ITER Control System Status Update

Anders Wallander
Head of Controls Division
ITER Organization Central Team

Introduction

The ITER project (and the control system) is currently in design, construction, commissioning and operation in parallel

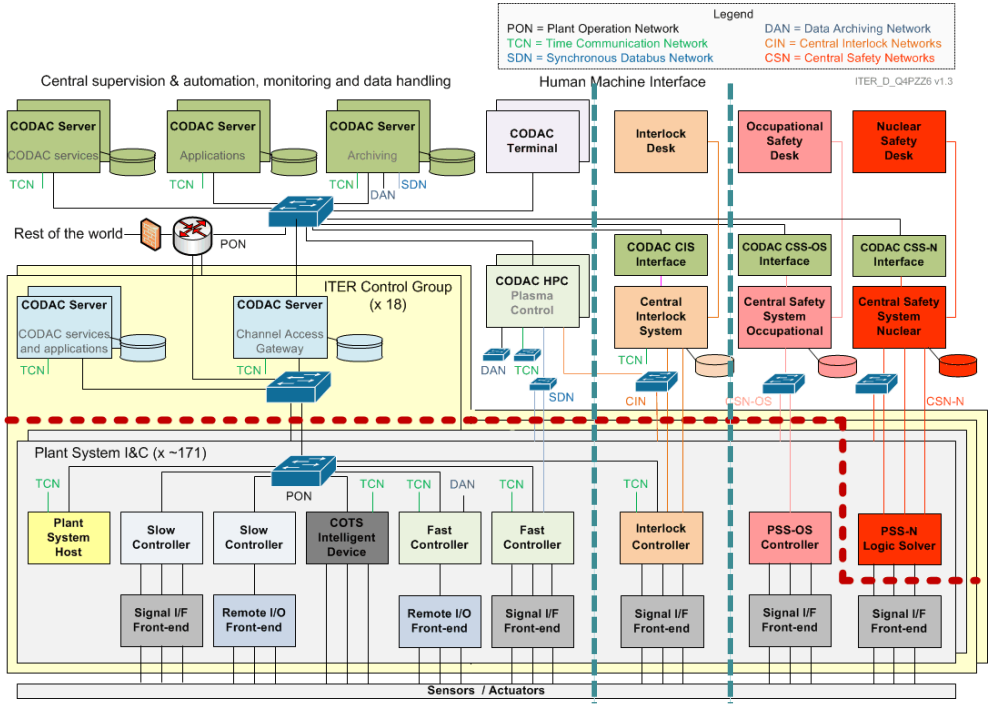
Activities on site continuously intensifying

Outline

- Design
- Construction
- Commissioning
- Operation

ITER Integrated Control System – Recap

- Three segregated vertical tiers
  - Conventional (CODAC)
  - Protection
  - Safety
- Two horizontal layers
  - Central
  - Local (“in kind”)
- 18 subsystems
- 171 local control system
- 101 suppliers with sub contractor
- >>100.000 input/output points
- Millions of process variables
- EPICS



ITER Integrated Control System – Status

Progress in 2020

- CODAC Core System yearly software release (EPICS, CS-Studio, etc.)
- Final design reviews (Central Safety System for Nuclear, Access Control and Plasma Control System)
- Development of concept of operation driven by Operation Division
- 24/7 operation of infrastructure and systems in operation (electrical, buildings, services, cooling water)
- Expanded back-end monitoring, archiving and associated tools
- Commissioning electrical, buildings, liquid & gas, cooling water and started on first protection and safety systems
- Improved software configuration control and deployments

Construction Status – Machine assembly started in 2020

Tokamak Building

Assembly Hall

Cryostat base installed in Tokamak pit May 2020

Cryostat lower and upper cylinders

Construction Status

August 2020
Installation of lower cryostat cylinder (375 tonnes)

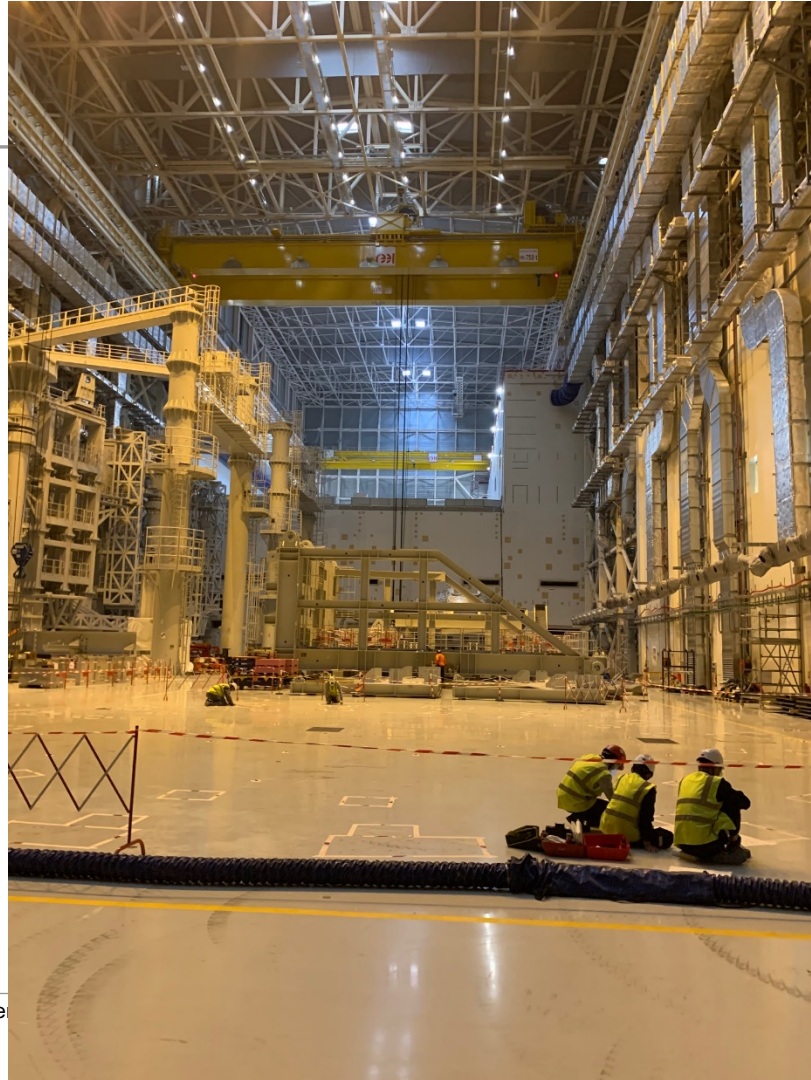
Welding started

People

Construction Status

September 2020
Assembly Hall cleanliness protocol implemented
Preparing start of vacuum vessel assembly

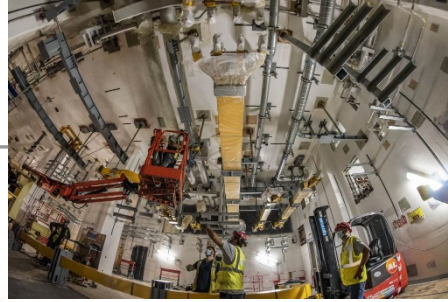
October 2020
Vacuum vessel thermal shield outboard segment



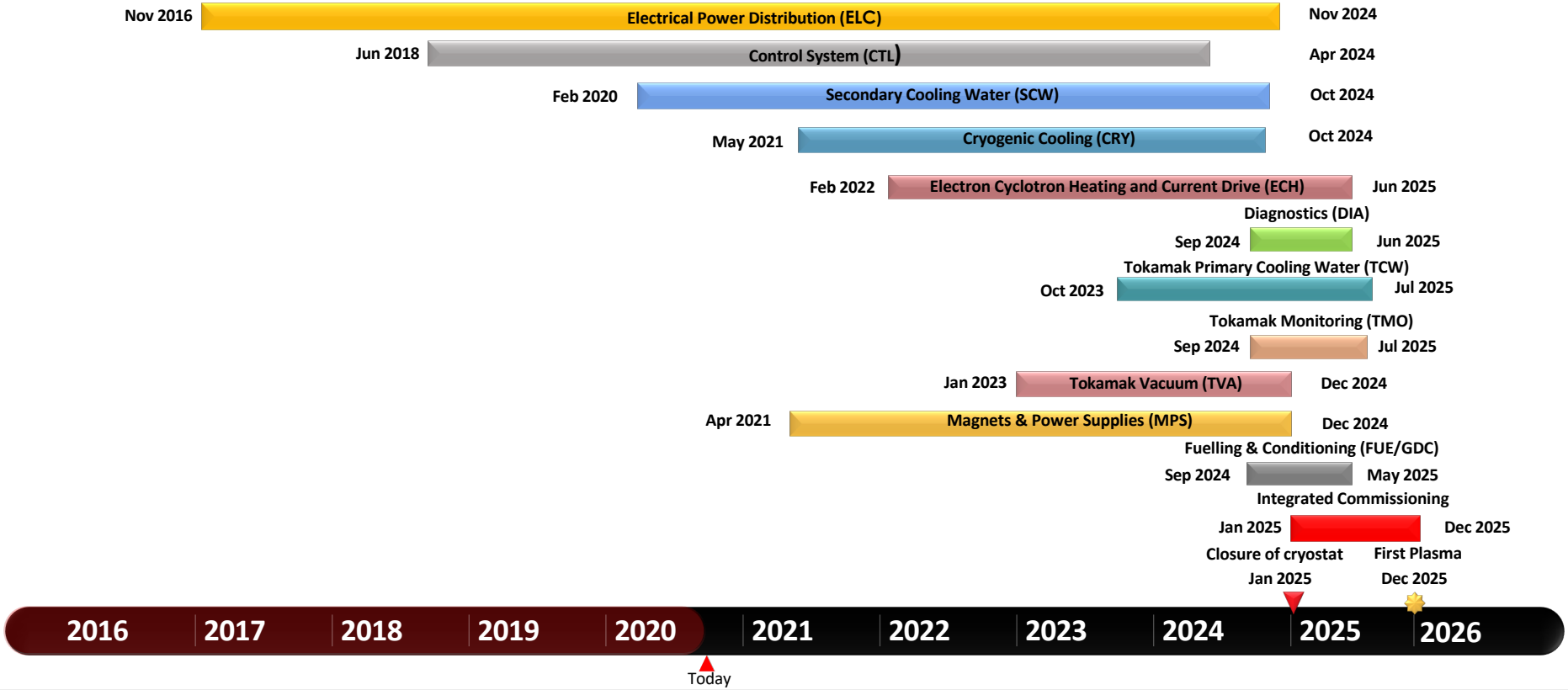
Construction Status

3D model of Tokamak Complex

Installation of cryolines, pipes, busbars,… ongoing



Global Commissioning Schedule

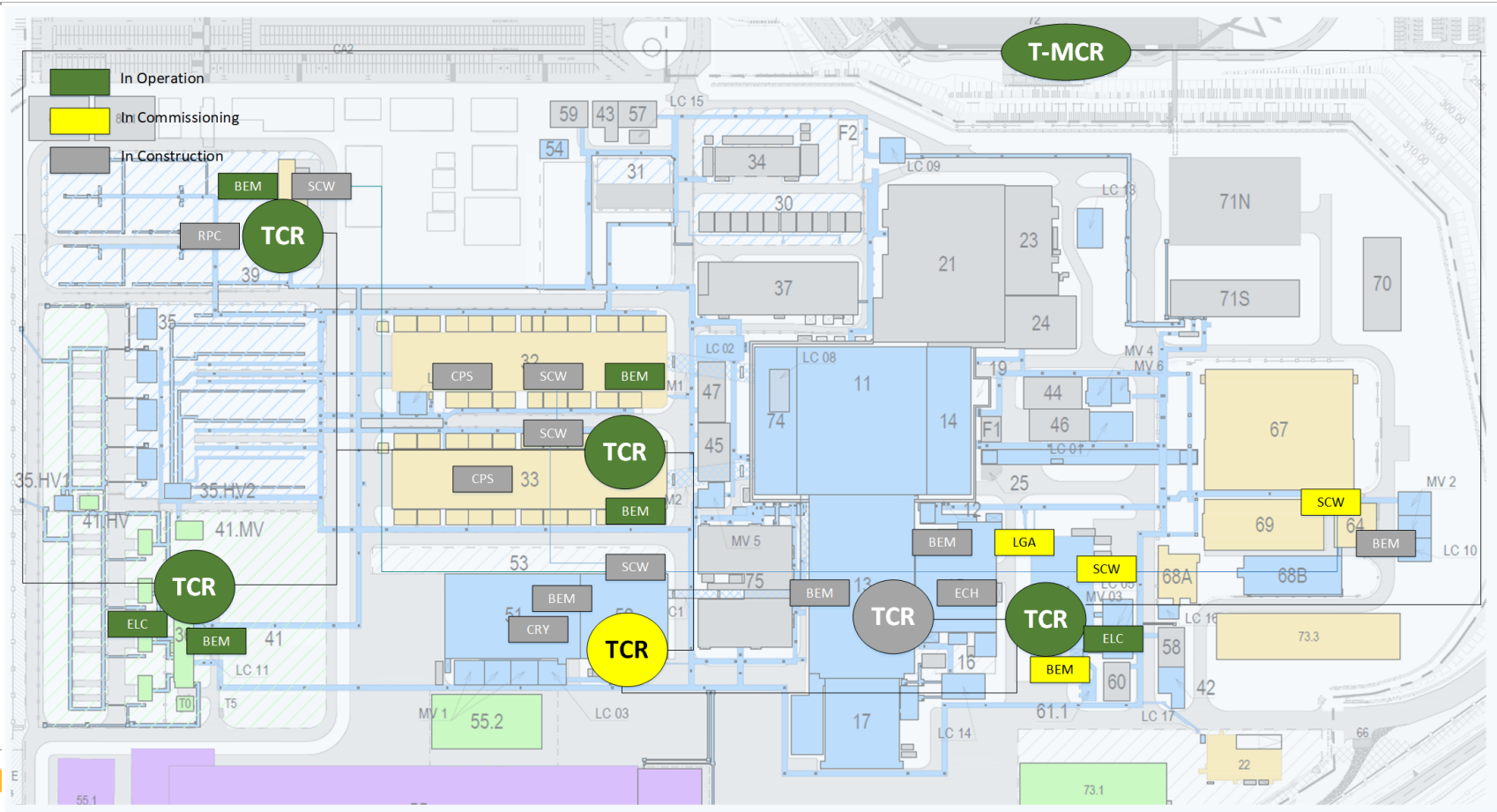


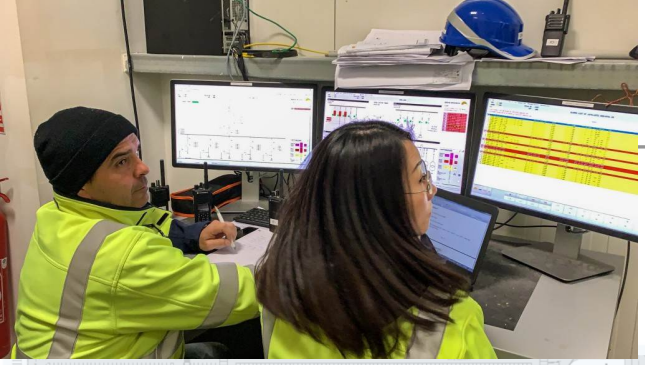
Status Control System

- The construction of the heart of the Control System, the Control Building, has just started, but will not be ready until 2022

- A temporary infrastructure has been implemented to allow commissioning and operation now
- A distributed control room consisting of multiple “Temporary Control Rooms (TCR)” interconnected with temporary network fibers
- In 2020 three TCR’s have been added as well as a Temporary Main Control Room located in the office building

Status Control System





Status Electrical

In operation since 2019 and expanding adding load centers (7 in 2020)

11:38
◂ Mail
AA
controls.iter.org
SSEN Voltages

Name	Value	Time (UTC)
UTIL-MV-M1:TP1001-ET02	0.00 KV	2020-10-23T
UTIL-HV-S22-BUS1:TP1000-ET07	22.16 KV	2020-11-09T
UTIL-HV-S22-BUS2:TP2000-ET07	22.23 KV	2020-11-09T
UTIL-HV-S22-BUS3:TP3000-ET07	22.19 KV	2020-11-09T
UTIL-HV-S22-BUS4:TP4000-ET07	22.23 KV	2020-11-08T
UTIL-HV-S22-BUS5:TP5100-ET07	22.24 KV	2020-11-08T
UTIL-HV-S22-BUS6:TP6100-ET07	22.18 KV	2020-11-09T
UTIL-HV-S22-BUS7:TP7100-ET07	22.19 KV	2020-11-09T
UTIL-HV-S22-BUS8:TP8100-ET07	22.21 KV	2020-11-09T
UTIL-HV-S400-BAY1:TP1000-ET05	405.70 KV	2020-11-09T
UTIL-HV-S400-BAY2:TP2000-ET05	405.57 KV	2020-11-09T
UTIL-HV-S400-BAY3:TP3000-ET05	405.64 KV	2020-11-09T
UTIL-HV-S400-BAY4:TP4000-ET05	405.53 KV	2020-11-09T
UTIL-LV1-LC05:TP1000-ET01	409.00 V	2020-11-09T
UTIL-LV1-LC05:TP2000-ET01	409.00 V	2020-11-09T
UTIL-LV1-LC14:TP1000-ET01	409.00 V	2020-11-09T
UTIL-LV1-LC14:TP2000-ET01	0.00 V	2020-10-22T
UTIL-LV1-LC14:TP3000-ET01	409.00 V	2020-11-09T
UTIL-LV1-LC14:TP4000-ET01	409.00 V	2020-11-09T
UTIL-LV2-LC03:TP1000-ET01	410.24 V	2020-11-06T
UTIL-LV2-LC03:TP2000-ET01	410.18 V	2020-11-06T
UTIL-LV2-LC06:TP1000-ET01	411.31 V	2020-11-09T
UTIL-LV2-LC06:TP2000-ET01	411.38 V	2020-11-09T
UTIL-LV2-LC11:TP1000-ET01	411.60 V	2020-11-09T
UTIL-LV2-LC11:TP2000-ET01	411.04 V	2020-11-09T
UTIL-LV3-LC10:TP1000-ET01	411.40 V	2020-11-09T
UTIL-LV3-LC10:TP2000-ET01	411.40 V	2020-11-09T
UTIL-MV-M2:TP1001-ET02	6.65 KV	2020-11-09T
UTIL-MV-M3:TP1001-ET02	6.65 KV	2020-11-09T

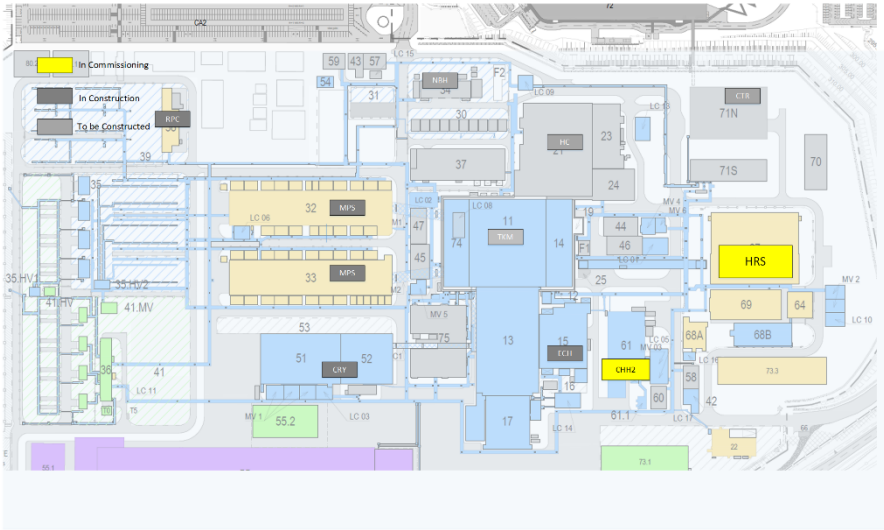
UTC 10:38:46 - Local 11:38:46 (+01:00) 09/11/2020 v1.1.0#111253

Status Secondary Cooling Water

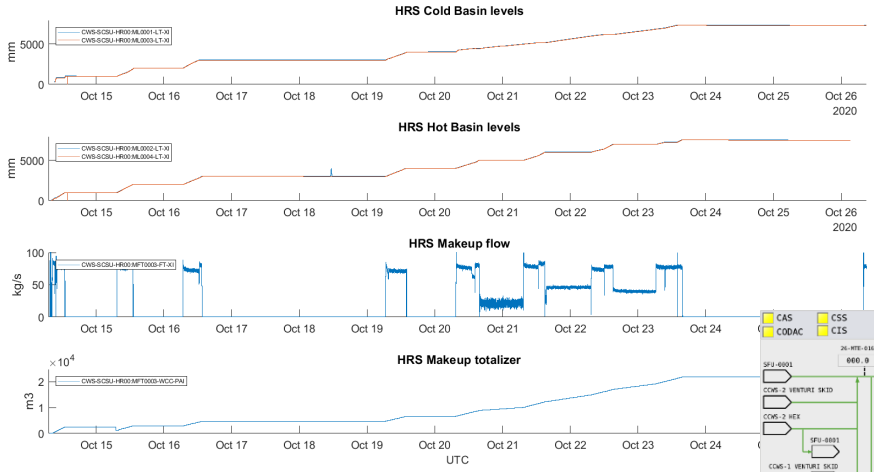
Commissioning in full swing

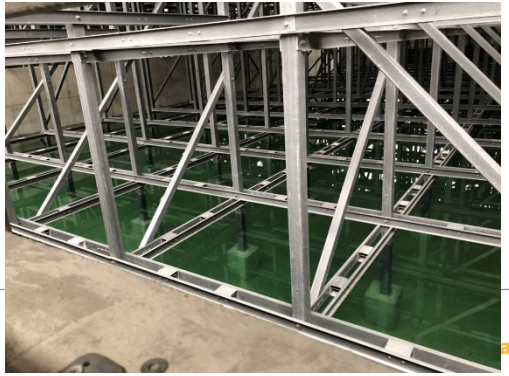
Commissioning of Heat Rejection System and first cooling loops started.

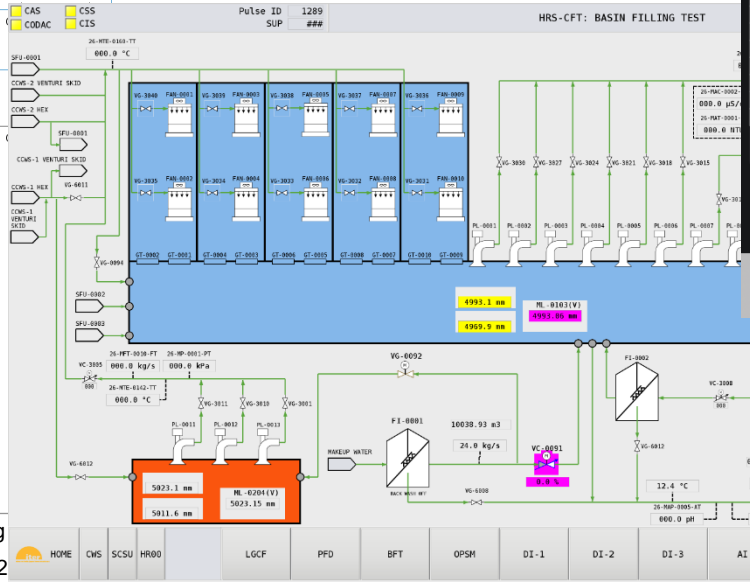
Clients distributed around the sites

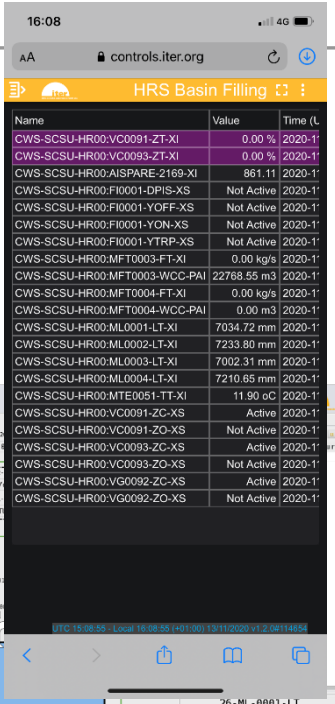


Secondary Cooling Water – First Water



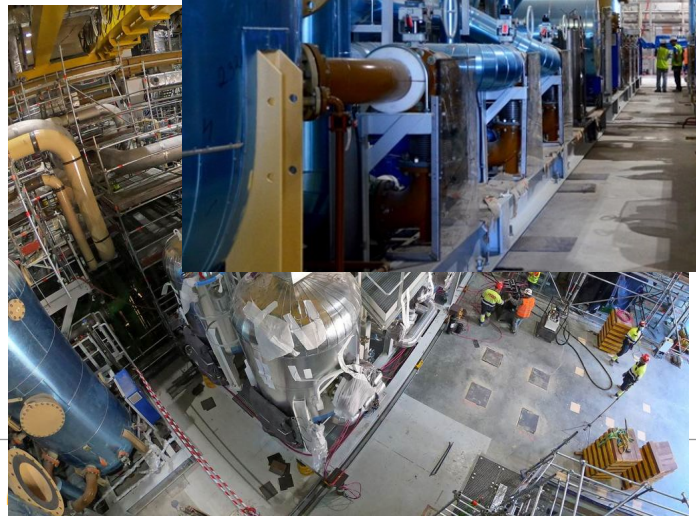






Commissioning coming up in 2021

Cryoplant



Reactive Power Compensation

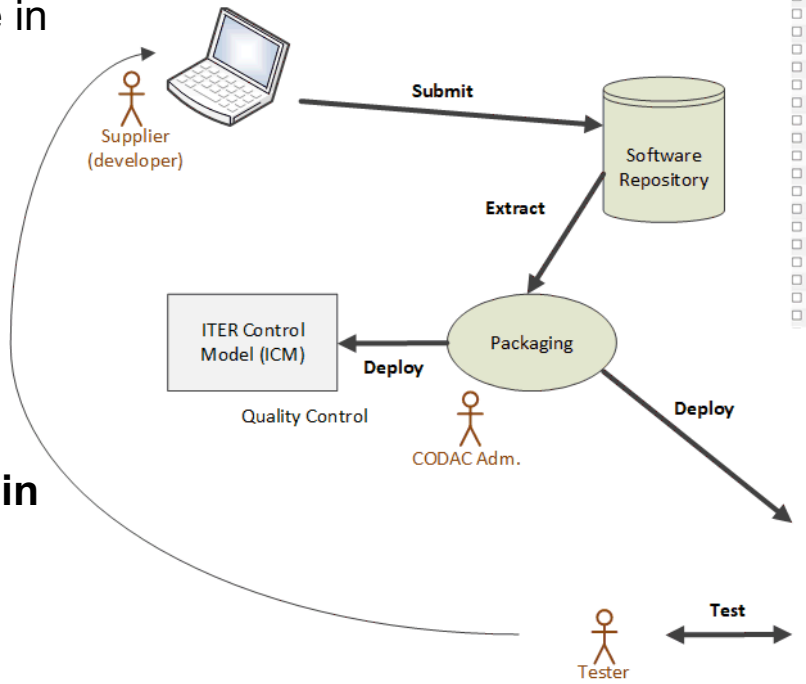
Software delivery and verification

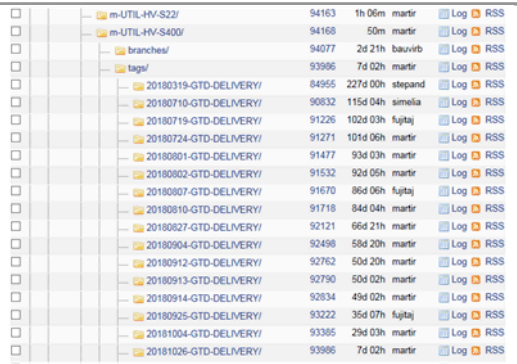
1. Supplier delivers software in repository (SVN)
2. IO package software and perform quality control in test-bed
3. IO deploy software on target
4. Ticketing system to track issues

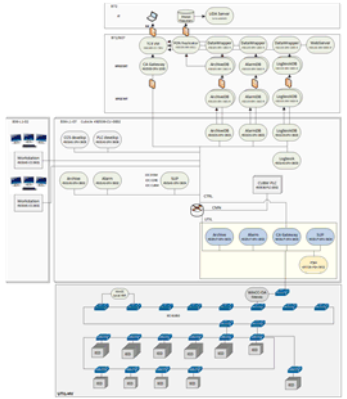
Software repository is a main communication channel

Configuration control is ensured

The earlier this is established the better for everyone

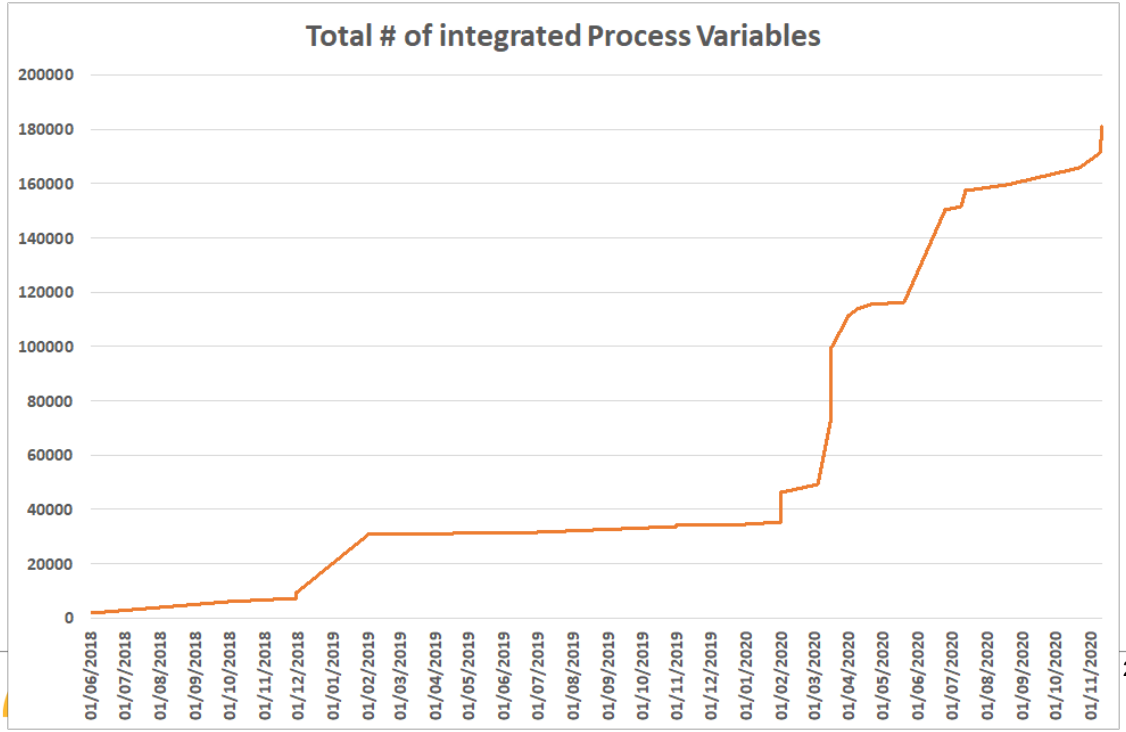


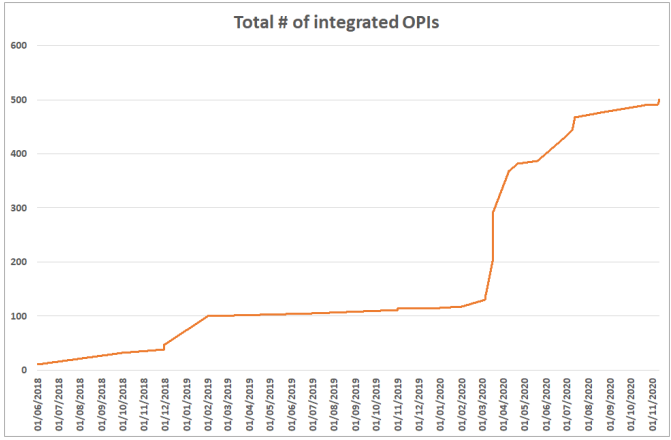


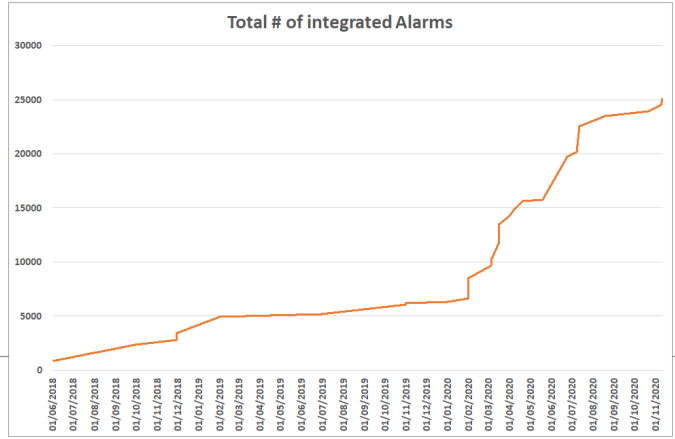


Control System Status

Control software deployed on ITER as expressed in number of process variables, operator interfaces and alarms



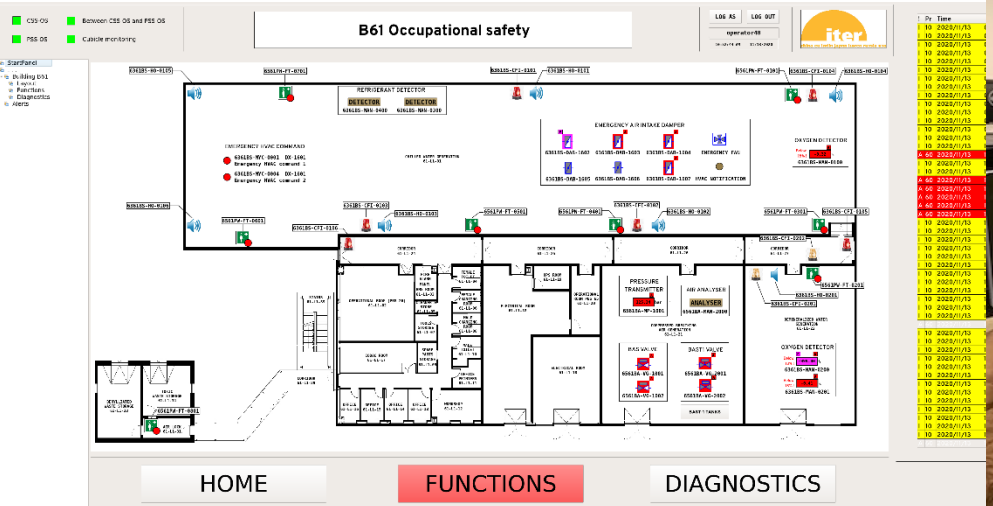




First Occupational Safety System going online

High integrity (IEC 61508, SIL classified, redundancy,…) system in site service building

- Anoxia
- Refrigerator leaks
- Breathing air
- Safety showers
- Sirens
- Flash lights



Data

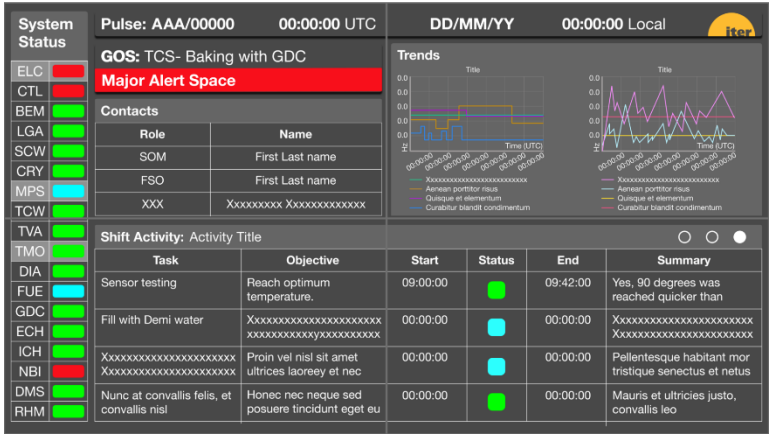
- Data archiving system capable of supporting current commissioning and operation running in the IT domain
- Unified data access API for python, matlab, etc. in use
- Data streaming to “easy to customize” Dashboard running on web and phone
- Development of full fledged data visualization initiated
- Forming alliances with Google, Microsoft, IDM, Amazon, NTT,… for development of Scientific Data and Computing Centre (SDCC)
- Initial on-site location of SDCC identified and prototyping starting next year

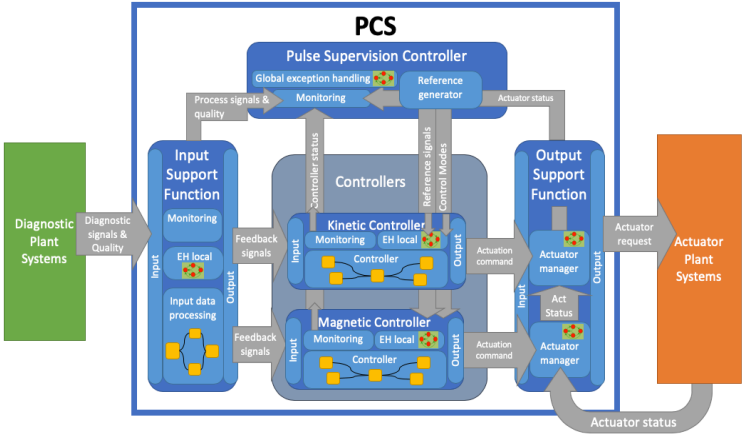
High level control software design

- Supervision and automation
- Sequencer

- Wall displays
- Control room layout

- Distributed Plasma Control System (PCS)
- Real-time Framework





Procurements

Needed competencies and capabilities

- Competencies in ITER selected technologies
- Site presence
- Engineering services (control system software development, commissioning support, engineering)

Procurements

- Many big contracts placed in 2020

How to get involved

- Consortia
- Sub-contractor
- Diagnostics

Our current industrial partners

Summary

- ITER Integrated Control System is in design, manufacturing, commissioning and operation in parallel
- In 2020 Tokamak assembly has started with installation of first parts of the cryostat
- In 2020 commissioning of the first large plant system, cooling water, has also started
- The Integrated Control System supports and sometimes drives the commissioning
- Design of high level operation software advancing with inputs from Operation and Scientists

ITER Organization Business Opportunities

– https://www.iter.org/proc/overview

ITER Organization Jobs Opportunities

– https://www.iter.org/jobs

ITER Project Associate (Academia OR Industry)

– https://www.iter.org/jobs/IPA