Managing the Development of Plant Subsystems for a Large International Project

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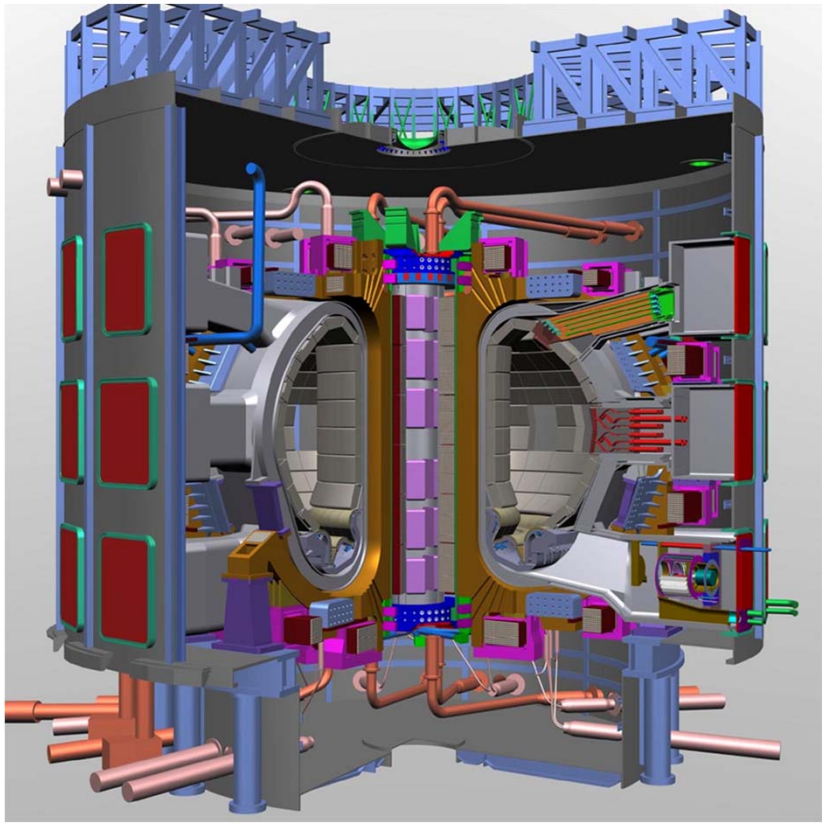
ITER: International Thermonuclear Experimental Reactor

- But now it's just "ITER"
  - "**I**nternational" is still OK, but…
  - "**T**hermonuclear" was bad
  - "**E**xperimental" was bad
  - "**R**eactor" was bad

- … but it's still BIG
  - Big Power: 500 MW, Q = 10
  - Big Money: ~ 14 Billion Euros
  - Big Collaboration
    - 7 "Countries," Half the World
  - Big Politics
  - Big Challenges
    - Technical, Managerial



ITER

ITER has both Technical and Management Challenges

- So does the Control System
- Technical aspects of the Control System are described elsewhere in this Conference:
  - Wallander et al, Status Report – too late if you missed it
  - Stepanov et al, Configuration DB – mini talk and poster this afternoon
  - Di Maio et al, Software Distribution for Plant Systems – poster this afternoon
  - Zagar et al, CODAC Software Packaging – poster Wednesday afternoon
- This talk deals with the management and structural challenges for Controls

A note on jargon

CODAC (**CO**ntrol, **D**ata **A**ccess and **C**ommunications)
⇨ Either the central control or the controls group at Cadarache

IO (**I**TER **O**rganization) ⇨ The ITER organization at Cadarache

Collaboration leads to Implementation Model

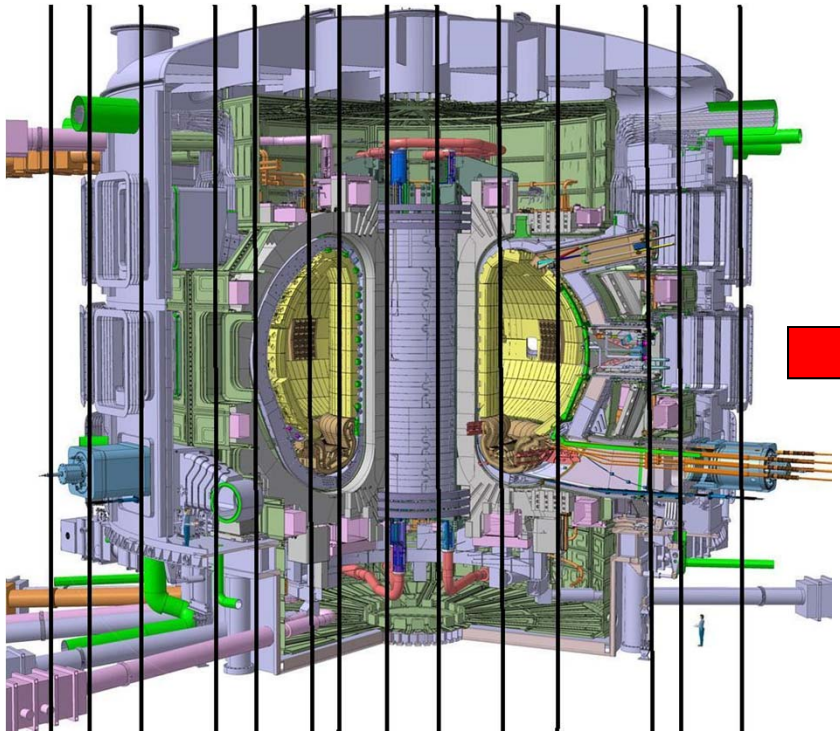
- Project Culture differs among the partners
  - Funding, governance, reasons for participating
- Work must be distributed among participating regions
- Role of ITER Organization (IO) is limited and defined
  - Mostly functional specs; some “build to print”
  - Site Infrastructure, Buildings, CODAC
- All parties must agree ⇒ Heavy management overhead
  - Difficult (and slow) to make decisions
  - Many signatures required (from staff) (my example)
  - Many rebaseline, reschedule efforts
  - Council and Committees
- Working with distant partners
  - Very limited travel budget

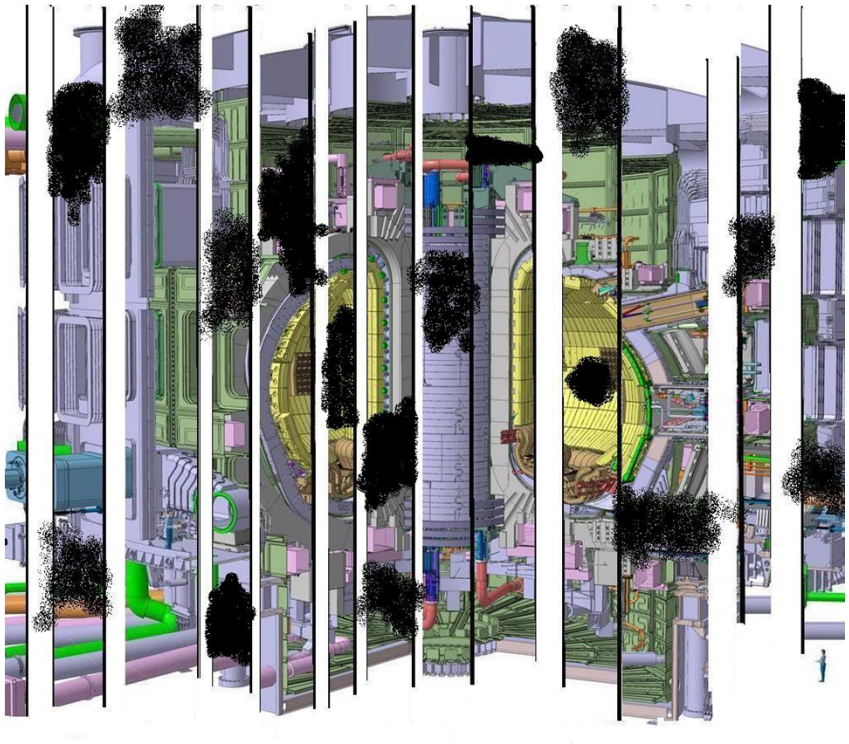
The environment is difficult

- Staff size is limited (for ITER IO and for CODAC)
  - Cost, Approach
  - Much work must be done with external contractors
  - Staff spends time writing technical specs and managing contracts
  - Some “insourcing” successful
  - Currently there is an unrealistic (non-market) limit on contractor rates
- No laboratories
  - CODAC has a small “technical area” with limited access
  - Staff gets very little “hands-on” experience
- Biggest issue will be integration of “Plant I&C Systems”
  - ~30 Plant Systems (PBS elements)
  - ~90 “Procurement Arrangements” which cross plant system boundaries
  - ~220 “Plant I&C Systems”
  - Design by Procurement Arrangement

ITER is made up of many Plant Systems delivered “in kind”

This seems likely to lead to integration issues…

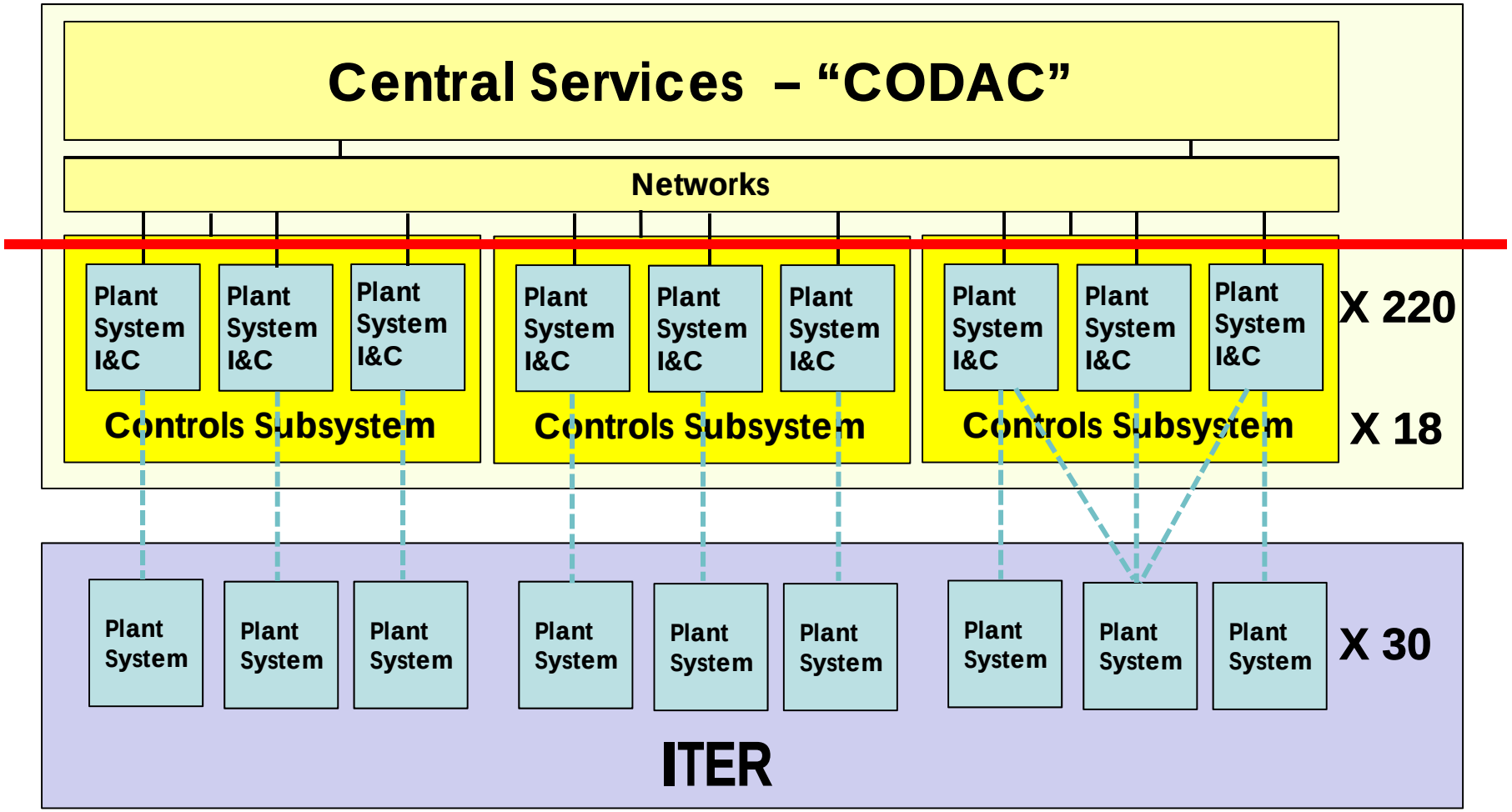




Credit: Anders Wallander

… and the Control System has the same issues

- Each Plant System comes with its own Controls
  - This is known as the “Black Box” model



Rules and standards for PS Controls were needed

- "Plant Control Design Handbook" (PCDH)
  - Definition of Standards and Procedures
    - EPICS
    - Catalogue of Hardware and Software
      - PLCs, I/O buses, Racks…
    - Naming (but handicapped by existing constraints)
    - Much more….
  - "PCDH Campaign"

- Provision of some standard Hardware and Software
  - "Plant System Host"
  - "MiniCODAC"

- Addition of "I&C Support" budget through a PCR

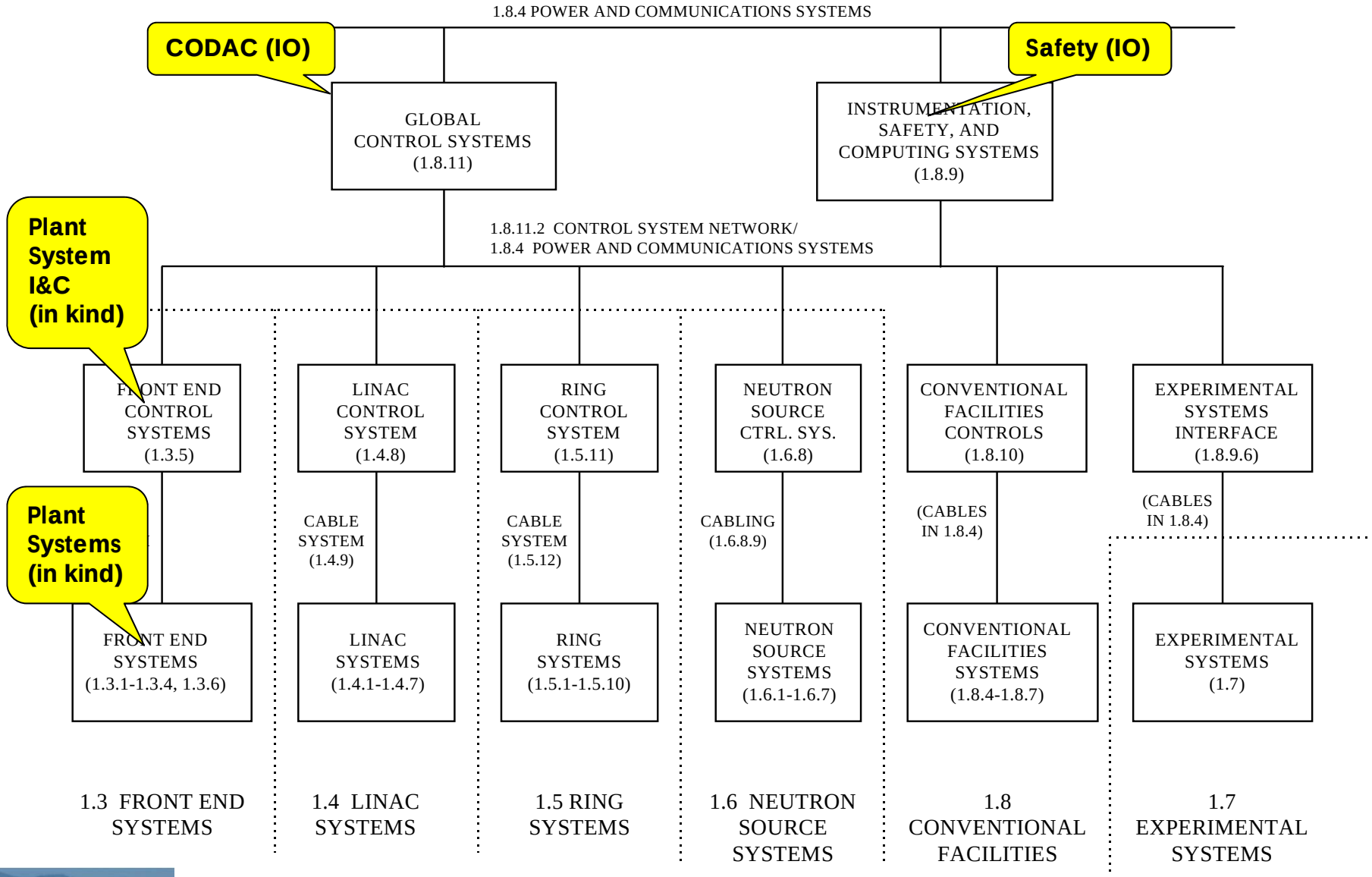
… but there are further concerns with this model

- Not everyone accepts the standards
  - For any system there's likely a cheaper or better way
- No integration strategy specified
  - Some plant systems are distributed among partners
- Many of the Plant System Contracts did not even mention Controls and had allocated no budget for it
- Still looks like a train wreck…

Moreover, the model looked strangely familiar to me…

Oak Ridge, circa 1998…

Looks a lot like SNS at its CDR

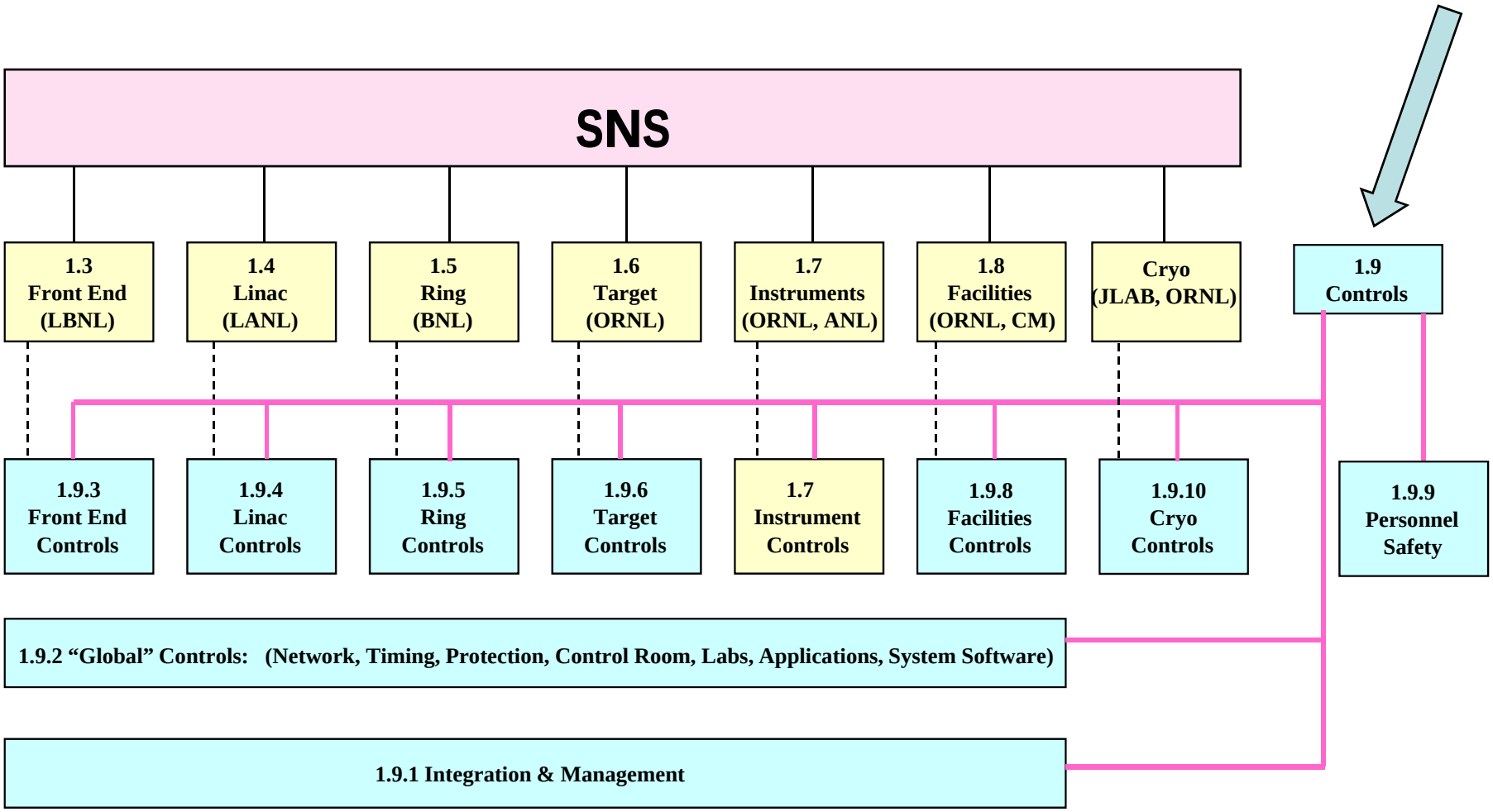


The SNS CDR Committee didn't much like this plan…

- So the CDR Committee (US DOE) said:
  - "That's not going to work. How are you going to integrate??"
- So we said:
  - "We have standards. And we have EPICS. And we're pretty smart."
- So the Committee said:
  - "Good luck with that. Change it." (And they suggested how.)

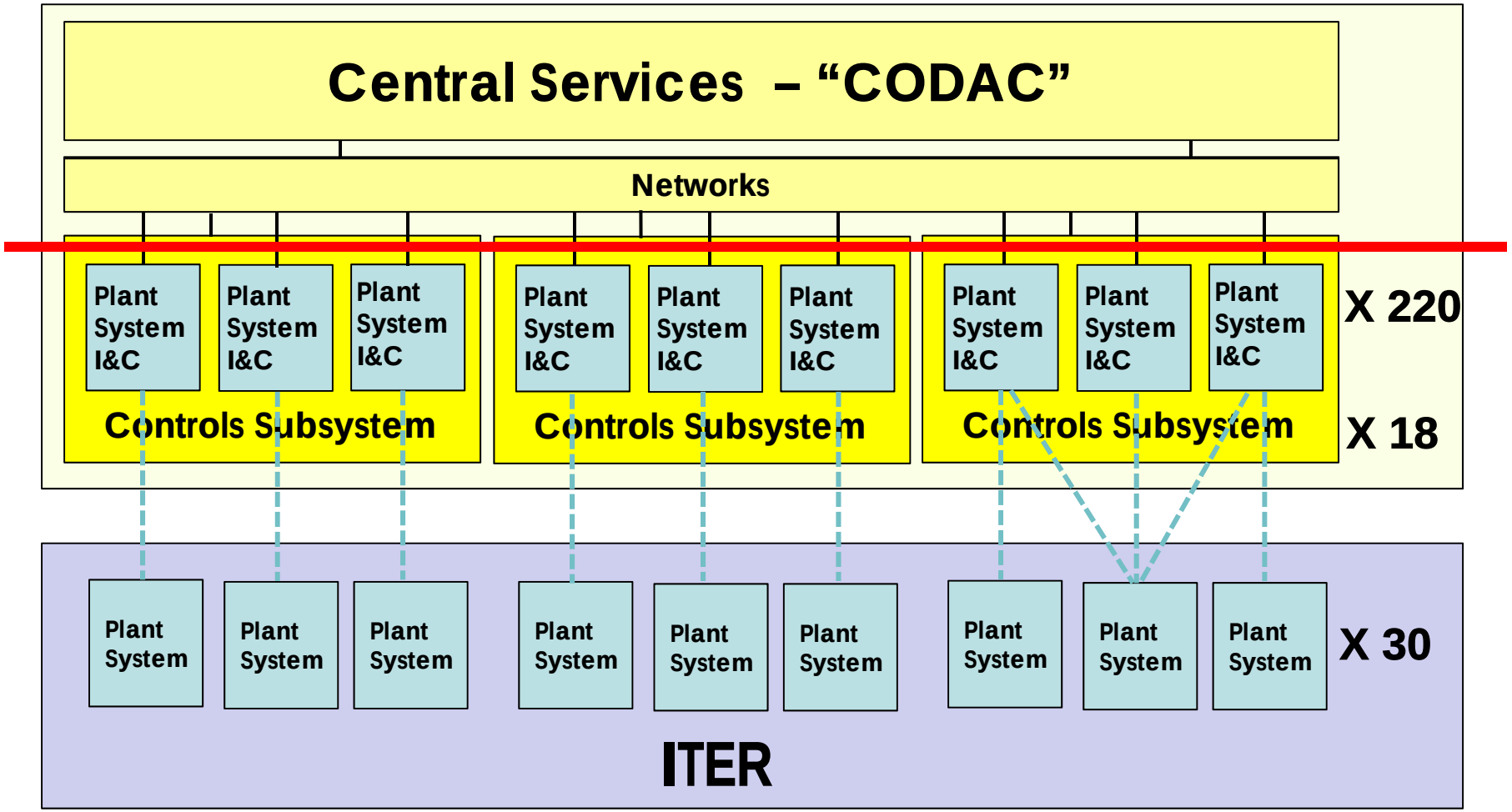
…So this is what we did:

- Took over financial responsibility for the “Plant System” Controls
- Had teams at each partner laboratory to build the “Plant I&C”



That worked. So could we do the same at ITER??

Take over responsibility for Plant System I&C
… and make it a central responsibility



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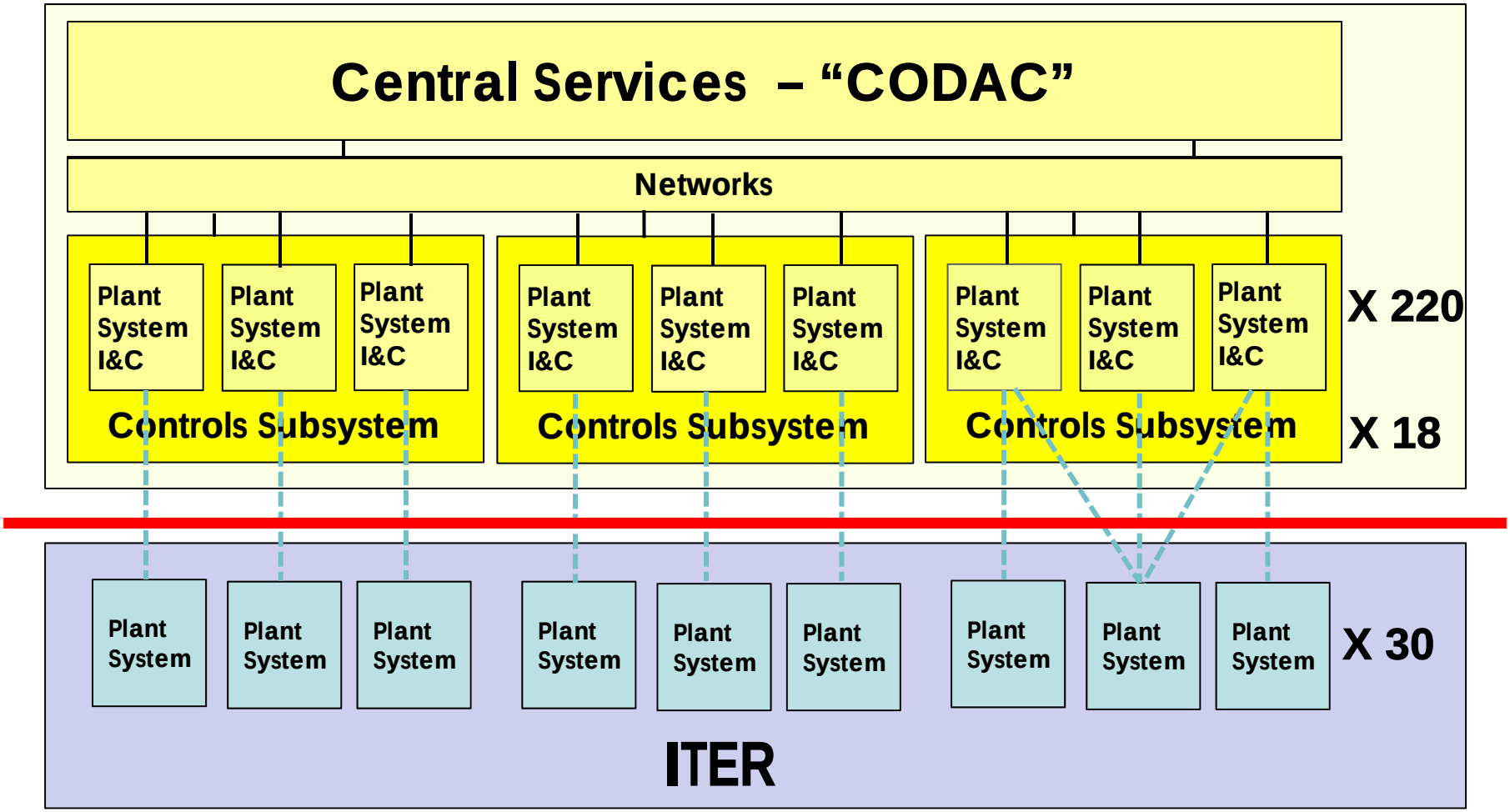
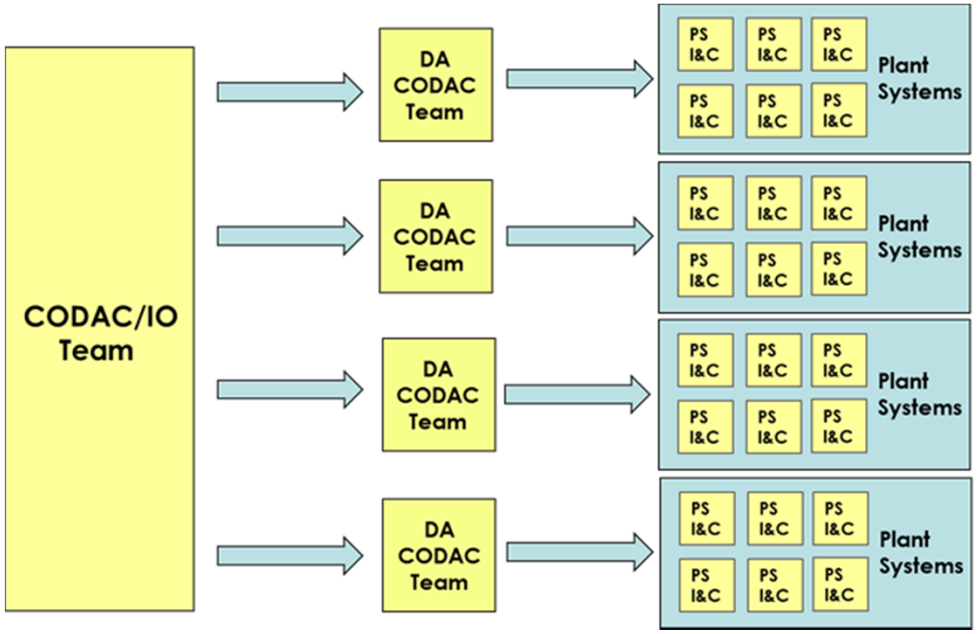


A detailed proposal was made in 2010

- Controls Teams to be formed at each “Domestic Agency”
  - They would oversee all PS I&C development for their areas
  - Leaders would be hired and trained by central team at IO
  - Their activities and purchases would be funded by IO
  - Common items (Hardware and Software) would be supplied by IO
  - Software would be routinely uploaded to Cadarache



- Funds would be transferred to IO to do this work

The Proposal was not accepted by the Domestic Agencies

- Many reasons given:
  - No one willing to transfer their funds
  - Cost Savings only hypothetical
    - True – it was really about risk mitigation
  - Too late – some contracts were already in place
  - Many thought (think) CODAC already responsible
- So back to the drawing board…

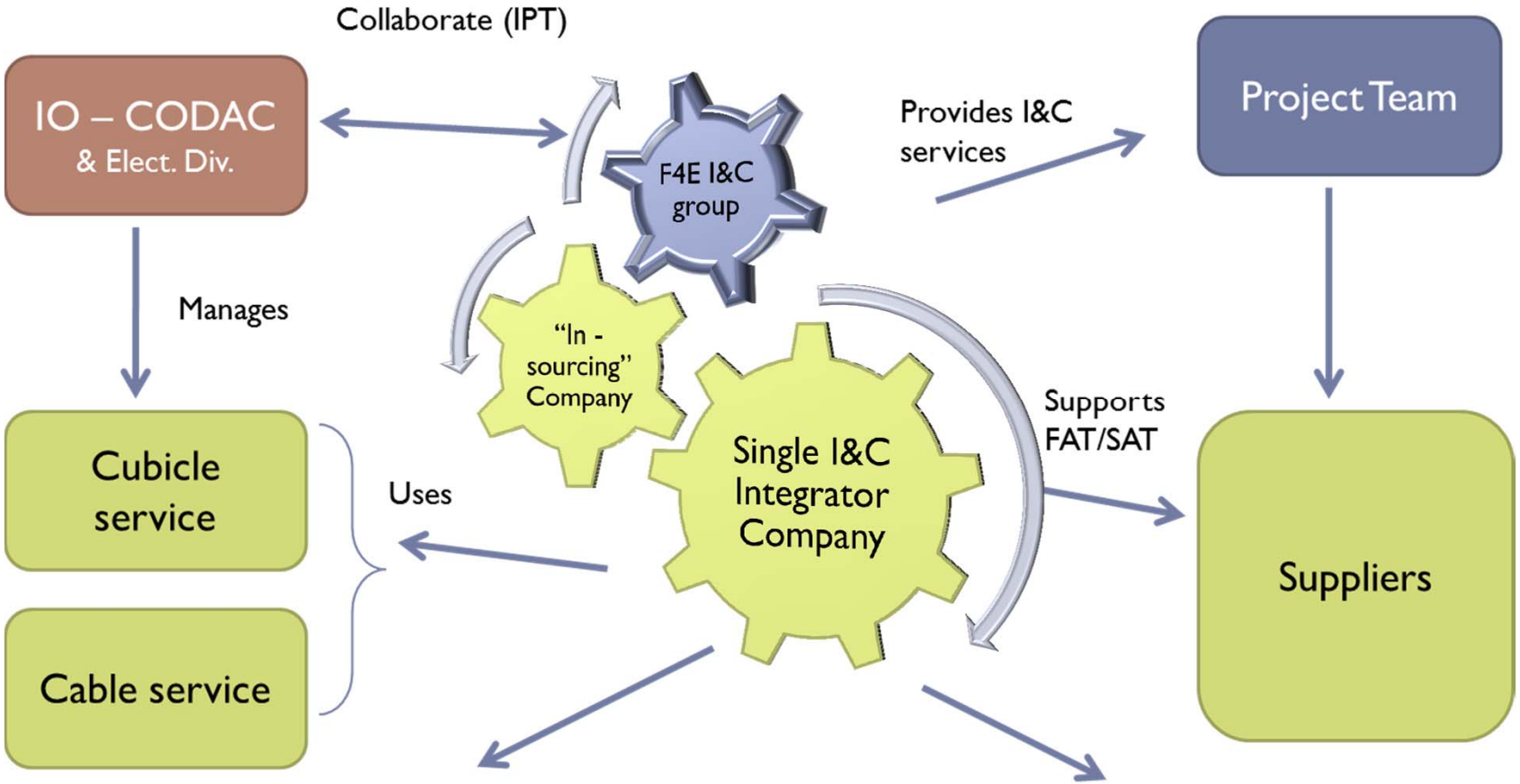
- Interesting Sidebar and Lesson Learned
  - An almost identical proposal for Nuclear Safety looks as if it will be accepted
    - (Believe it or not even Nuclear Safety has the same distribution of responsibility!!)
  - No fund transfer was included – to be resolved later

… but the DAs have similar integration issues…

	Scope of I&C Activities
Industrial Systems	
CRYO-Plants (LN2 & 80K)	Help Tender Preparation
Remote Handling (4 systems)	Help Follow-up activities
Tritium Plant systems	Develop interface to CODAC
Buildings Management System	
Electrical Distribution	
Waste process	
Test Blanket	
Fusion Systems	
Diagnostics (14 systems)	Help Tender Preparation
Additional Heating (3 systems)	Help Follow-up activities
Standalone instrumentation	Develop interface to CODAC
Vacuum Vessel	**Develop control system**
Divertor (?)	
Blanket (?)	

Europe has made a similar proposal (1)

Credit: Filippo Sartori - F4E (Europe DA)



Europe has made a similar proposal (2)

- Similarities
  - Central Team at the DA manages all of that DA's plant I&Cs
  - Close collaboration with CODAC IO
- Differences
  - Direct funded by DA
  - Team not managed from ITER I/O
  - Work done using Integration Contractors
- Status
  - Still not formally approved by F4E, but…
  - Initial Meeting with potential integrators drew large crowd

Will this proposal be successful?

- Less jurisdictional conflict (Trust)
- Use of contractors is more “the ITER way…”
- No money transfer or “tax”
- Support from CODAC

ITER is breaking new ground…

- **ITER must learn to operate efficiently with the extra challenges of a large international collaboration.**
- **CODAC will learn to do the same.**
- **Lessons learned in Cadarache will be invaluable to future large collaborations, such as the ILC**