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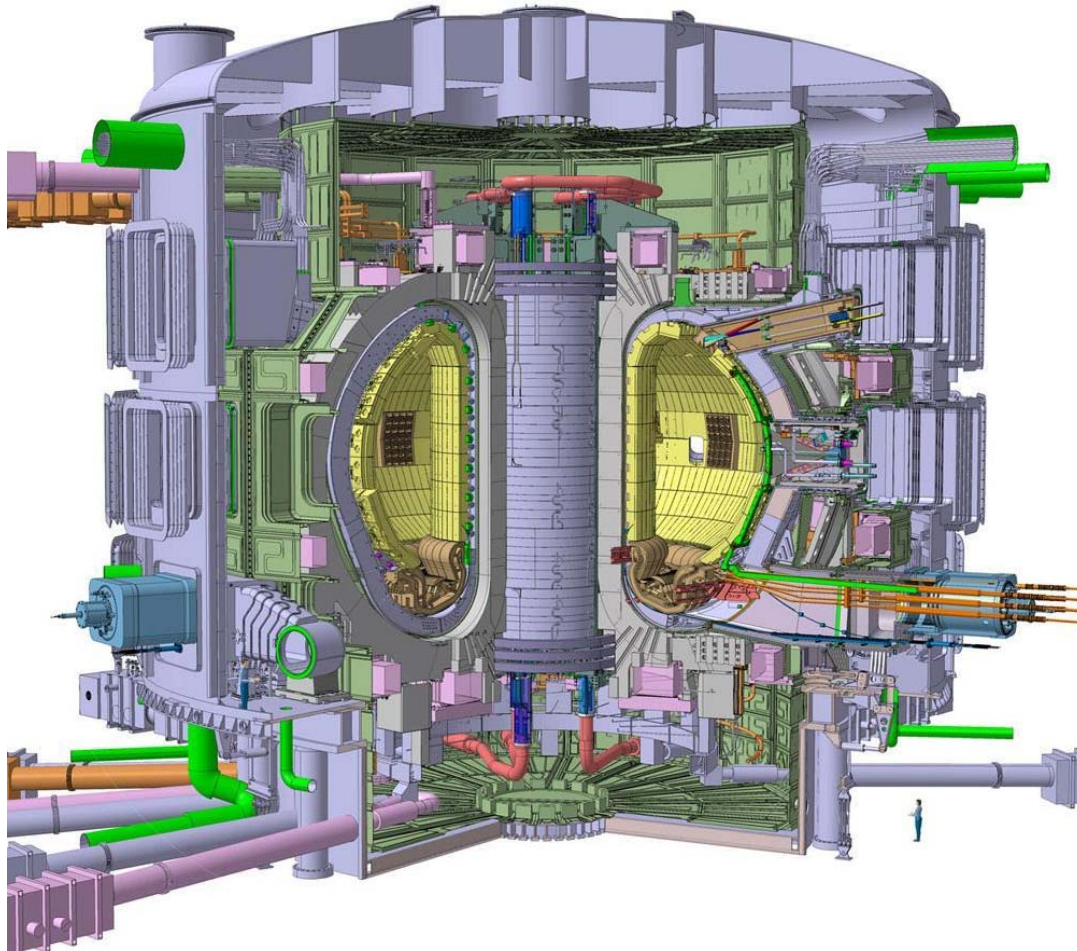
F4E Instrumentation and Control (I&C) activities

**Sartori Filippo
F4E I&C and CODAC group**

Summary



- **Introduction to ITER and control**
- **EU I&C Scope of Supply**
- **I&C organisation in F4E**
- **I&C Group Strategy**



A Tokamak....

Many tons of electro-mechanical components to form and contain the plasma.

Large industrial plants to supply electrical power, cooling water, cryogenic materials...



Instrumentation and Control is only about 5-10% of the value of ITER...

...but obtaining a burning plasma will only be obtained thanks to a complex and intimate coordination among all ITER systems.

Instrumentation and Control is very important!

ITER Control: the main objectives



How to coordinate the activity of all the ITER components and achieve:

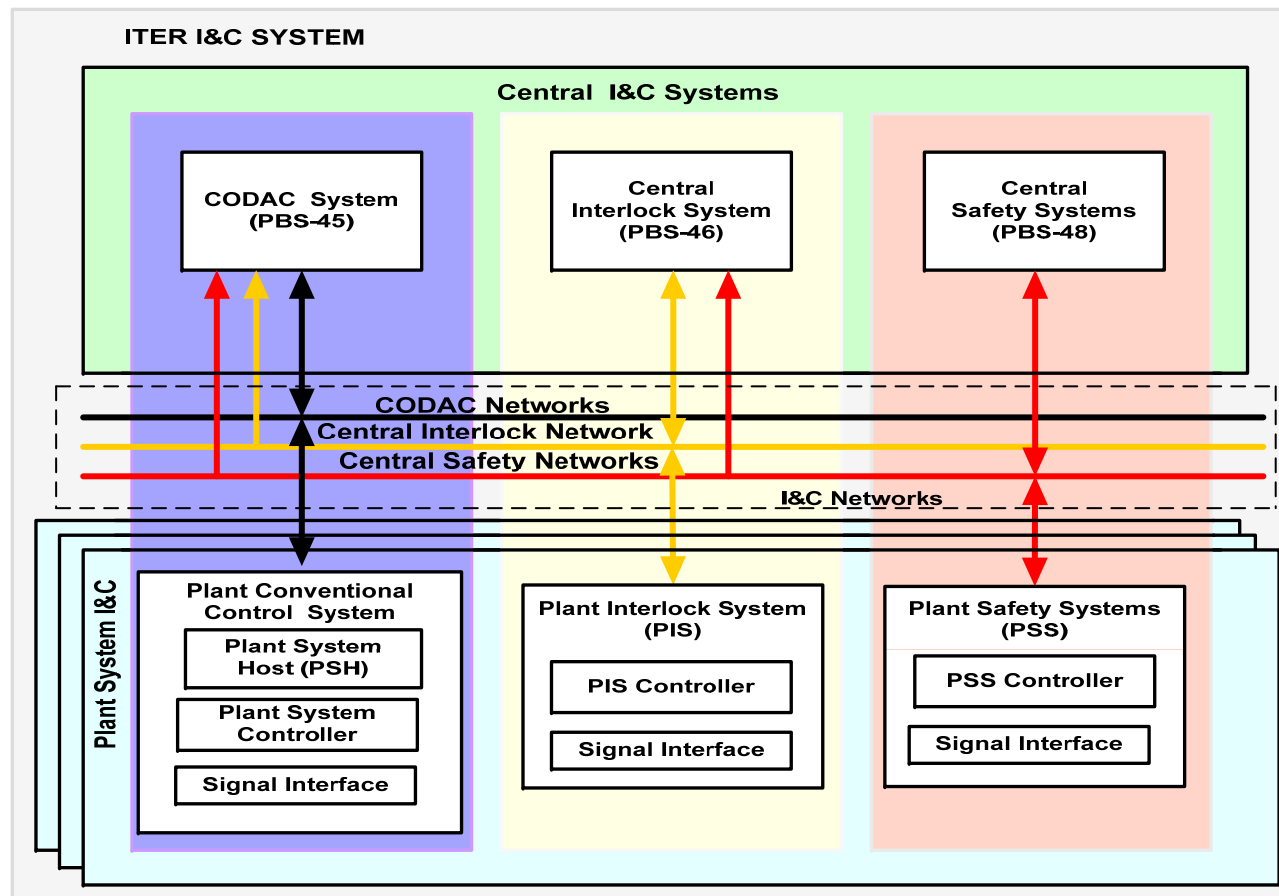
- 1. Safe operation: environmental and human**
 - Safety System
- 2. A device that is protected against costly failures**
 - Interlock System
- 3. A working tokamak device!**
 - Control System
- 4. A flexible experimental device able to evolve and achieve the project goals!**
 - Plasma Control System

ITER Control main architecture



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ITER control is divided horizontally and vertically, 3 tiers and 2 layers:



Focus: 2 Layers



ITER Control is divided between

- **Central Control Systems**
 - Top level control and safety functions obtained by co-ordination of Plant Systems
 - No actuator or sensors here....
 - Designed and built by ITER organisation.
- **Plant System I&C**
 - Local control and protection functions and contribution to global functions
 - Integral part of the various ITER systems.
 - Procured in kind!

DAs I&C scope



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Domestic Agencies do not supply CODAC!

DAs provide in kind systems to ITER

As part of these systems DAs provides Plant Systems I&C.

Plant System I&C includes all the hardware and software necessary to perform all the System control and measurement functions.

The System functions include interfacing to the central Control Systems.

I&C integration standards



To interface to central Systems and finally to obtain a fully working control system – all Plant Systems I&C need to be developed to the same standards and using same methodologies.

Plant Control Design Handbook is the ITER document that defines these standards.

Plant System I&C integration to CODAC is performed using EPICS.

PCDH also **prescribes** a catalogue of PLCs : Siemens
PCDH **offers as guideline** a cubicle and a PXI catalogue...

I&C integration risk



ITER has recently understood that the current model leaves significant risks that the final integration between Central and Plant Systems will not happen smoothly.

DAs and their industrial suppliers may encounter difficulties in implementing correctly some of the methodologies both because of the adoption of non industrial standard technologies (EPICS) and because of communication problems.

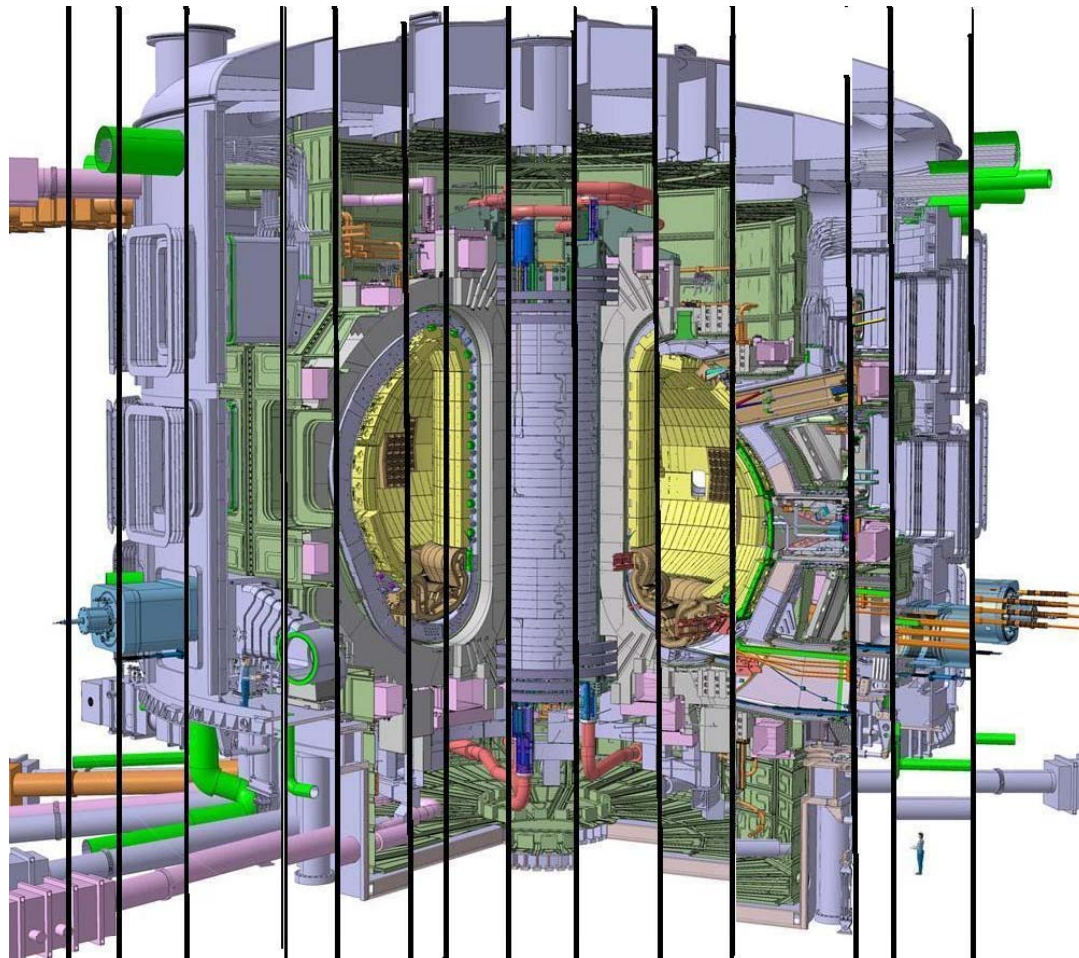
Single I&C integrator



F4E is now collaborating with IO to formulate a solution that minimises this risk... the current idea is that a single industrial I&C integrator *for each DA* will prepare hardware and software to interface and integrate working systems supplied by industry to ITER central control systems.

(More details later →)

Further I&C problems



Many Plant Systems are supplied to ITER as contribution of many DA.

EU supplied 7/9 of Vacuum Vessel

ECH system components come from 5 distinct DAs...

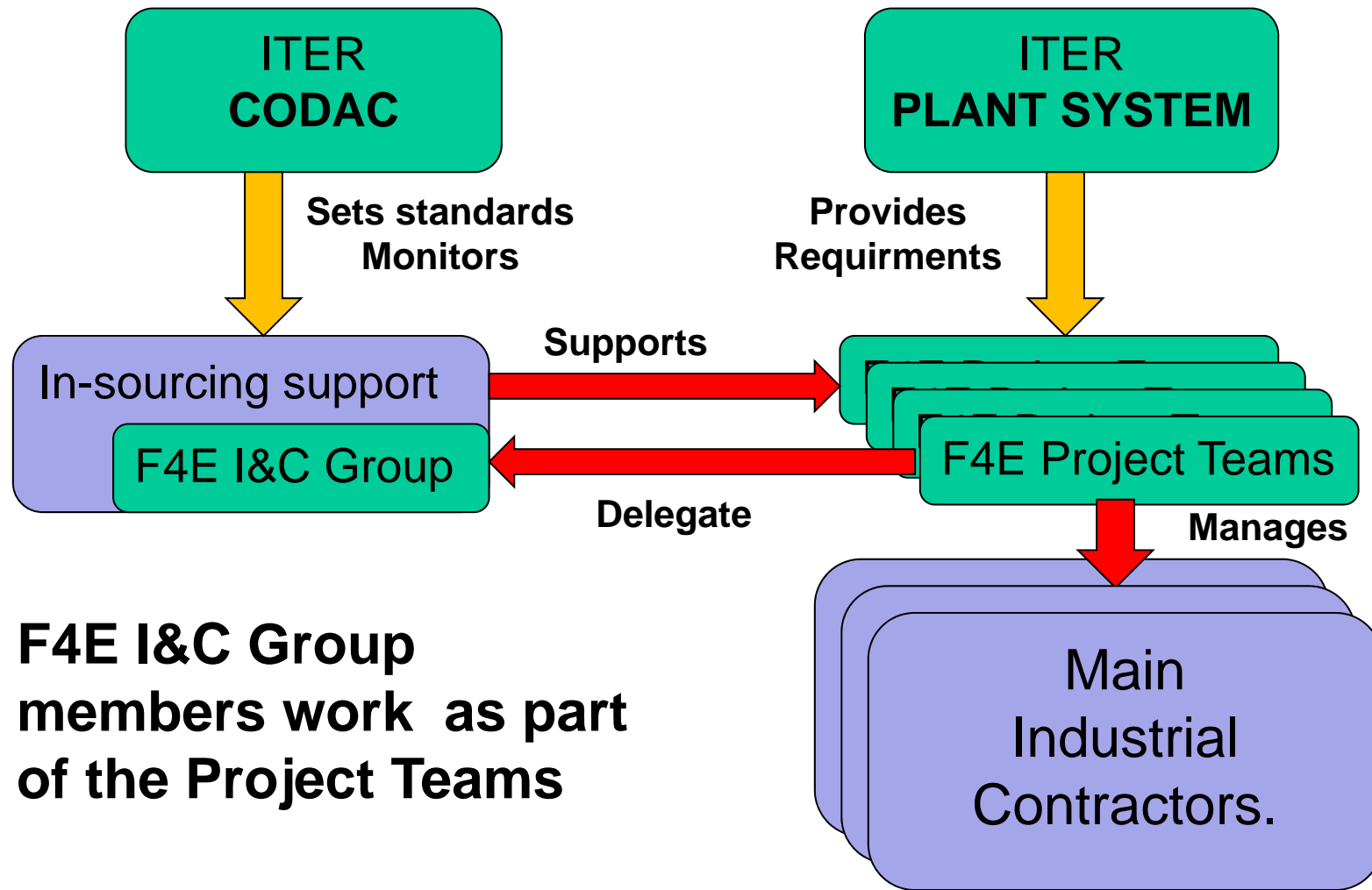
**Integration of these components into a working Plant System is ...
a missing item.**

EU-DA I&C scope of supply



- **Industrial Plants**
 - 80K loop and LN2 plants
 - Electrical Distribution
 - Buildings
- **Instrumented Mechanical Components**
 - Vacuum Vessel
 - Divertor and Blankets (I&C in F4E scope?)
- **Fusion Systems**
 - **Additional Heatings**
 - Neutral Beam and Neutral Beam Test Facility
 - ECH system (part of)
 - ICH system (part of)
 - **Diagnostics (15 diagnostics)**
 - **Vacuum and Pumps (some systems)**
- **Nuclear Systems**
 - 4 Remote Handling systems
 - Waste Treatment (part of)
 - Tritium Plant (part of)
 - Test Blanket

F4E I&C organisation



F4E I&C Group members work as part of the Project Teams

F4E I&C group strategy



F4E I&C group needs to increase its ability to support I&C activities within each project team. **An I&C support contract has been recently launched.** → Check F4E industrial portal for details.

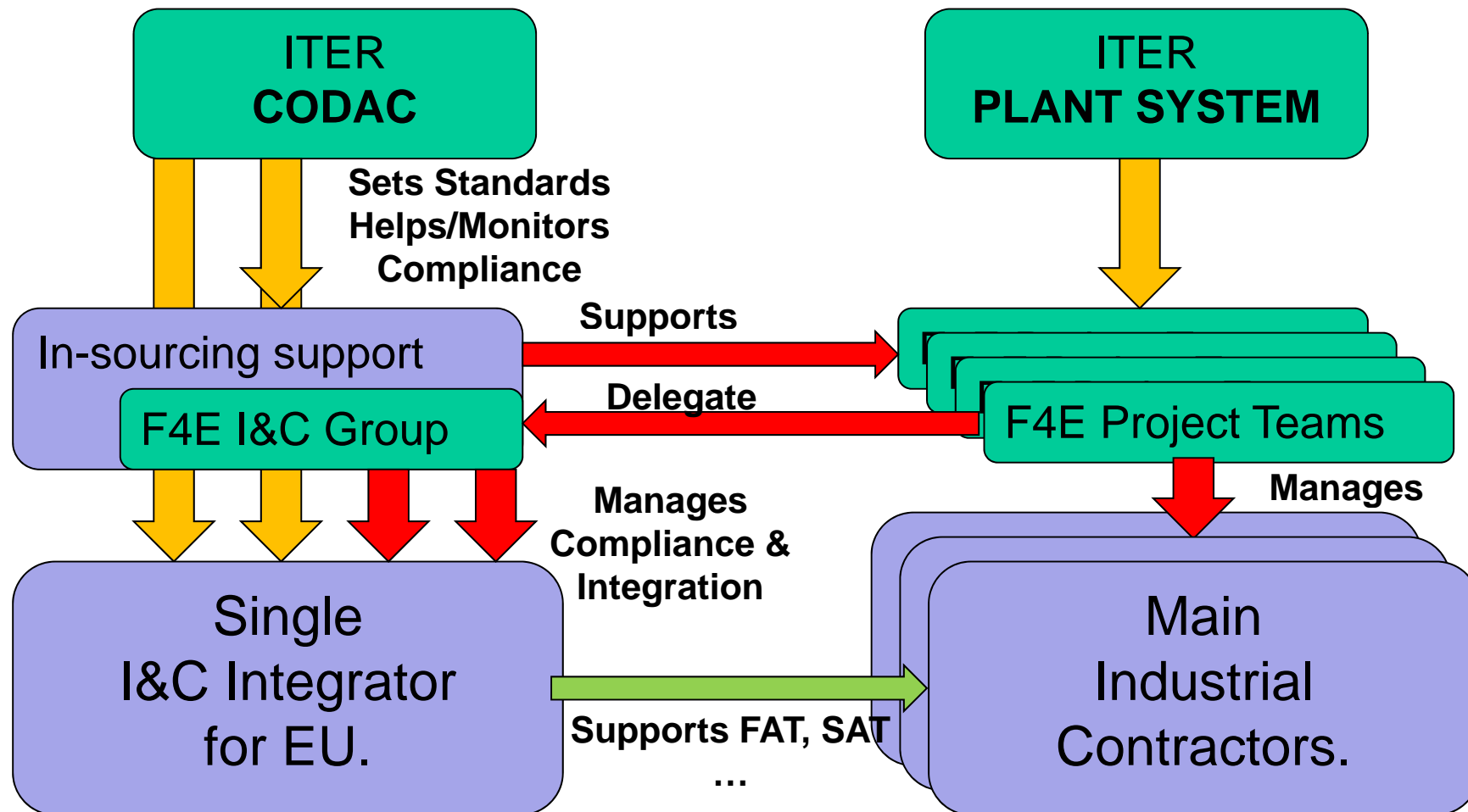
F4E CODAC/I&C group agrees with IO on the need for a single point of I&C integration for Europe. The group is currently working on the details...

here are some of the current ideas...→

Potential new I&C organisation



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I&C Integrator: Scope – Some details



In general there are several scenarios....

1. Simple Industrial Integration (Cryo...)

- The PSH = an interface adapter
- Mimics
- Support to SAT / FAT
- Documentation satisfying PCDH

2. Fusion System Integration (Diagnostics..)

- +Some Control and Data acquisition
- +Some Plasma Control interfaces
- +Some Offline elaboration software

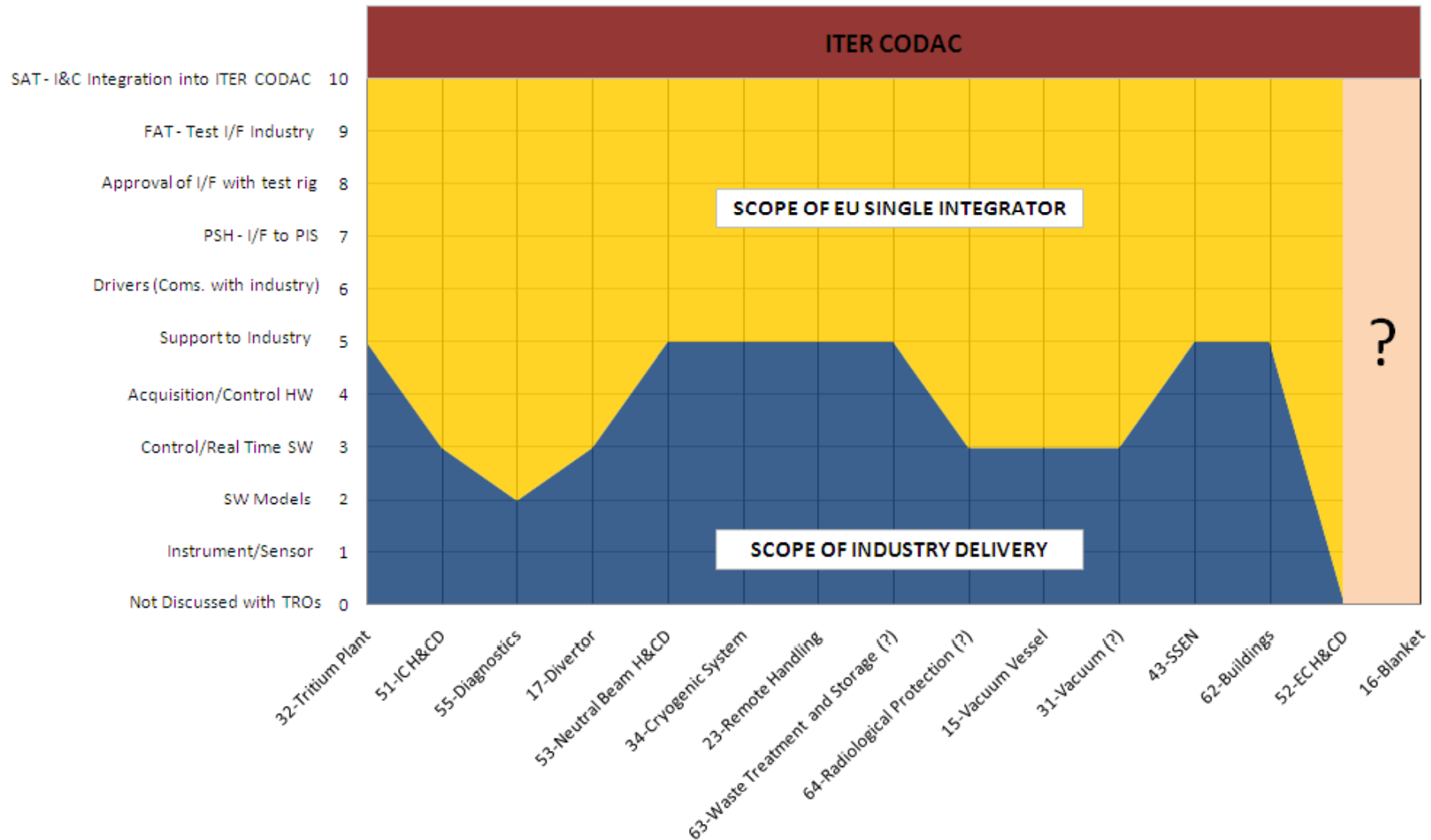
3. Complex System Integration (NBTF...)

- Mix between industrial and fusion system...
- Interlock Coordination ...

I&C Integrator Scope



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I&C Integrator: Implementation details



The technical specification for the integrator is been prepared by F4E I&C group with help from IO CODAC.

These are the main points:

1. **There is a facility where all main integration activities are held.**
 - The facility hosts test benches for plant system integration hardware and software.
 - Other F4E expert contractors (experts, associations,?) or any integrator subcontractors if required to contribute to actual Plant System integration tasks will do so in the facility.
2. **There are specific project integration tasks**
 - to implement the integration of a plant system (or part of).
 - to support FAT, SAT and help the main industrial integrator when needed.
3. **There are process optimisation tasks**
 - to set up the facility and to organise with IO the integrator work methodologies and tools: compliance to PCDH.
 - IO CODAC will provide training to the integrator
4. **F4E owns the tools / test benches and the methodologies.**
 - F4E controls the facility.

I&C integrator- Schedule



Our objective is to make this proposal a reality as early as next year in order to be able to help the integration of Building I&C.

Other I&C potential activities



- **Vacuum Vessel instrumentation**
 - Task Agreement IO → EU
 - Identify requirements and
- **Remote Handling standardisation**
 - How to create a RH components interconnection standard that can be adopted by industry
 - Collaboration IO and F4E.
- **Diagnostics Hardware standardisation**
 - Situation not clear yet...
- **Radiation Hard I&C**
 - Some work happening within RH
 - Other Systems may also need it
- **Real Time**
 - Network & SW Framework