

### **Outline**

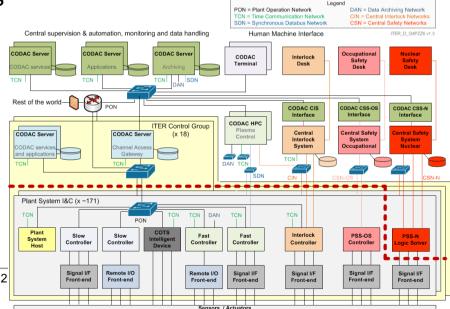


- Current status
- Upcoming challenges
- Needed competences and capabilities of suppliers
- Upcoming procurements
- Summary and Opportunities

## **Integrated Control System Overview**

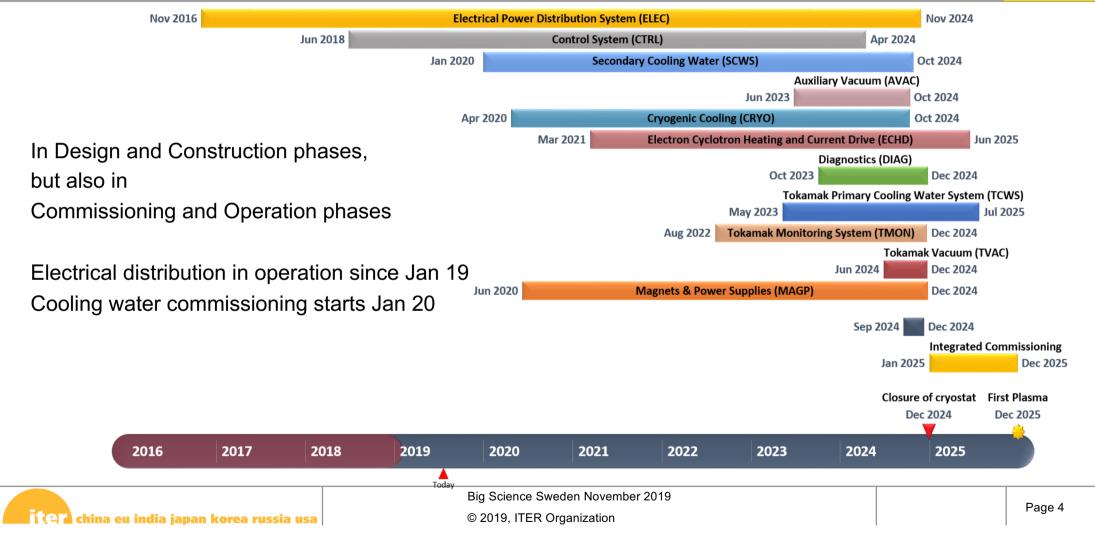


- 90 % in-kind (101 procurement arrangements with Members)
- Integrated Control System has 18 subsystems and 171 local control system (delivered in-kind)
- Segregation of conventional control, protection and safety
- 5000 Instrumentation and Control Cubicles (or cabinets)
- Few hundreds of thousands of input/output points
- Millions of process variables
- Slow industrial control (<50 Hz)</li>
- Fast plasma control (> kHz)
- Data streaming and archiving (> GB/s)
- Time stamping (<50 ns RMS)</li>



# **Commissioning Schedule**





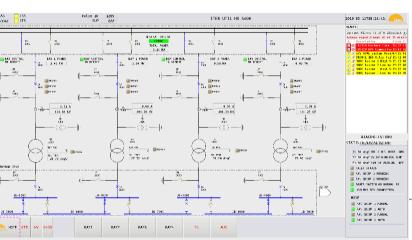
Electrical – First plant system commissioned and in operation





Mar 2019

Apr 2019



# Challenges



# Integration

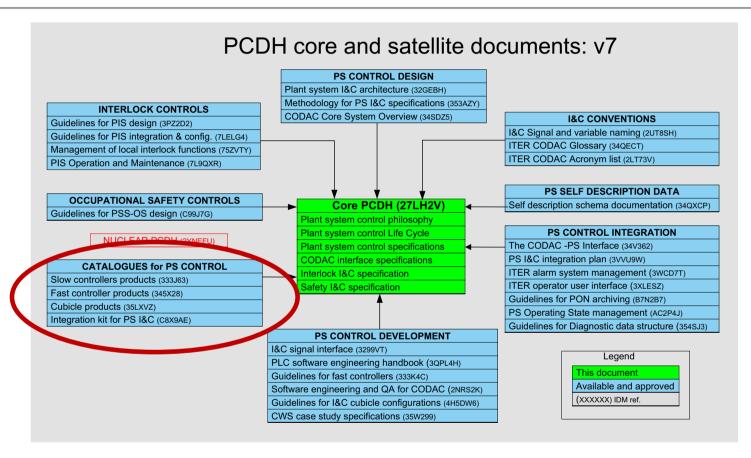
171 local control systems, 101 suppliers with sub-contractors

### Size

5000 I&C cabinets with hundreds of thousands of input/output points

### **Standardization**





Publicly available at <a href="https://www.iter.org/mach/codac/PlantControlHandbook">https://www.iter.org/mach/codac/PlantControlHandbook</a>



### **HW Standardization**



#### Principles:

- Commercial off-the-shelf (COTS)
- Select market leaders
- Negotiate strategic agreements with selected suppliers

#### Why?

- Maintainability and Upgradeability
- Obsolescence management
- Retain competencies

# **I&C** Cubicles (or cabinets)



### Quantity: 5000

#### **Qualified for ITER**

- EMC
- Environment
- Seismic
- Mounting
- De-commissioning
- etc.





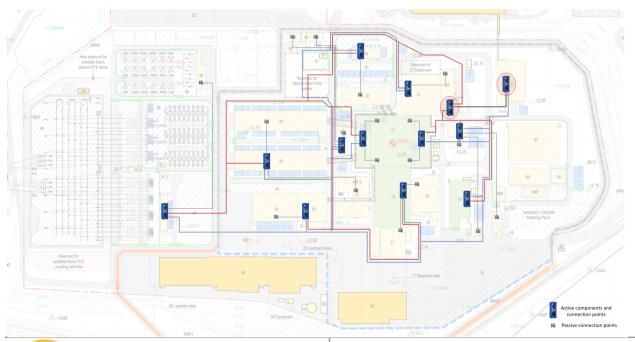


### **Networks**



#### Quantities:

- 300 km single-mode multi-core fibers
- 170 km multi-pair copper cables
- 350 switches



# Plant Operation Network (PON) General purpose command, status, archive,... (Gbps Ethernet)

# Synchronous Databus Network (SDN) Distributed feedback control (10 Gbps Ethernet, cut-through UDP/IP multi-cast)

- Time Communication Network (TCN)
  Absolute time synchronization
  (Ethernet IEEE 1588 2008, timing boards)
- Data Archiving Network (DAN)
  High volume data archiving (10-40 Gbps Ethernet)
- Central Interlock Network (CIN)
  Industrial Ethernet, Hardwired
- Central Safety Networks (CSN)
  Industrial Ethernet, Hardwired

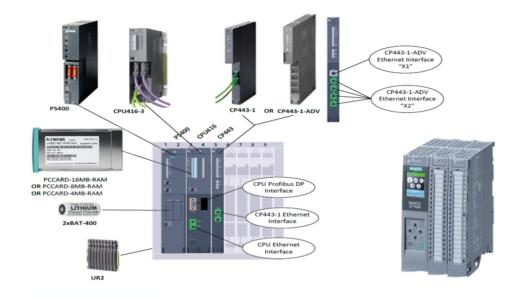
# **Slow Controllers (PLC)**



#### Industrial control

(cooling water, cryogenic, vacuum,...)

- S7-300/S7-400/S7-1500 series
- Step 7/TIA portal



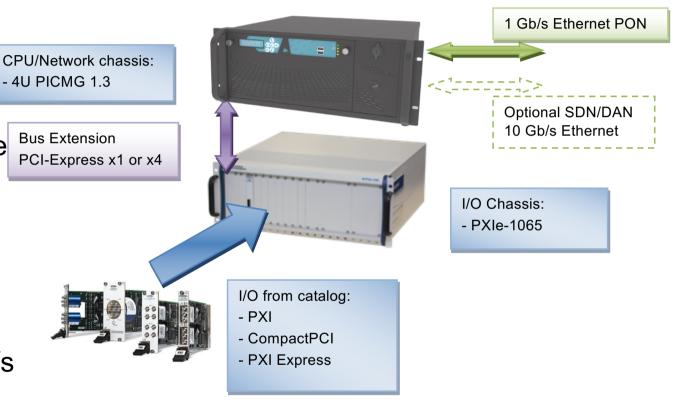




### **Fast Controllers**

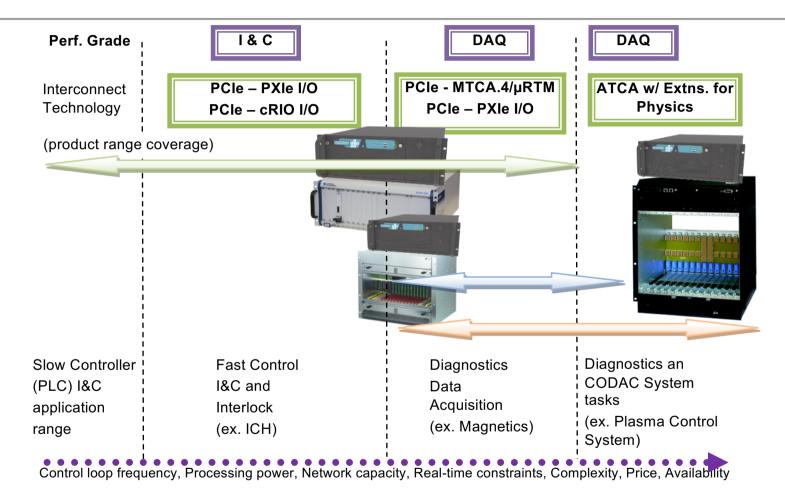


- PCI express
- Separation of CPU and input/output
- DAQ: kS/sec GS/sec
- Optional high performance network interfaces
- Timing (50 ns RMS)
- Distributed control loops (latency < 50 µs app to app)
- Bulk data transfer > 2 GB/s



### **Fast Controllers**





Big Science Sweden November 2019 © 2019, ITER Organization

### **Fast Controllers**



- CPU (Industrial PC)
- I/O chassis (PXIe, cRIO, µTCA)
- Network interfaces
- Input/outputs (DI, DO, AI, AO) (channels, resolution, sampling,...)
- Camera Link / GigE Vision
- Labview FPGA
- PTP (IEEE 1588 2008)







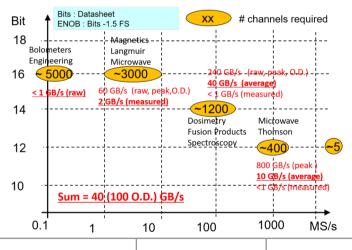








#### Estimate of ADC channels and Data



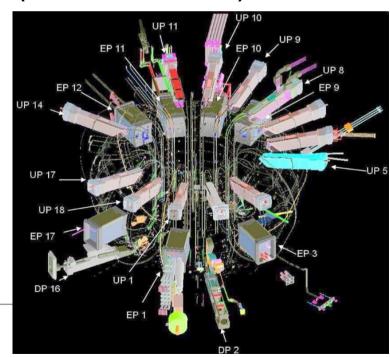




# Needed competencies and capabilities



- Competencies in ITER selected technologies
- Diagnostics may have special needs (niche market)





# **Upcoming procurements**



- Engineering support in many different areas
- Servers and control room
- Diagnostics

# Summary



- Technologies well established
- High level of standardization
- COTS
- Opportunities in niche markets, particular Diagnostics
  - Many Diagnostics still to be designed
  - Environment (radiation, static magnetic field,...)
  - Special cables

**—** ...

### **Opportunities**



#### **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

#### Fusion for Energy (F4E) Business Opportunities

- https://fusionforenergy.europa.eu/procurementsgrants/iterIO.aspx
- https://industryportal.f4e.europa.eu/IP\_PAGES/ehome.aspx

