Integration Progress on ITER In-Cryostat Components

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ITER Organization

(The views and opinions expressed herein do not necessarily reflect those of the ITER Organization).

Outline

- Configuration Management in ITER – Requirements
- Measurements for integration progress
- ITER Tokamak components
- Integration progress examples
- Space management inside Cryostat
- Summary

Configuration Management in ITER - Requirements

ITER Project Requirements

1.5.3 Configuration Management Model and Site Master Plan

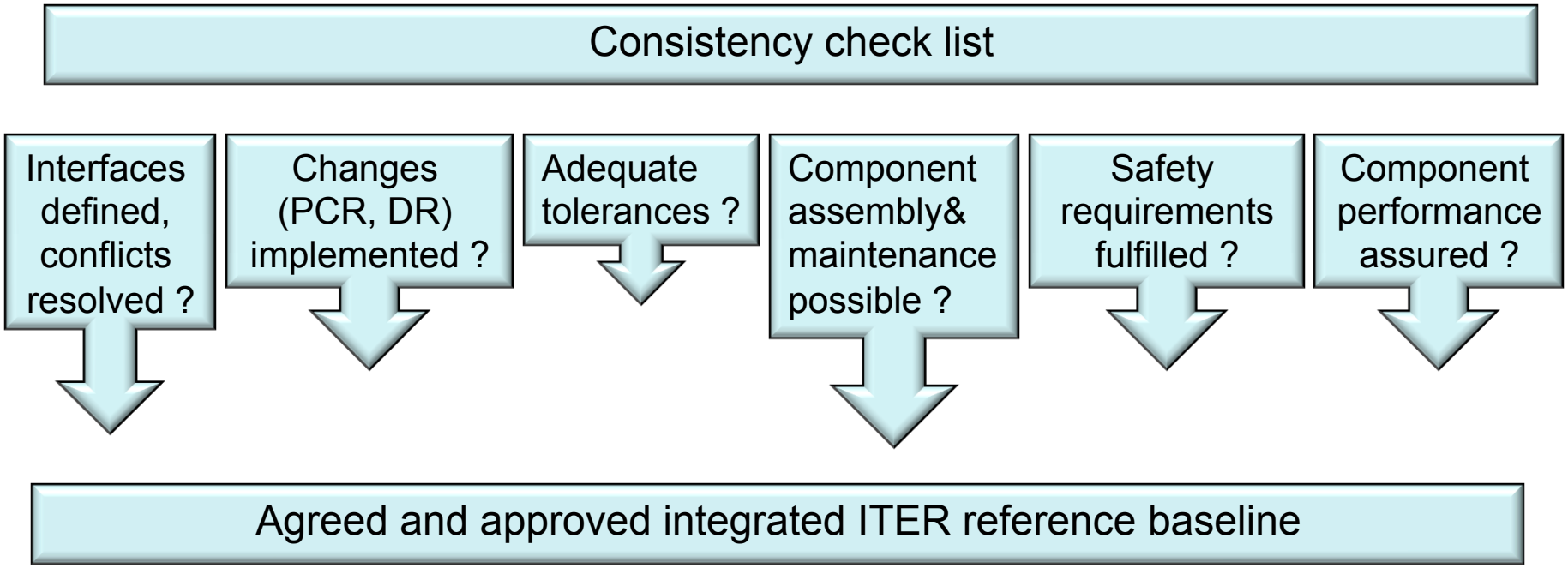
"ITER has to assure consistency between all components and with the site and buildings. ***This will be realized by establishing*** three-dimensional (3D) CAD models that make up the ***"Configuration Management Model" (CMM)*** [7] which represents the structure and geometry of the components in the Tokamak Complex. In the ***CMM,*** the configuration ***is defined in terms of component envelopes and interface characteristics.*** The CMM is ***used to assure that interferences do not exist and that the Tokamak*** (including port-mounted equipment) ***can be assembled and maintained*** as designed..... [PR38-I]"

- Design Integration is subdivided into Tokamak and Building Integration

Measurements for integration progress

Tools or How we can realize it in practice?

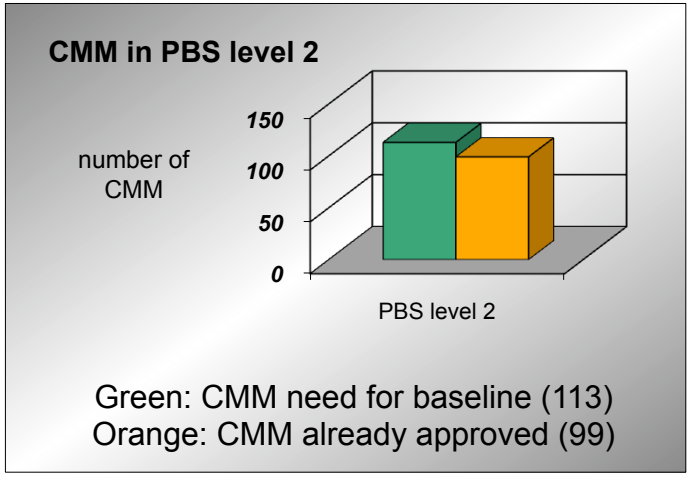
- Configuration Management Model (CMM)
- Physical and functional interface definition in Interface Control Documents (ICD), Interface Sheets (IS)
- Design Integration Review (DIR)
- Model Review Meetings (MRM)
- Virtual Reality (VR) …



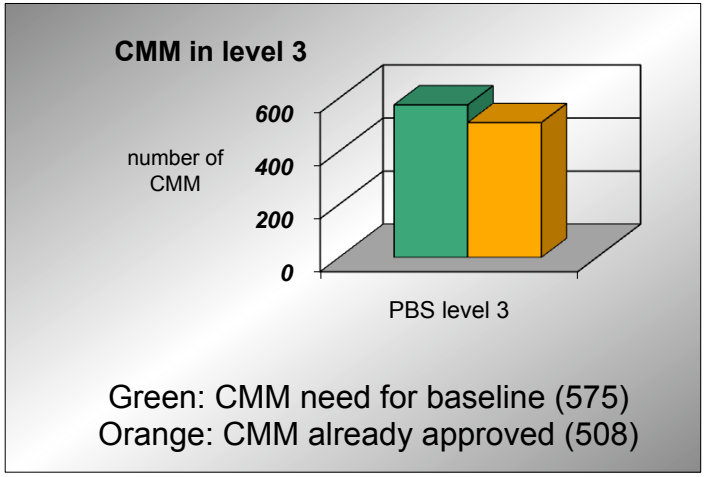
Measurements for integration progress

CMM according to Plant Breakdown Structure (PBS) until level 3

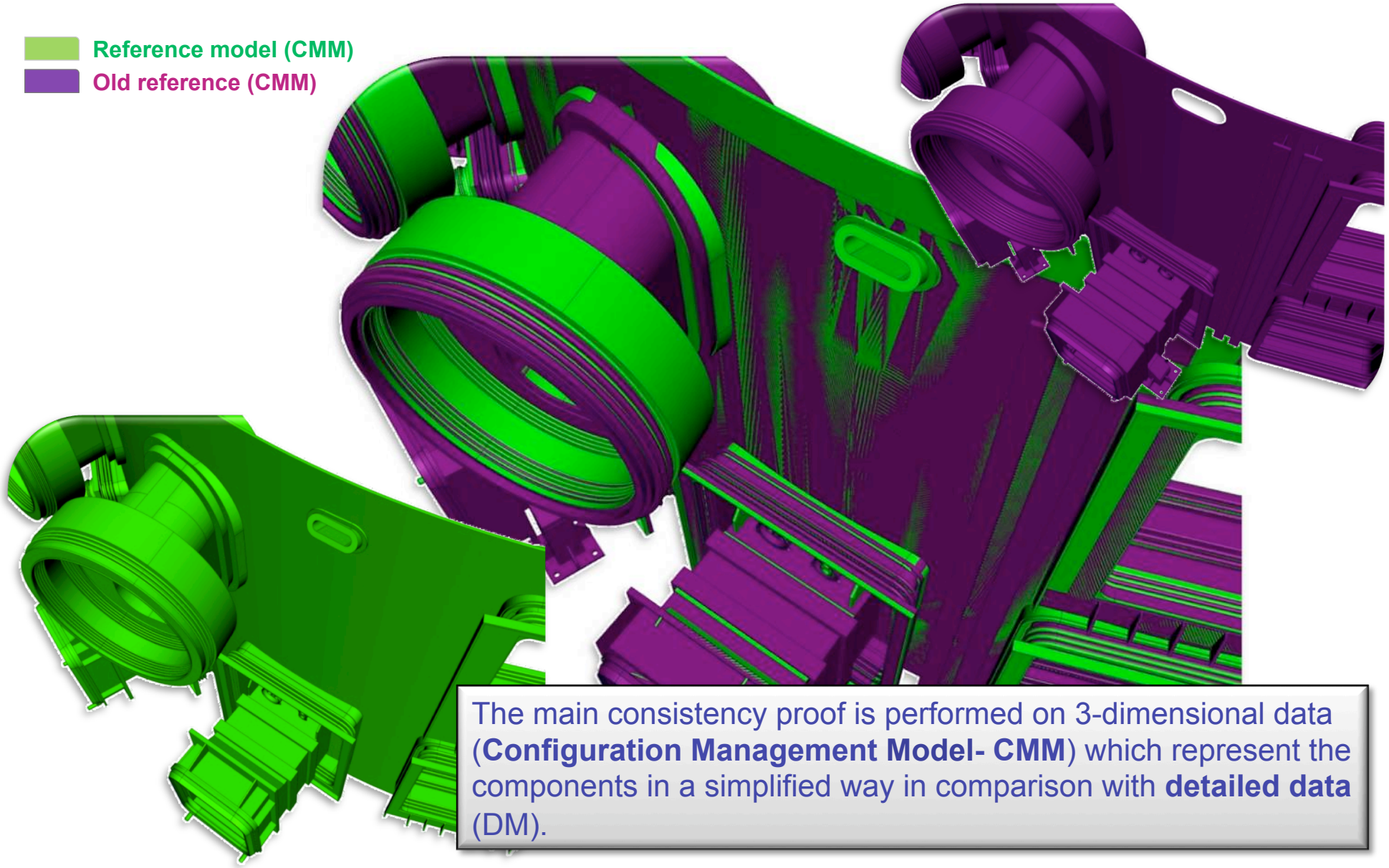
PBS level 1	PBS level 2	PBS level 3	Description
15.VV			Vacuum Vessel
	15.VV.IW		In-Wall Shielding
	15.VV.MV...	15.VV.S1	Main Vessel, sector 1
		15.VV.S2	Main Vessel, sector 2
		15.VV.S3…	Main Vessel, sector 3



Approximately **690** different Tokamak CMM had to be created and have now to be maintained

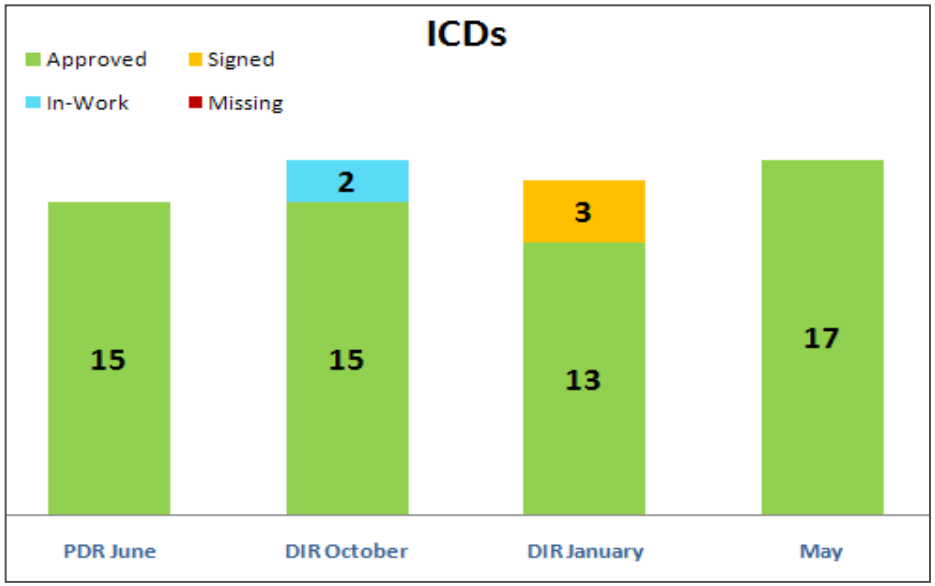


Measurements for integration progress



The main consistency proof is performed on 3-dimensional data (**Configuration Management Model- CMM**) which represent the components in a simplified way in comparison with **detailed data** (DM).

Measurements for integration progress

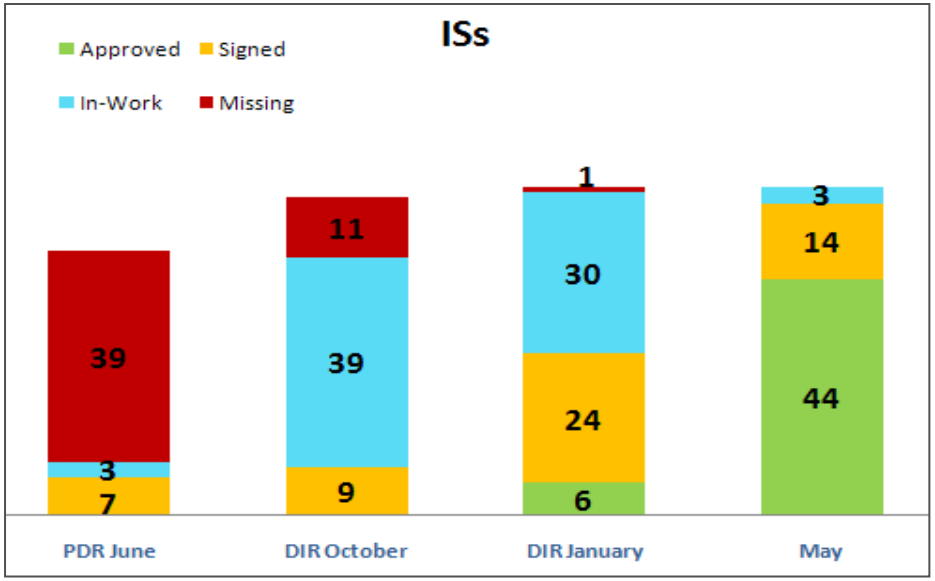


Example: PBS 24- Cryostat interface definition

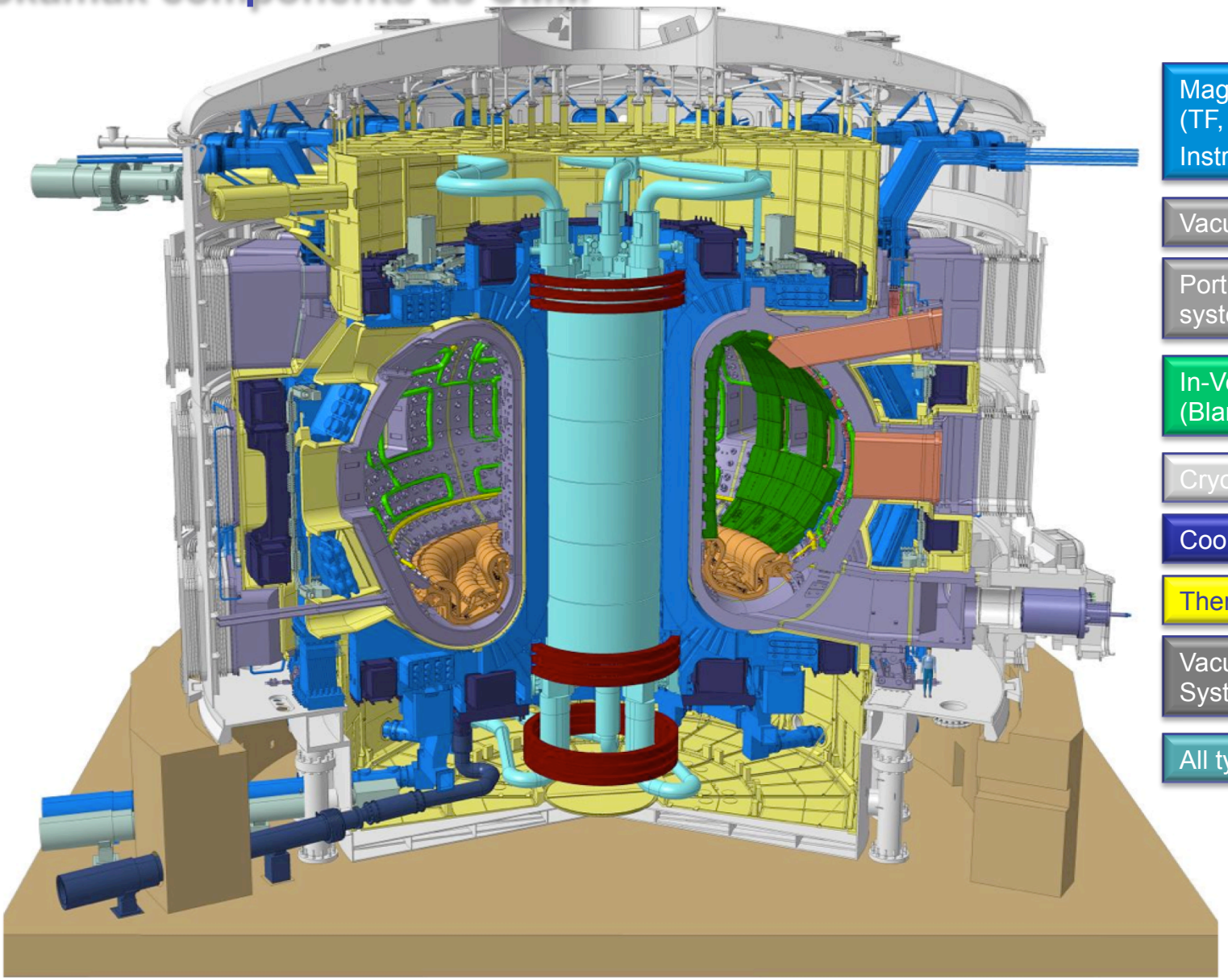
PDR- Preliminary Design Review
DIR - Design Integration Review
FDR- Final Design Review

Interface graphs Improvements as outcome of RO and Integration work

Result: improved Cryostat interface situation

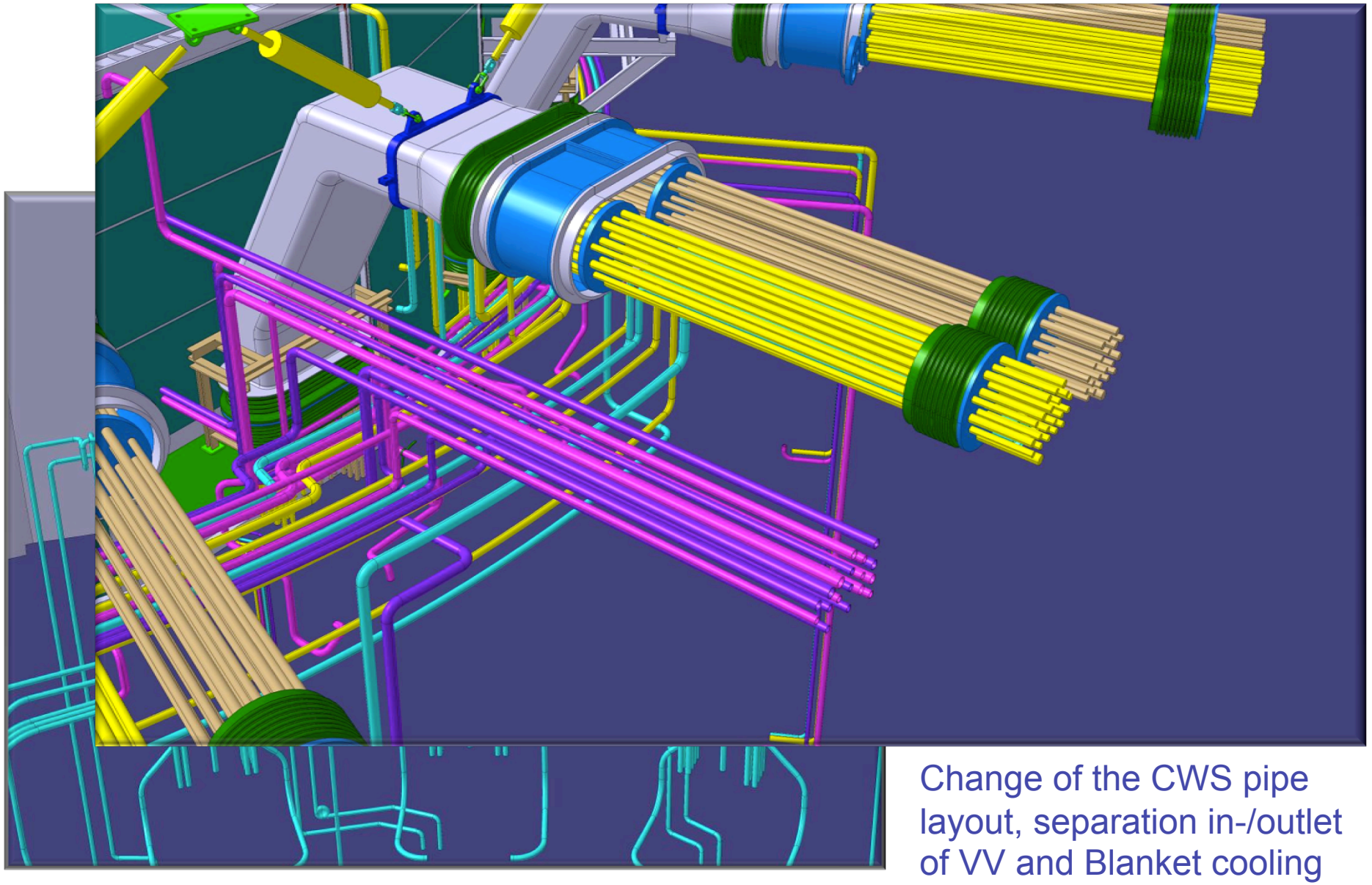


Tokamak components as CMM



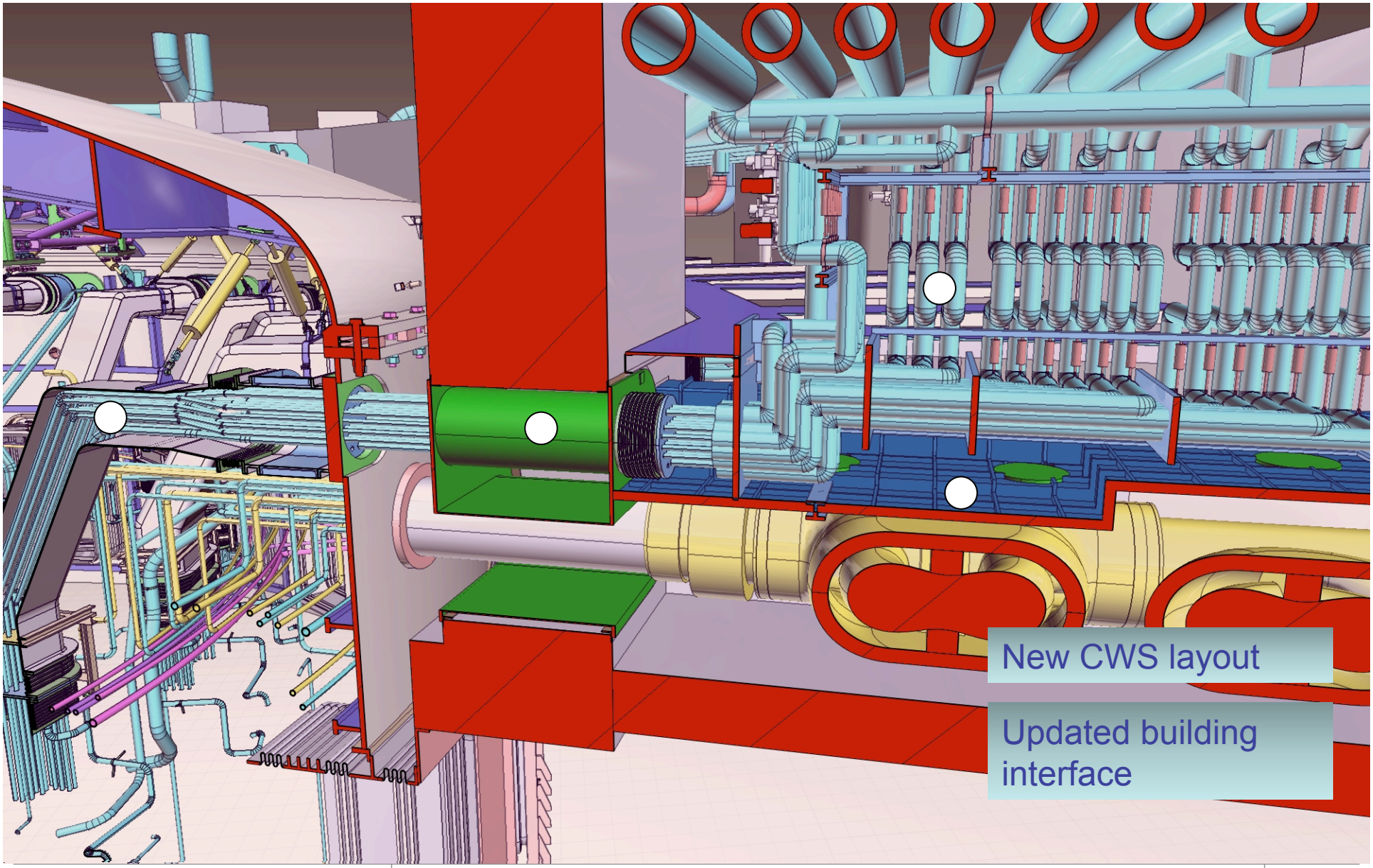
- Magnet systems (TF, PF, CS, CC, Feeder, Instrumentation)
- Vacuum Vessel
- Port systems and Heating systems
- In-Vessel components (Blanket, Divertor, IVC)
- Cryostat
- Cooling Water Systems
- Thermal Shield
- Vacuum & Pumping Systems
- All types of Diagnostics

Integration progress examples- upper Cryostat

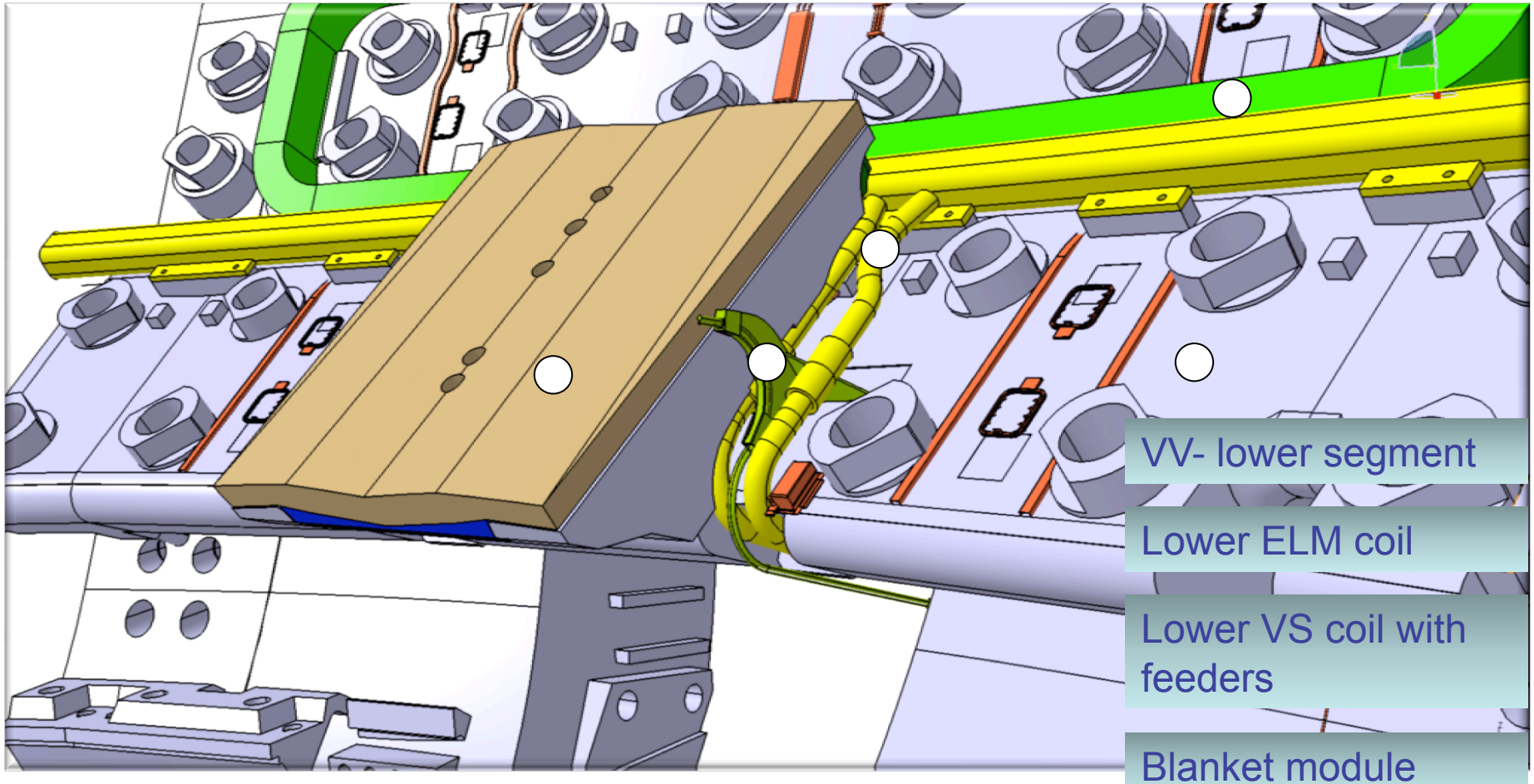


Change of the CWS pipe layout, separation in-/outlet of VV and Blanket cooling

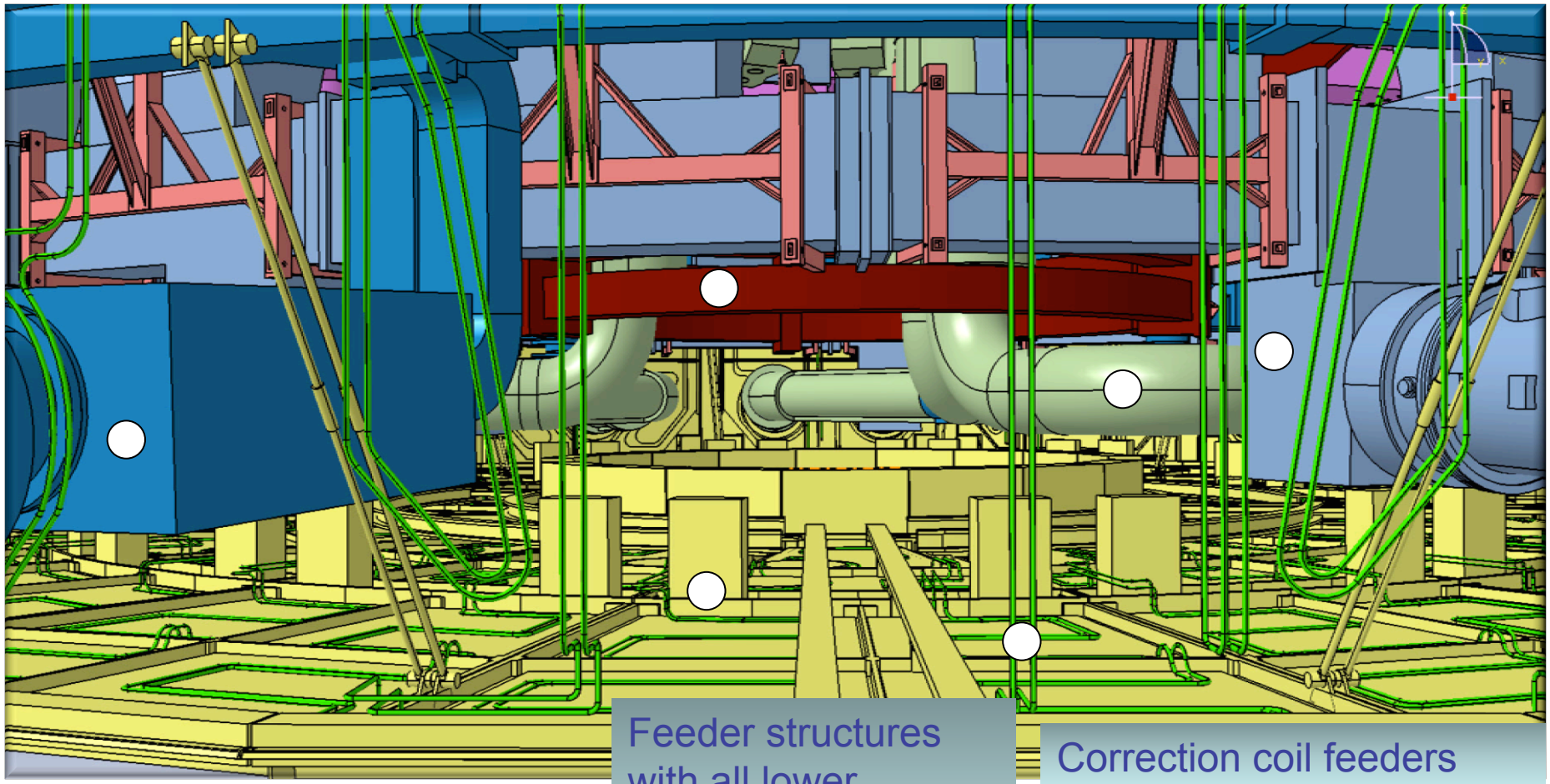
Integration progress examples- upper Cryostat



Integration progress examples- lower Vacuum Vessel



Integration progress examples- lower Cryostat



Lower Cryostat thermal shield

Thermal shield cooling pipes

Feeder structures with all lower feeders like TF feeder and feeder ring

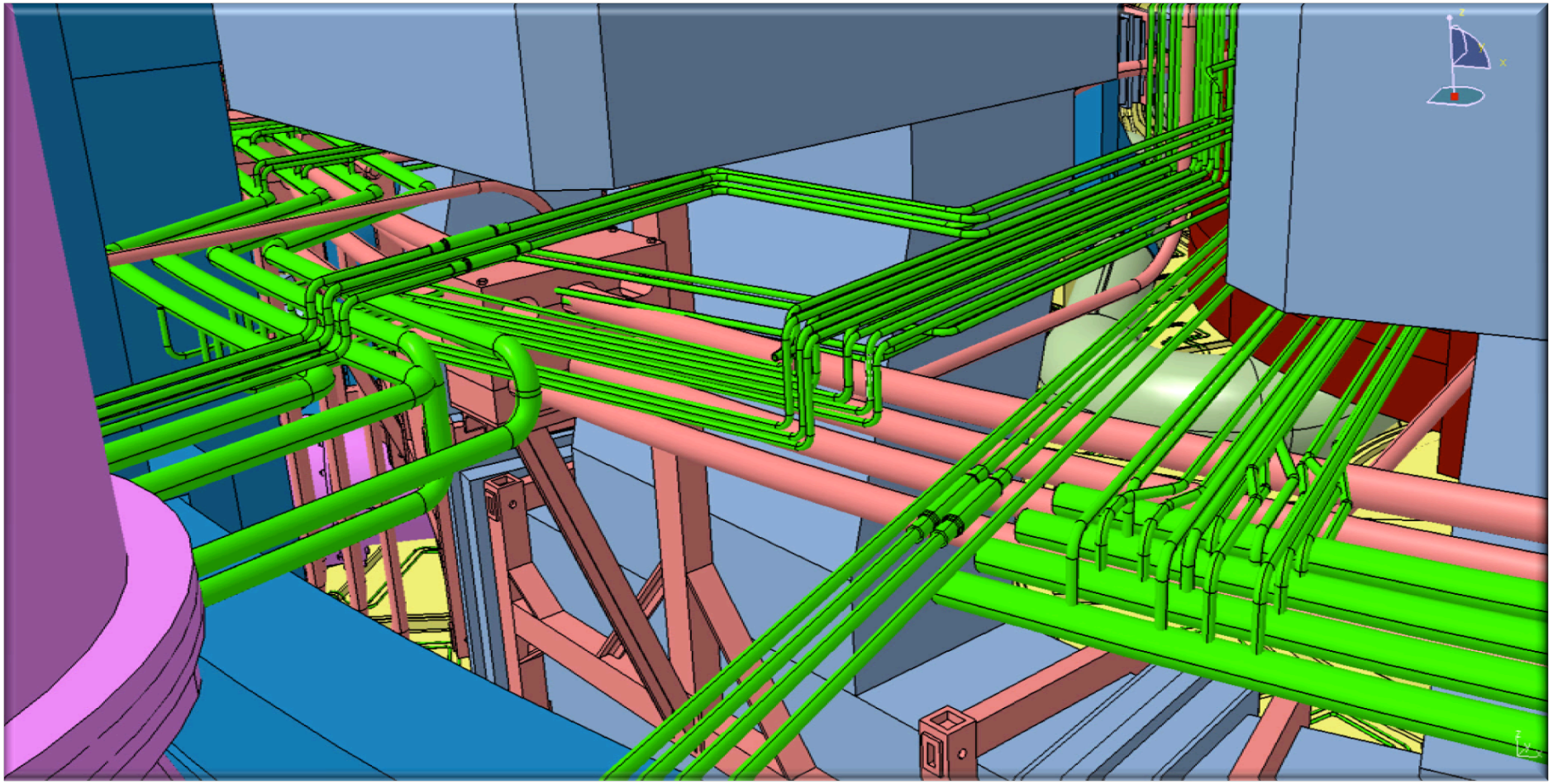
Correction coil feeders

CS coil feeders

TF pre-compression rings

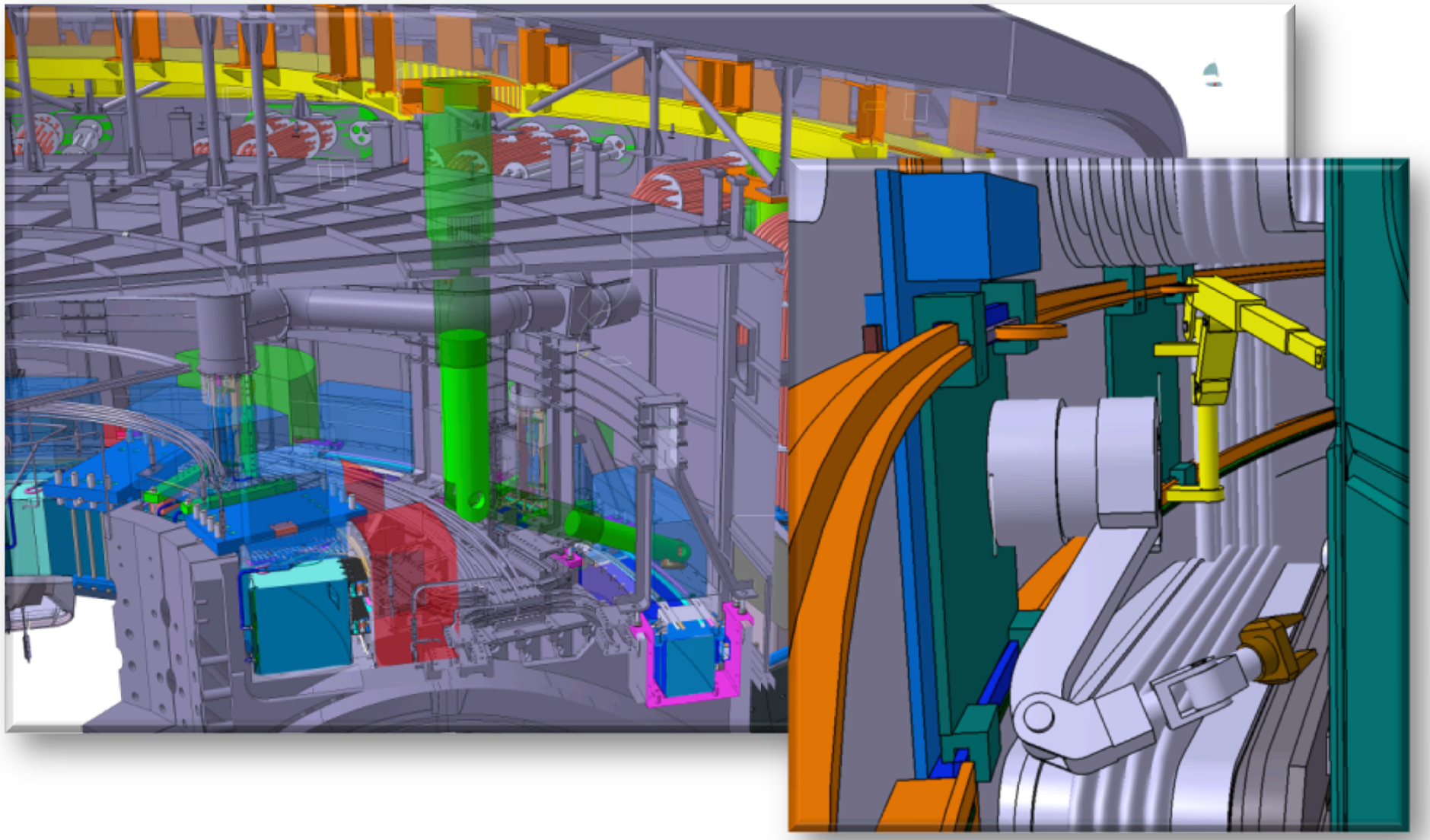
Space Management inside Cryostat

Additional spaces inside Cryostat for components, assembly and maintenance



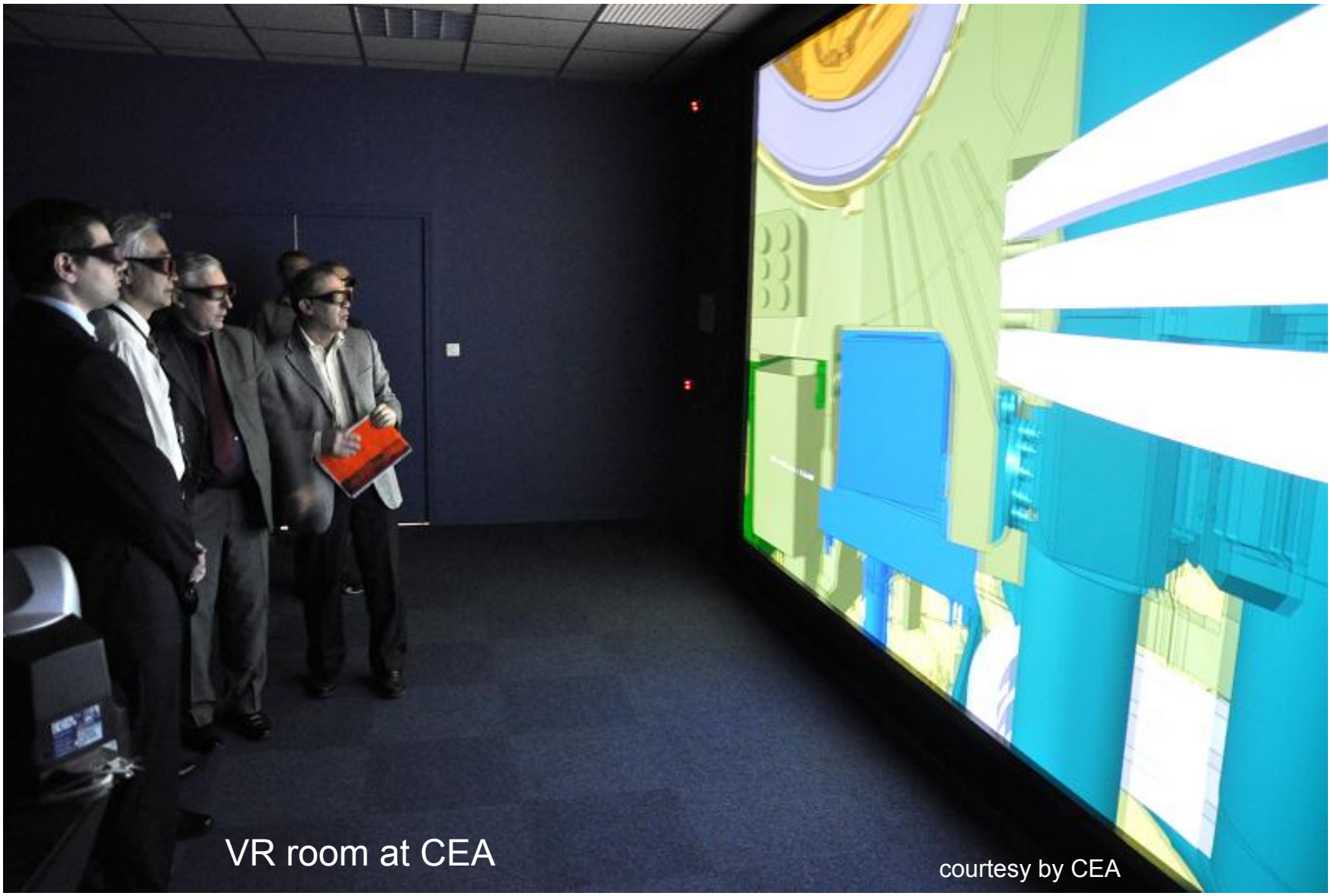
Pipe layout inside Cryostat- necessity to manage the spaces

Space Management inside Cryostat

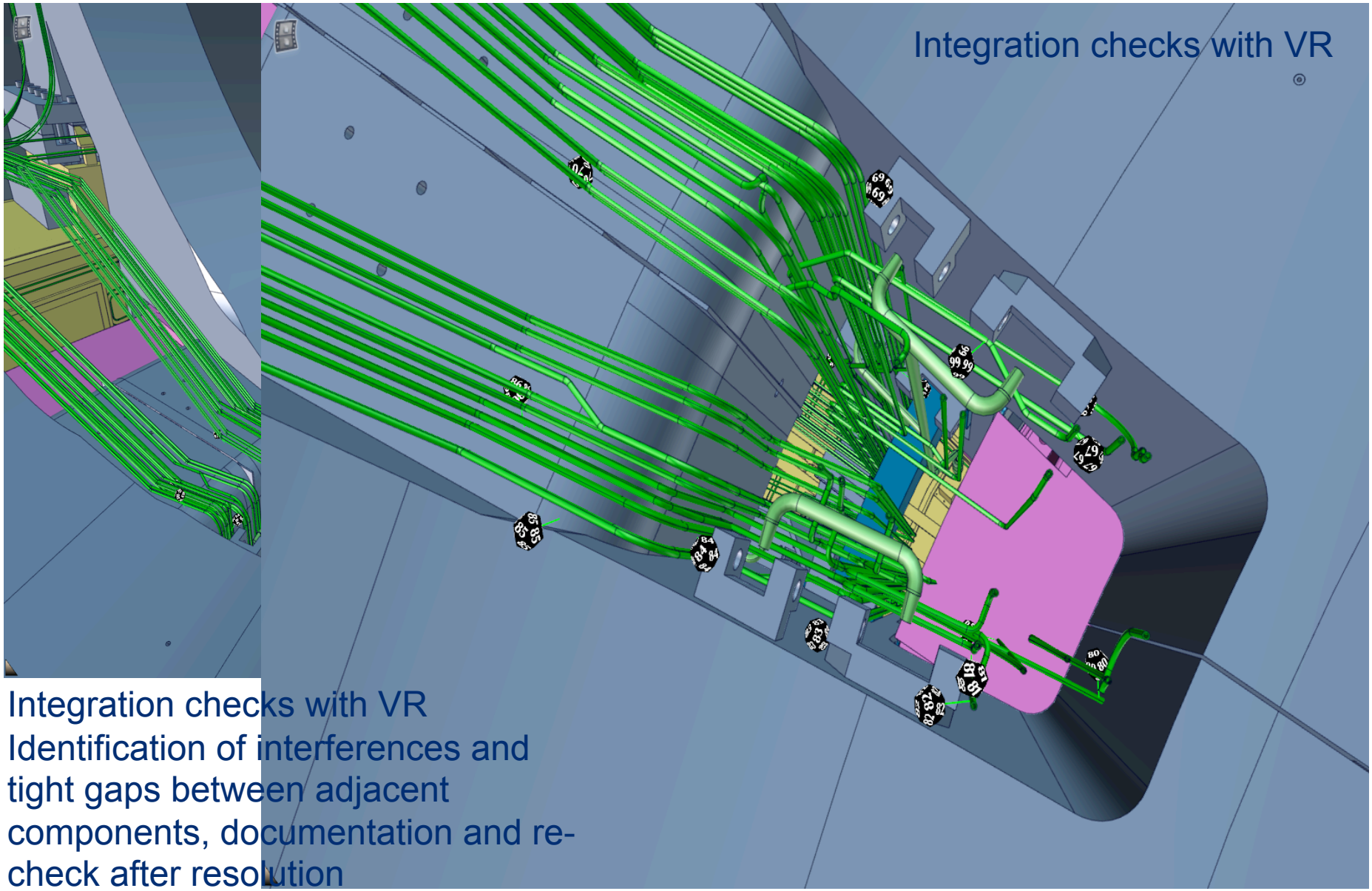


Spaces (e.g. concepts for tools) are integrated into the Tokamak design;
(critical and safety related components to be considered)

Virtual Reality platform



Virtual Reality platform



Integration checks with VR
Identification of interferences and tight gaps between adjacent components, documentation and re-check after resolution

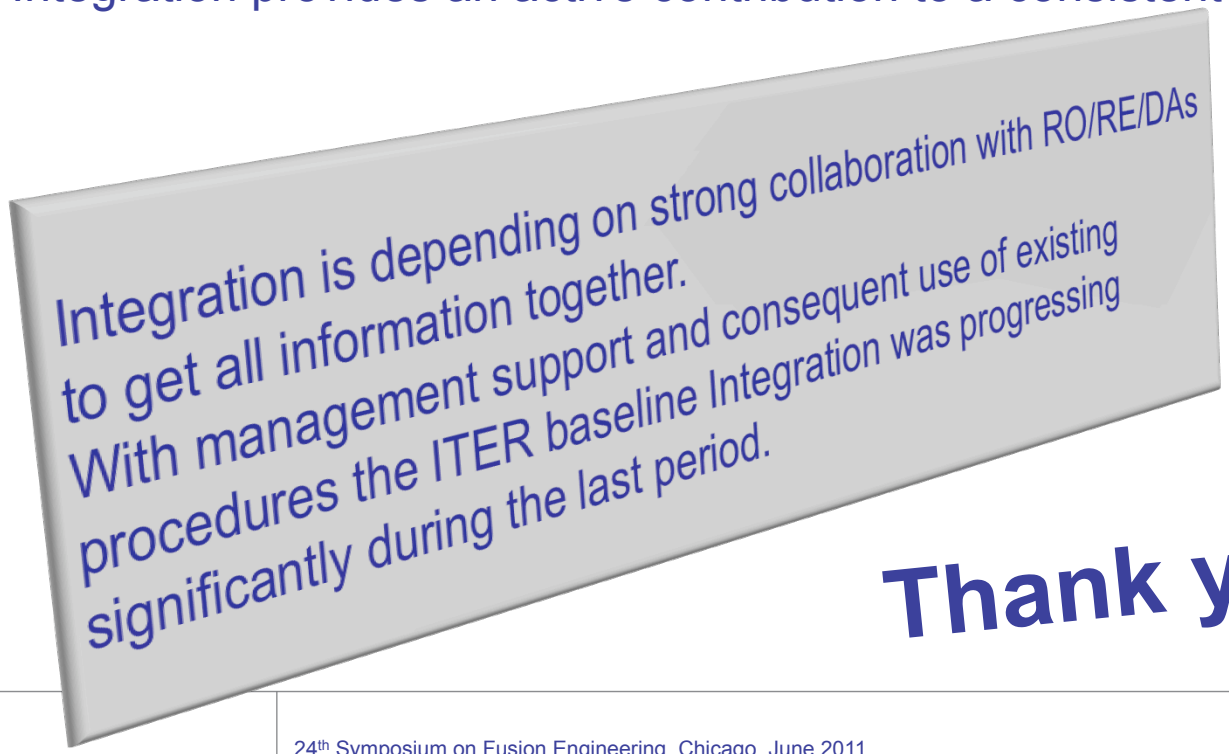
Summary

- Integration is a key horizontal function in ITER

- Tools and rules to perform Integration of systems were successfully established (CMM, VR, tolerance studies)

- There is a visible progress on main ITER components in terms of reference baseline definition & agreed interfaces

- Design Integration provides an active contribution to a consistent ITER baseline



Thank you