ITER ORGANIZATION

STATUS AND PERSPECTIVES

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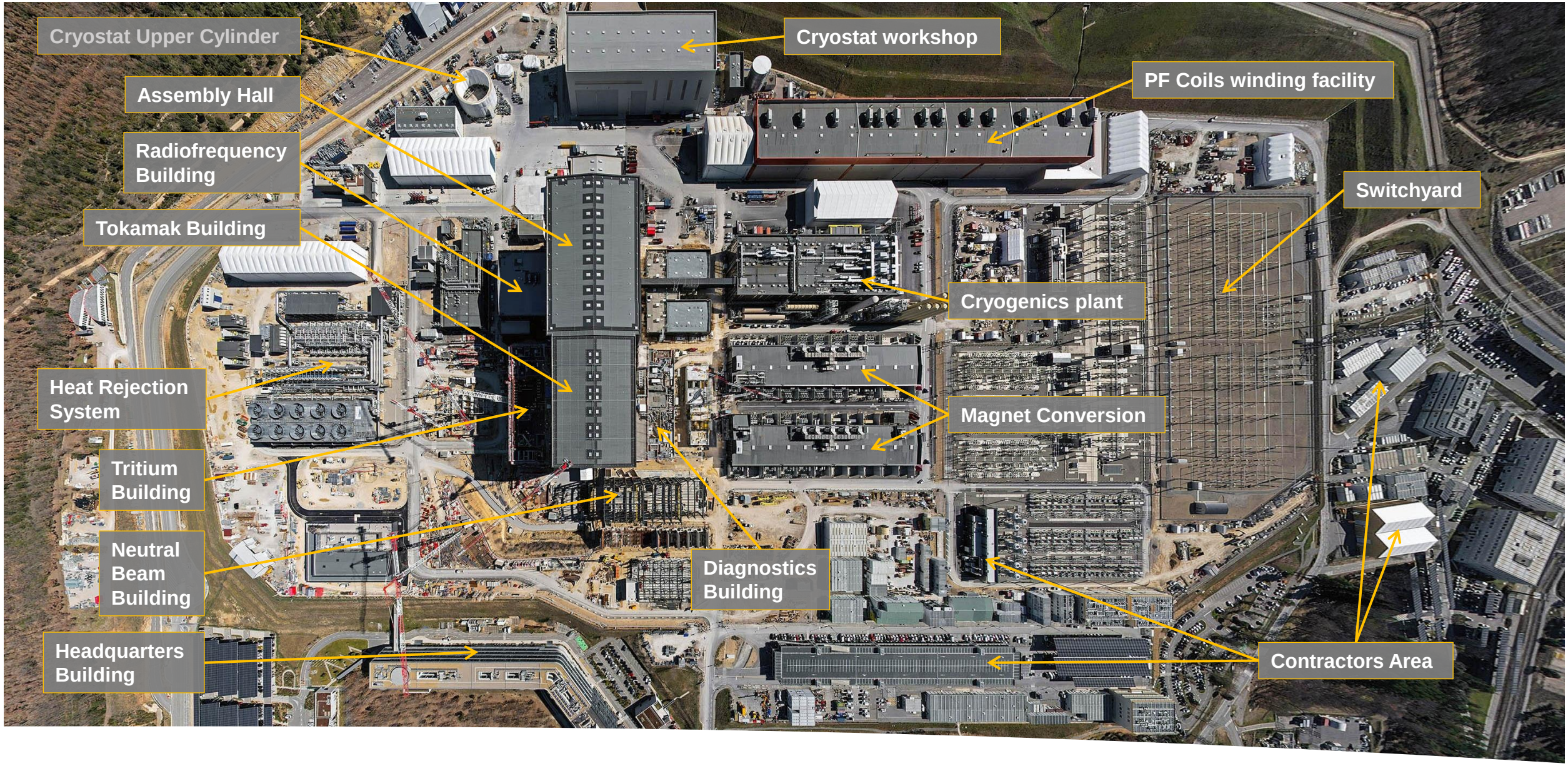
Forum Fusion Deutschland – Berlin – 5 June 2023

china eu india japan korea russia usa

AGENDA

1. ITER Organization Status
    - Plant Support Systems
    - Assembling the Machine
    - Current Challenges
2. ITER Perspectives
    - Business Opportunities
3. Conclusion



WORKSITE CONSTRUCTION

Aerial perspective, March 2023

PLANT SUPPORT SYSTEMS

ITER has two overall power supply systems: the steady-state electrical network, commissioned in January 2019; and the pulsed-power electrical system (sometimes called “reactive power compensation”), for which the equipment is largely installed.

PLANT SUPPORT SYSTEMS

Equipment installation is 100% complete in Magnet Power Conversion Building #33; and is nearly complete in Building #32.

PLANT SUPPORT SYSTEMS

Heat Rejection System: Equipment installation is complete, and the system is now in pre-commissioning phase.

PLANT SUPPORT SYSTEMS

The Cryogenics Plant equipment installation is complete, and has entered pre-commissioning phase.

Largest portion of cryogenic pipes are installed.

PLANT SUPPORT SYSTEMS

The Cryogenic bridge is installed, now connecting the Cryoplant Building with the Tokamak Complex.

PLANT SUPPORT SYSTEMS

The Neutral Beam Power Supply High Voltage Building is under construction.

December 2022

PLANT SUPPORT SYSTEMS

Control Building construction is largely complete and is now “ready for installation.”

January 2023

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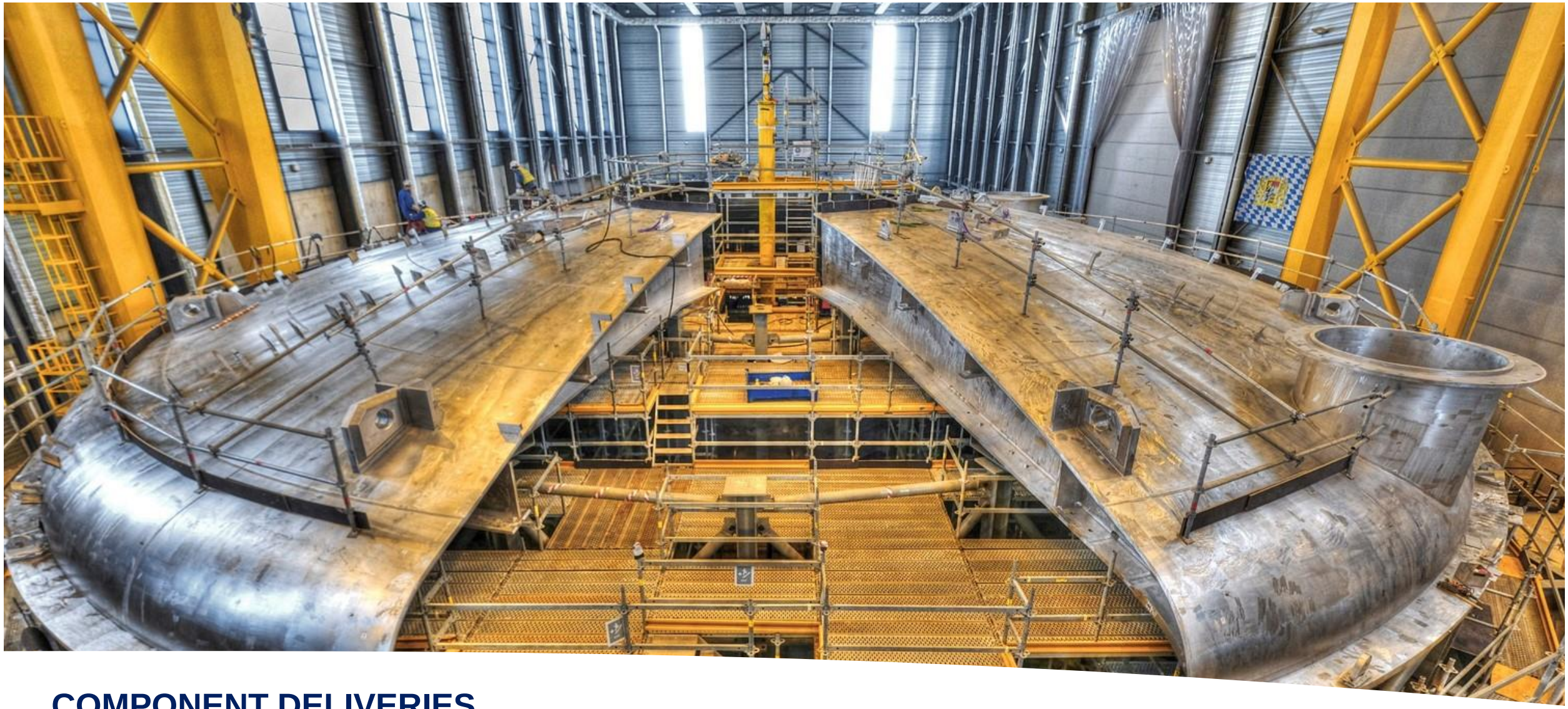
COMPONENT DELIVERIES

Main components delivered since 2020:

- 16 TF coils (out of 18+1 spare)
- 4 PF coils (plus 2 close to be manufactured)
- 3 vacuum vessel sectors (out of 9)
- 2 Central solenoid modules (out of 6+1 spare)



COMPONENT DELIVERIES

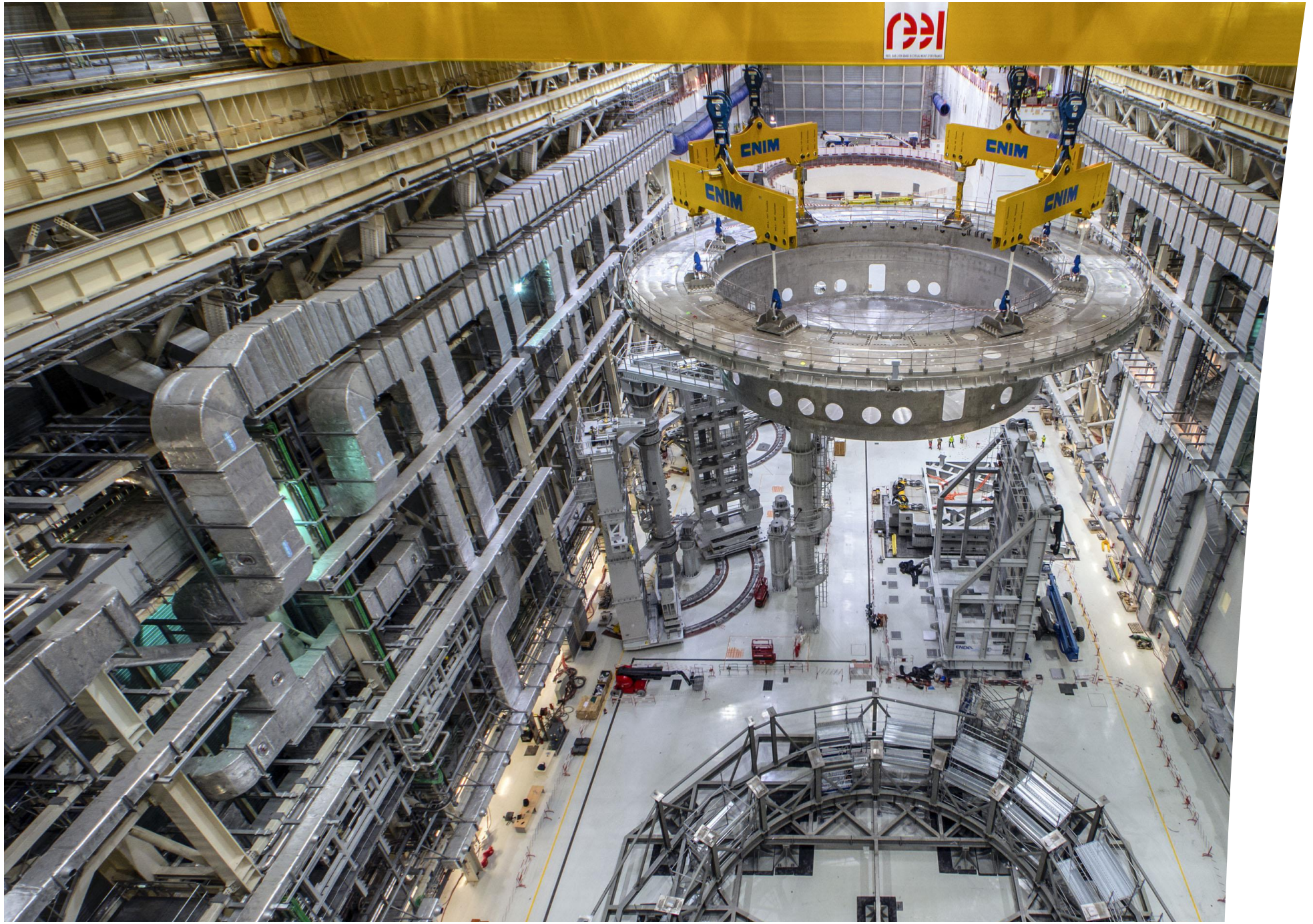
All main Cryostat components manufactured

- Cryostat Base and Lower Cylinder are installed in the tokamak pit
- Last item manufactured was Cryostat Top Lid

COMPONENT DELIVERIES

All main Cryostat components manufactured

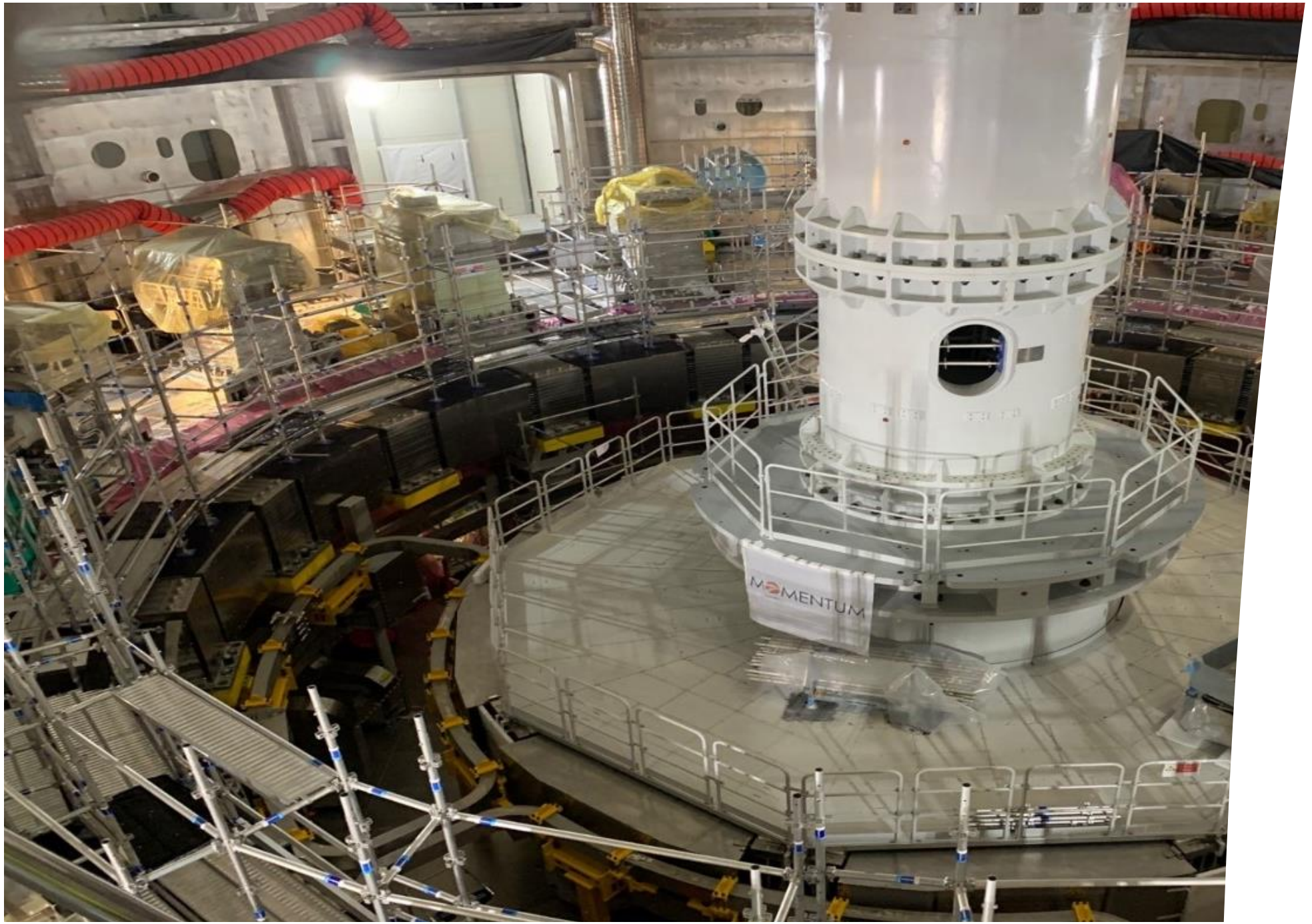
- Upper Cylinder and Top Lid in storage positions, April 2023



ASSEMBLING THE MACHINE

Cryostat Base installation (1350 t), traversing the Assembly Hall

May 2020

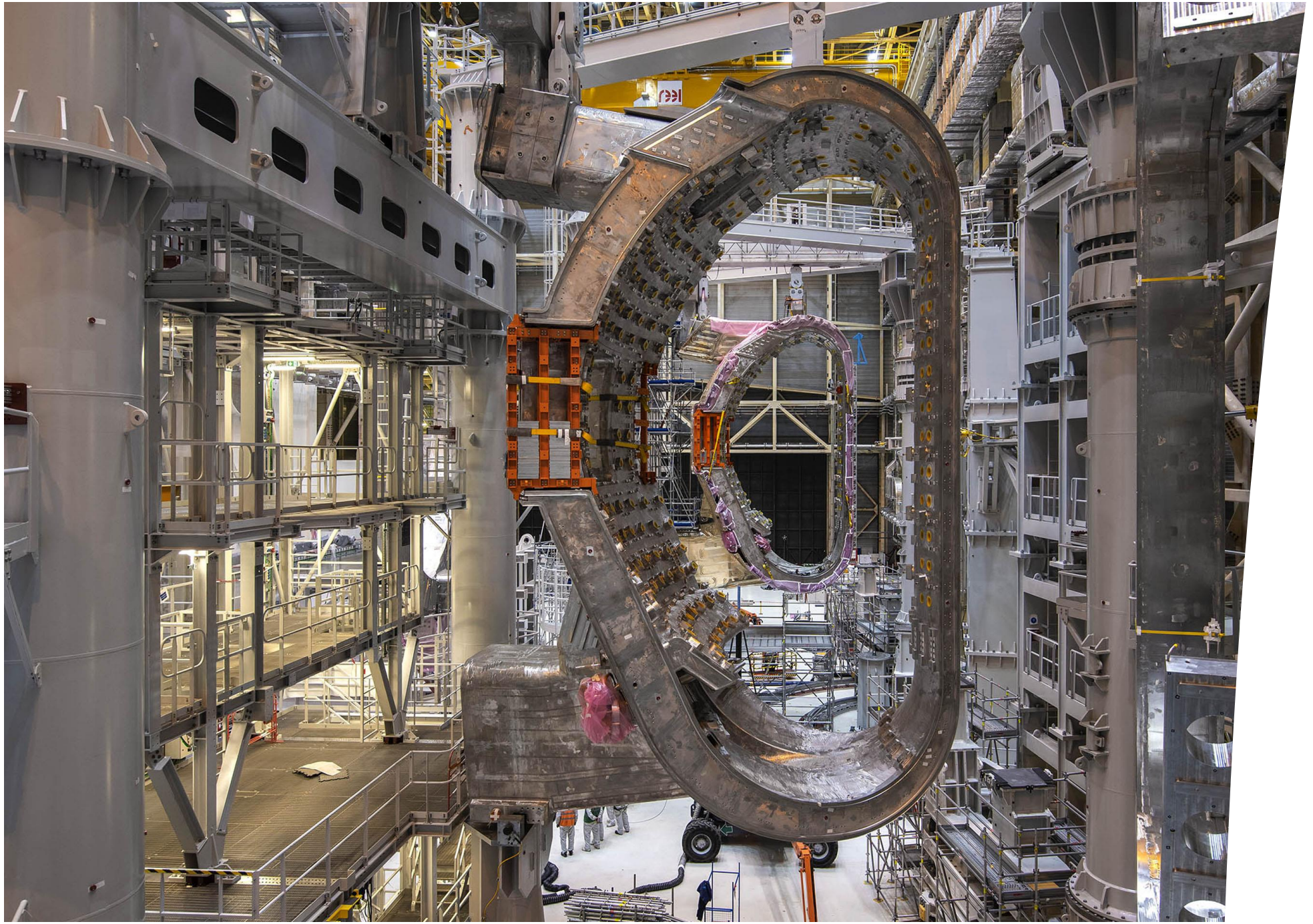


ASSEMBLING THE MACHINE

Tokamak Pit shown ready to receive the first Vacuum Sector Module

- Cryostat Base and lower Cylinder
- 2x Poloidal Field coils, 6x Correction Coils
- Lower Cryostat Thermal Shield
- Central Column as assembly tool
- Gravity supports & Instrumentation

November 2021



ASSEMBLING THE MACHINE

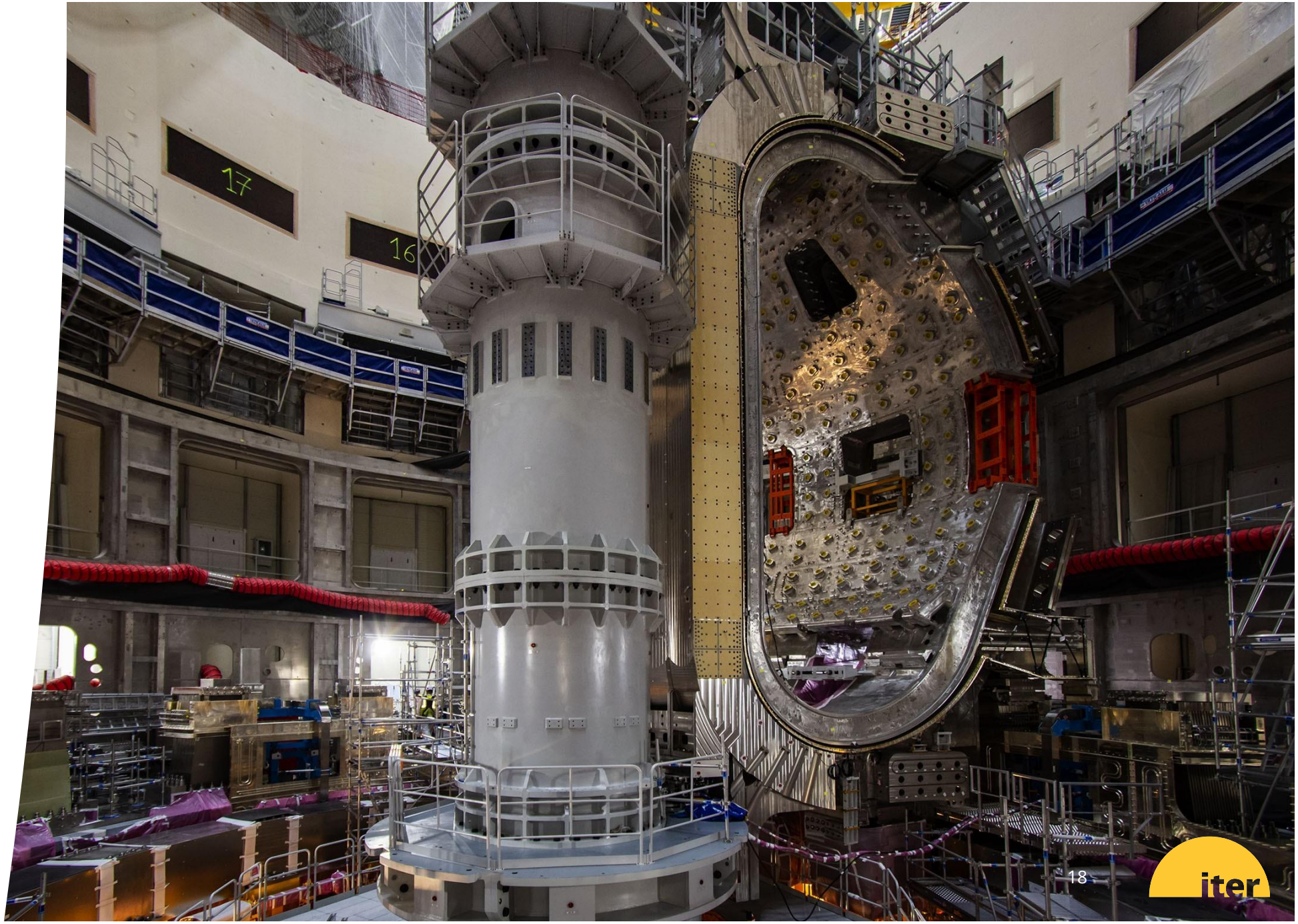
Preparation of two Vacuum Sector Modules in Assembly hall in parallel (Sectors 6 & 7)

2021/2022

ASSEMBLING THE MACHINE

First complete Vacuum Vessel Sector Module installation

May 2022



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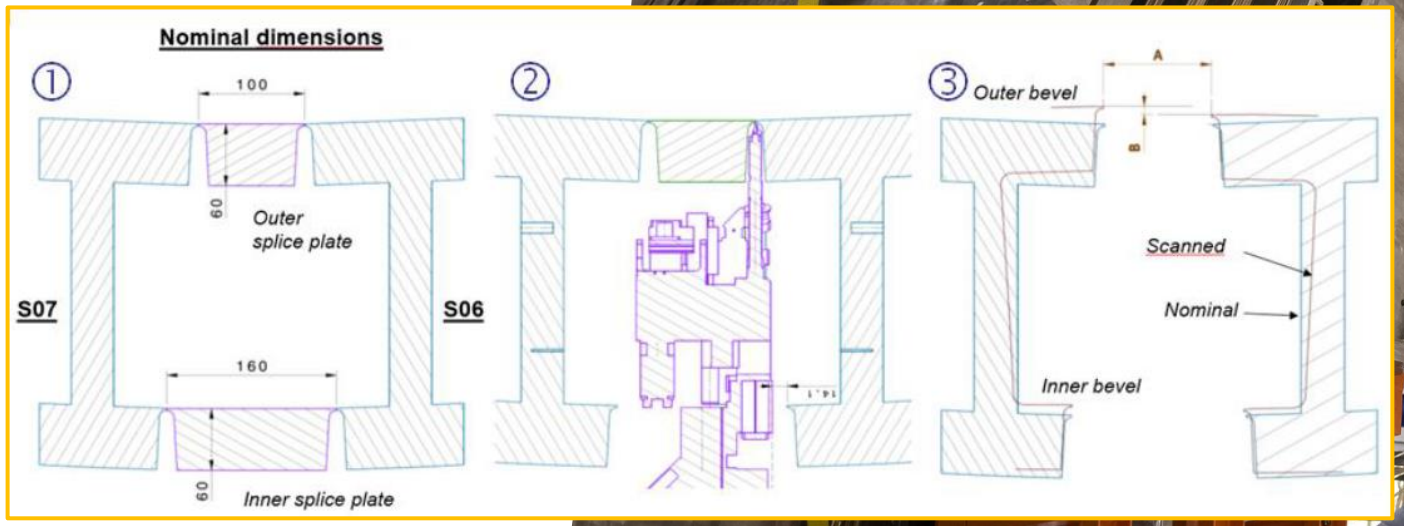
CHALLENGES OF FIRST-OF-A-KIND COMPONENTS

Geometric non-conformities found in Vacuum Vessel sector field joints.

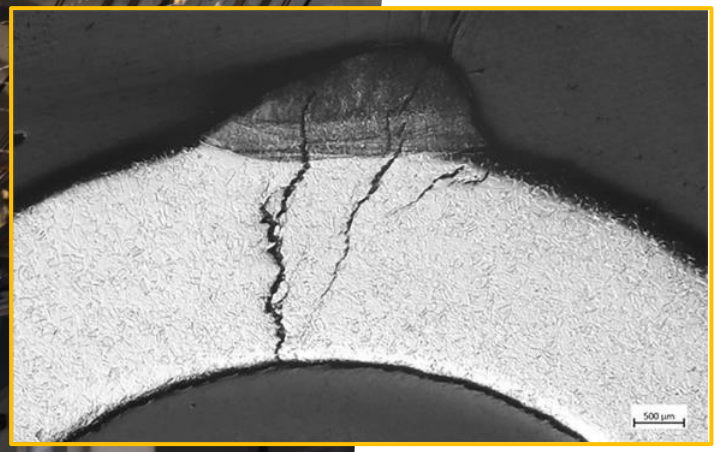
Repair strategy defined. Accelerated procedure underway to select specialize subcontractors for the repairs.



CHALLENGES OF FIRST-OF-A-KIND COMPONENTS

Leakage identified in thermal shield cooling piping due to chloride stress corrosion.

Repair strategy defined. Accelerated procedure underway to select multiple, specialize subcontractors for the repairs.



FROM BERYLLIUM TO TUNGSTEN

The ITER Organization is currently advocating to change the First Wall material from Beryllium to Tungsten. The final choice is pending the ITER Council’s decision.

ADDRESSING CHALLENGES

The current ITER cost and schedule “baseline” was set in 2016. Given recent challenges, a review of the baseline is underway, and a new baseline proposal will be presented to the ITER Council in 2024.

Key challenges and considerations include:

- Known delays created by the Covid-19 pandemic and First-of-a-Kind technical challenges.
- Repairs to the Vacuum Vessel sectors and Thermal Shield cooling pipes, as described earlier.
- Ensuring mutual alignment with ASN, the French nuclear safety regulator, on any concerns.
- Ensuring a strong quality culture, project-wide.
- Opportunities to offset future risks by further testing of completed components.
- Adjustments to the scope of First Plasma (the first experimental campaign) or machine design elements that could add efficiency while preserving performance goals.

A new baseline proposal will be presented to the ITER Council in 2024.

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ITER BUSINESS OPPORTUNITIES: HOT CELL FACILITY

- To maintain activated and/or contaminated equipment,
  - In Vessel Components
  - Port Cell Equipment
  - Tokamak Remote Handling equipment
- To treat and interim store radioactive waste,
- To import and export components and waste,
- Human access to the Hot Cell and the Tokamak machine.

New conceptual design under study, as the old design was obsoleted.

ITER BUSINESS OPPORTUNITIES: TOKAMAK COMPLEX DETRITIATION SYSTEM

Design and Fabrication contract

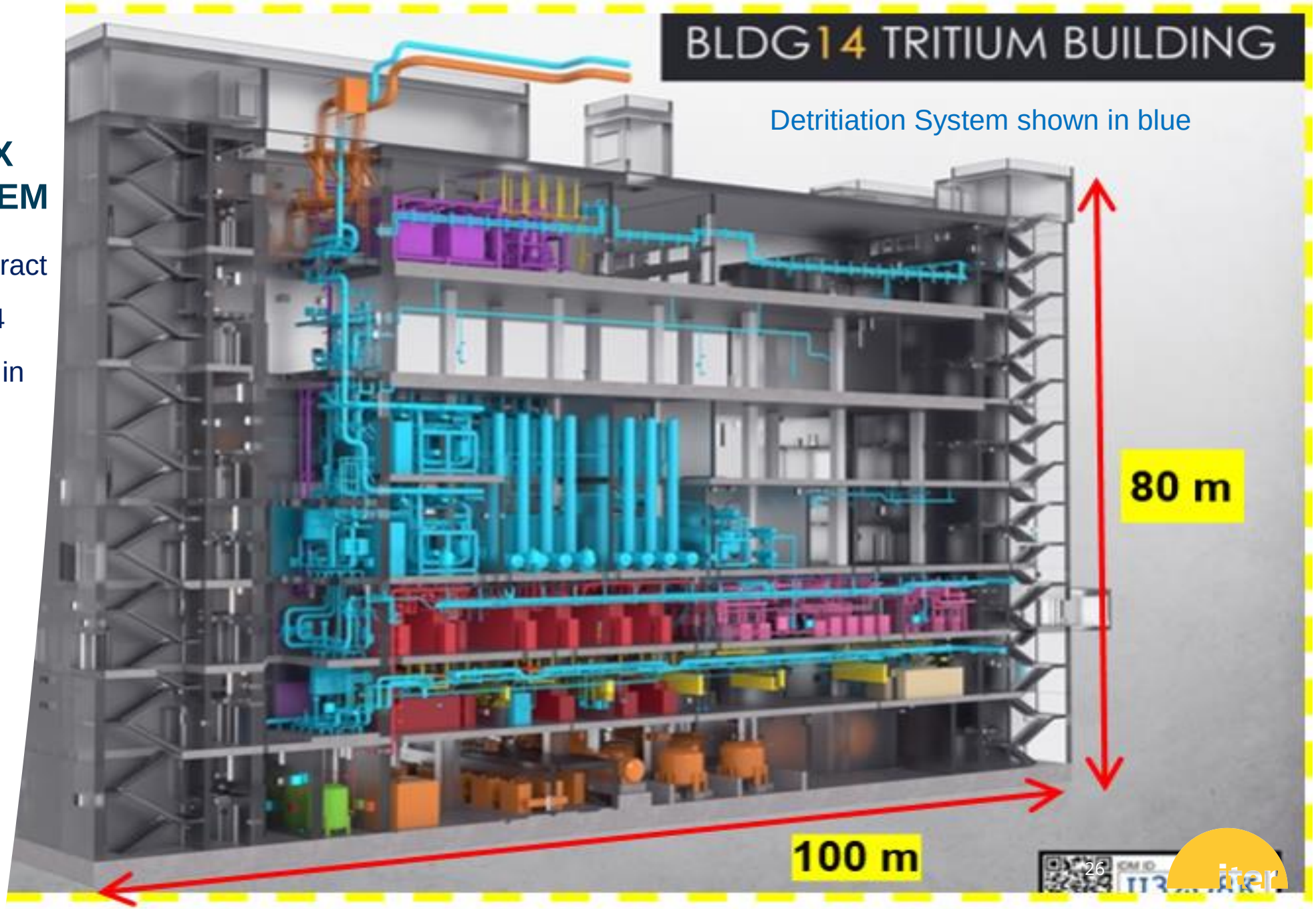
- To be signed during 2024
- Tens of millions of Euros in business volume

Process System in B14

- 16 catalytic reactors,
  8 scrubber columns,
  8 blowers organized into
  8 separate modules

Piping Network

- Connects to 150+ clients
- ~11km stainless steel piping



CIVIL AND MECHANICAL ENGINEERING

- Maintenance & Preservation of buildings and components
- Diagnostic prototypes & devices
- TCWS Supplies
- Engineering Services
- Logistic Services
- First Plasma Components

CORPORATE SERVICES

- IT Support services
- IT Security Consulting services
- SAP Application Maintenance services
- MIS Global Support services
- Site Emergency services
- Maintenance plotters, photocopiers, printers and scanners

DIAGNOSTICS

- Purpose built tools maintenance
- Disruption Mitigation System (DMS) Manufacturing and Supply
- Shielding blocks
- In-Vessel camera

ITER ORGANIZATION (IO) PROCUREMENT: TOOLS

- IPROC
  - Sourcing (request for offers)
  - Supplier database (suppliers need to register)
- IO web page on procurement

IO is looking for industrial partners, combining Tokamak scientific knowledge and industrial know-how

Communication and document exchange through digitalization and web publishing

ITER ORGANIZATION (IO) PROCUREMENT: SUPPLIER REGISTRATION

- Supplier registration is mandatory in order to participate to IO tenders and to be awarded with contracts and purchase orders;
- Today, >800 suppliers are registered in IPROC;
- Instructions for supplier registration in IPROC are available on the ITER Industrial Portal: https://iter.org/proc/overview

REGISTERED GERMAN SUPPLIERS

ACENTRIX GMBH; ALLECTRA GMBH; BABILON GMBH WERKZEUGBAU; CADFEM GMBH; C-CON GMBH; CRYOTHERM GMBH & COKG; EXOMATTER GMBH;FAP GMBH; FORSCHUNGSZENTRUM GMBH; FRAMATOME GMBH; G+H ISOLIERUNG GMBH; HECHT - CRYO & GAS EXPERT GMBH; HEGELMANN EXPRESS GMBH; HEICO BEFESTIGUNGSTECHNIK GMBH; INTERSTUHL GMBH & CO. KG; ITH GMBH & CO. KG; JUNGMANN SYSTEMTECHNIK GMBH & CO. KG; KAMPF TELESCOPE OPTICS GMBH; KRAFTANLAGEN HEIDELBERG GMBH; LISEGA SE ; MAX PLANCK INSTITUTE; NUKEM TECHNOLOGIES GMBH; OWNCLOUD GMBH; ROLF KIND GMBH; SPACE STRUCTURES GMBH; SYSTEMWORKX AG; THALES DIS BPS; DEUTSCHLAND GMBH; THIELE TECHNOLOGIE & MANAGEMENT; TS VERBINDUNGSTEILE GMBH; WILHELM SCHULZ GMBH; ZAE BAYERN.

CONCLUSION

- ITER has addressed major technical issues (e.g., non-conformance report on delivered components) and made huge efforts to implement corrective actions on repair work. A new baseline will be established.
- In participating to the ITER Project with the IO and/or the Domestic Agencies, the Industry develops competencies that will be key for the next steps of the fusion programme.
- The ITER Project and Industry together have to find economically efficient solutions to a great technical challenge requiring high skills and experience with the latest technologies, nuclear fabrication, and construction.
- There are still significant business opportunities!

Thank you very much!

Any Questions?