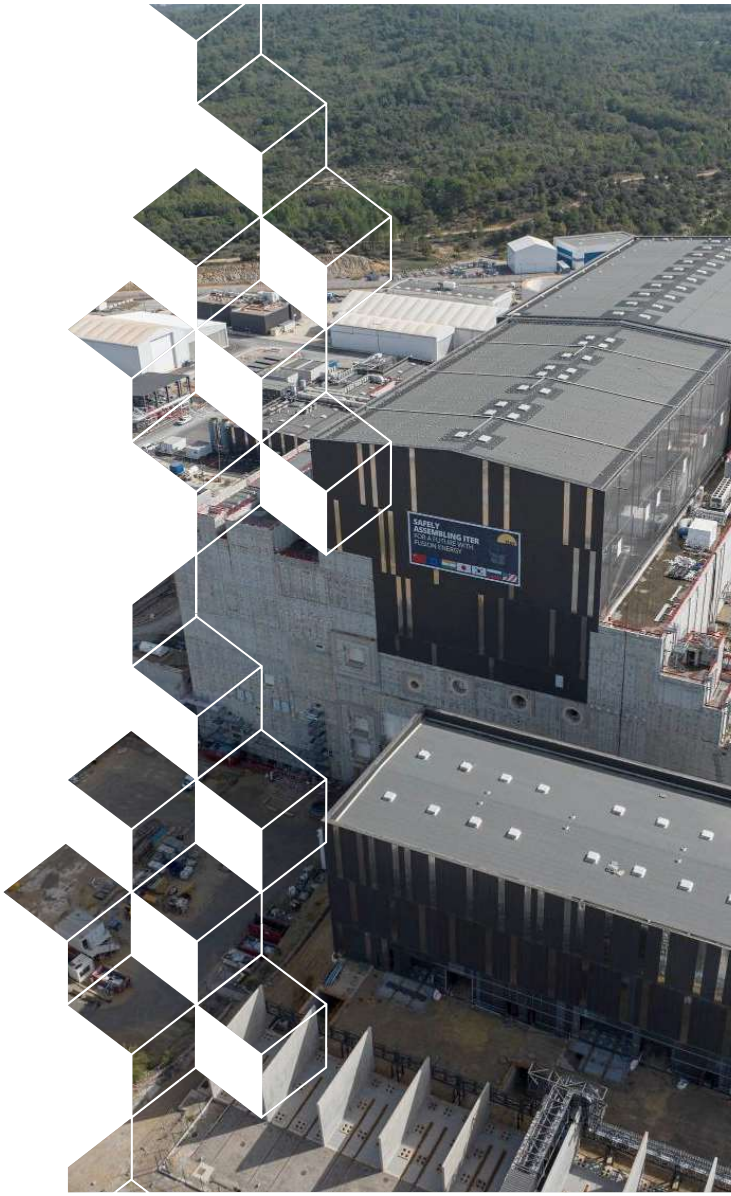
Process
Support for management tools upgrade
Process testing (virtual reality, ...)

Documentation
Documentation update
Databases update and statistics analysis
Maintenance plans

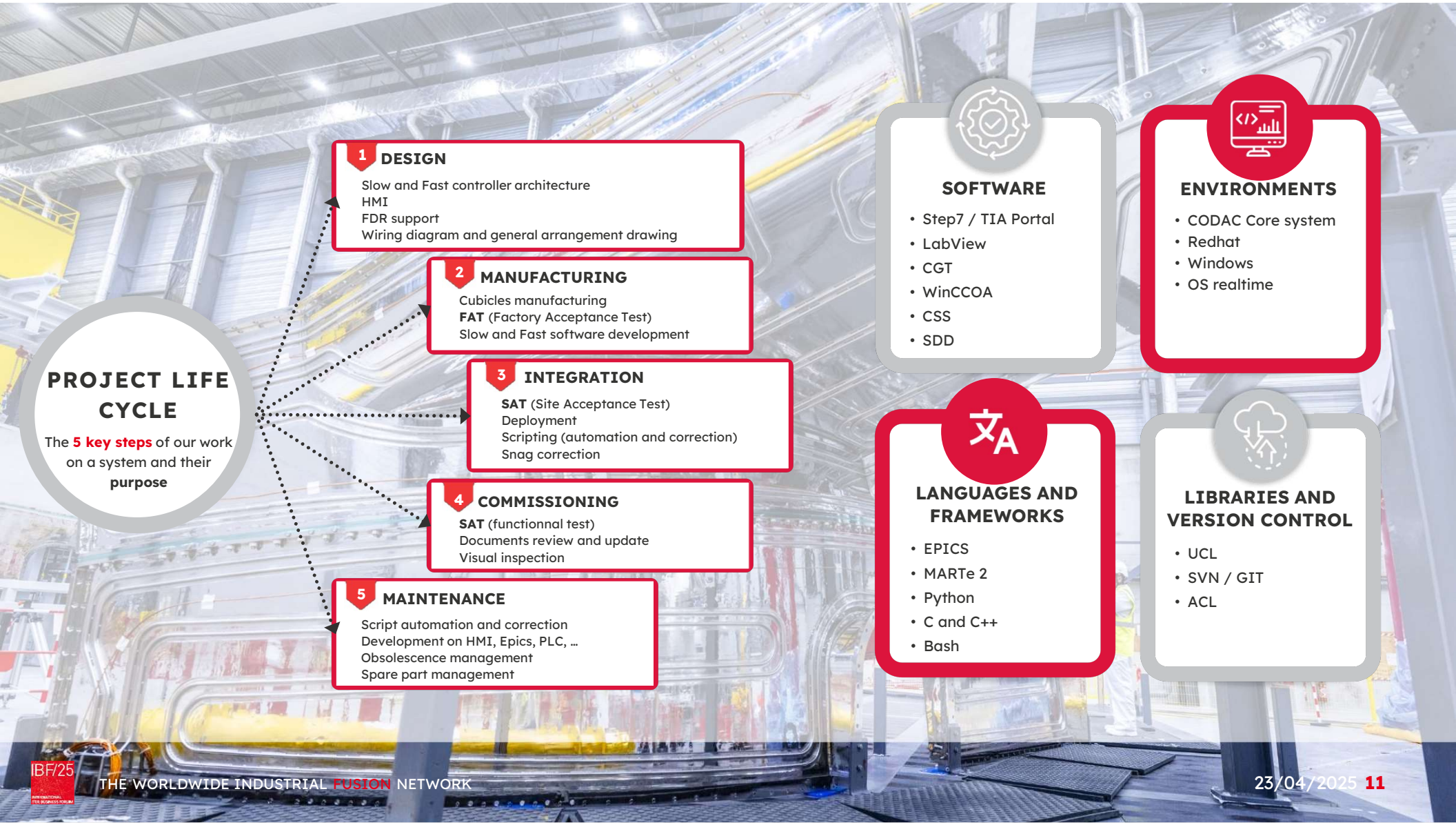
Maintenance
Preventive (inspections, stocks management)
Corrective (interventions on site)

I&C support
2013~2025

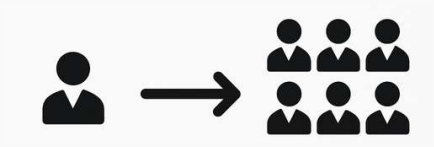
- Equipment test and installation
- Technical rooms management
- Wiring
- Network Support
- Inventory (Component Lifecycle Management)
- Spare parts and consummables management



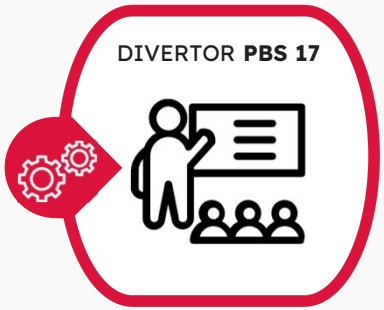
3. Assystem Know-how.


PROJECT LIFE CYCLE
The 5 key steps of our work on a system and their purpose
1 DESIGN
Slow and Fast controller architecture
HMI
FDR support
Wiring diagram and general arrangement drawing
2 MANUFACTURING
Cubicles manufacturing
FAT (Factory Acceptance Test)
Slow and Fast software development
3 INTEGRATION
SAT (Site Acceptance Test)
Deployment
Scripting (automation and correction)
Snag correction
4 COMMISSIONING
SAT (functionnal test)
Documents review and update
Visual inspection
5 MAINTENANCE
Script automation and correction
Development on HMI, Epics, PLC, ...
Obsolescence management
Spare part management
SOFTWARE
• Step7 / TIA Portal
• LabView
• CGT
• WinCCOA
• CSS
• SDD
ENVIRONMENTS
• CODAC Core system
• Redhat
• Windows
• OS realtime
LANGUAGES AND FRAMEWORKS
• EPICS
• MARTe 2
• Python
• C and C++
• Bash
LIBRARIES AND VERSION CONTROL
• UCL
• SVN / GIT
• ACL

4. Assystem Delivery model.



2013 **I&C MAINTENANCE** 2025



I&C INTEGRATION & COMMISSIONING

01

SKILLS DEVELOPMENT

Capitalise on competences improvement and form a multi-skilled and adaptable team

02

TECHNICAL EXPERTISE

Develop a deep knowledge of ITER I&C systems, associated technologies and methods

03

STAKEHOLDER COMMUNICATION

Communicate with various stakeholders (IO, DAs, suppliers, subcontractors)

04

PROBLEM SOLVING

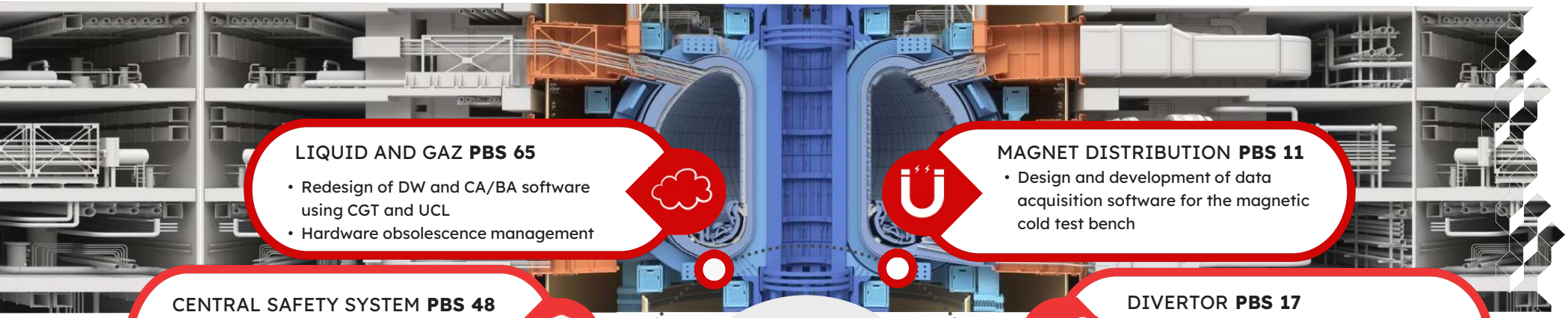
Be able to analyse and diagnostic deviations and find appropriate solutions, manage configuration

05

OPPORTUNITY DETECTION

Anticipate and detect opportunities

5. Assystem Work localisation.



ITER PLANT

On which plant systems do we already have expertise?

LIQUID AND GAZ **PBS 65**

- Redesign of DW and CA/BA software using CGT and UCL
- Hardware obsolescence management

MAGNET DISTRIBUTION **PBS 11**

- Design and development of data acquisition software for the magnetic cold test bench

CENTRAL SAFETY SYSTEM **PBS 48**

- Library development and test for PLC
- Validation of SCADA test
- Implementation of OVERRIDE redundancy functionality

DIVERTOR **PBS 17**

- Hard and Soft architecture design
- Realtime software development
- Prototyping

SS ELECTRIC POWER SUPPLY NETWORKS **PBS 43**

- Maintenance (PLC, alarm, HMI, WinCC…)

COOLING WATER SYSTEM **PBS 26**

- Migration of SCW loops software using CGT and UCL
- Hardware obsolescence management
- Software maintenance

COIL POWER SUPPLY AND DISTRIBUTION **PBS 41**

- FAT and SAT of FPIC CompactRIO
- Verification procedure PCF

VACUUM SYSTEM **PBS 31**

- Integration and commissioning (PLC HMI)

CRYOGENIC SYSTEM **PBS 34**

- FAT execution

6. Perspectives.

IN FUSION WE TRUST

ASSYSTEM EMERGED FROM COMPLEX ENGINEERING PROJECTS

assystem

1966 FUSION ENERGY OF THE FUTURE

SIGNATURE OF THE ITER AGREEMENT

2005 NUCLEAR SAFETY ENGINEERING

SECURITY & EXTERNAL PROTECTION

2008 DESIGN OFFICE

DESIGN AND ENGINEERING ACTIVITIES

2009 CODAC

EXPERTS IN INSTRUMENTATION & CONTROL

2010 ENGAGE

ORCHESTRATES CONSTRUCTION TEAMS

2014 REMOTE HANDLING

ROBOTIC INTERVENTION INSIDE THE REACTOR

ZIP!

2016 MOMENTUM

CONSTRUCTION MANAGEMENT : PREPARES THE MACHINE ASSEMBLY SEQUENCES.

WE'RE BUILDING A CATHEDRAL THAT HEATS UP TO 150 MILLION DEGREES!

AUTHOR'S NOTE: CATHEDRALS ARE BEAUTIFUL... BUT PYRAMIDS ARE SIMPLER TO DRAW.

2021 INTEGRATION + COMMISSIONING

ITER A KEY STEP FORWARD

+30 NATIONS
150 MILLIONS °C
500MW

iter

DT

FME

SRO

2025 ARCHITECT ENGINEERING PHASE II

ASSEMBLY
TEST COMISSIONING
FUEL CYCLE
I&C
HOT CELL
HEATING SYSTEM
DIAGNOSTIC

MAKE FUSION AN INDUSTRY

OTHER FUSION PROJECTS

GUILLAUME MAZURAGE

IBF/25
INTERNATIONAL ITER BUSINESS FORUM

THANKS

TO BE PART OF THE WORLDWIDE **FUSION** NETWORK

Romain BUISSON
I&C Business Manager

PLATINIUM SPONSOR | SILVER SPONSOR | SILVER SPONSOR | BRONZE SPONSOR