

PLENARY SESSION

General overview & insights on the new ITER baseline



Pietro **BARABASCHI**

Director-General, ITER Organization

Pietro Barabaschi serves the ITER Organisation since 2022, overseeing the reforms and the construction of the ITER project.

Prior to this role, he led an R&D Department in Fusion-for-Energy (F4E), the European Joint Undertaking responsible for delivering European components to the ITER and Broader Approach (BA) Fusion international projects.

He also acted as the Interim Director of F4E.

Before joining F4E, Pietro Barabaschi was the Deputy Project Leader and head of the Design Integration Division of the ITER International Team at the Munich

Joint Work Site and previously in San Diego, USA.

Shortly after completing his university studies in Electromechanical Engineering, he joined the JET Project in Culham, UK, where he contributed to the machine development department.

At 59, Pietro Barabaschi has dedicated his career to Nuclear Fusion research, with a focus on developing and constructing the research infrastructures essential for advancing nuclear fusion as a viable energy source.





THE ITER PROJECT

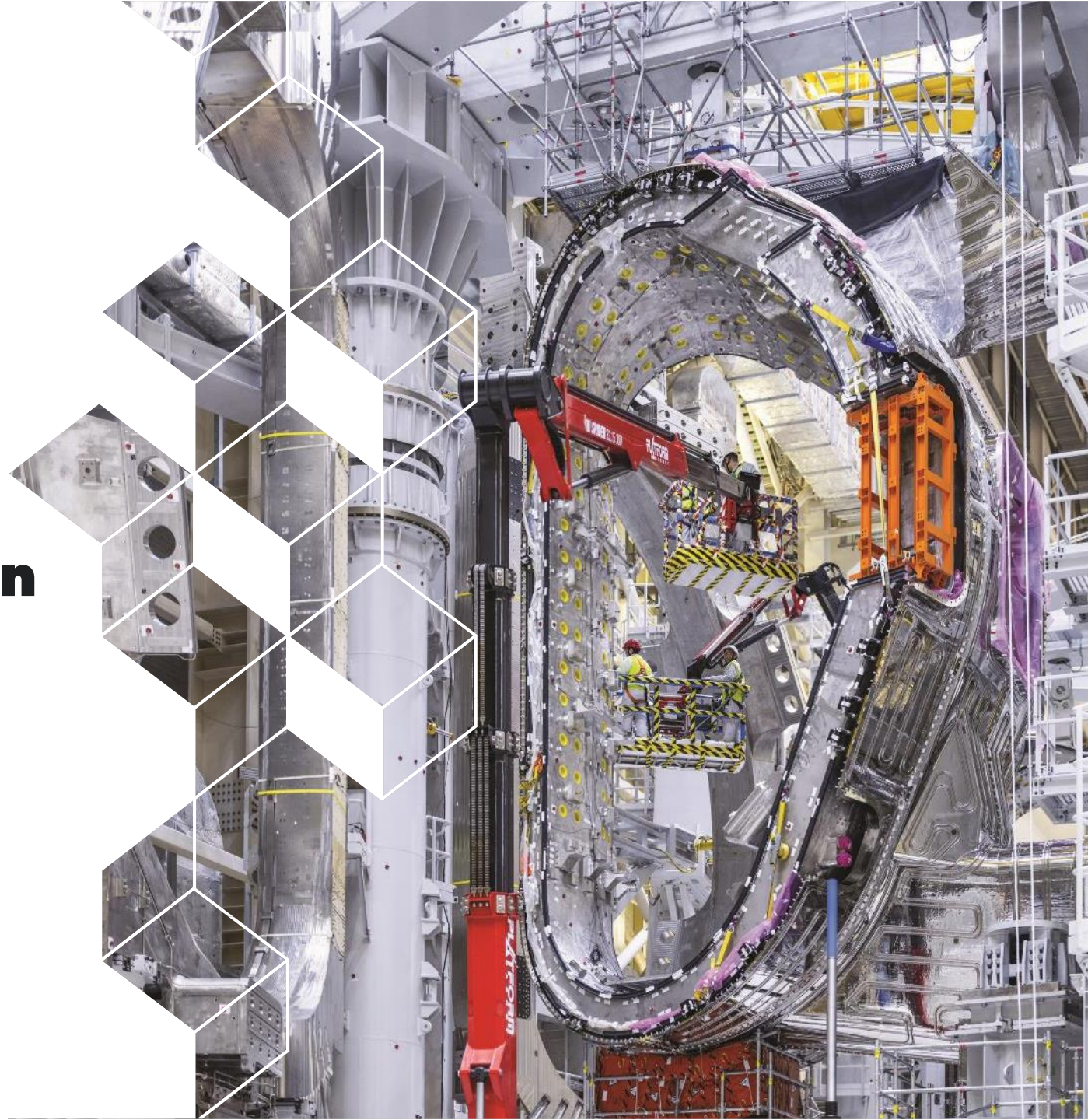
General overview & insights on the new ITER baseline



Pietro BARABASCHI

Director-General

THURSDAY APRIL 24th



From 2019 to 2025



ITER site in March 2019



ITER site in November 2024

FROM THE TURNAROUND YEAR IN 2023, THE ITER PROJECT PERFORMED AT RECORD RATES OF EXECUTION IN 2024

Repair of components;

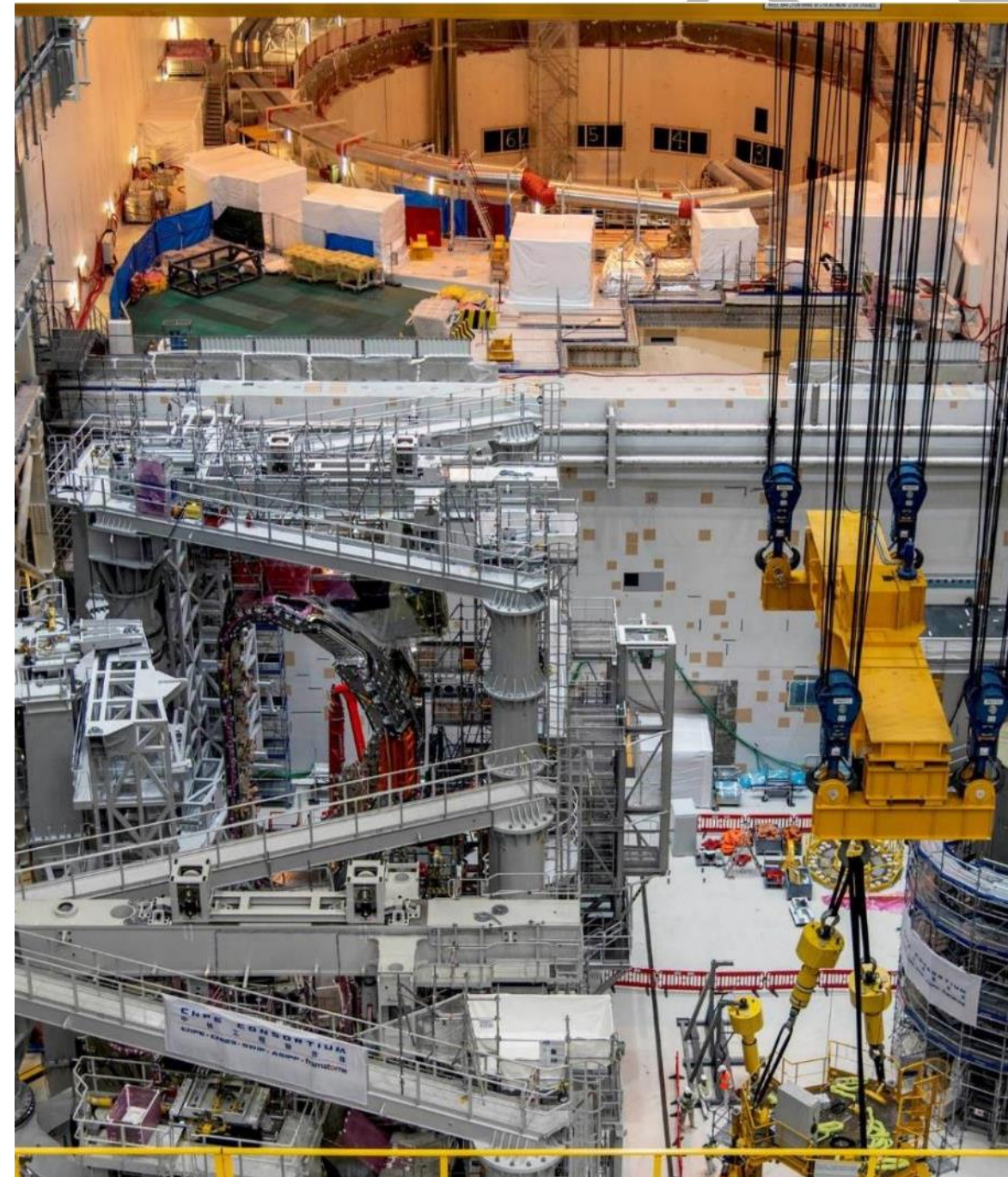
**Reorganisation of project: flatter and with
matrix structure;**

**Recovery of trust with the French Nuclear
Regulator (ASNR);**

Development of the Baseline with many new
technical developments therein;

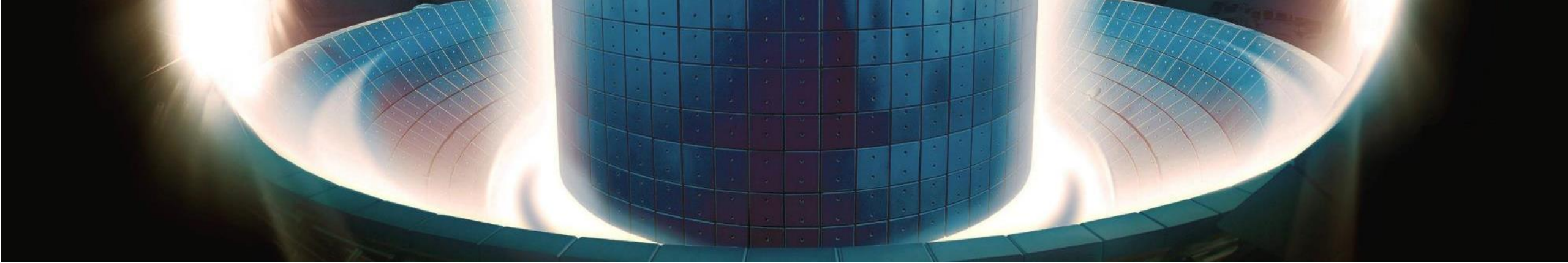
**Improvement of project and design control
processes;**

**...while achieving record (100%) execution
(with CPI=1.05) in ITER construction.**





1. New ITER baseline



The PREVIOUS (2016) BASELINE:

Designed to reach First Plasma – *any symbolic plasma experiment* – as rapidly as possible

Constrained by the fact that some key components would not be available

First Plasma scheduled for end-2025: a brief, low-energy machine test (100 kA)

To be followed immediately by further in-vessel components assembly

Reaching full plasma current in 2033, and starting DT operations in 2035

OVERVIEW OF 2024 REVISED PROJECT BASELINE

WHY?

Delays in deliveries (e.g. VV), issues of quality, issues with regulator, Covid impacts, unrealistic plans

GOAL:

Deliver substantive research as rapidly as possible

KEY CHANGES:

- More components are now available to build a more complete machine
- **Start of Research Operations targeted in 2034**
 - To include 27 months of research
 - **Full Magnetic Energy: delayed from 2033 to 2036**
- **Start of DT Operations Phase: delayed from 2035 to 2039**





2. Project Status



WORKSITE CONSTRUCTION & COMMISSIONING

~ 5000 staff every day enters the worksite

Most plant support systems are operational or in commissioning.

24/04/2025

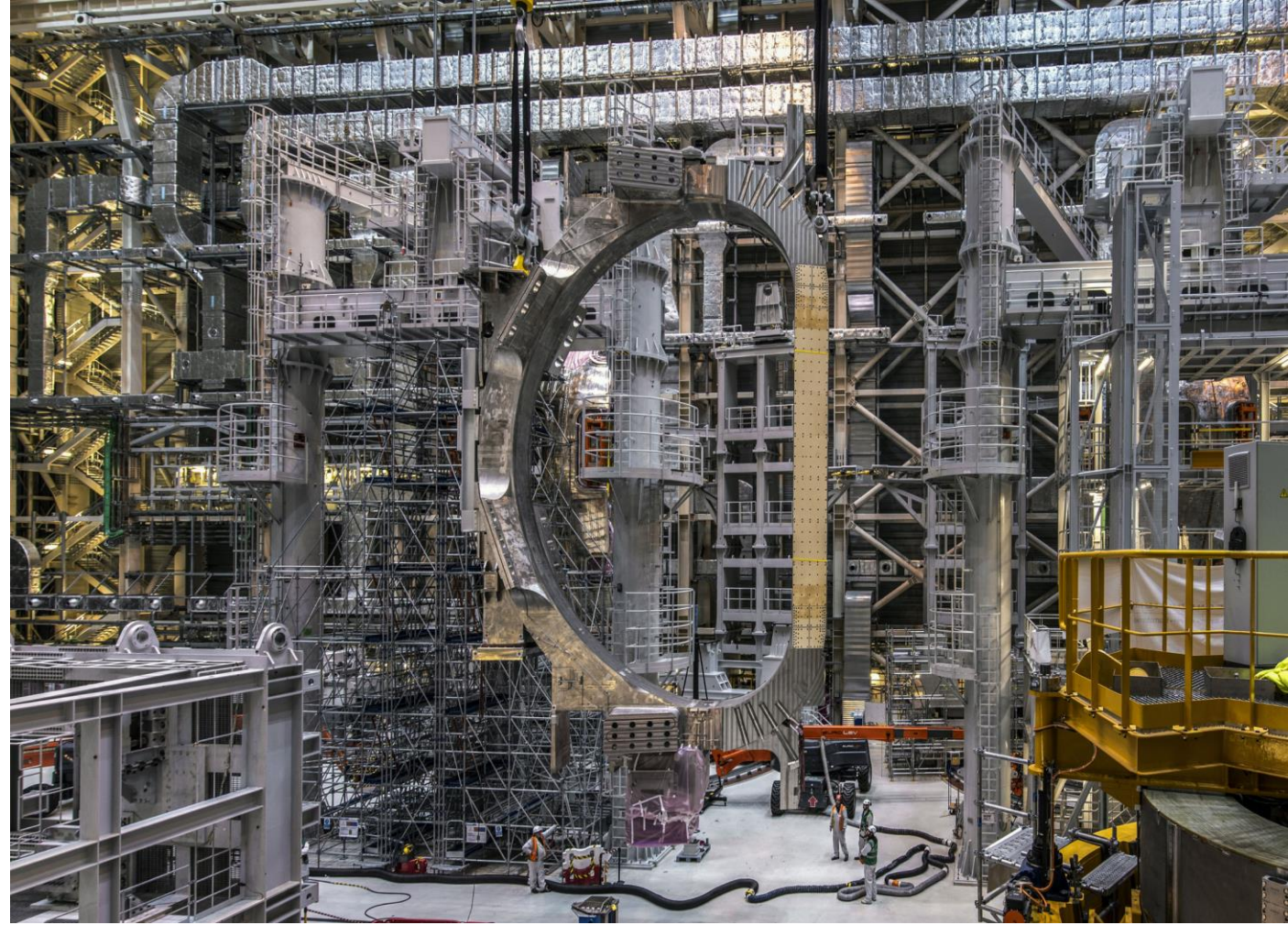
TOROIDAL FIELD MAGNET MANUFACTURING AND DELIVERY

All Toroidal Field coils, manufactured by Europe and Japan (18 + 1 spare), are completed and delivered on site.

- 18 coils
- 41 gigajoules
- 11.8 Tesla

Each coil:

- 360 tons
- 9 x 17 meters



POLOIDAL FIELD MAGNET MANUFACTURING AND DELIVERY

All six Poloidal Field coils have been completed and delivered (PF2 pictured at right).

The largest with a diameter of 24 metres, weighing 400 tonnes.

Total magnetic energy:
4 gigajoules

Maximum magnetic field:
6 Tesla



CENTRAL SOLENOID DELIVERY AND SUB-ASSEMBLY

All required CS modules now completed.

Fourth Central Solenoid module was lifted successfully in January 2025.

CS installation continues with support to busbar connection and drilling of spacer plates.

Fifth CS module now in shipment.

Sixth CS module completed testing at GA last week.



Stacking fourth module,
January 2025



Korean sector #7

VACUUM VESSEL SECTORS

Korea has delivered all its four sectors

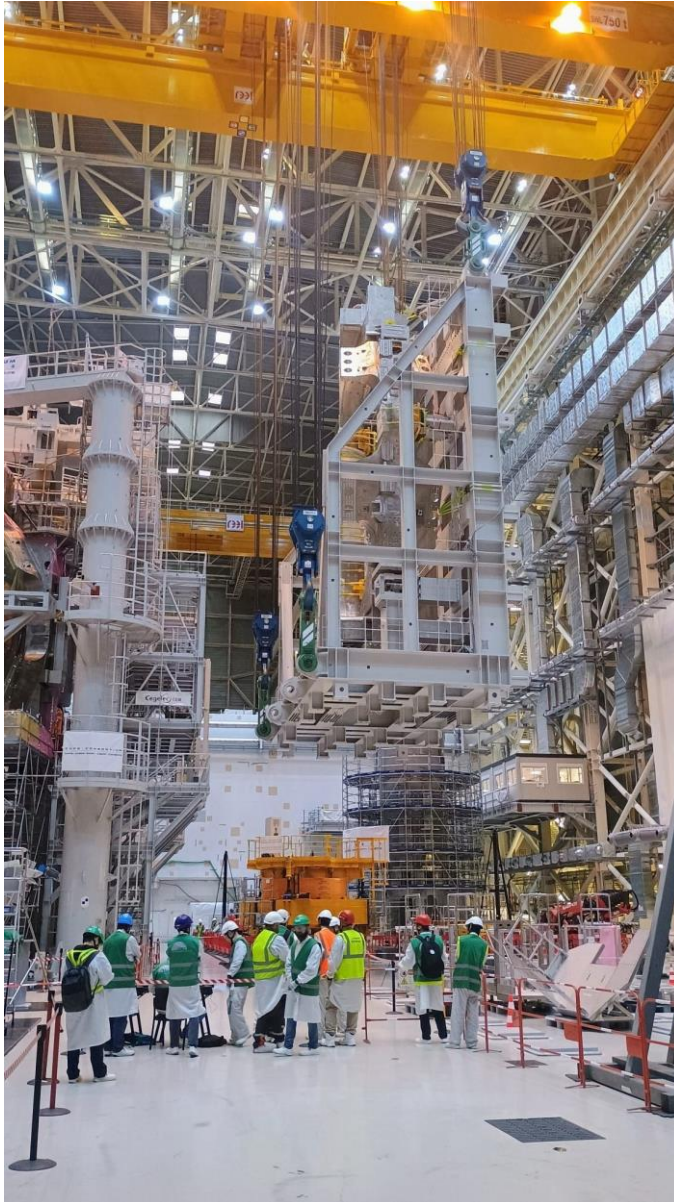
Europe delivered its first vacuum vessel sector in October 2024.

Second was completed in March 2025 and will be delivered to ITER in May.

EU sector arrival at ITER, 25 Oct 2024



TOKAMAK MACHINE ASSEMBLY



Assembly Contracts and organization reset in 2023

SECTOR MODULE 7:

- Sub-Sector assembly completed in March 2025 and installed in the pit on 10 April 2025.

SECTOR MODULE 6:

- Advanced activities on SSAT (Sub Sector Assembly Tool).
- Target of Sub-Sector assembly completion by July 2025.

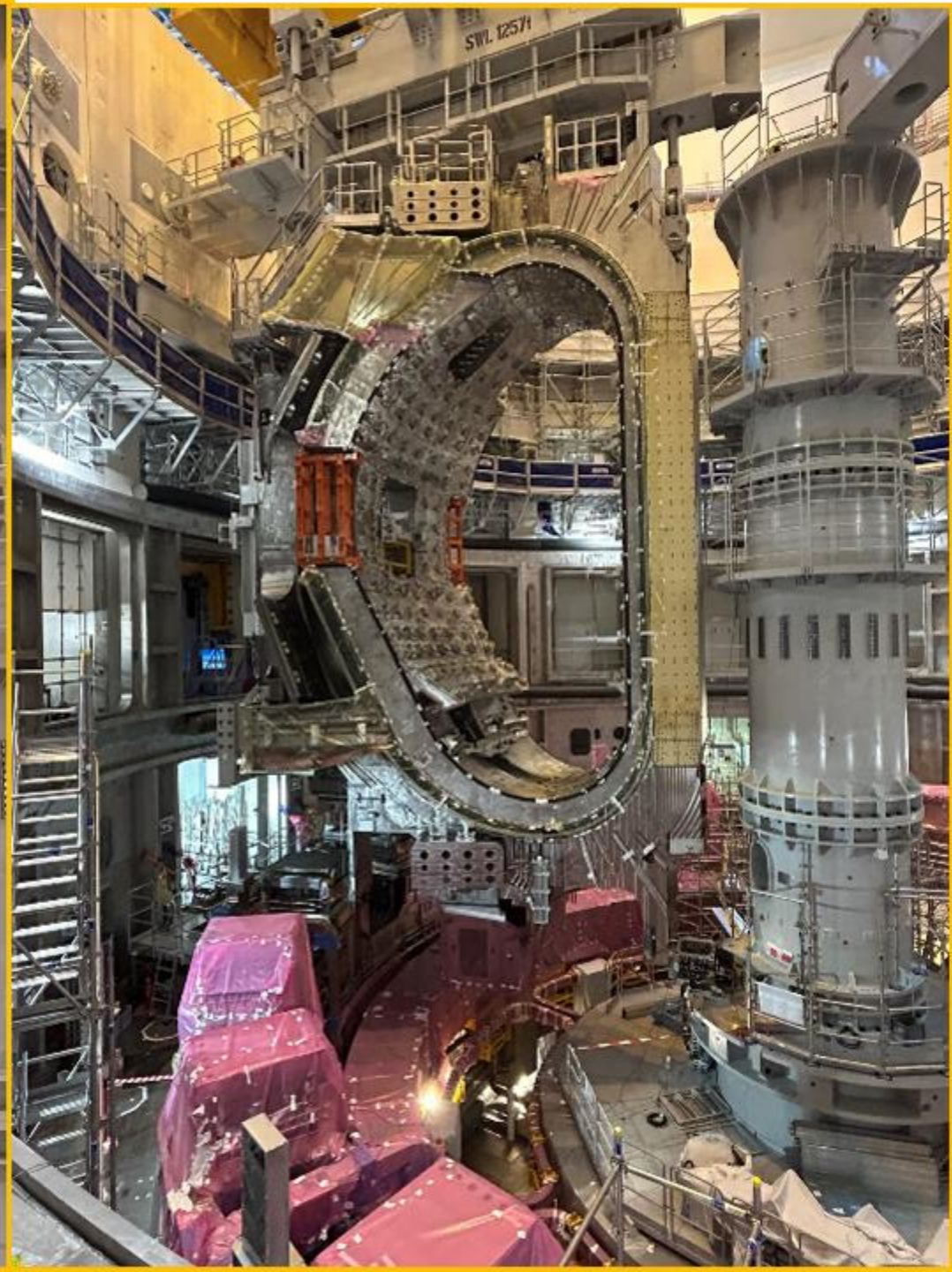
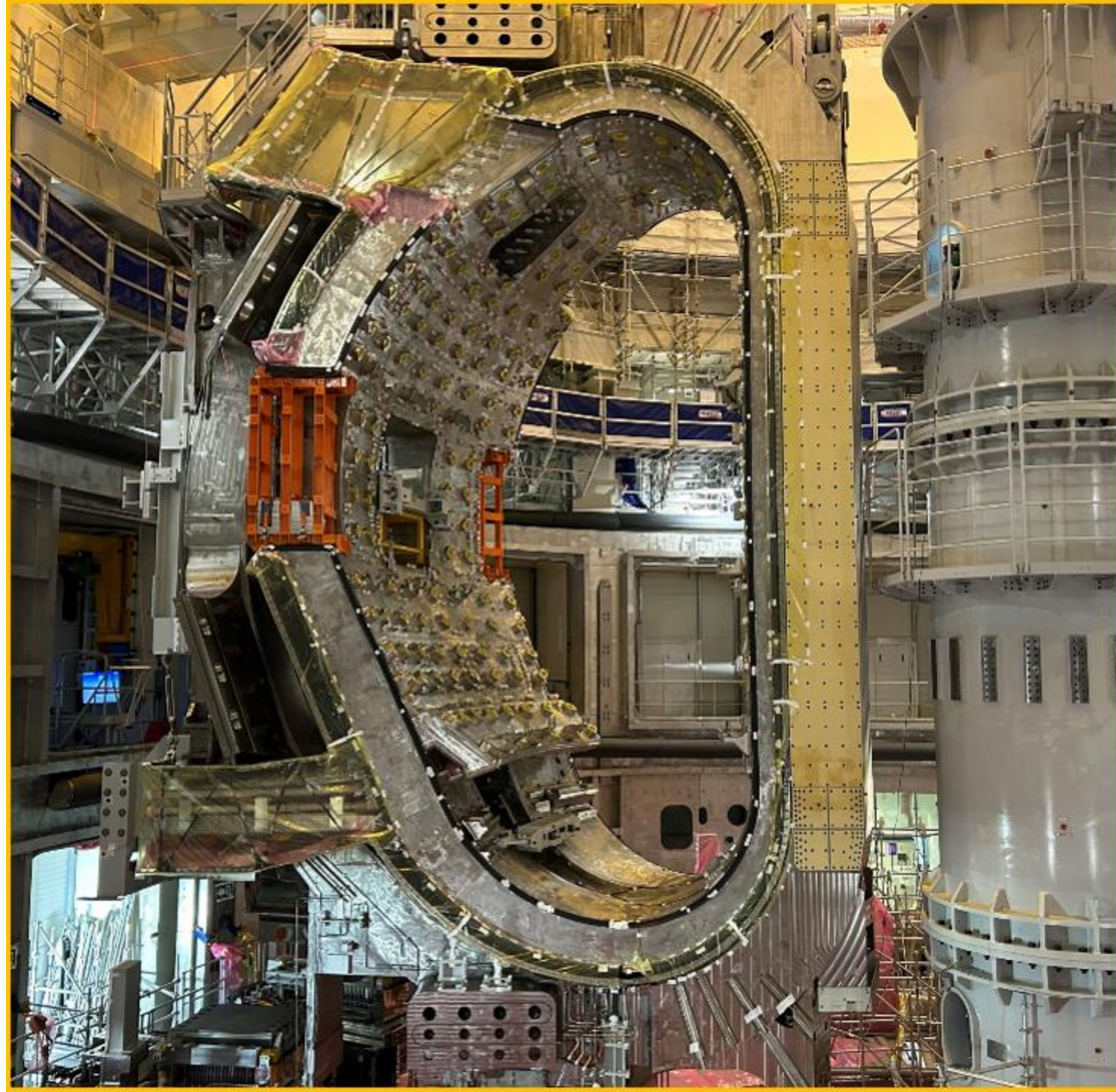
SECTOR MODULE 5:

- Assembly activities on SSAT planned to start in May 2025.
- Target of Sub-Sector assembly completion by November 2025.

FIRST VACUUM VESSEL SECTOR IN THE PIT

On 10 April, three weeks ahead of schedule, sector module #7 is lowered into the tokamak pit.





REPAIRS TO VACUUM VESSEL SECTOR BEVEL JOINTS

Issue:

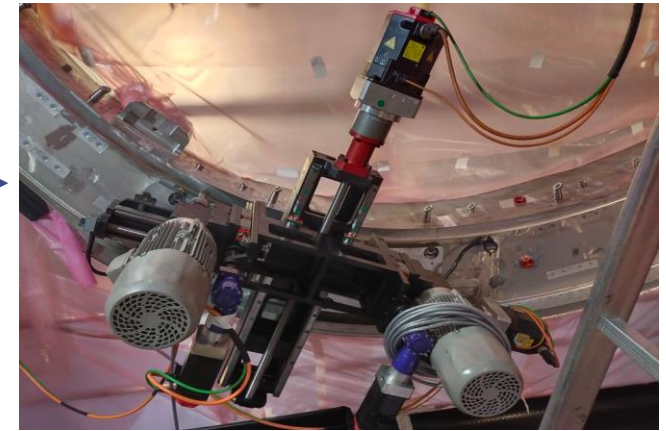
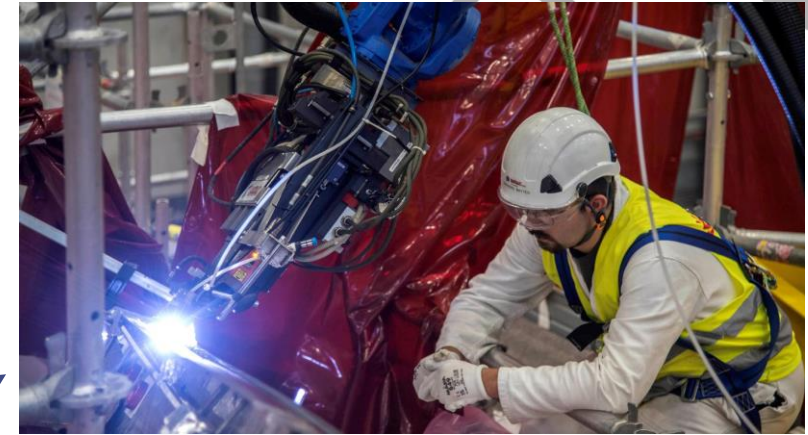
Main reason: Segments machined before assembly into sector

- Weld distortions incompatible with planned sector welding
- Assembly halted in 2021 due to ASN raising major issue in hold point

Solution:

Bevel Build-up (manual tig / mechanized tig) + NDE (M-UT and RT).

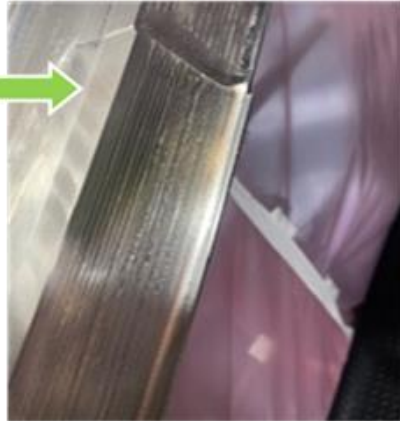
Bevel machining, with portable milling machine(s) bolted to the Sector T-rib



BEFORE REPAIR



AFTER REPAIR



STATUS

Sector 5 (at EU Supplier): successfully repaired

Sector 7 & 6 (at ITER): successfully repaired

Sectors 8 & 1 (at ITER): repairs in progress

Sector 4: Manufacturing completed. Delivered to ITER in May.

Sectors 2, 3, 9: manufacturing still in progress

REPAIRS TO THERMAL SHIELD

Issue:

2022: Leakage identified in thermal shield cooling piping due to chloride induced stress corrosion.

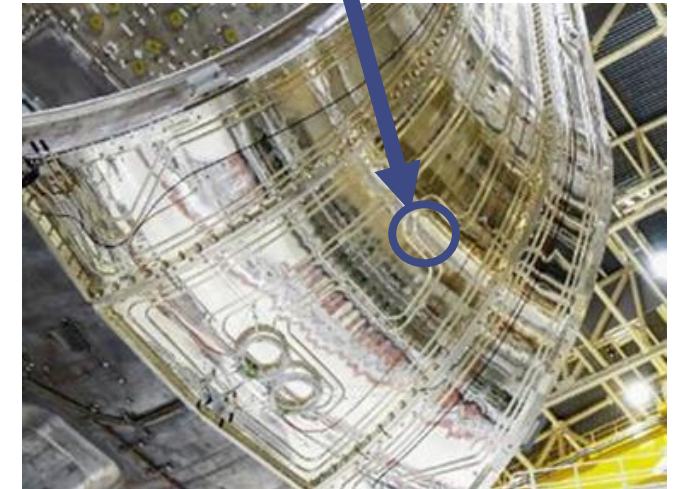
Solution:

Removal of cooling pipes, panel machining (2 mm) to eliminate potential panel corrosion risk

Replacement of corroded pipes with new 316L pipes

Surface polishing with no Ag coating: surface roughness less than $0.1\text{ }\mu\text{m}$ – low emissivity at 80K

Remanufacturing of 2 sectors as risk mitigation



STATUS

VVTS repairs for sectors 6, 7, and 8 have been completed. Work is ongoing for sectors 2, 3, 4 & 5.

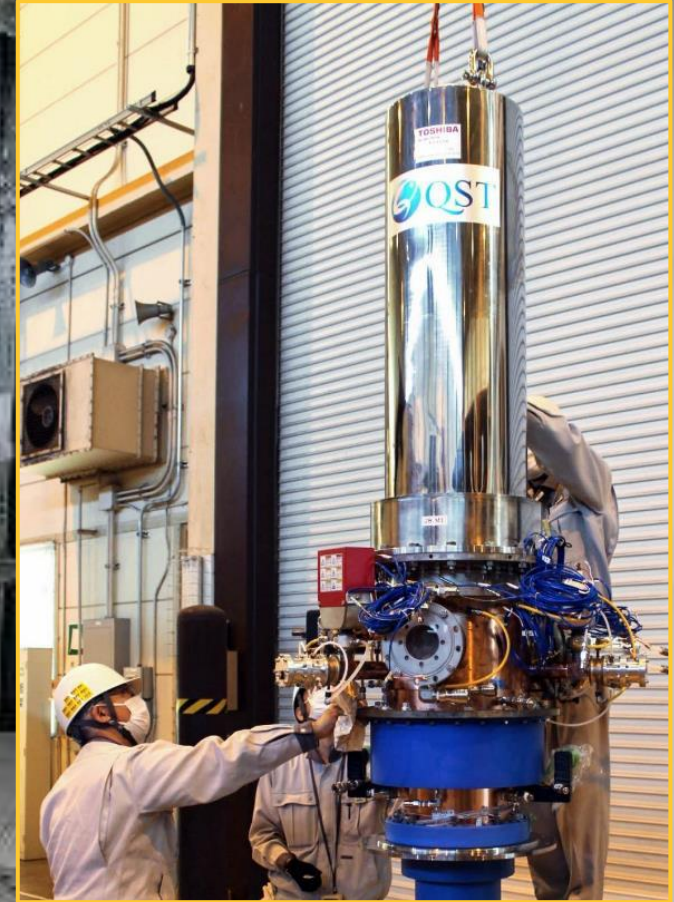
Remanufacturing for sector 1 and 9 has been progressing with an expected delivery date in Q2 and Q3-2025 respectively.



ELECTRON CYCLOTRON HEATING

The first energization of the 22kV main switchgear via the Pulsed Power Electrical network (PPEN) was successfully completed in August 2024.

Gyrotron installation began in November 2024.



TWO POWER SUPPLY SYSTEMS



Steady-state electrical network

Pulsed-power electrical network (sometimes called “reactive power compensation”)

The image shows a vast industrial interior, possibly a fusion reactor under construction or commissioning. In the foreground and middle ground, there are large, complex structures covered with blue and silver insulation or protective materials. These structures are part of a larger system, with various pipes, cables, and mechanical components visible. In the background, several workers wearing high-visibility yellow safety vests and hard hats are standing near the equipment. The ceiling is high, with numerous overhead cranes and support beams. The overall atmosphere is one of a busy, high-tech industrial environment.

MAGNET CONVERSION

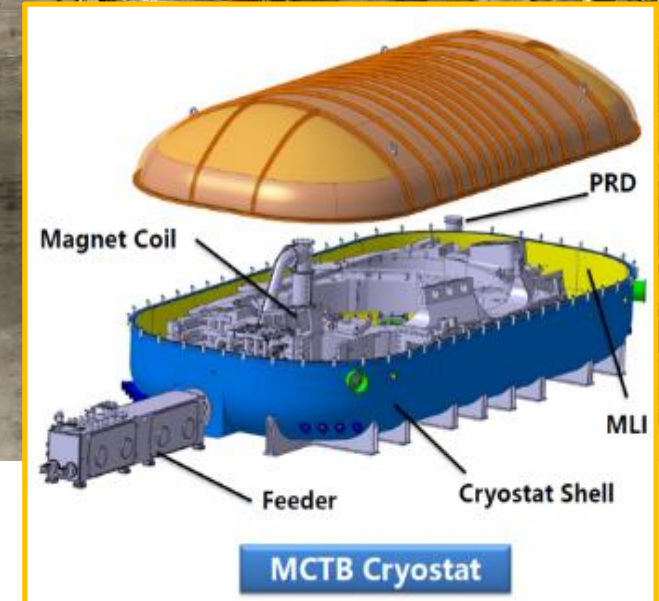
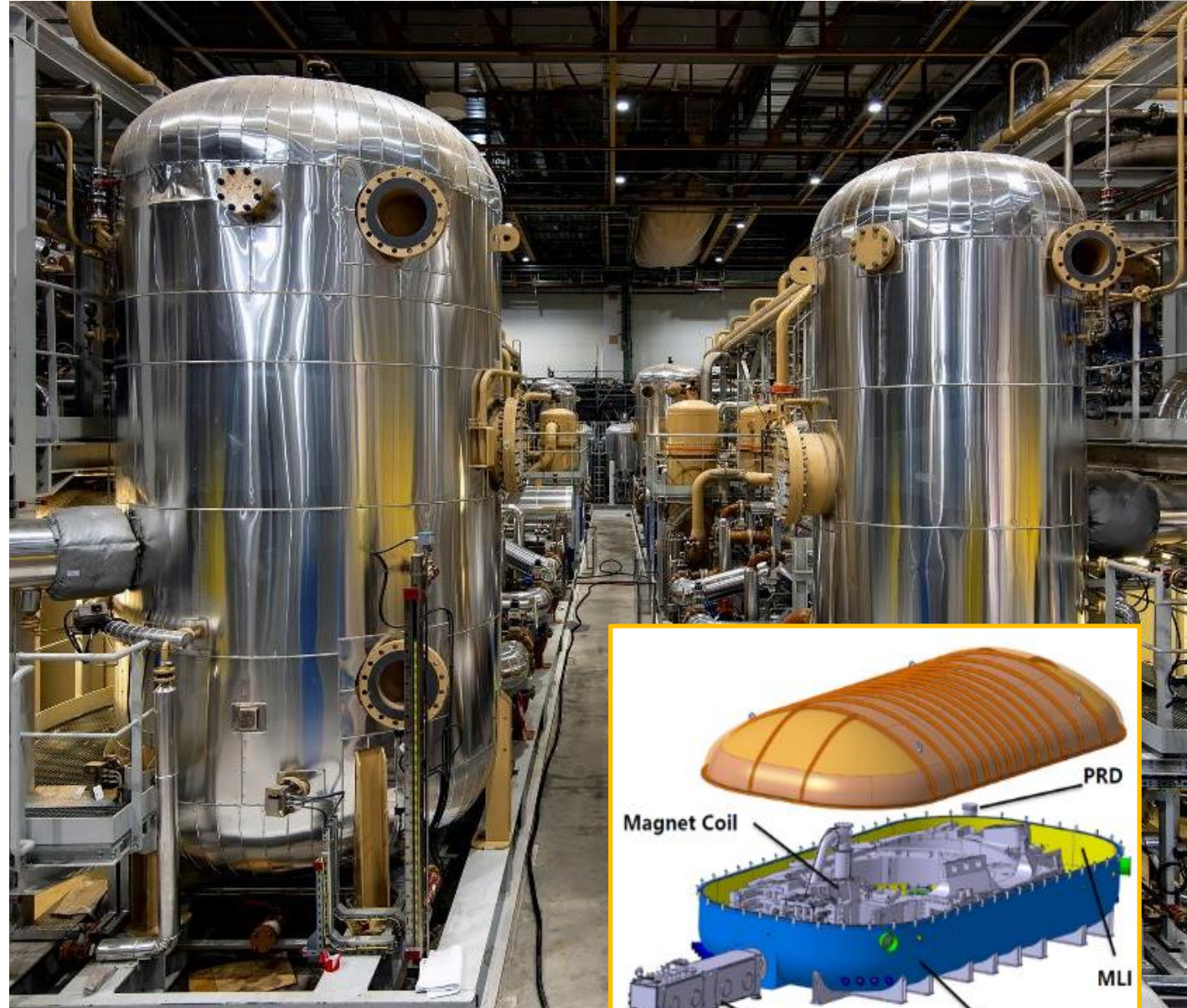
Equipment largely installed and commissioned

CRYOGENICS PLANT COMMISSIONING

Helium gas compressor and gas distribution network has completed functional testing in July 2024.

This completes the performance test of the first compressor train.

Helium liquefaction achieved in 2024. This will support operation of a Magnet Cold Test Bench (MCTB) under construction.



ADDITIONAL MANUFACTURING AND DELIVERIES

Second upending tool to speed up the assembly of the sector modules was delivered at ITER in April 2025.



A full-scale prototype of an enhanced heat flux first wall panel with beryllium armor tiles was produced at Efremov Institute.

All eight cryopumps were manufactured, tested and delivered to the ITER site in April 2025



Approximately 55% of shield block fabrication is now complete in Korea and China.



3. **ITER & Industry**

ITER CONTRACT OVERVIEW

Current Contracts: ~1300 contracts with 630 companies

Total Contract Value: € 2.7 billion

2025 Forecast Commitments: € 900 million

New Contracts Since January 2025: ~ 90 contracts with cumulative value of € 180 million

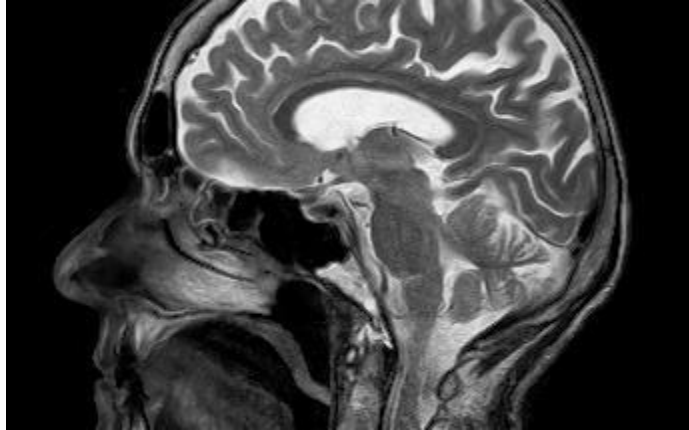
INNOVATION AND SPIN-OFFS FROM ITER

ADVANCING MEDICINE, MANUFACTURING, AND MORE

Superconductor magnet advances



Enhanced mapping of the human brain



Explosive forming



High-strength components such as aircraft



Complex aluminum structures



Enhanced electric train bodies



High-precision diagnostics



Enhancements for geothermal energy, laser welding, cancer treatment, etc.

ENGAGEMENT WITH PRIVATE SECTOR FUSION INITIATIVES

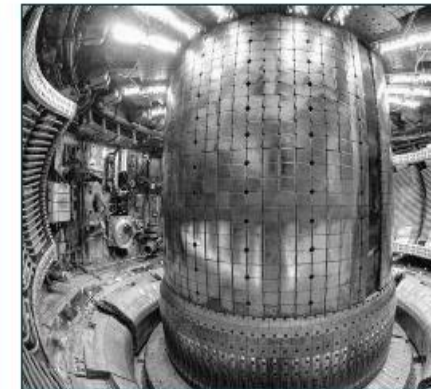
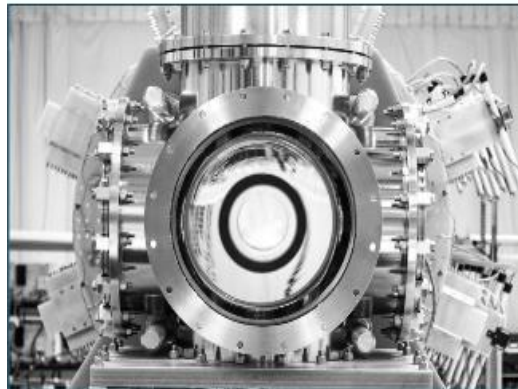
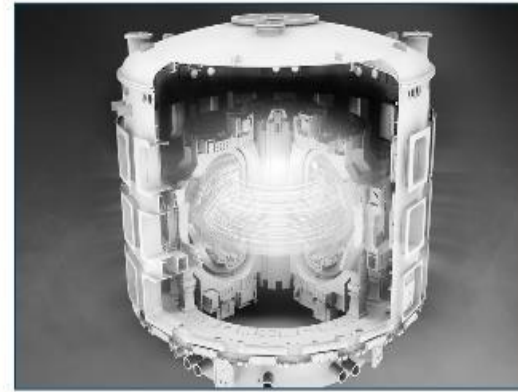
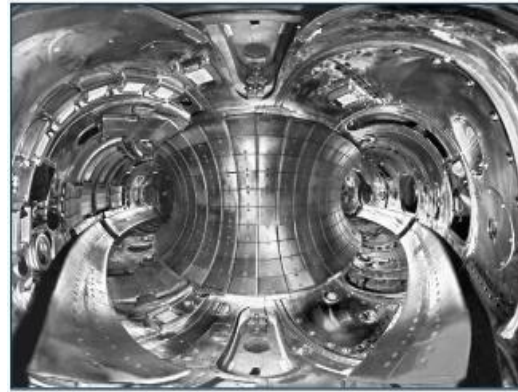
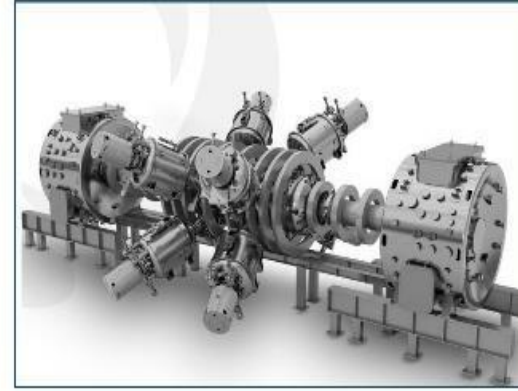
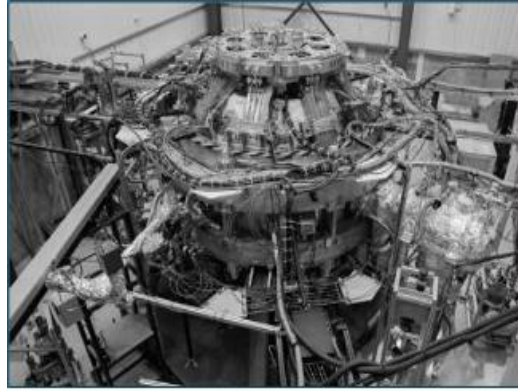
Requested by ITER Council, Nov 2023

2nd Workshop at ITER this week

- 350 participants
- strong private sector endorsement

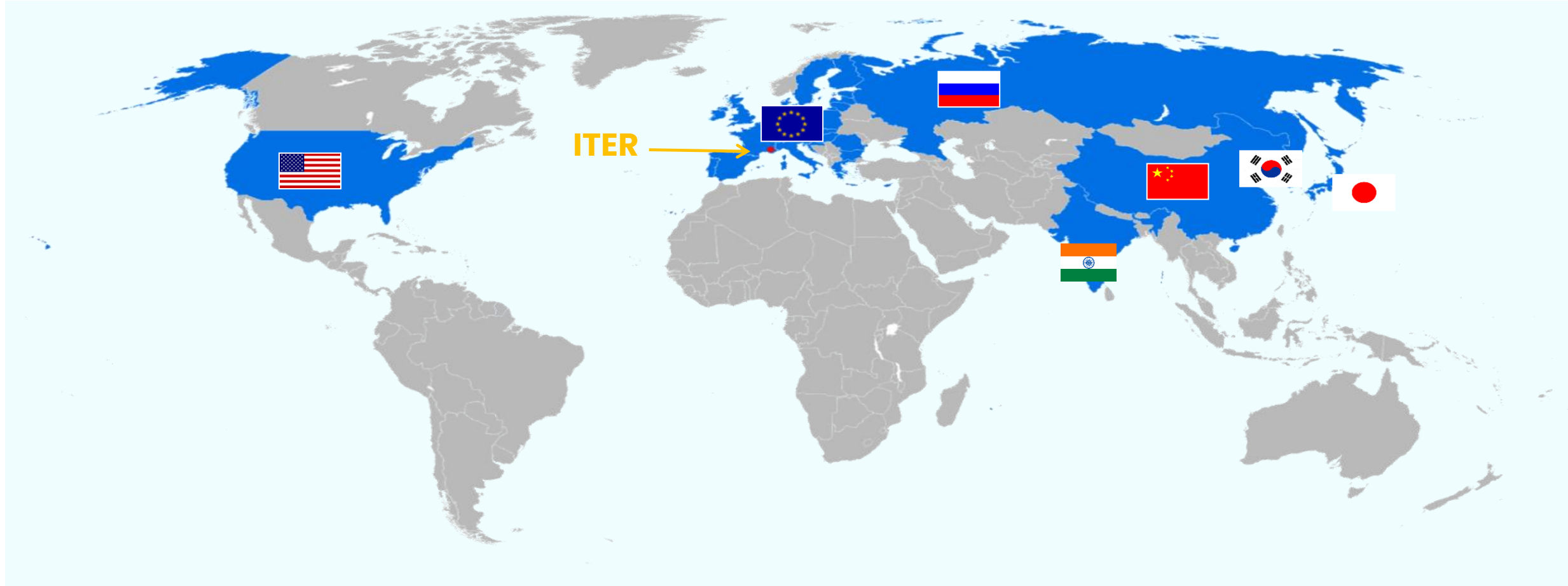
Establishing channels for further engagement and knowledge sharing

- ITER Design Handbook
- Systematic approach for access to ITER documents
- Incorporation of appropriate resource and legal constraints
- Discussions with ITER technical experts
- Open-sourcing of some ITER science software
- Etc.



ECONOMIC BENEFITS

15 billion euros is currently engaged in construction and manufacturing contracts for ITER worldwide



FUSION'S REMAINING CHALLENGES

- Materials resistant to extreme conditions (intense flux of high-energy neutrons)
- Heat exhaust management in the divertor region
- Remote handling for maintenance
- Tritium fuel cycle (breeding tritium at scale)
- Efficient heat removal for electricity generation





Thanks!

24/04/2025