The ITER Project

Progress amid challenges

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Fusion Power Associates 43rd Annual Meeting and Symposium
07 December 2022

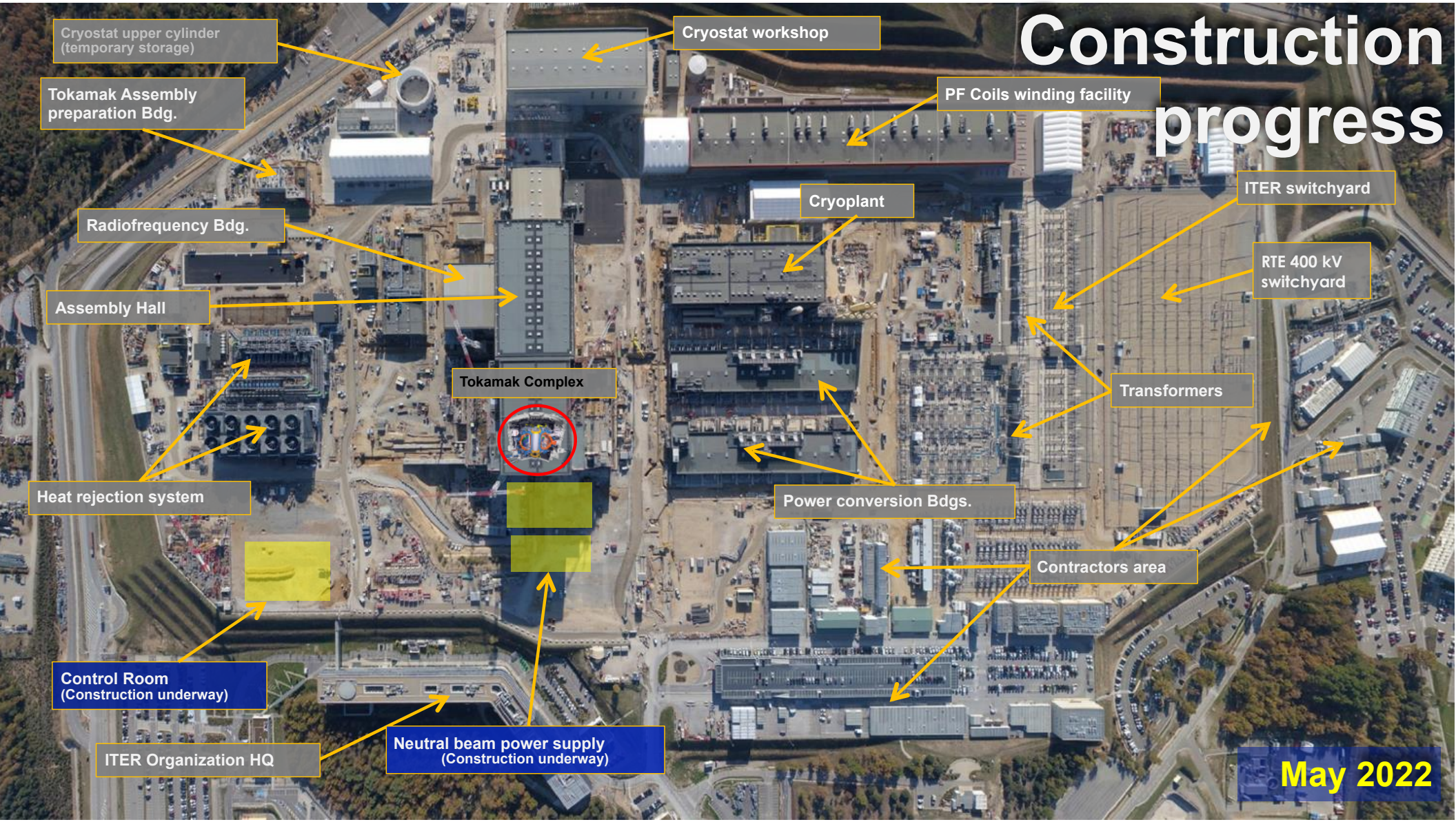
Agenda

1. Project progress
2. Appointment of new DG
3. Addressing challenges
4. Q&A

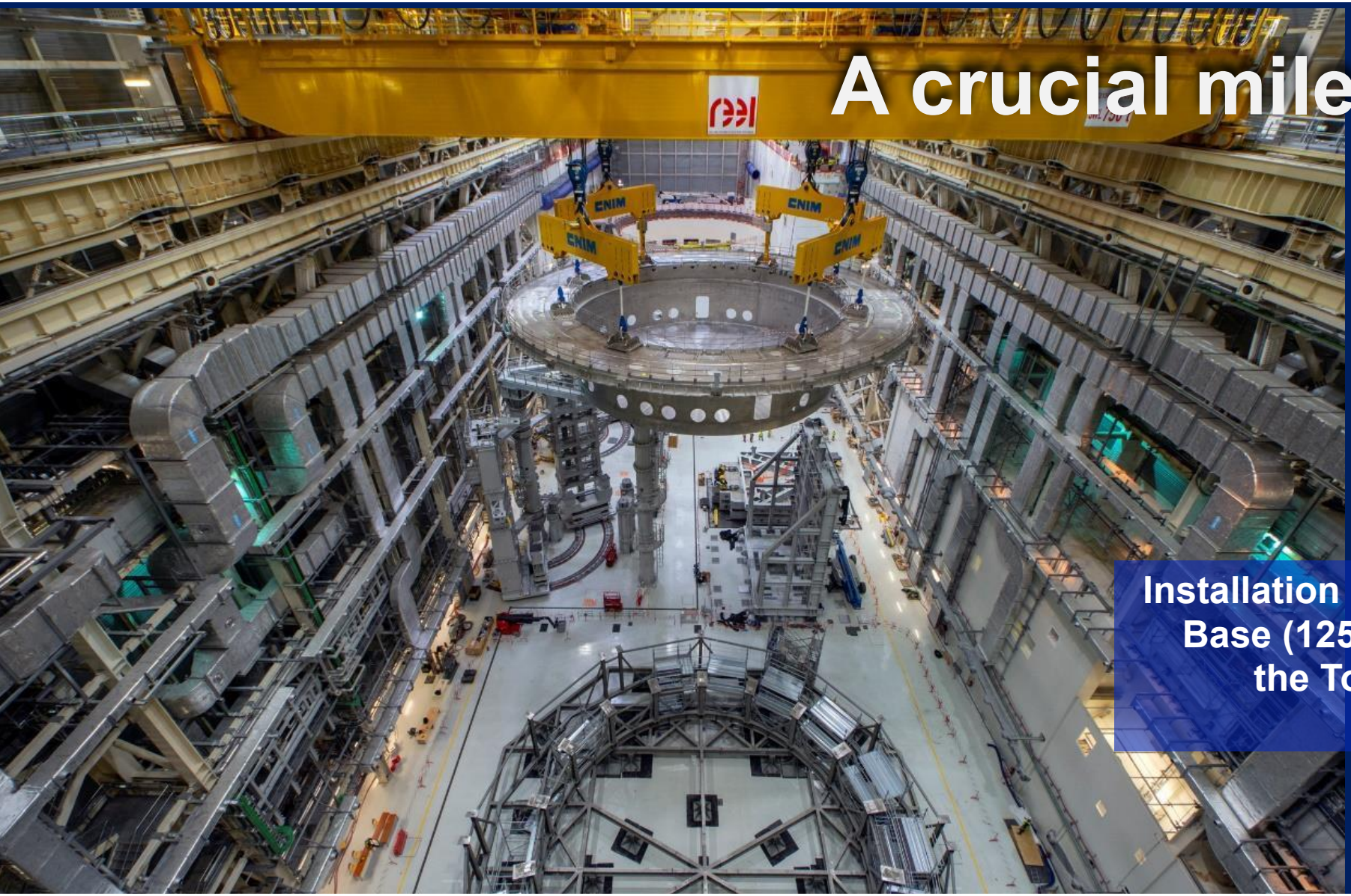
Eight years of steady progress

2014–2022

>80% of civil works complete


Construction progress
Cryostat upper cylinder (temporary storage)
Cryostat workshop
Tokamak Assembly preparation Bdg.
PF Coils winding facility
Cryoplant
ITER switchyard
Radiofrequency Bdg.
RTE 400 kV switchyard
Assembly Hall
Tokamak Complex
Transformers
Heat rejection system
Power conversion Bdgs.
Contractors area
Control Room
(Construction underway)
ITER Organization HQ
Neutral beam power supply
(Construction underway)
May 2022

A crucial milestone

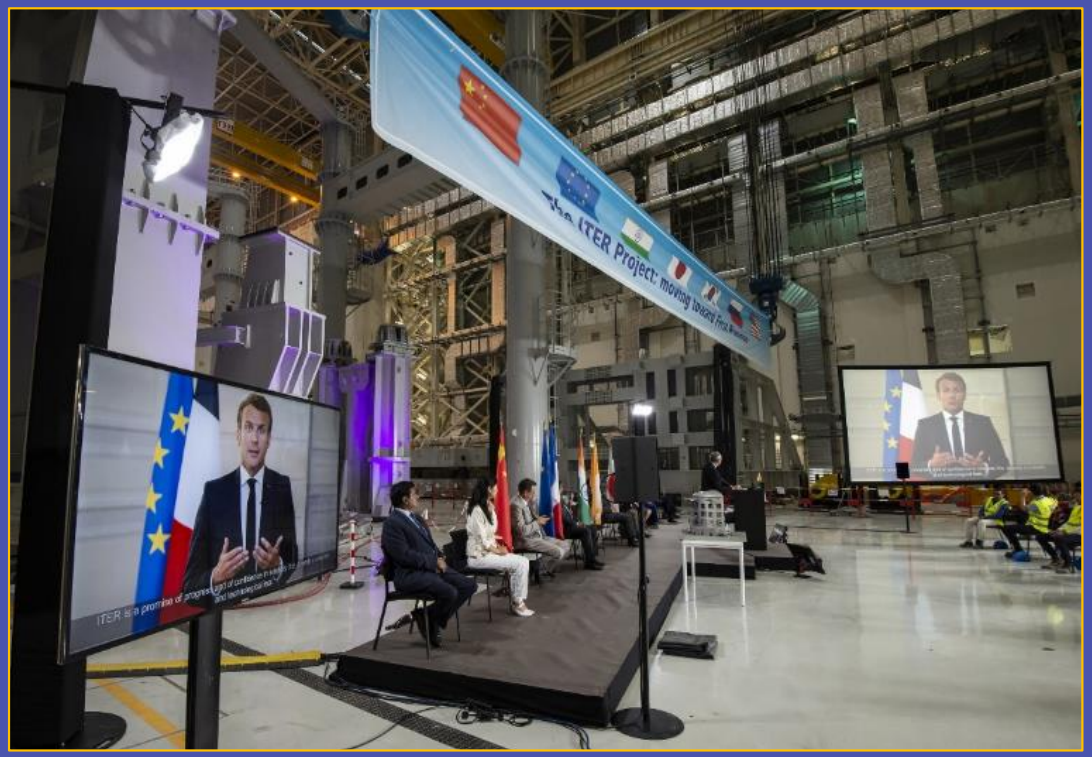


Installation of Cryostat Base (1250-tonne) in the Tokamak Pit. (May 2020)

A crucial milestone

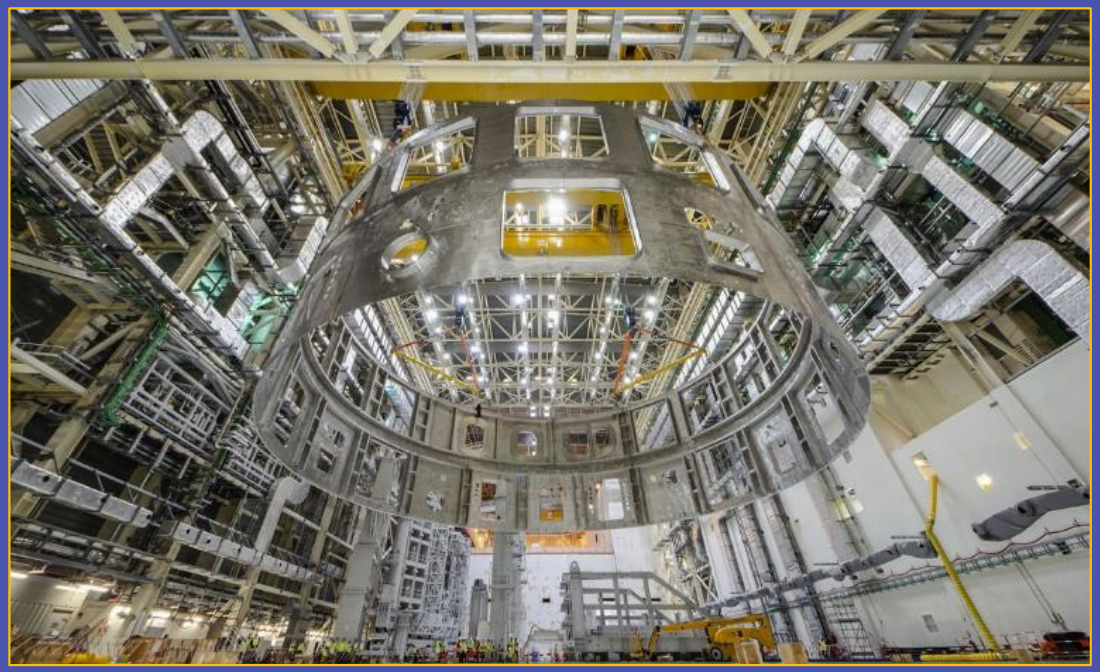
Top-down view of Cryostat Base (30m diameter) installed in Tokamak Pit. Final tolerance under 3 mm at all metrology points

Celebrating Start of Machine Assembly

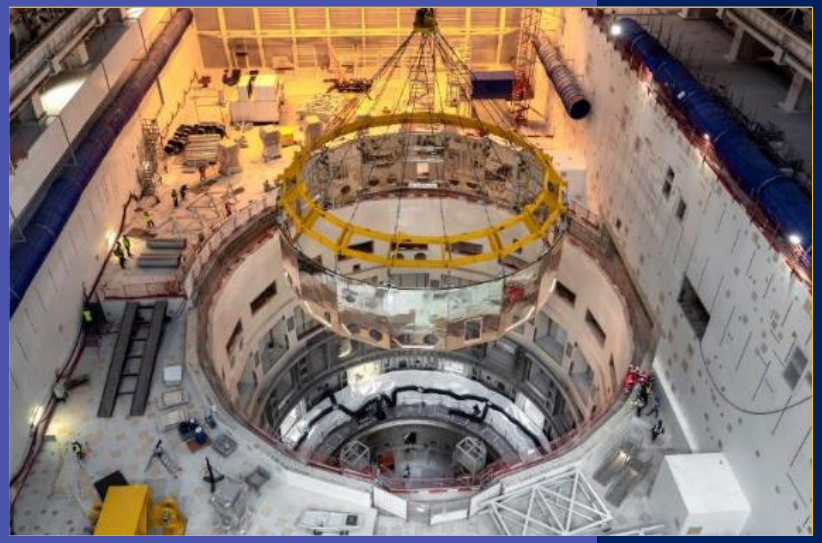


July 2020: ITER celebrated the Start of Machine Assembly with a virtual ceremony, hosted by French President Emmanuel Macron, with contributions from 7 ITER Heads of State and multiple ministers

Two years of recent progress: Tokamak Complex

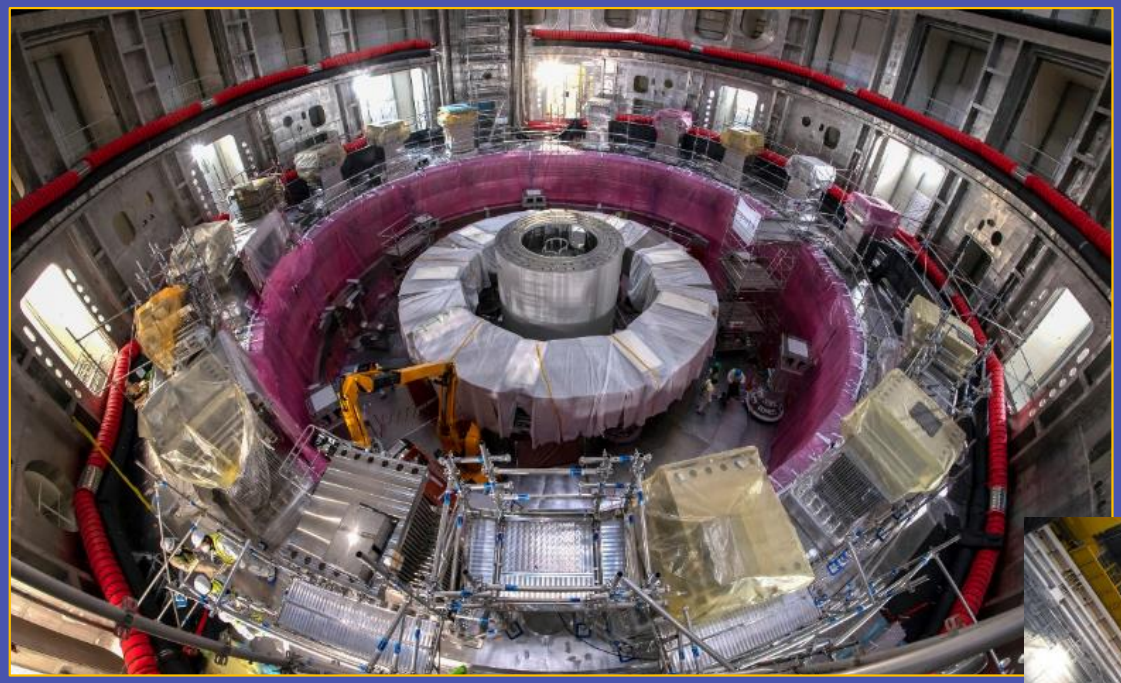


Cryostat Lower Cylinder lift
August 2020



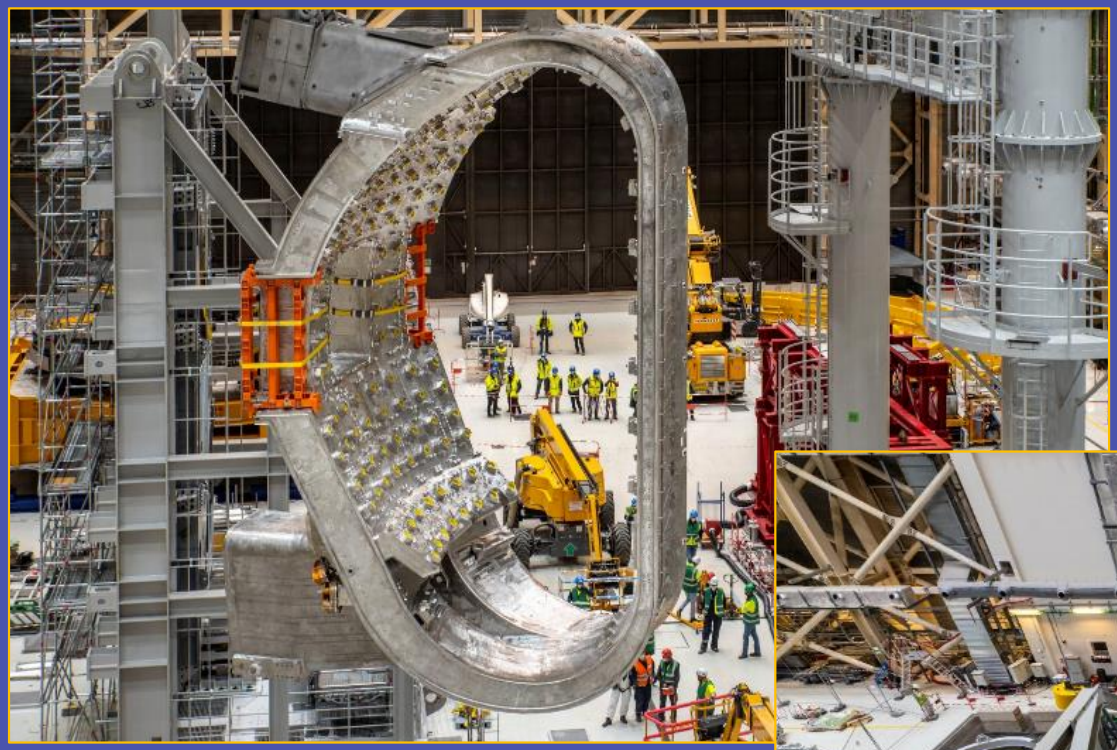
Inserting the Cryostat Thermal Shield
January 2021

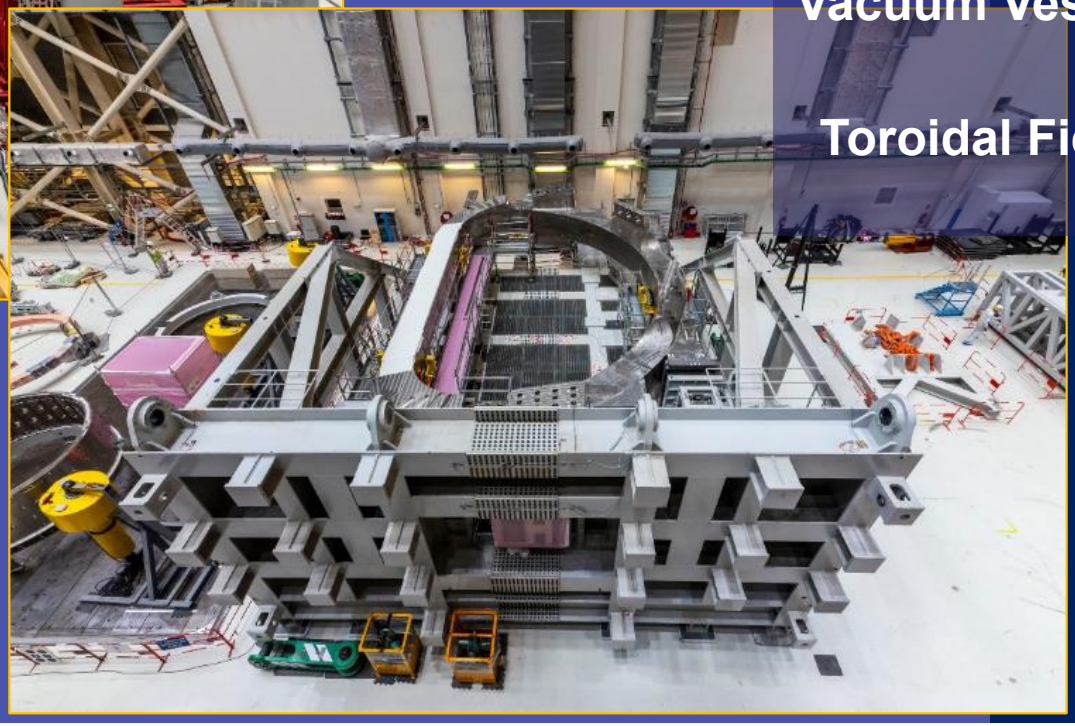
First Magnets Installed



Poloidal Field Coil #6
April 2021

Poloidal Field Coil #5
August 2021





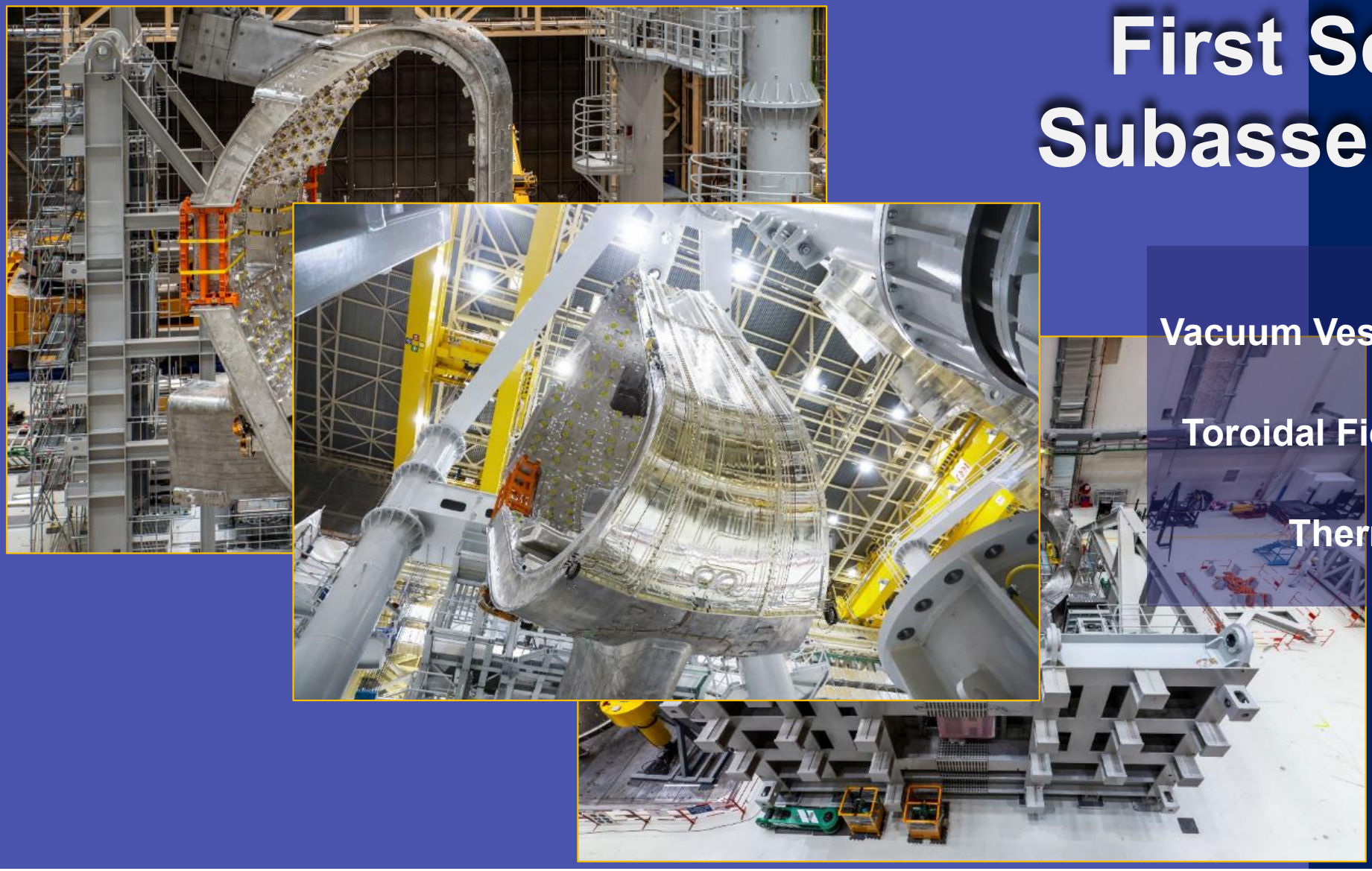
First Sector Subassembly

June 2021

Vacuum Vessel sector 6 (Korea);

Toroidal Field Coil 12 (Japan).

First Sector Subassembly



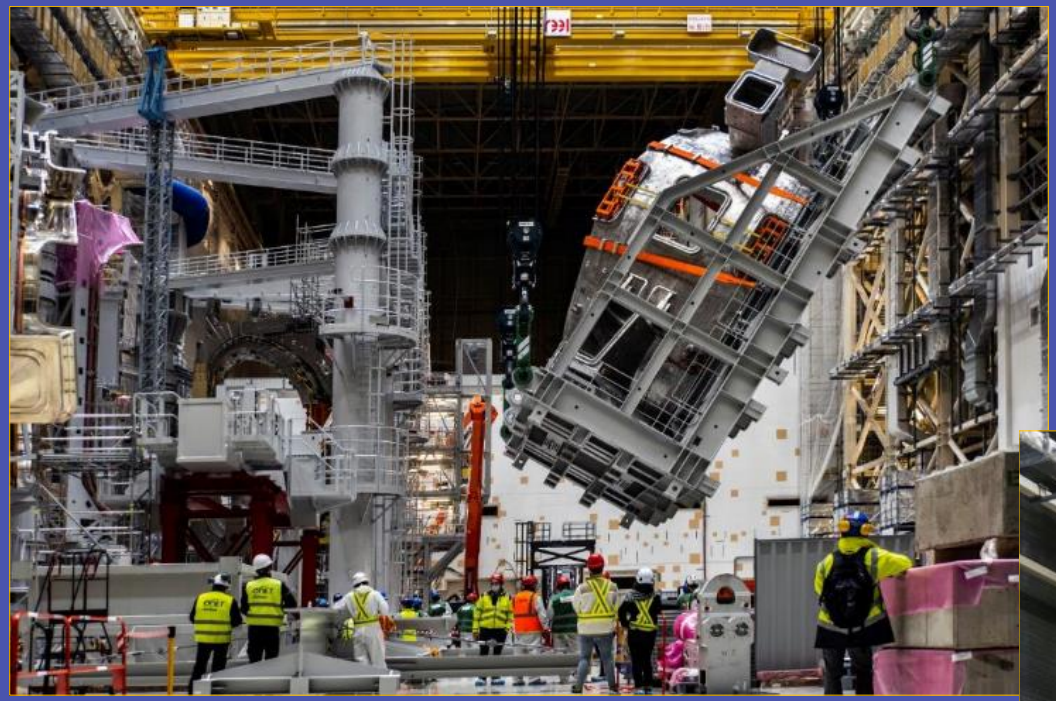
June 2021

Vacuum Vessel Sector 6 (Korea);

Toroidal Field Coil 12 (Japan);

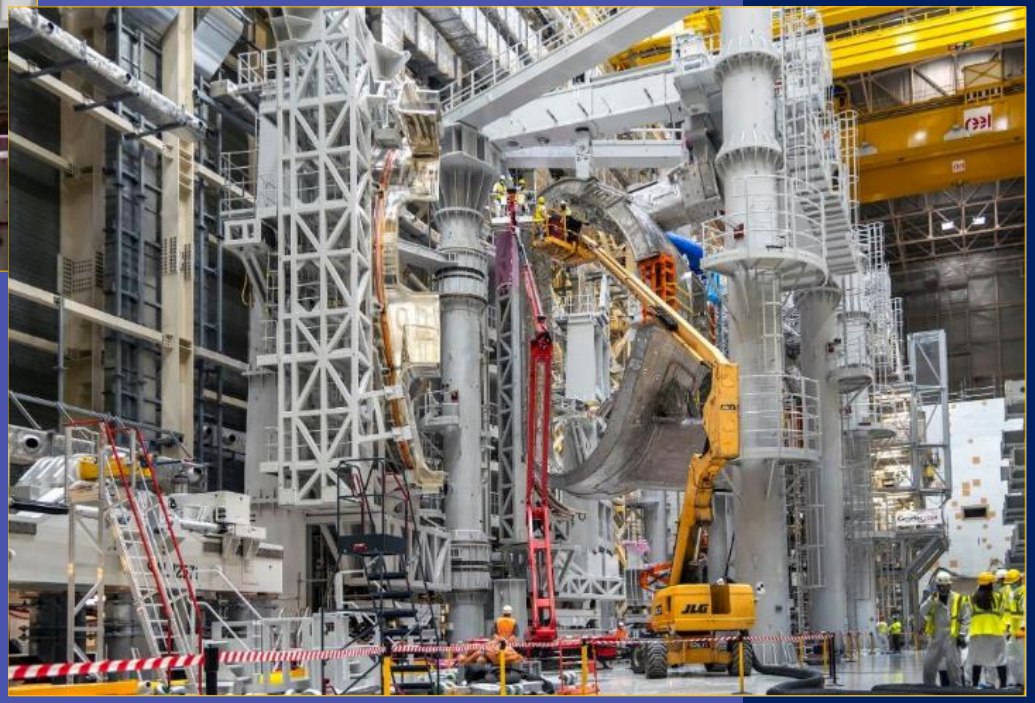
Thermal Shield (Korea).

The second …



December 2021

January 2022

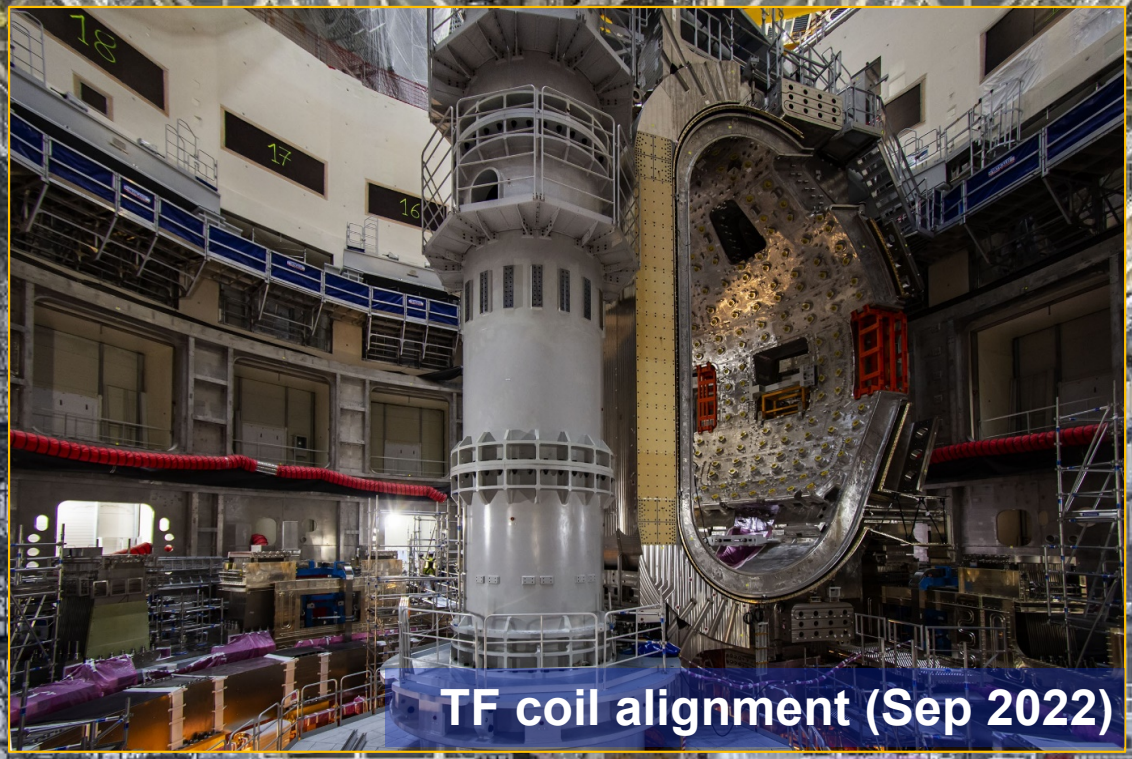



And the
cond ...
And the
third ...
September
2022

Project Progress

Installation of Vacuum Vessel Sector Module 6 (May 2022)

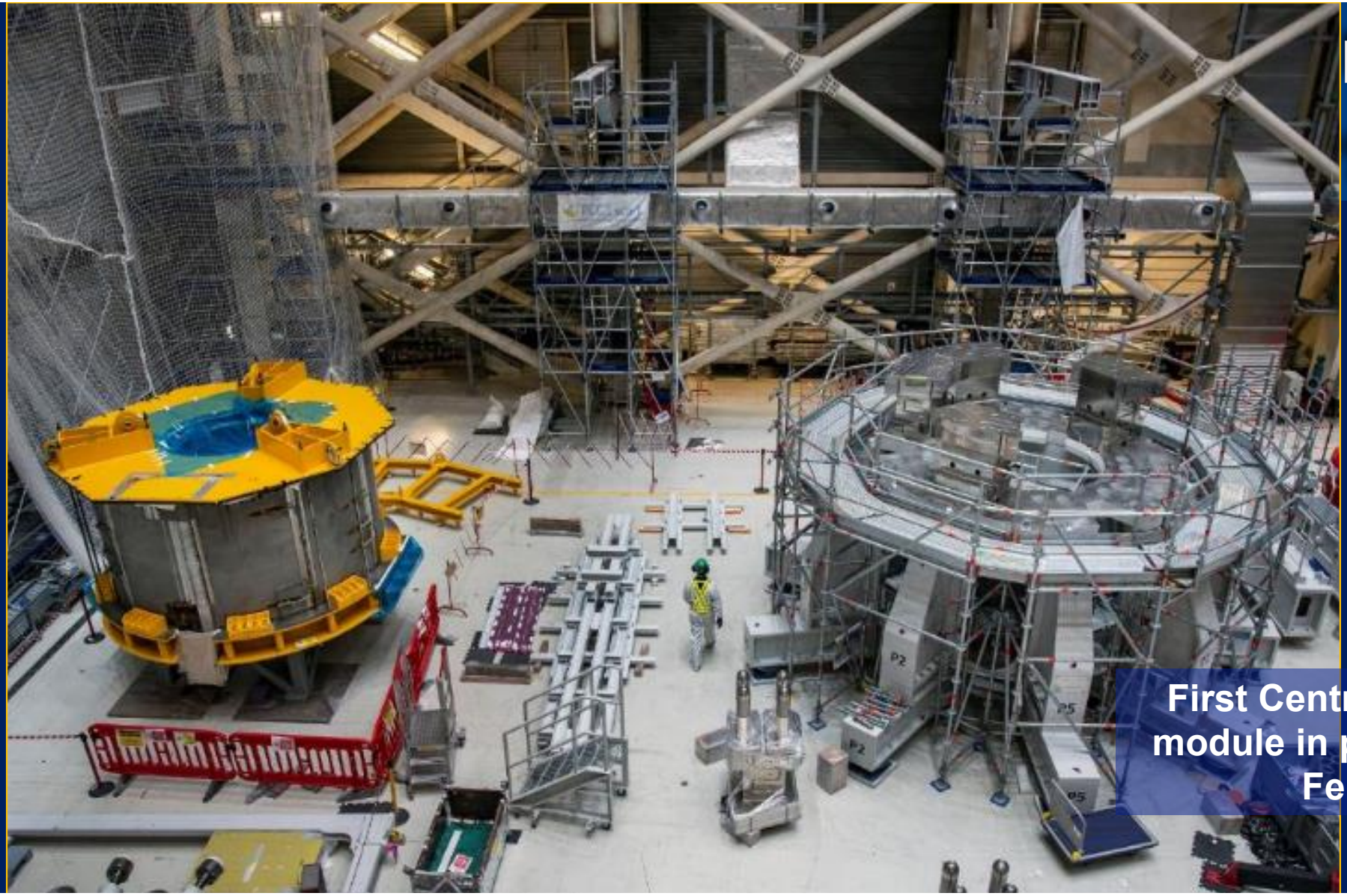
Project Progress



TF coil alignment (Sep 2022)

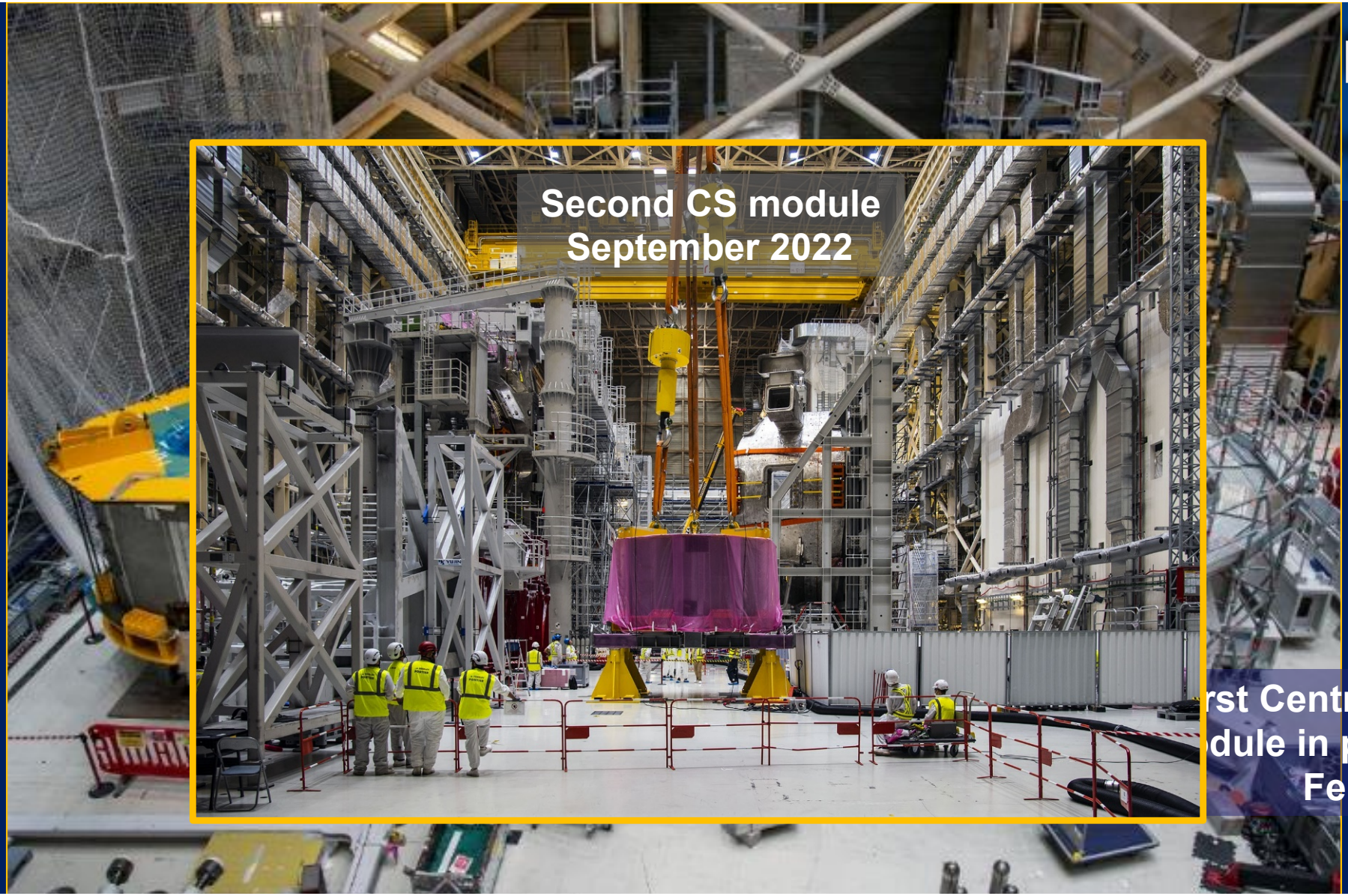
Installation of Vacuum Vessel Sector Module 6 (May 2022)

roject gress



First Central Solenoid module in preparation, February 2022

roject gress



rst Central Solenoid
dule in preparation,
February 2022

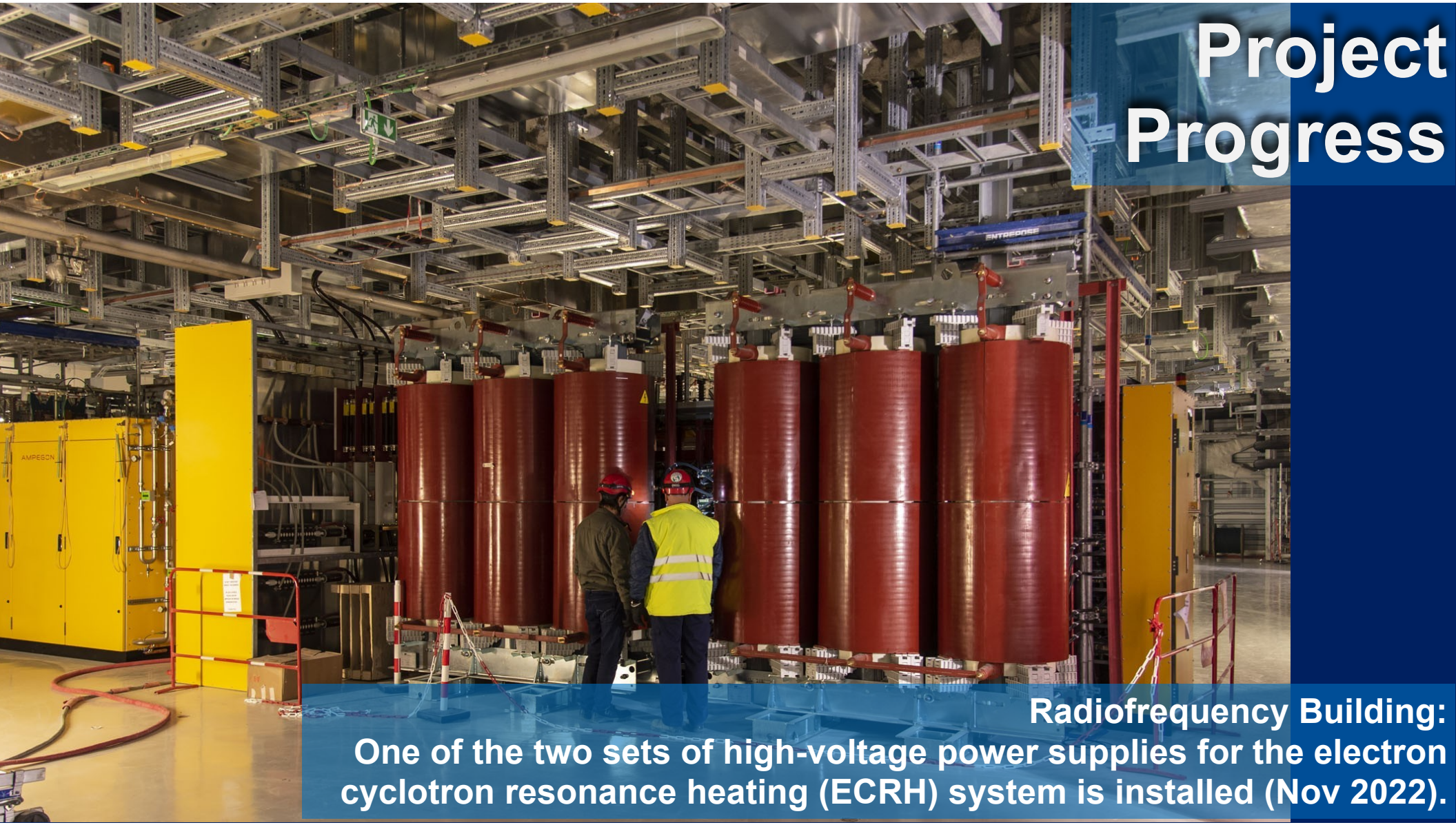
Project Progress

Control Building (B71):

Project Progress

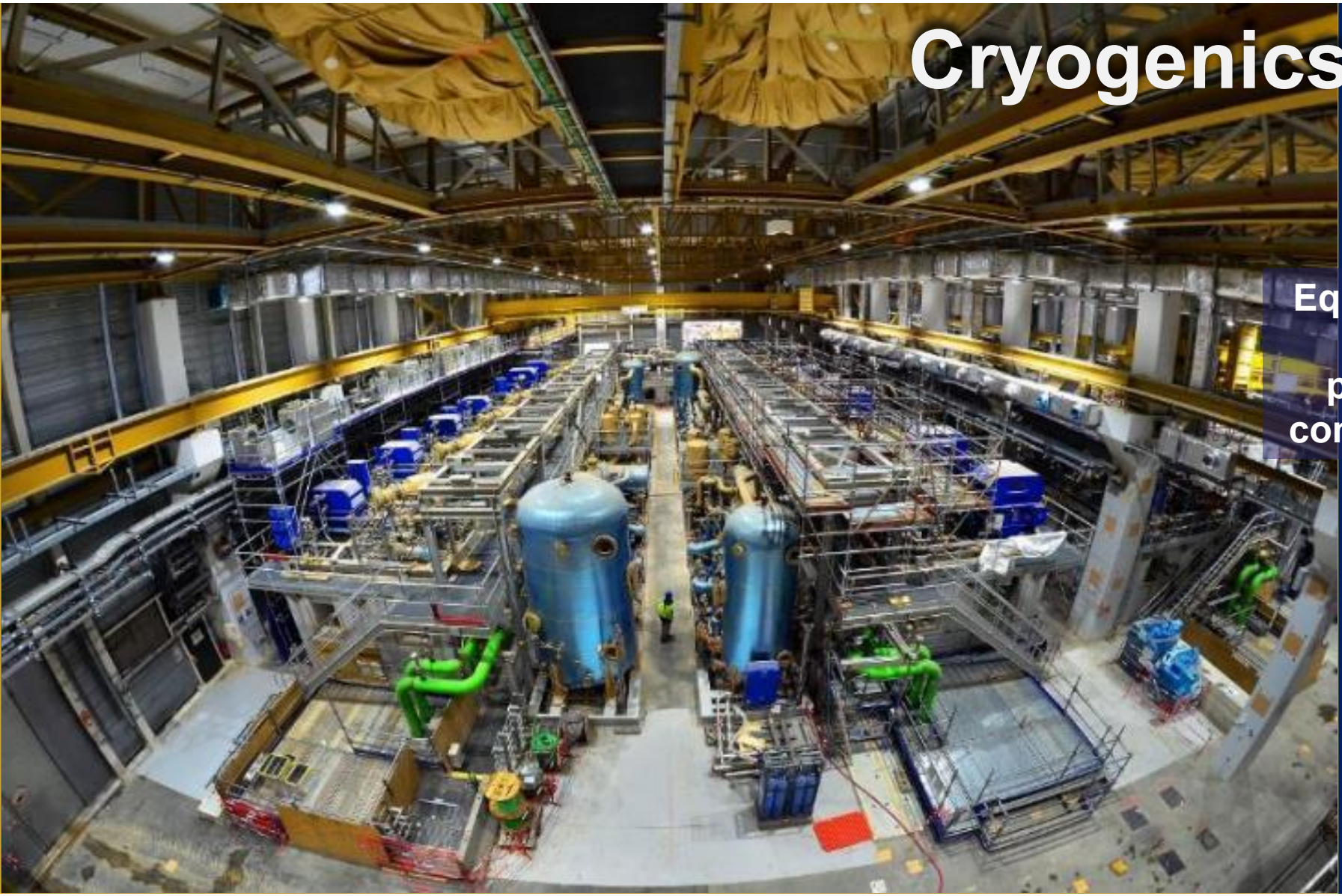
Four of 13 steel frames in place for the Neutral Beam High Voltage Building

Project Progress



Radiofrequency Building:
One of the two sets of high-voltage power supplies for the electron cyclotron resonance heating (ECRH) system is installed (Nov 2022).

Cryogenics Plant



Equipment fully installed; proceeding to commissioning.

Cryogenics Plant

Start of liquid helium plant commissioning, 30 November 2021

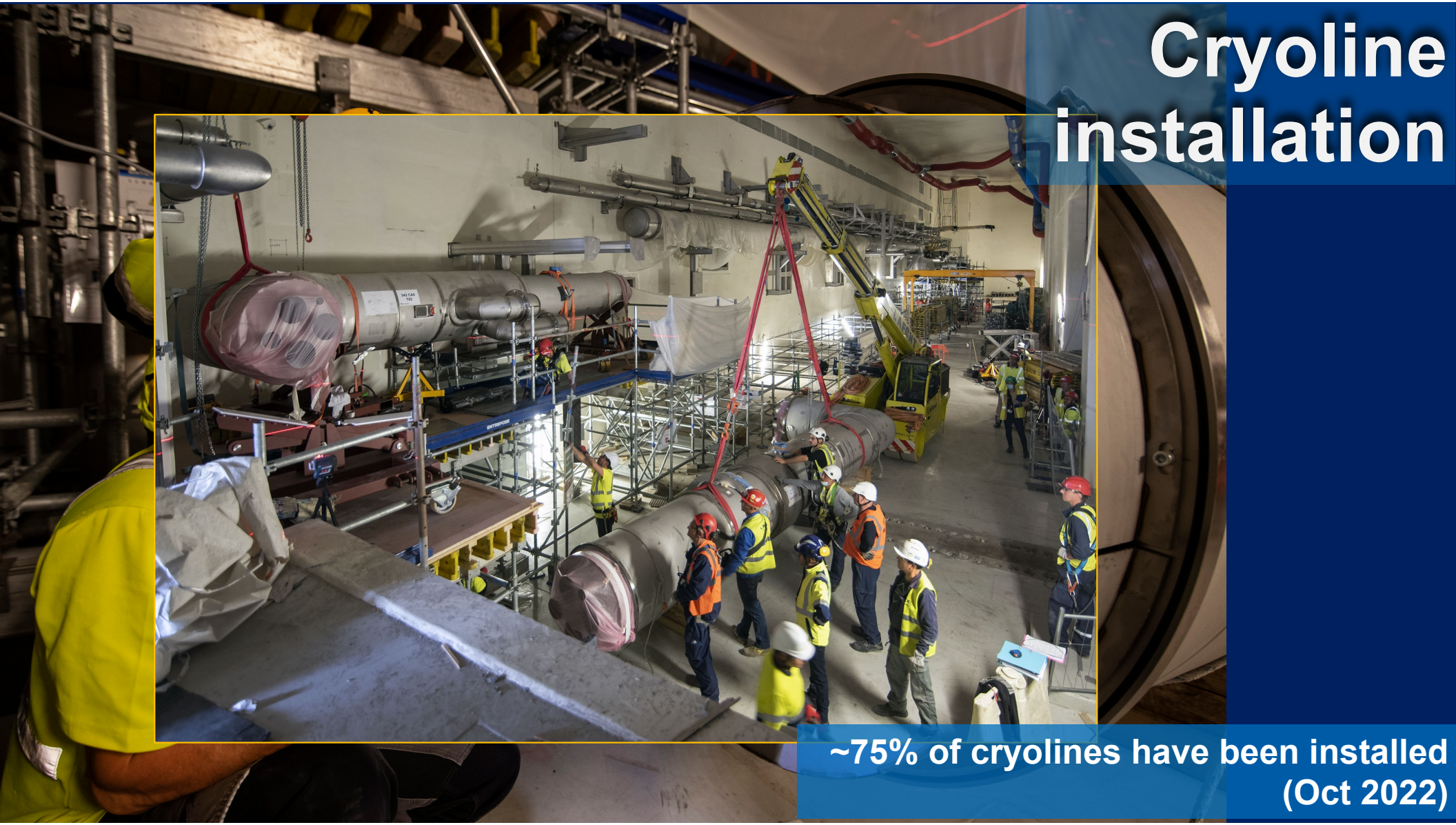
Cryogenics Plant

Liquid Nitrogen Plant: filling tank to evaluate evaporation rate (May 2022)

Cryoline installation

~75% of cryolines have been installed (Oct 2022)

Cryoline installation



~75% of cryolines have been installed (Oct 2022)

Electrical networks

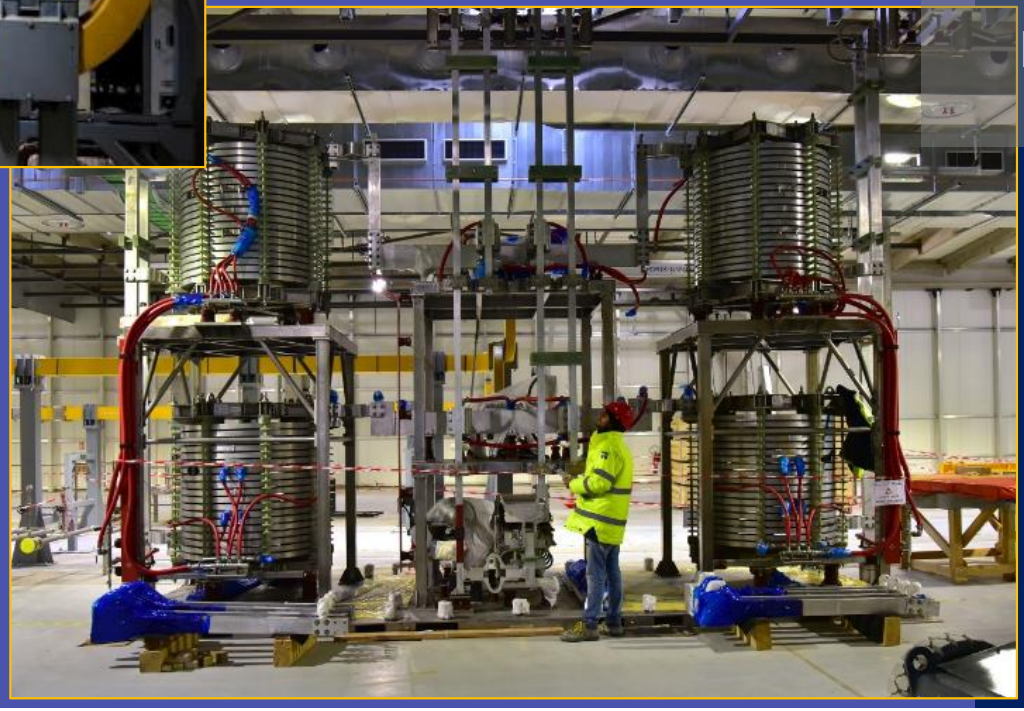
January 2019:

Connected to French grid

June 2021:

Reactive power compensation equipment largely installed.

Magnet Power Conversion

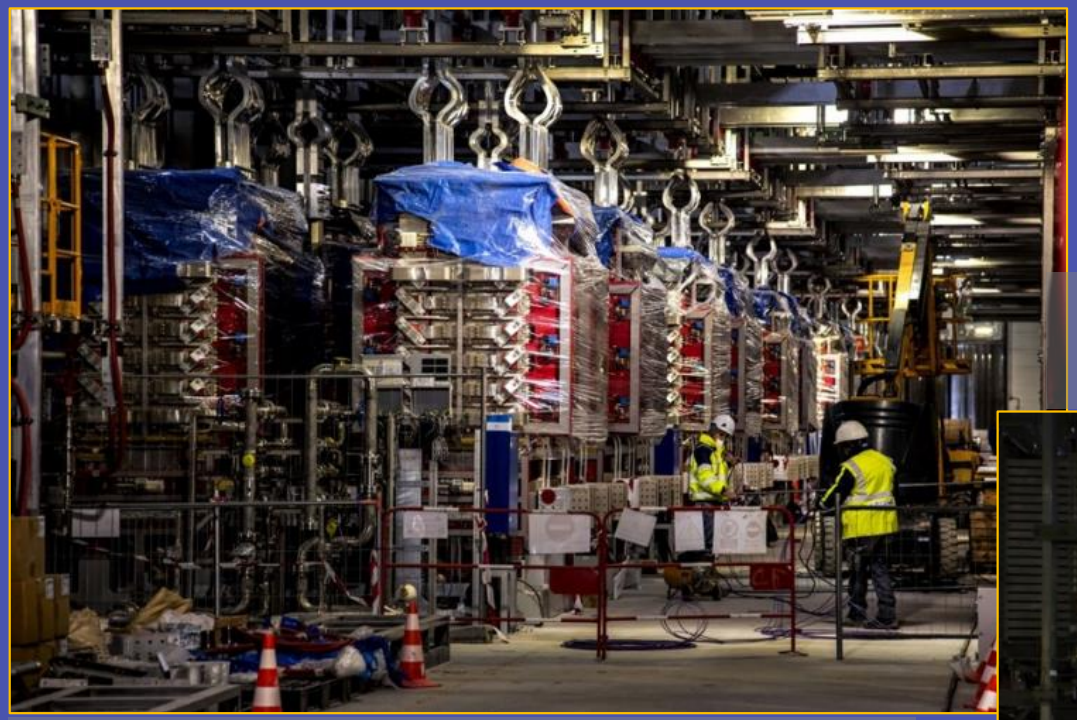


Components from China, India, Korea and Russia.

Global supply chain:

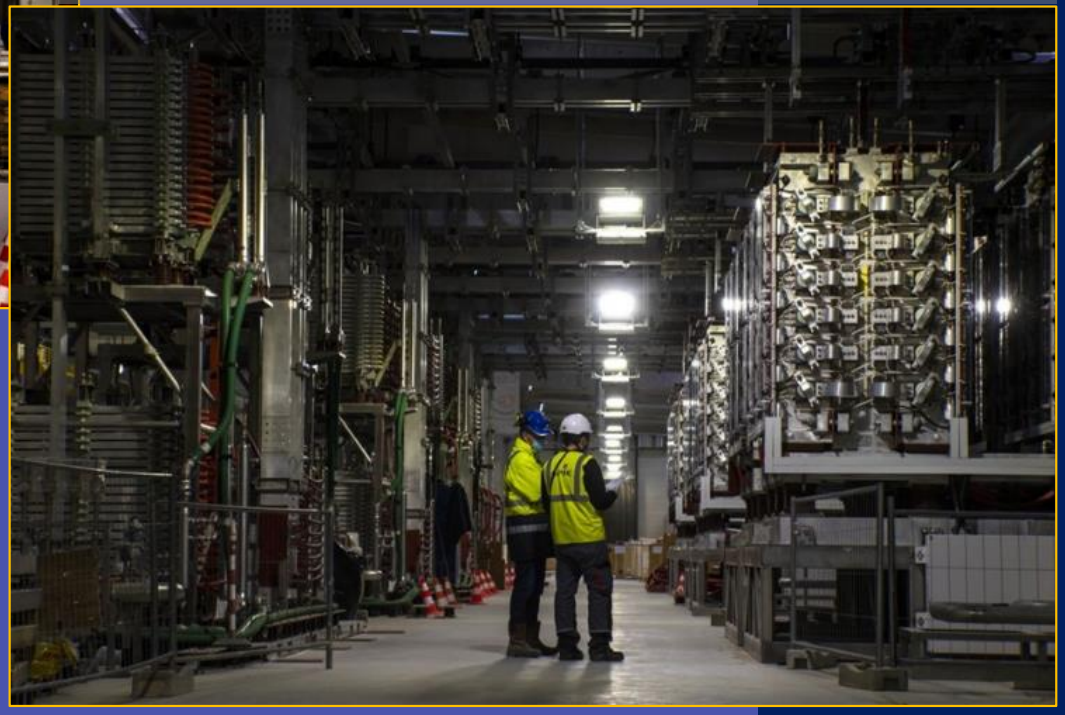
The ITER project is creating a worldwide network of companies with experience in meeting the demanding requirements of fusion engineering.

Magnet Power Conversion



100% of equipment installed in the Magnet Conversion Building 33 March 2022

Underground infrastructure includes cooling water for electrical components



Heat rejection system

ITER's cooling water systems will be capable of removing ~1.2 gigawatts of heat.

Heat rejection system

First transfer of water from hot basin to two cooling tower cells, March 2022

Onsite Manufacturing

PF Coil manufacturing essentially complete

Manufacturing and deliveries

First correction coils installed

Cryostat completion celebrated in March 2022

Five vacuum vessel sectors in advanced fabrication

Multiple TF coils delivered, two installed

Manufacturing and deliveries

Three VV sectors delivered

Poloidal field coil #1 ready for shipment, May 2022

Two central solenoid modules delivered, five more in late stages of fabrication

Manufacturing and deliveries

Three VV sectors delivered (most recent was 1 April 2022)

Poloidal field coil #1 ready for shipment

Poloidal Field Coil #1 in shipment (Oct 2022)

dules delivered,
of fabrication

Appointment of Director-General Pietro Barabaschi

- May 2022: ITER Council initiated new DG search
- July: interviews of selected candidates
- 15 September: final interviews and selection
- 16 October: new DG took office
- 16-17 November: presented outlook to ITER Council at IC-31

Appointment of Director-General Pietro Barabaschi

Key points of emphasis

- Accuracy and transparency in communication
- Improved integration of IO and DAs
- Improved relationship with French regulator
- Reliable solutions to technical FOAK challenges*
- Need for improvement in quality culture

**Timing coincided with completion of analysis of Thermal Shield cooling pipe stress corrosion*

Addressing Challenges

VV/TS repairs

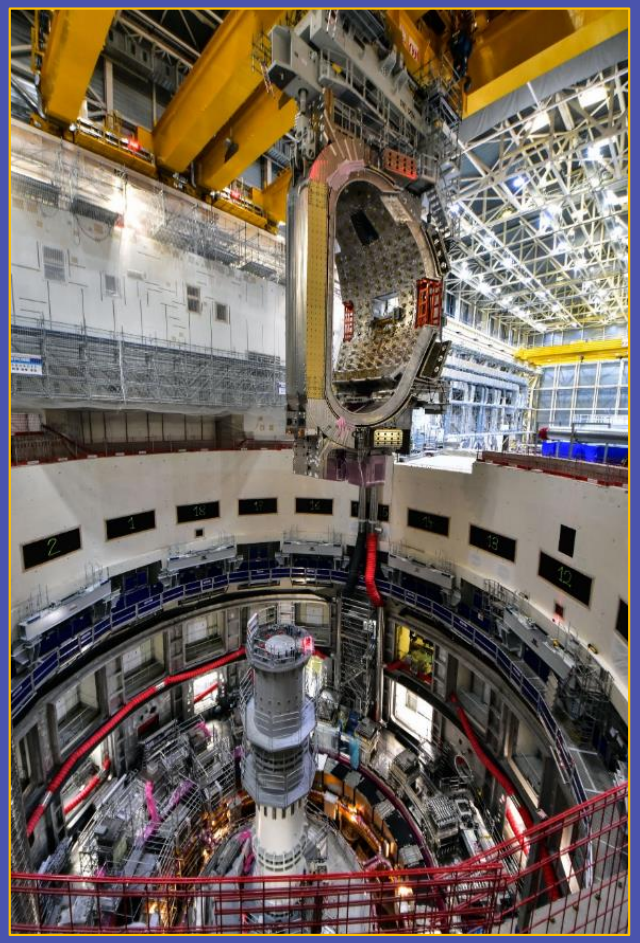
FOAK/Covid delays

Regulatory relations

Offsetting future risks

Baseline update

Assembly status

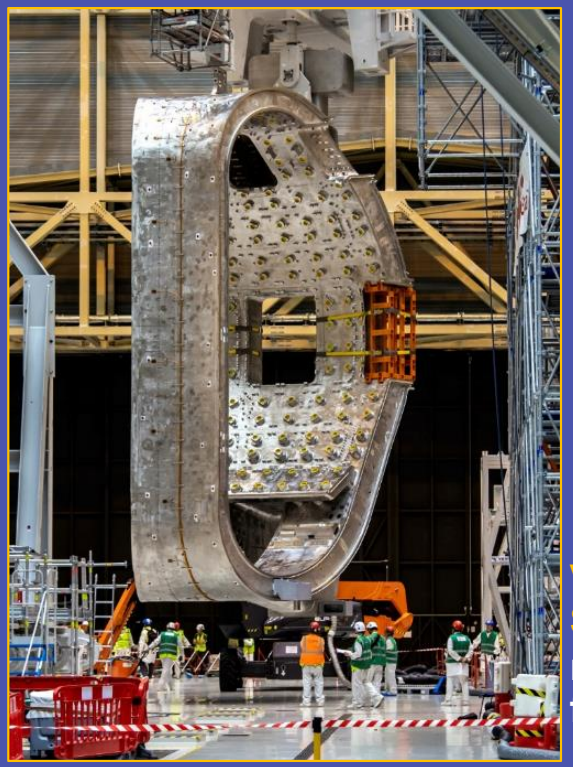


Vacuum vessel sector modules:

- Building blocks of the Tokamak (9 in total).
- Each is comprised of one 40° vacuum vessel sector, two toroidal field coils and a set of thermal shield panels.
- Problems have been identified in thermal shield cooling pipes (cracks) and in vacuum vessel sector field joints (dimensional non-conformities) that will require repairs

Challenges of FOAK components

Thermal Shields: stress corrosion identified in cooling pipes

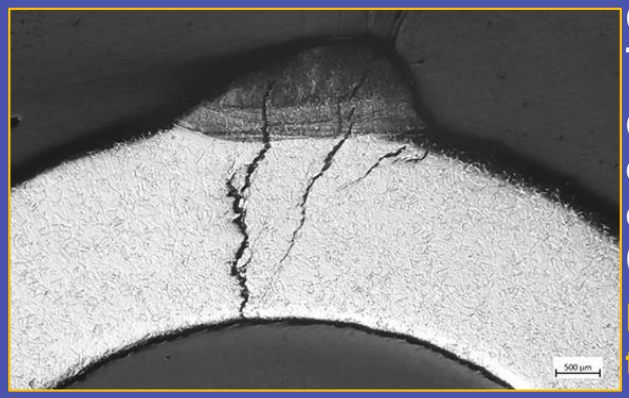


Vacuum Vessel Sectors: Dimensional non-conformities at field joint bevel

Issues have been investigated, and repair strategies initiated.

Lift, extract, and repair

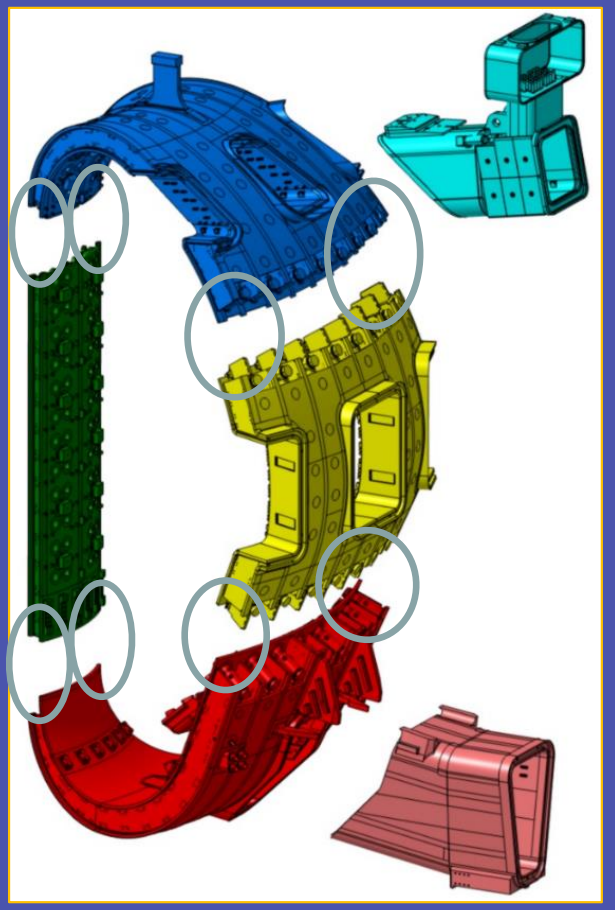
Thermal shield: actively-cooled component between the VV sectors and TF coils.



Cracks detected in TS cooling pipes

Cause: stress corrosion due to chlorine residues (design flaw)

Decision: replace the pipes



Complex welding requirements on the four main sections of the VV sectors caused deviations.

These deviations affect the interface between sectors.

Addressing Challenges

In parallel with these repairs, we will:

- Address other FOAK & Covid delays
- Ensure strong ASN relations
- Seek to offset future risks
- Create new Baseline


Thank you for your attention!
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Questions?