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SPALLATION
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ICS approach to commissioning

Integrated Control System

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Outline

ICS approach to commissioning

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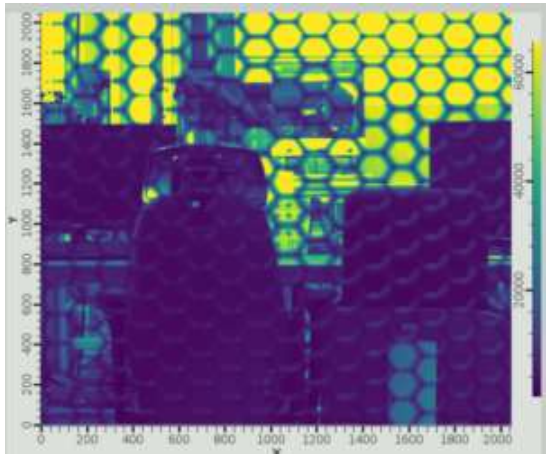

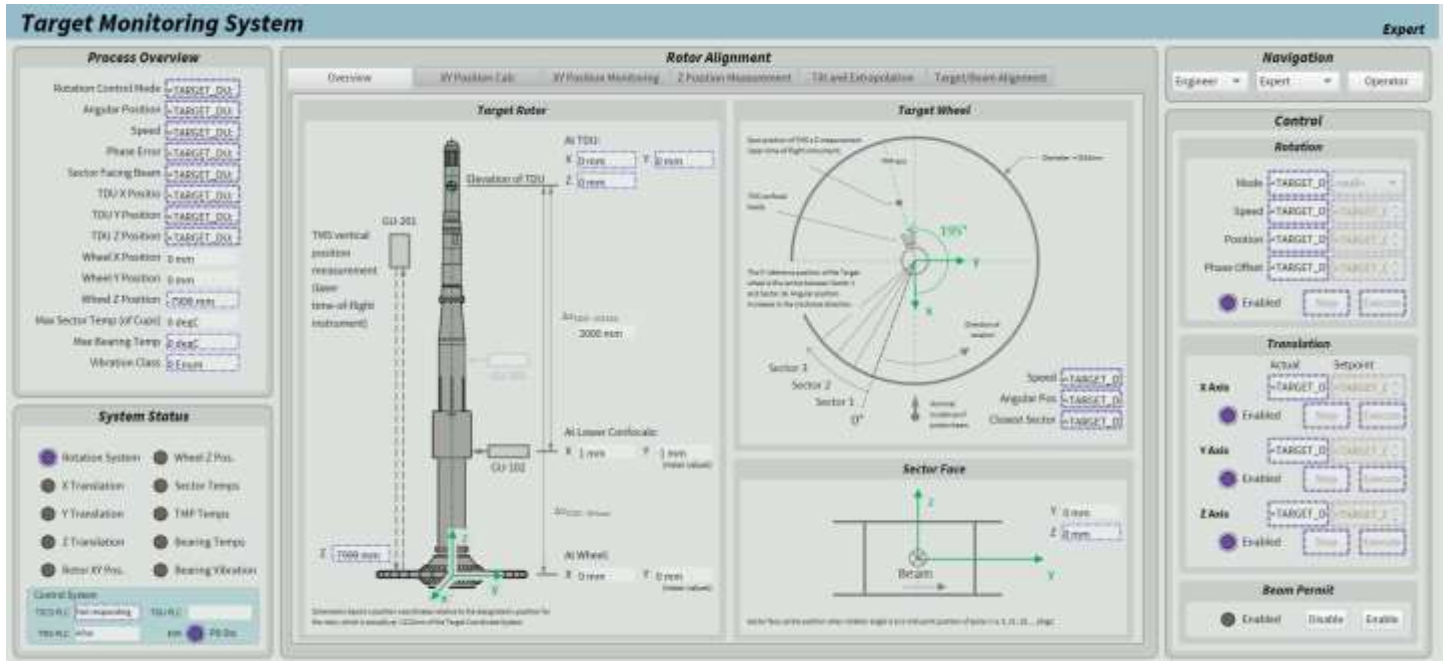

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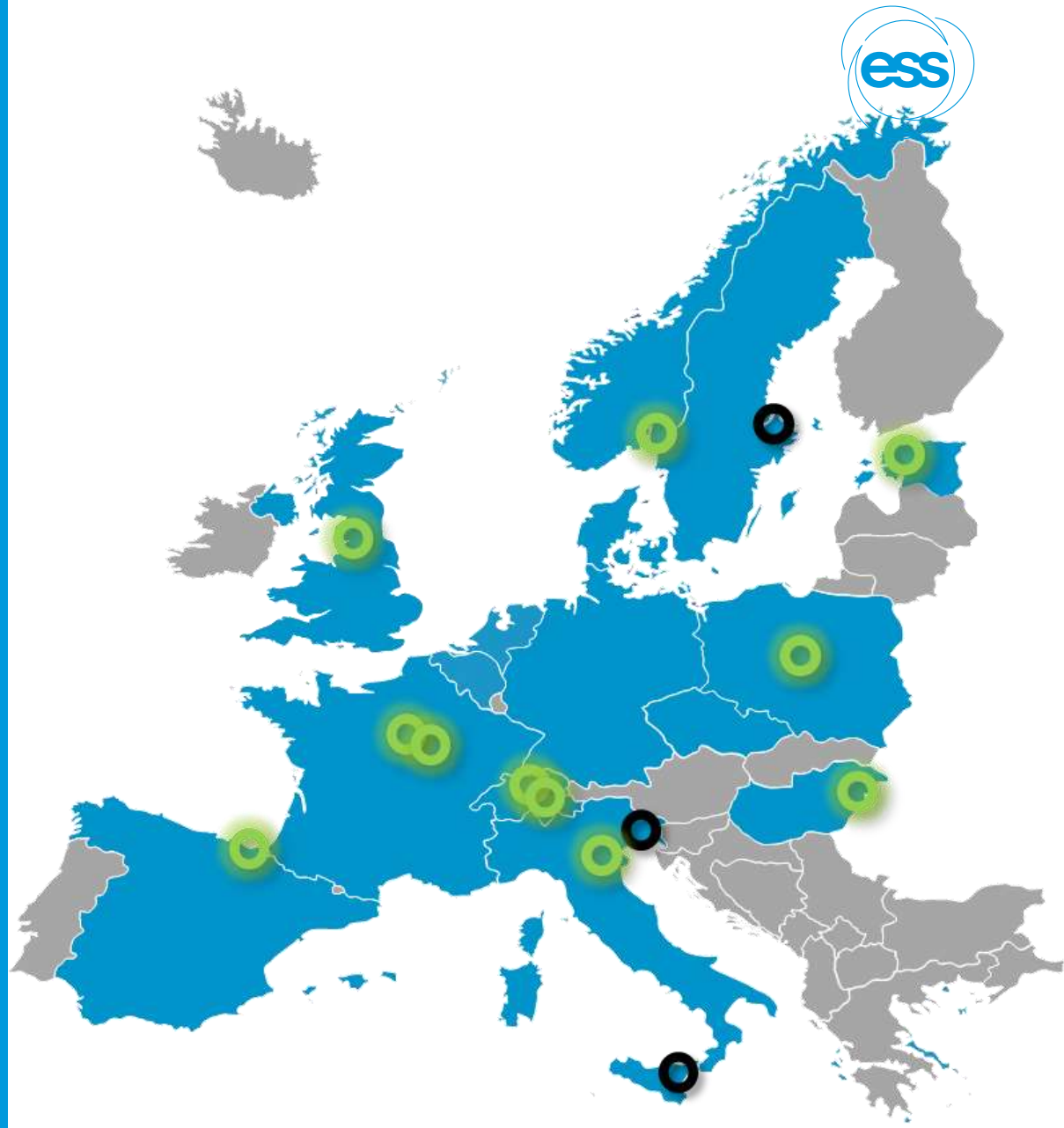
About the Integrated Control System



ICS in-kind partners

The ESS integrated control system

Overview

The ESS facility is a large and complex machine with very much and diverse equipment that needs to work in synchronization and with well-known configurations

The Integrated Control System Division is responsible for the control systems within the ESS facility including controls for

- **Accelerator**
- **Target**
- **Neutron Scattering Systems**
- **Conventional Facilities**

In addition, ICS will implement

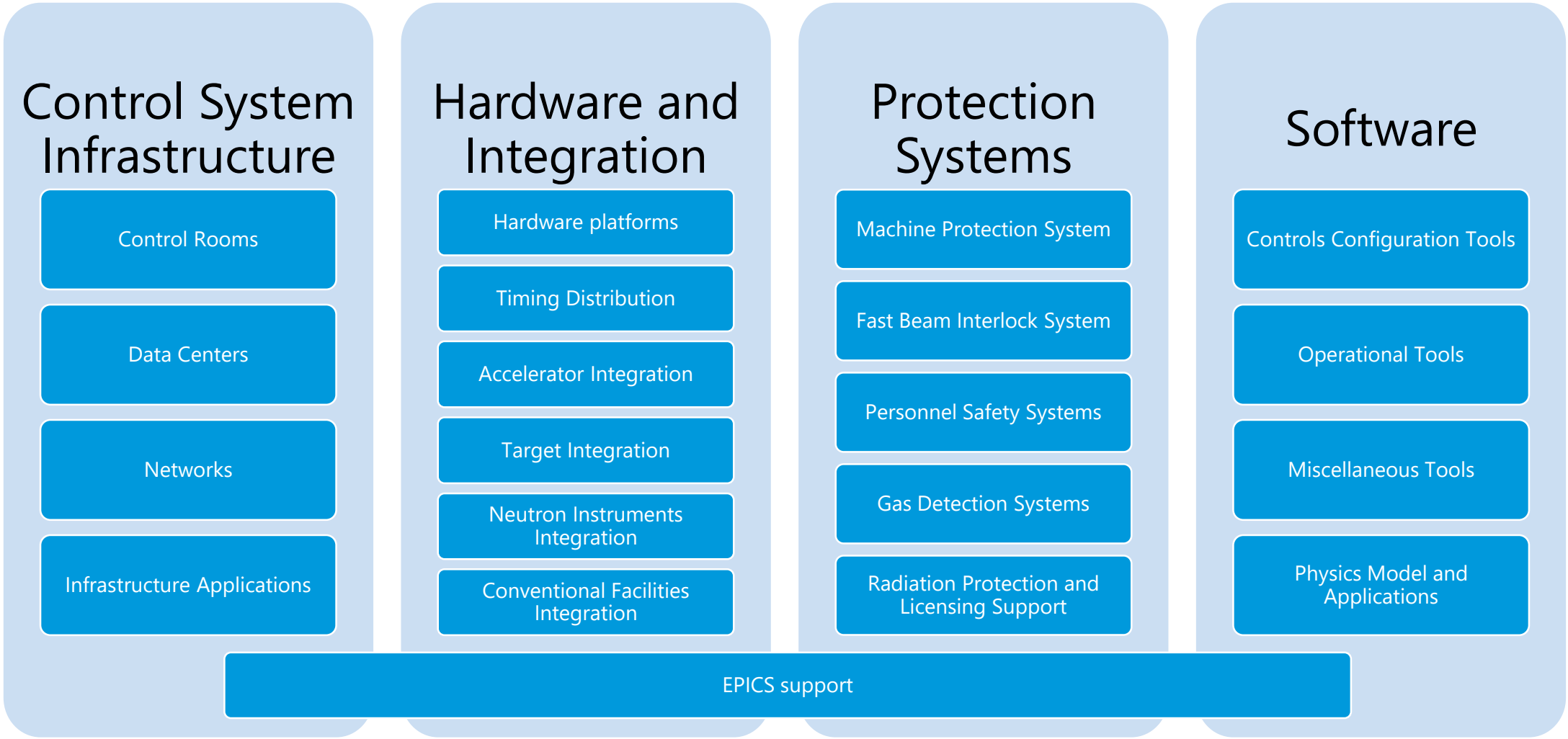
- **Machine Protection System**
- **Personnel Safety System**

To build a distributed control system of this size is a major undertaking

VR model of the ESS Main Control Room

Construction scope under ICS

Organization (4 lines) and Project (11-16 work packages)



Layered Architecture of ESS Control Systems

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Human Users
engineers, operators, scientists, technicians, ...

display ESS facility data, task execution

Applications
GUIs for data analysis, processing and archiving services, system configuration, ...

ESS facility data exchange

Facility Integration
runtime & historical data, complex control functions, configuration databases

system specific data exchange

Local System Control
process and device control, high dependability, executes local control functions

local control, run-time data

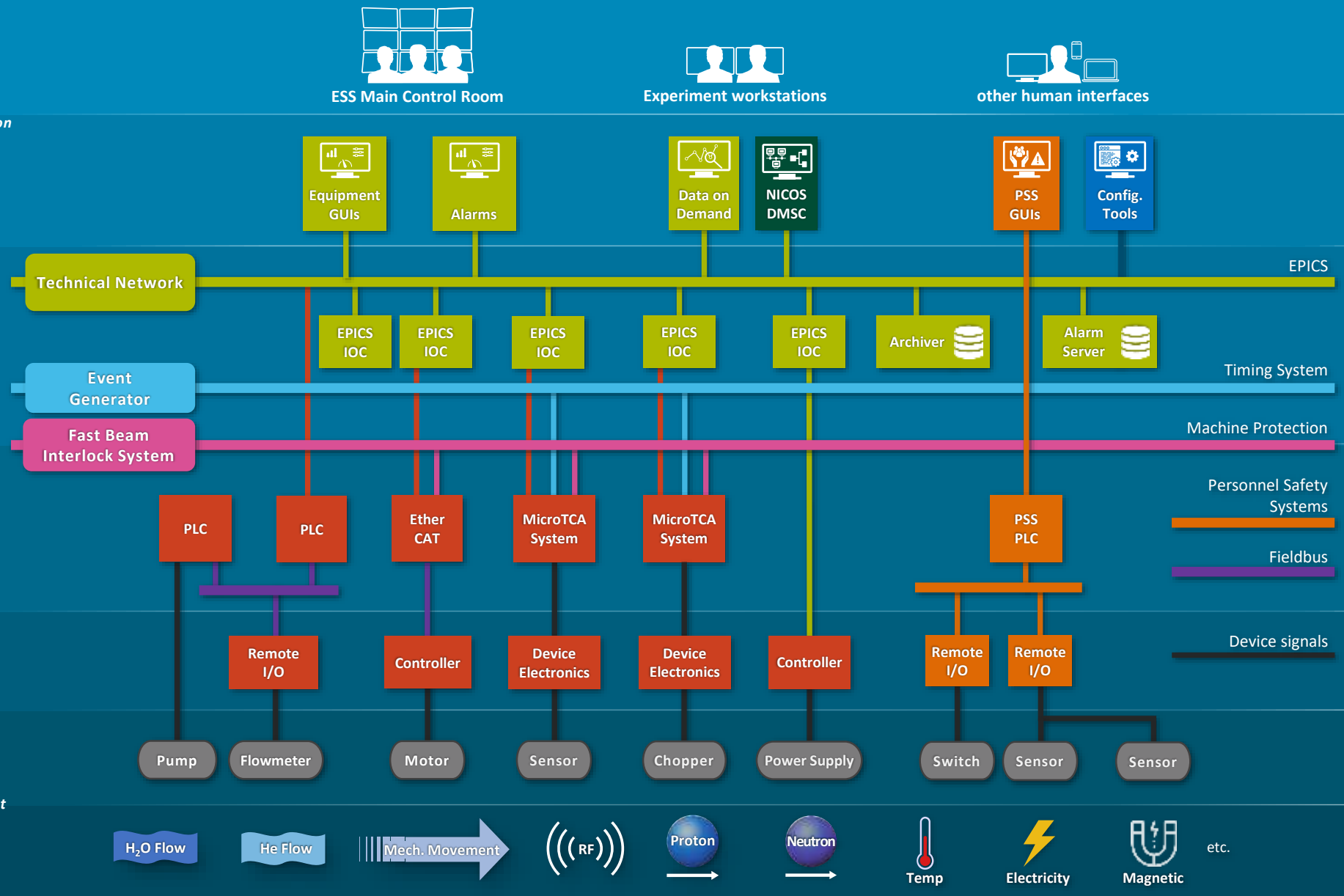
Signal Conditioning (a/d) and Electronics
Analogue and digital signals

device specific signals

Physical Equipment
machinery, sensors, actuators

measure and adjust

Physical Processes



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Approach to commissioning

ESS Management System

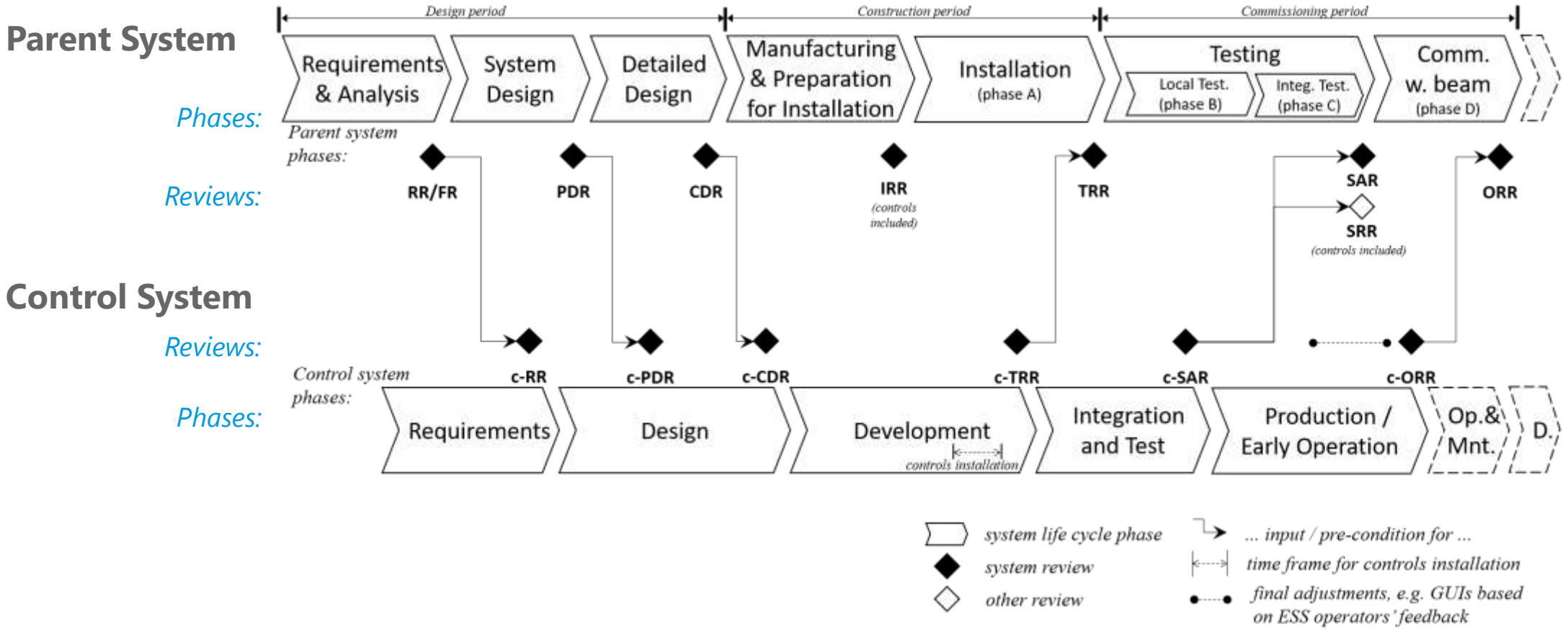
ESS Engineering Management

- All ESS facility systems must adhere to the ESS Management System
- The ESS Management System contains several "Ways of Working (WoW)"
- The Develop & Maintain Facility WoW outlines the process for developing a system.
- The process is defined in the "ESS Handbook for Engineering Management" [ESS-0092276].

ESS Engineering Management for ICS

Life cycle of an ICS control system with respect to parent system

- ICS division has customised this process specifically for control system development in our "**ESS Handbook for Engineering Management of Control Systems**" [ESS-0054678]



ESS Engineering Management for ICS

Key deliverables & reviews required

- Control system (HW + SW)
- Documentation
  - System Engineering Management Plan (SEMP)
  - Interface Control Document (ICD)
  - System Requirements Specification (SRS)
  - System Design Document (SDD)
  - Verification Plan / System Integration Plan (SIP)
  - Verification Plan / Test specifications
  - Test reports
- Reviews
  - Preliminary Design Review (PDR)
  - Critical Design Review (CDR)
  - Test Readiness Review (TRR)
  - System Acceptance Review (SAR)
  - Safety Readiness Review (SRR)
  - Operational Readiness Review (ORR)

Controlled documents are managed in CHESS (corporate tool for doc. mgmt.)

Documents are typically reviewed by stakeholders (designated responsible): parent system owner, owners of interfacing systems, group leader, chief engineer, project manager

Holistic review of development: check points for continuation.

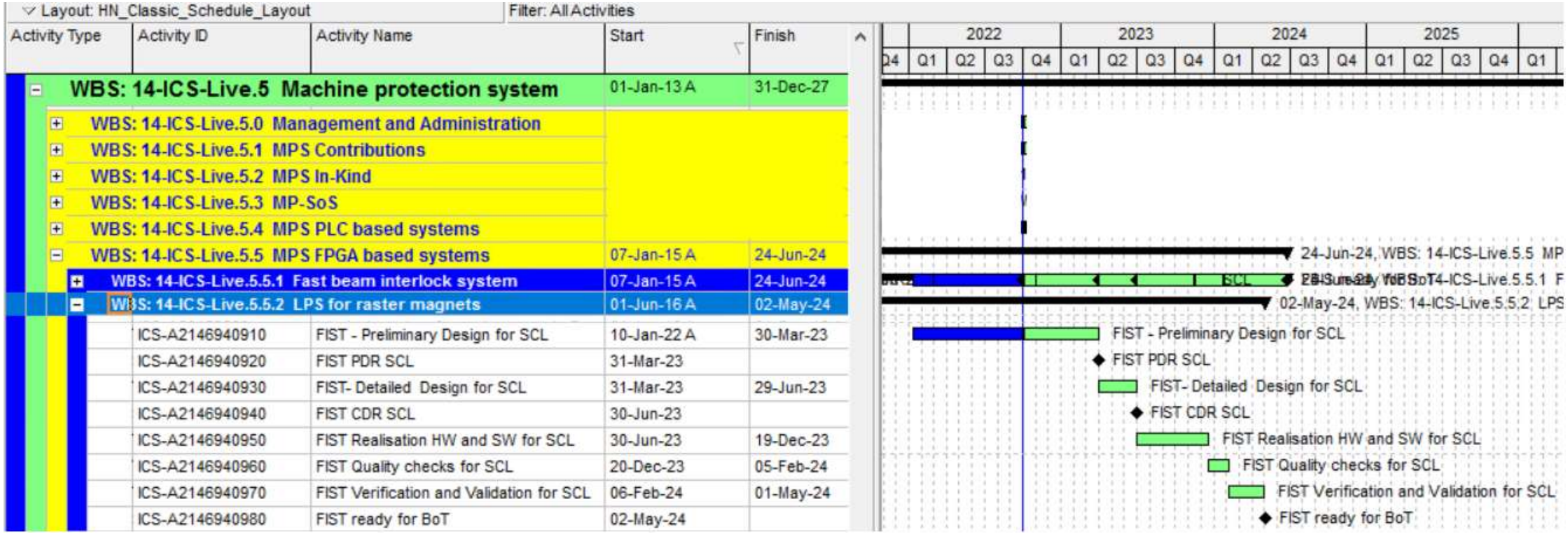
Reviews typically consist of a committee of engineers (both internal and external to ICS division) who assess the key deliverables and probe the design and project plans, in order to answer a set of charge questions.

Scheduling example

Planning with systems engineering in mind

To consider:

- Definition of readiness
- Interfaces and dependencies
- Handover (operational support)
- Maintenance (bug fixes and upgrades)



Software Tools

To support Commissioning

Controls Configuration

- Naming service (Naming Convention)
- Cable database
- Controls Configuration Database
  (Management of Devices, Properties & Relationships)
  - Will be replaced, keeping the “configuration” capability
- CCCE (IOC deployment tool)
- IOC Factory (will evolve to adapt to CCDB)
- E3 (ESS EPICS Environment)

Operation support

- Alarm service
- Archiver
- Control System Studio Phoebus
- OLOG (electronic logbook)

Miscellaneous tools

- Calibration Service (prototype during commissioning)
- Operation Sequencer (prototype)
- Synchronous Data Service (prototype)
- Software Interlock
- SuperCycle Tool
- Public Operation Screens
- ESS Notify (Smartphone app)

Continuous Integration / Continuous Deployment tools

- Infrastructure as a Service

3

Challenges

ICS challenges

General to the Construction phase of the project

Team expansion

- Growing up the team from a few people to over 100 people now, and keeping the development from diverging.

Inner-resilience

- Trying to cope with changes in the surrounding organization.
- New things come up that were not known, and adjusting our developments to that (examples: Enterprise Asset Mgmt, CHESS [doc.mgmt., Facility Breakdown Structures], Identity Access Mgmt.; these all have resulted in significant changes in the implementation plans)

Common platforms

- Trying to converge the different approaches and requirements of different divisions (ACC,TG,NSS), and create systems that serve all.

Forefront technology

- Taking up a still relatively new technology of MTCA and dealing with all the complexities.

ICS commissioning

Challenges

Ways of Working during transitions

- Adjusting from development phase (large freedom) to operation (limited freedom).
- Balance between fixing issues quickly and achieving a stable status.

Parallelization

- Stakeholder's activities are accumulating and running in parallel, this creates challenges related to everything being under construction at the same time.

User engagement

- Learning curve with our tools, both for ICS staff and users of our tools. Mix of training and knowledge transfer.
- For example, learning how to make best use of the archiver, setting up alarms (not quite there yet), etc.

Interfacing new stakeholders

- Finding a good way to support and cooperate with operations.

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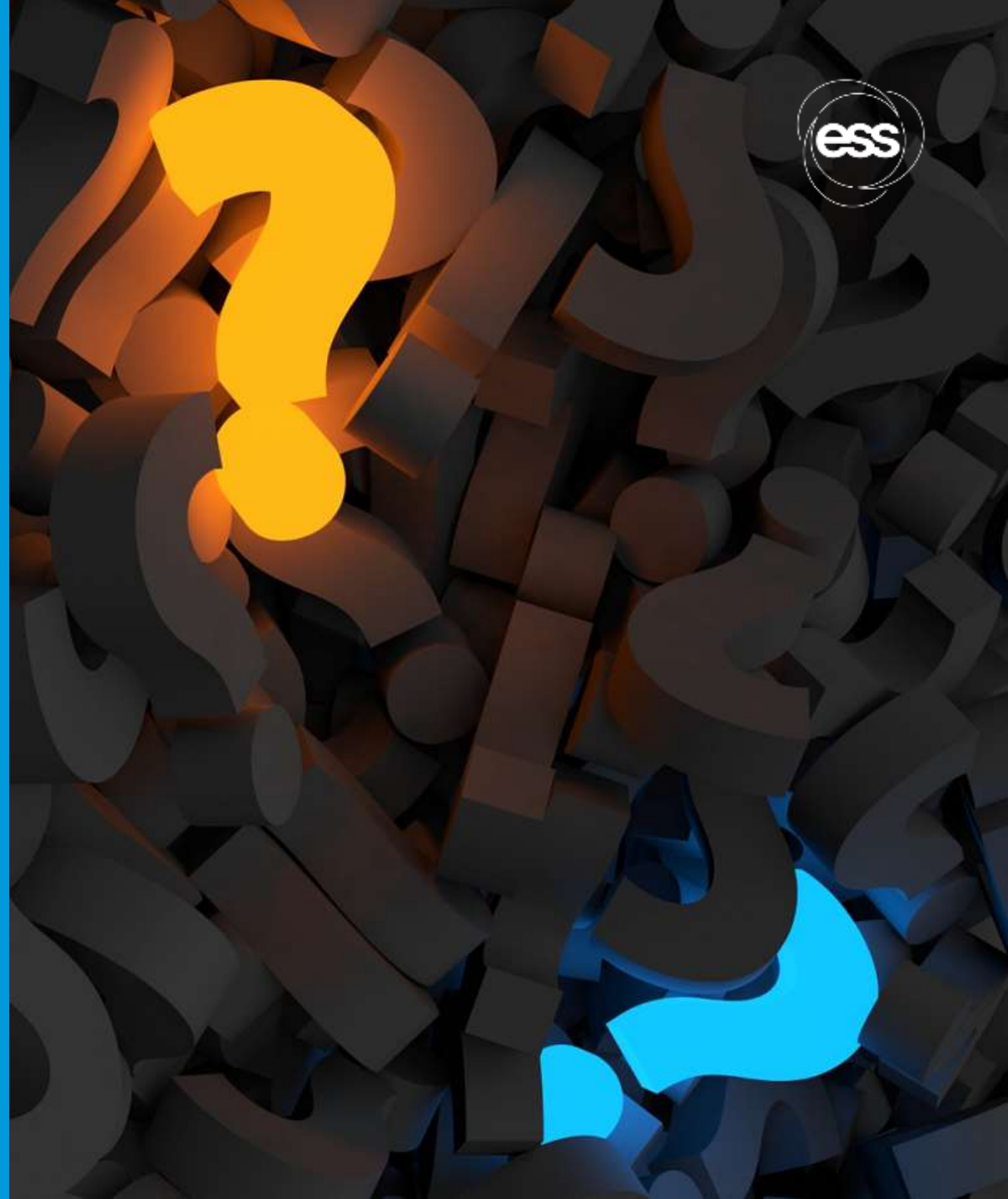
Questions to debate



Topics for discussion (1/2)

insights from J-PARC are most welcome ☺

- Archiving, data storage and retention policies, or networking challenges found during commissioning and of Accelerator / Target / Neutron Instrument systems. How have the systems evolved after commissioning?
- General status in regards to EPICS deployment. Most common (EPICS) version in use? How have you evolved since commissioning? (For target & neutron instruments: are you using EPICS to control your systems?)
- Fast/high data volume/beam synchronous acquisition, what has happened at J-PARC in the last 3 years?
- How do you communicate with other parts of the Machine (e.g. Accelerator + Target commissioning preparations)
- What is the support required from controls to moderator or neutronics commissioning activities? What about the involvement of controls with regards to activated materials?

Topics for discussion (2/2)

insights from J-PARC are most welcome ☺

- How are neutron instruments integrated (=controlled)? Is there a committed team for each instrument or a central support team?
- What was the process of building and commissioning the instrument suite at J-PARC? How long did it take, how was the controls team organized?
- What about detector controls integration and maintenance?
- How is neutron instrument data acquisition and storage done? i.e. through a common data storage approach or individual handling for each instrument.
- What are your impressions about beam presence during commissioning? How the different commissioning teams knew there was beam? i.e. from source to sample, how the instruments know when a pulse is coming? Can their data be correlated / linked to a given pulse?
- What about cybersecurity? Did you have any issues, any advice you could share? Did you allow remote/external access? How do you handle your users (neutron science researchers)?
- Do you have an on-call service for controls?

Summary

ICS approach to commissioning

- ICS is a division under the Technical Directorate with more than 100 people in four groups.
- ICS as a project in its Construction phase delivers an integrated control system for the Accelerator, Target, NSS suite of instruments, and also Machine Protection and Personnel Safety.
- ICS has tailored ESS Ways of Working to the delivery of control systems and related tools and platforms. This is also reflected in its project schedule.
- Commissioning of ICS' core systems (e.g. Technical Network, software platforms, Timing Distribution) relies mostly on ICS.
- Commissioning of control systems for stakeholders is embedded in their (sub-)system lifecycles.
- ICS faces challenges derived from the complexity of the machine, the project size and challenges specific to commissioning.
- ICS would like to have an open dialogue during this workshop with all areas participating from J-PARC

Thank you!