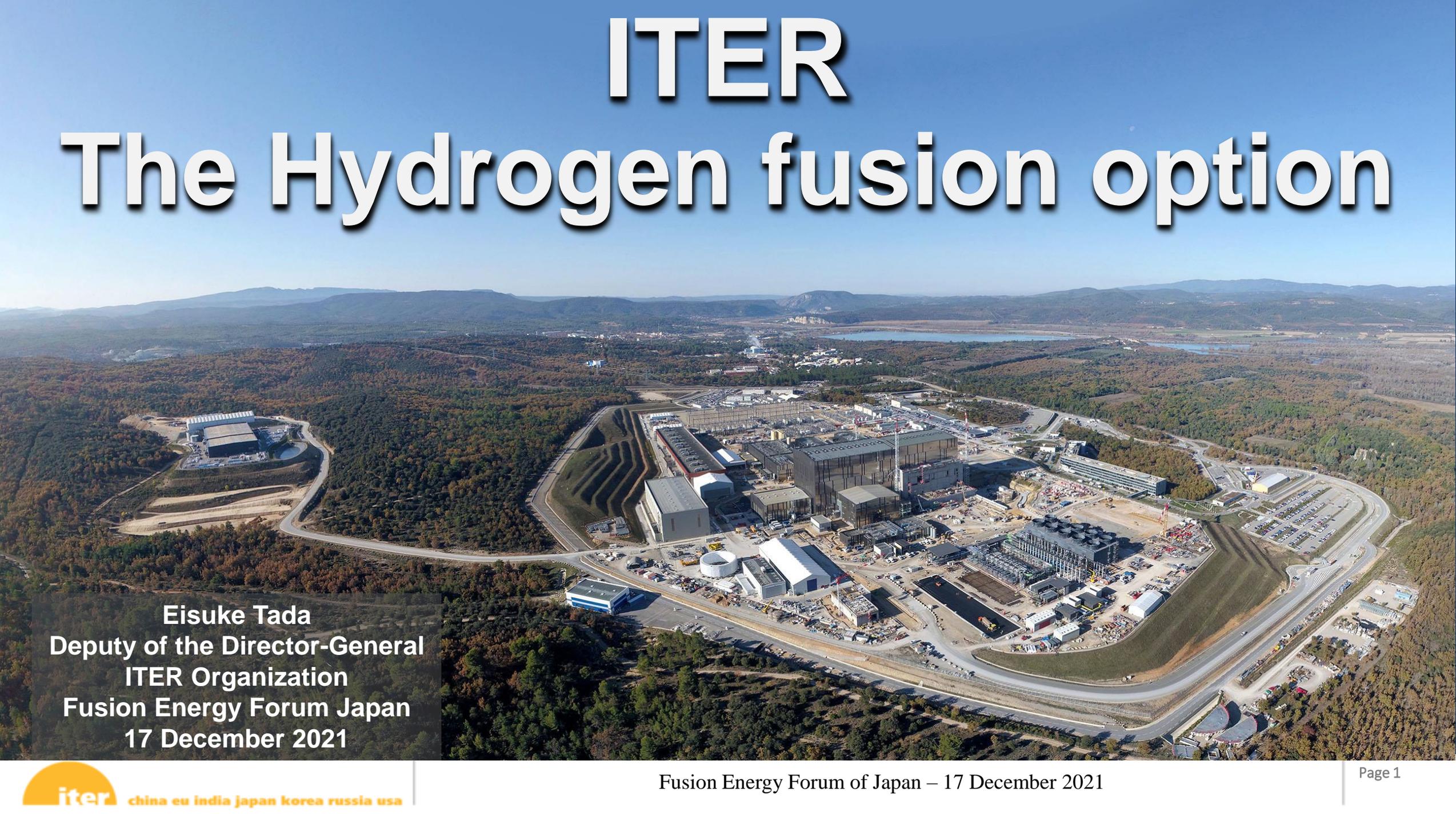


ITER

The Hydrogen fusion option



Eisuke Tada
Deputy of the Director-General
ITER Organization
Fusion Energy Forum Japan
17 December 2021

Work scope towards First Plasma > 75% complete



According to the stringent metrics that measure project performance, > 75 % of the "total construction work scope through First Plasma" is now complete. Average progression rate before Covid-19 pandemic: 0.7%. Now 0.4%. Full-power operation objective is maintained (2035).

Worksite progress

Cryostat upper cylinder (temporary storage)

Tokamak Assembly preparation Bdg.

Radiofrequency Bdg.

Assembly Hall

Heat rejection system

Control Room (Under construction)

ITER Organization HQ

Hot Cell Complex (Conceptual Design Phase)

Tokamak Complex

Neutral beam power supply (Under construction)

Cryostat workshop

Cryoplant

Power conversion Bdgs.

PF Coils winding facility

ITER switchyard

RTE (France) 400 kV switchyard

Transformers

Contractors area

Under construction

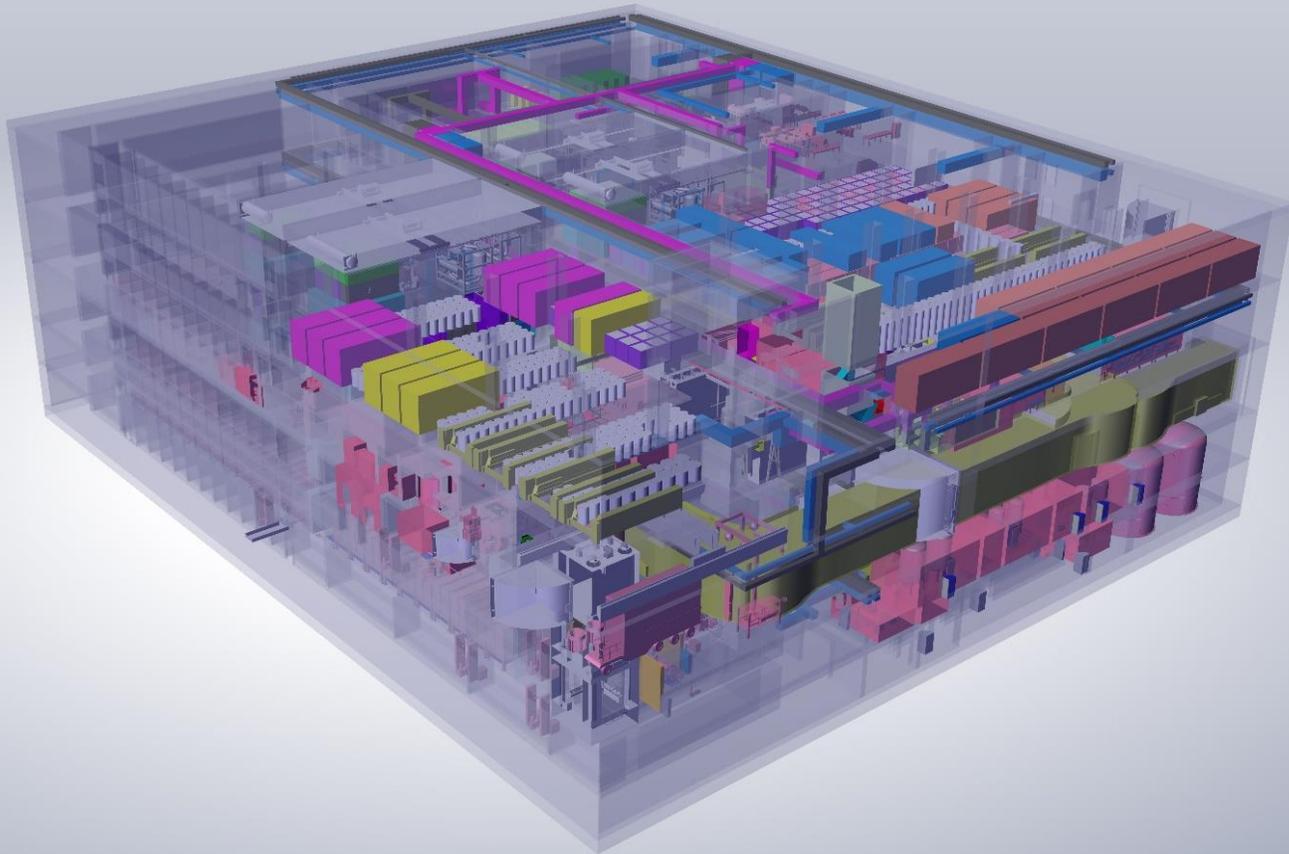


Control Room
3-storey, 3,500 m²



Neutral beam
power supply
bdg. 1 MeV
voltage fed to
the NB injectors

Conceptual design phase



Hot Cell Complex

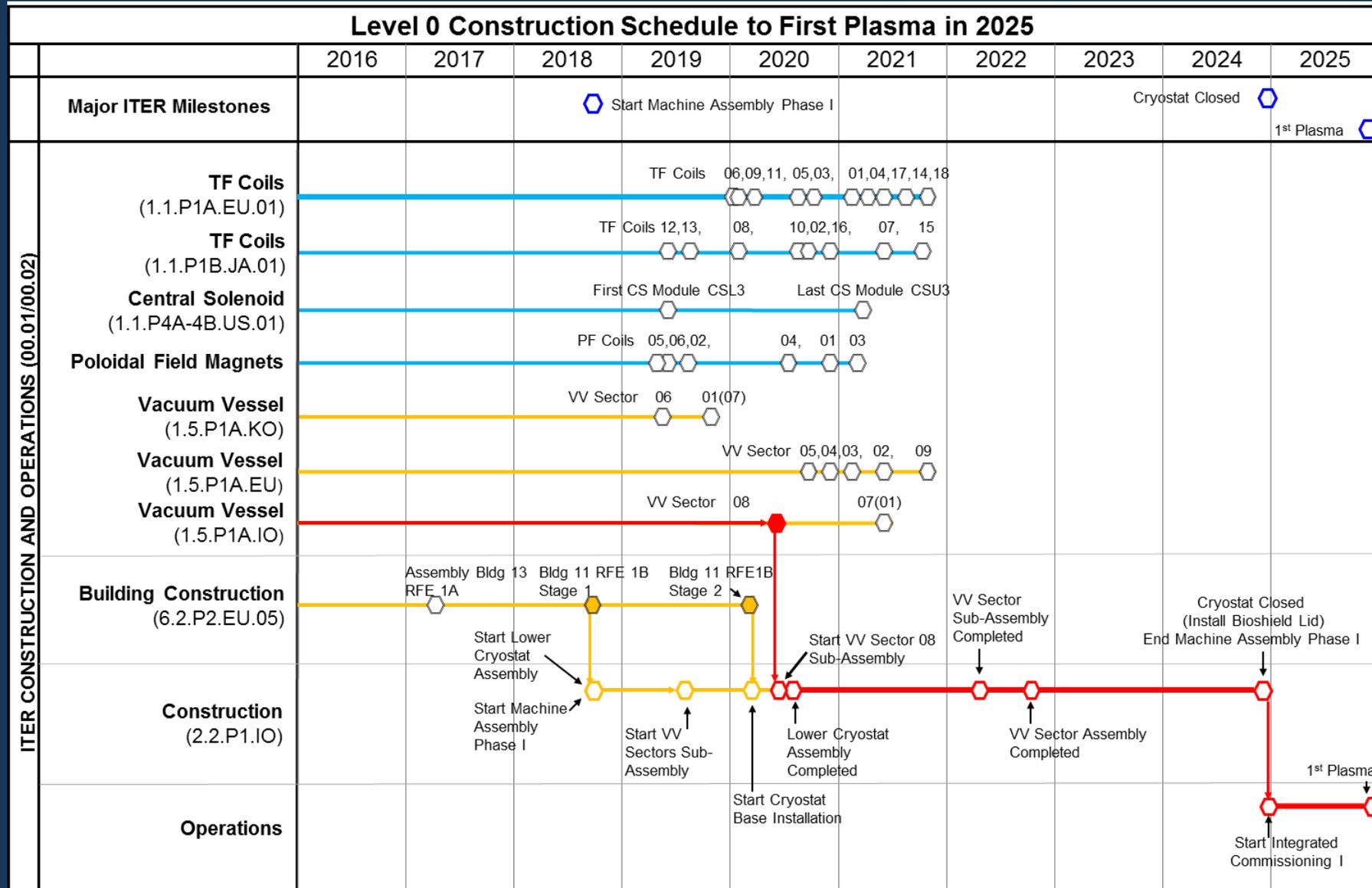
All processing, repair, refurbishment, and testing of components that have become activated by neutron exposure will take place in the ITER Hot Cell Complex.

Seven years of steady progress 2014 –2021



More than 80% of the installation's civil works is now completed.

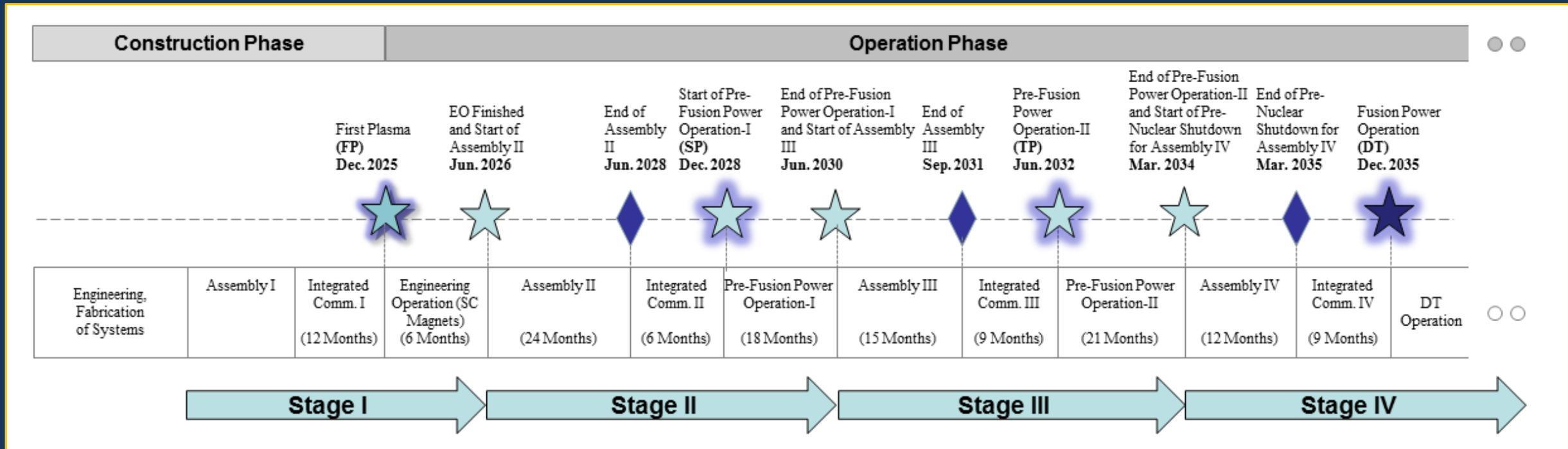
Baseline Schedule (*COVID impacts under investigation)



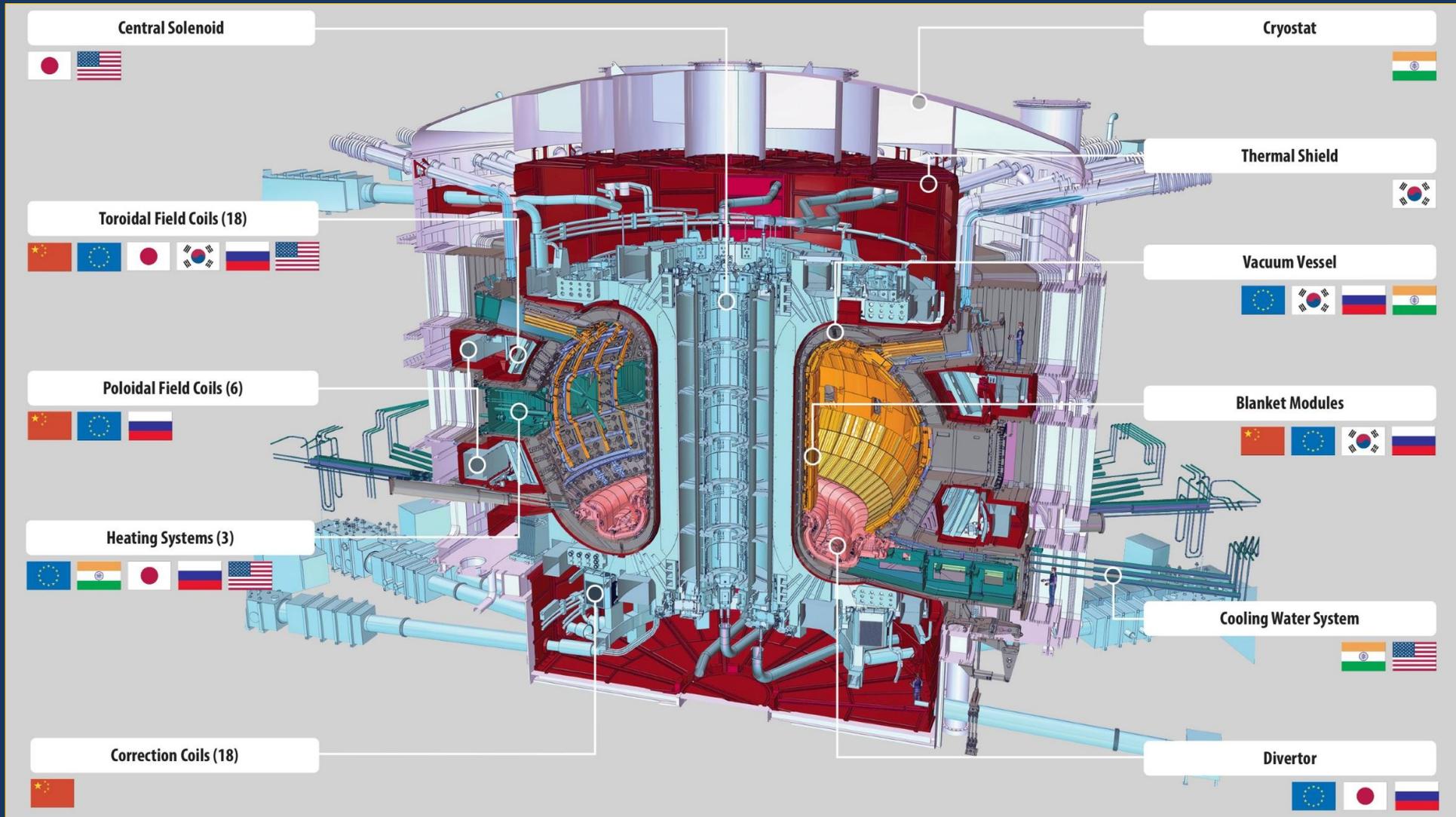
A staged approach to DT plasma

Extensive interactions among IO and DAs to finalize revised baseline schedule after COVID-19

- ✓ Schedule and resource estimates through First Plasma consistent with Members' budget constraints
- ✓ Proposed use of 4-stage approach through Deuterium-Tritium (2035) consistent with Members' financial and technical constraints



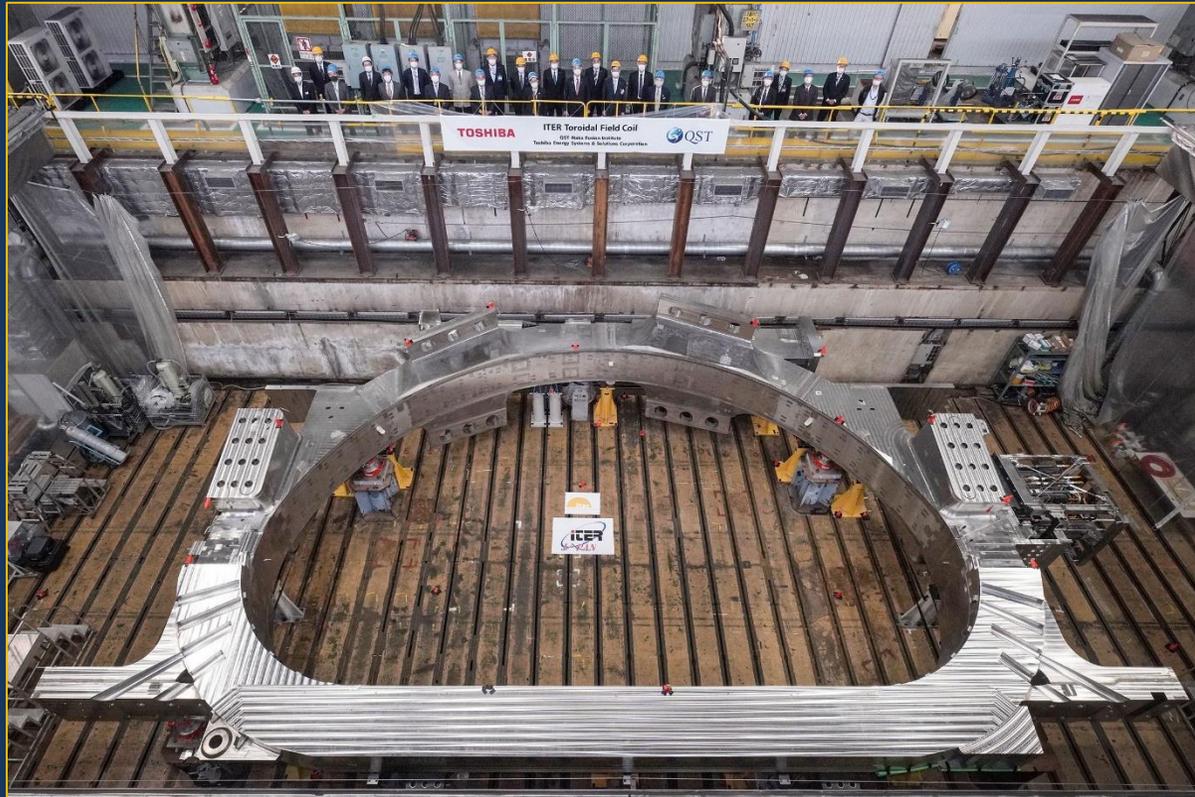
Who manufactures what?



The ITER Members share all intellectual and industrial property



85% of total manufacturing finalized



Japanese industry (Mitsubishi, Toshiba) is producing 9 out of 19 TF Coils for ITER. **Four have already been delivered** to the ITER site, a fifth is on its way. Here: Toshiba's first finalized coil in June 2021



Japan is producing **all the steel structural cases** that hold and protect the TF coils made in Japan and Europe. The pieces of the case must fit together with a tolerance of less than 1 millimeter.



85% of total manufacturing finalized



Japan is contributing the **1 MV power supply** for the **Neutral Beam Test Facility** under preparation in Italy. Neutral beam heating is one of the three ITER heating systems,.



Japan's QST has **manufactured 8 high-power microwave sources** (gyrotrons) for ITER's electron cyclotron resonance heating system. Factory acceptance testing has concluded successfully on the four units that are required for First Plasma.

85% of total manufacturing finalized



Five vacuum vessel sectors are **under fabrication** in Italy.
Completion rates range from 76 to 97%

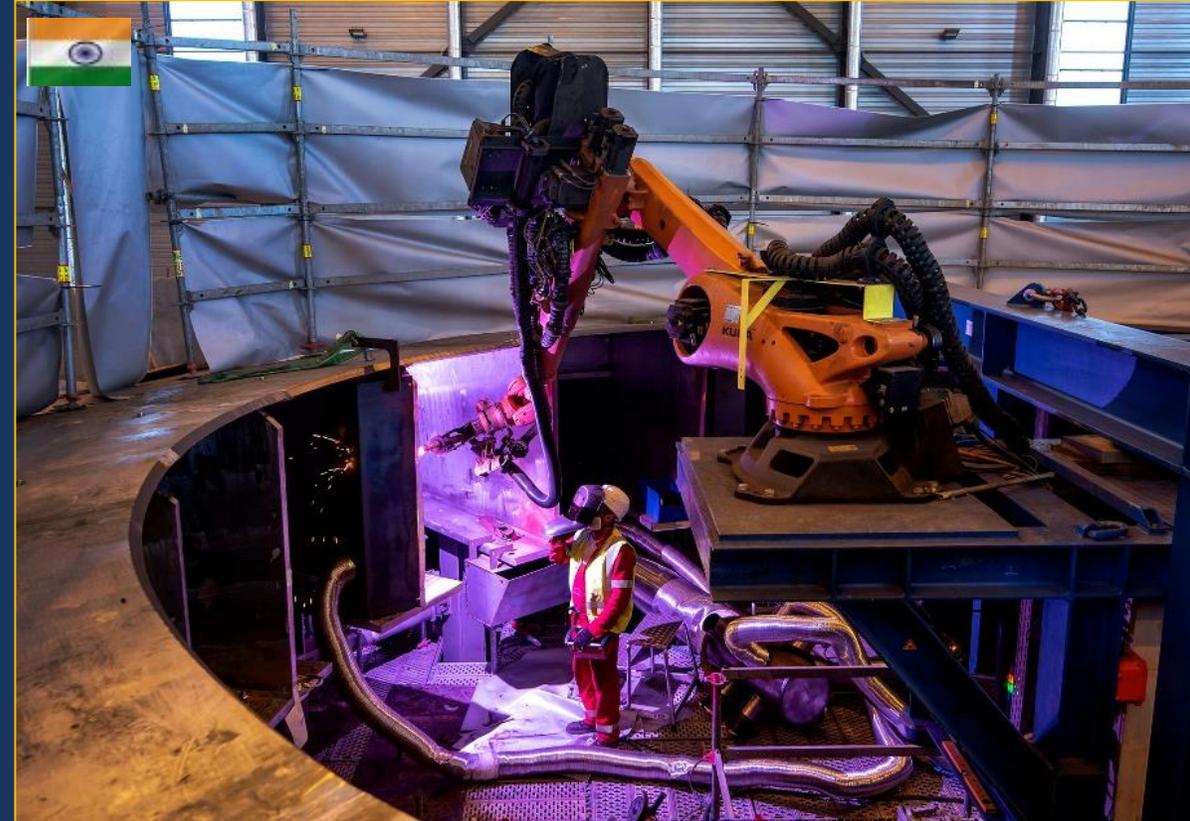


Two vacuum vessel sectors **delivered** - rate of completion of the remaining two : 98% and 92%

85% of total manufacturing finalized



Poloidal field coil #1 is entering the final stages of fabrication in Saint-Petersburg.

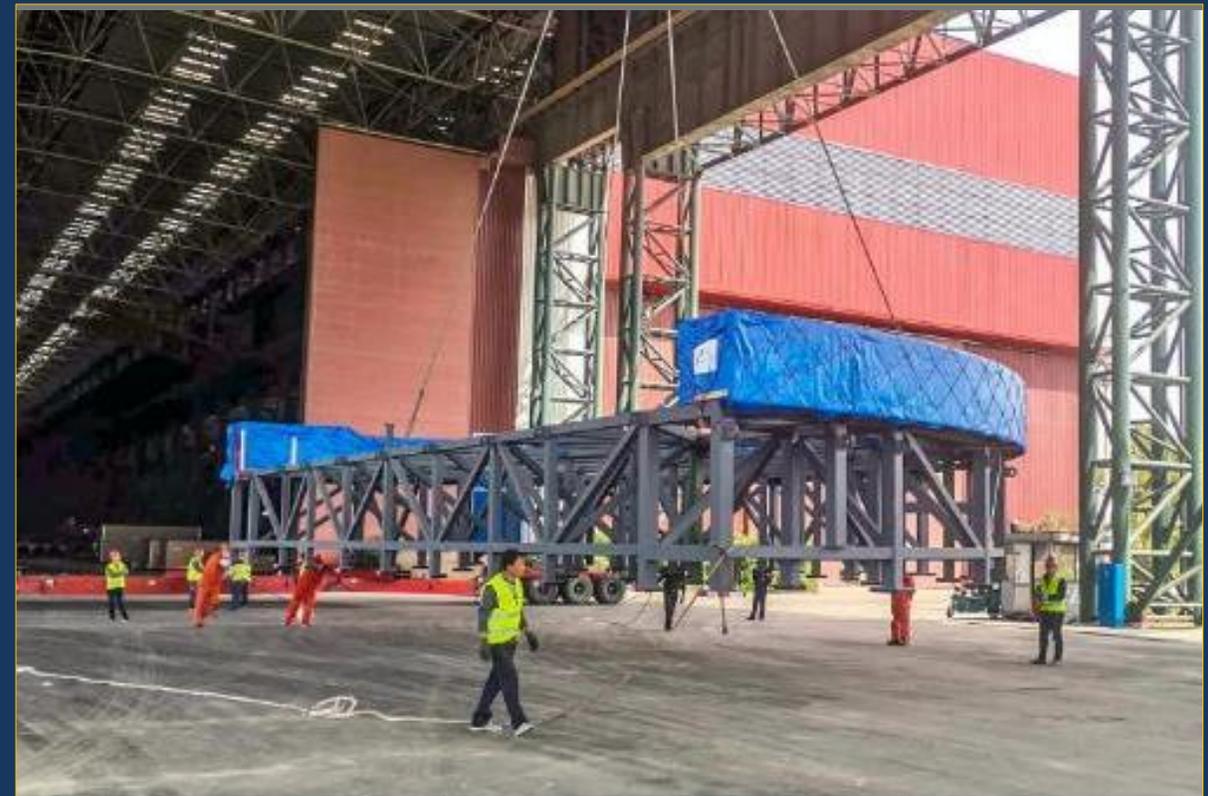


3 out of 4 sections of the Cryostat finalized, 2 installed. Top lid at final welding phase

85% of total manufacturing finalized

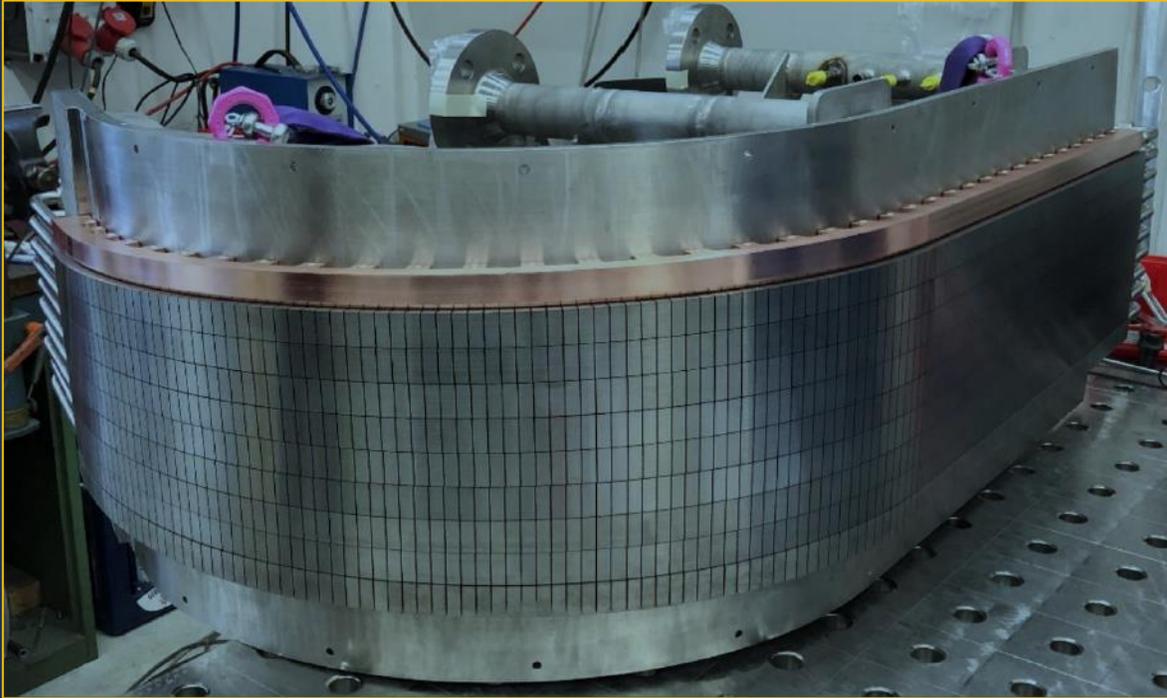


Two central solenoid modules **delivered** – 5 others (4 + 1 spare)
nearing end of fabrication



Ongoing delivery of more than 1,600 tonnes of equipment for the
magnet feeders

85% of total manufacturing finalized



Eight full scale Divertor Inner Target Plasma-Facing Units (PFUs) **manufactured** by Research Instrument (RI) Germany were **successfully tested** in the ITER Divertor Test Facility (IDTF) at the Efremov Institute (Russia)



Divertor Cassette Bodies series production on-going

85% of total manufacturing finalized



October 2021: **Installation** of 12m³ Water Detritiation water storage tanks



FAT of the 5th Gyrotron (for the ECRH) from RFDA held in Nov. 21

Start of assembly: A crucial milestone

On May 26-27 2020, the base of the Cryostat (1,250 t; procured by India) was successfully inserted into the Tokamak Assembly Pit.

Assembly progress: Cryostat installation

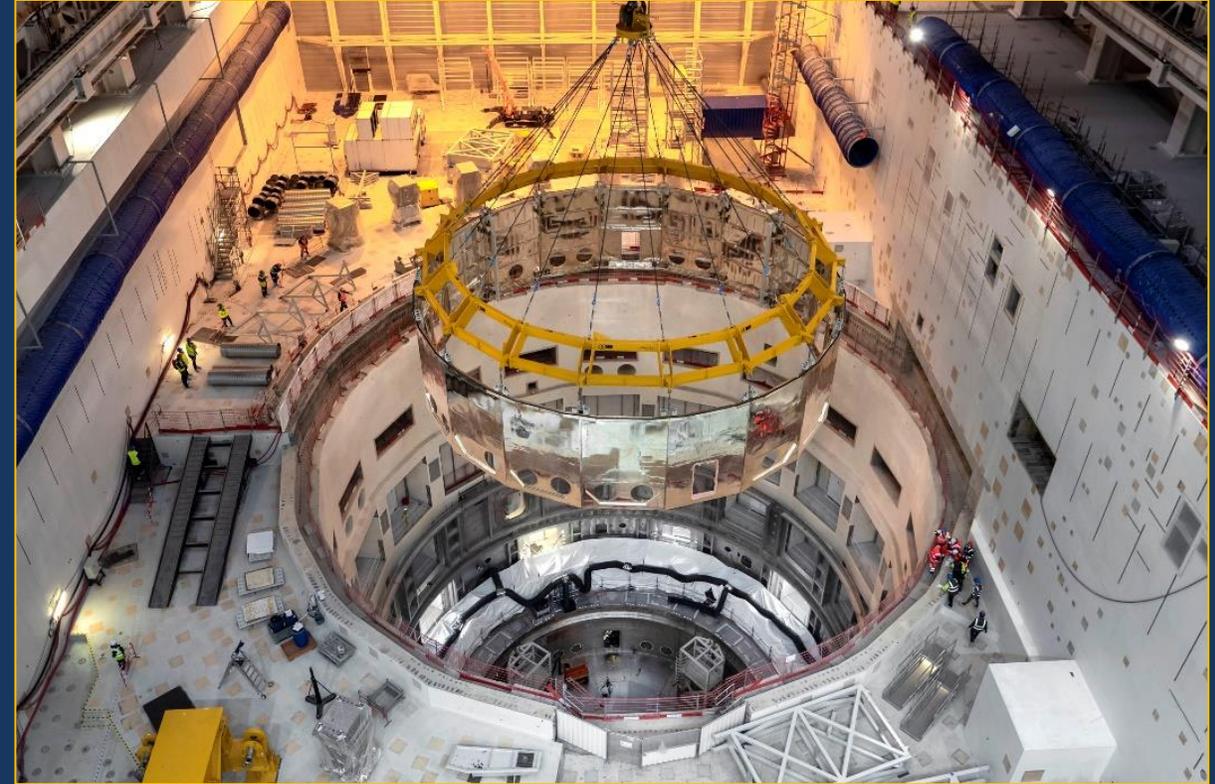
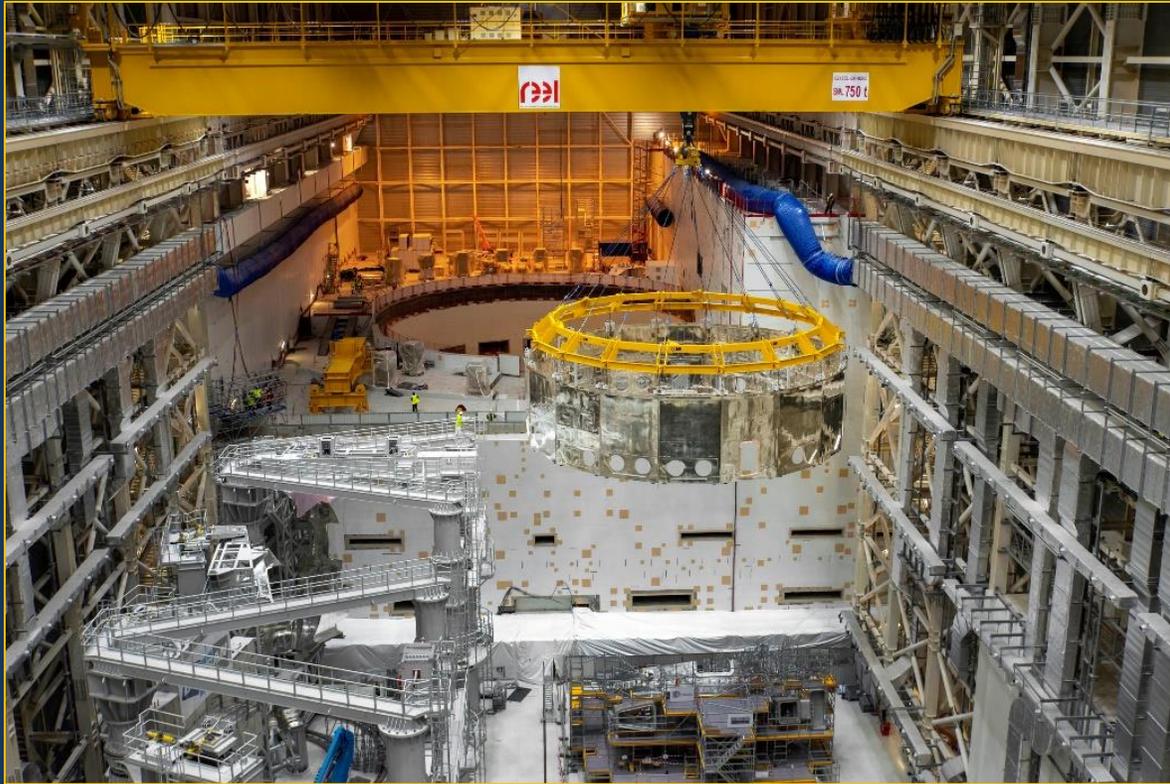


Cryostat Base lift,
26 May 2020



Inserting the Cryostat Lower Cylinder into the Tokamak Pit.
Perfect fit with the Base
31 August 2020

Assembly progress: Thermal shield insertion



The lower cylinder thermal shield (LCTS) was installed on 14 January 2021. A silver-plated component, the LCTS stands between the lower section of the Cryostat and the machine to act as an obstacle to thermal radiations.

Assembly progress: Tooling

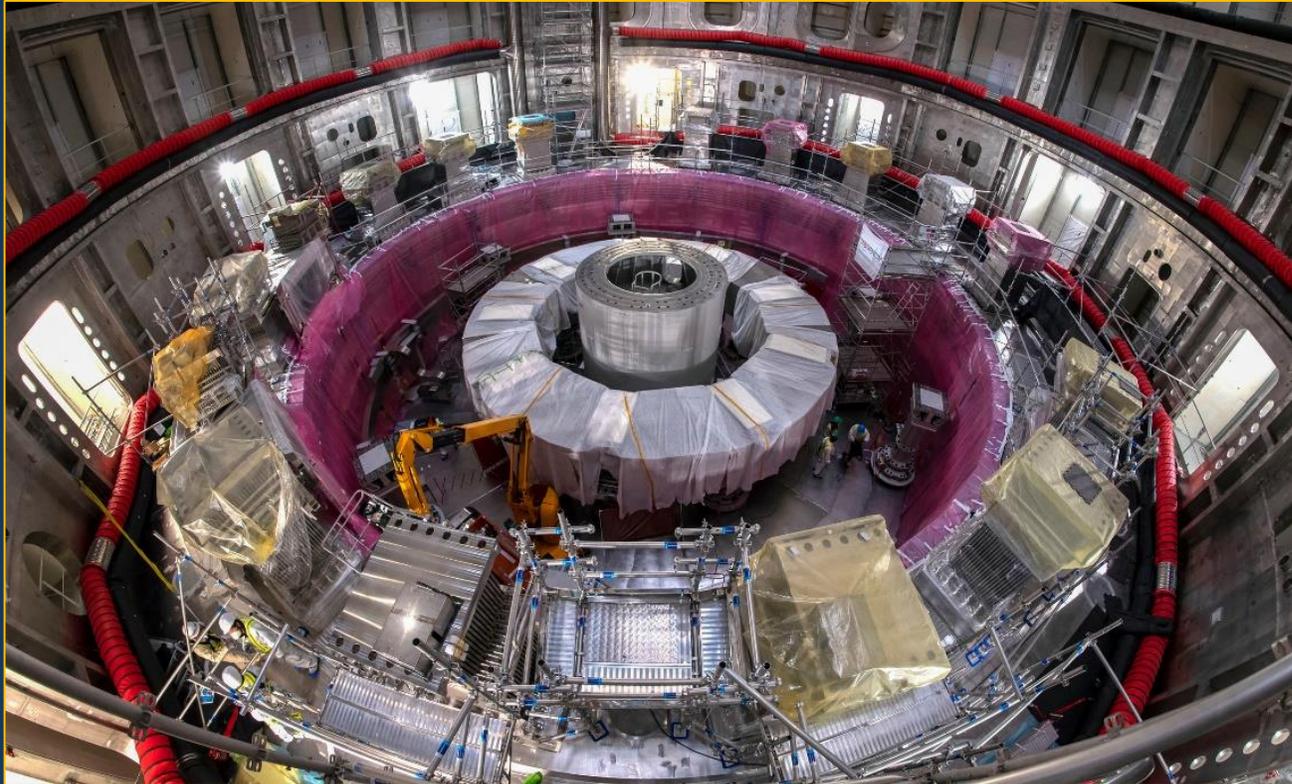


20 August 2021 – Central column (an in-pit assembly tool)

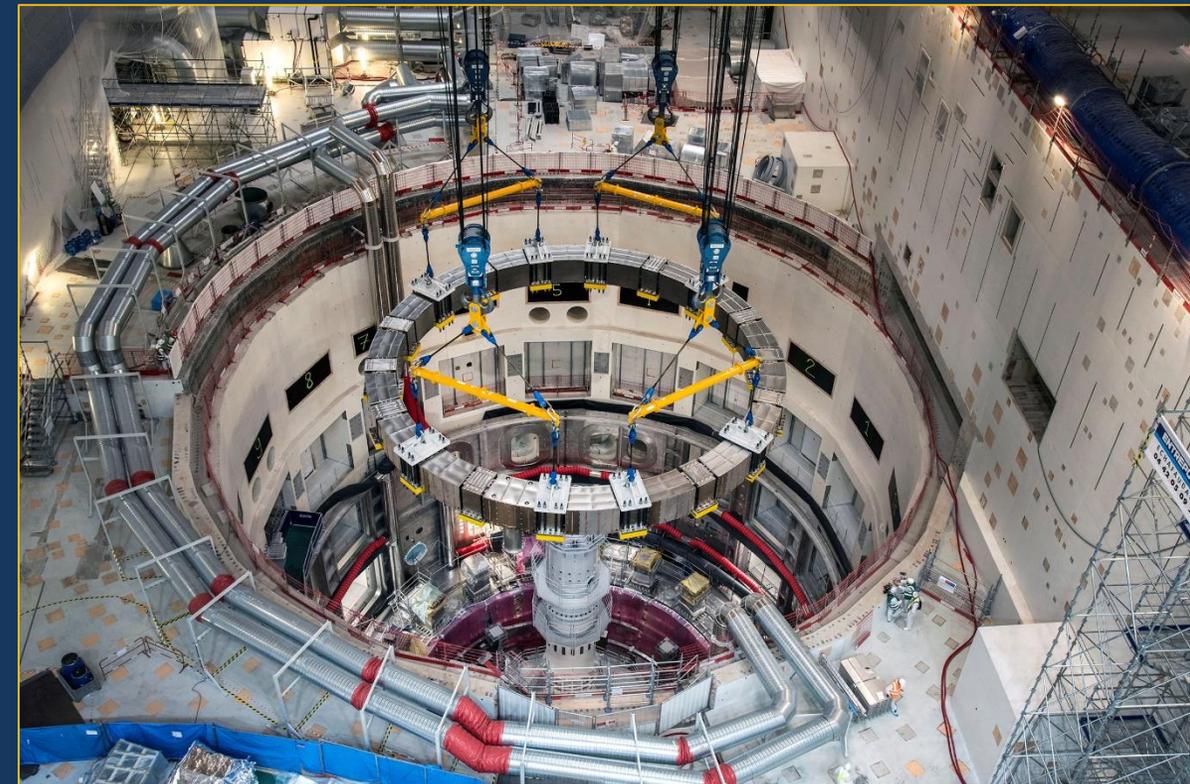


7-8 September 2021 – Test positioning of radial beam

Assembly progress: 2 ring-shaped coils (out of 6)

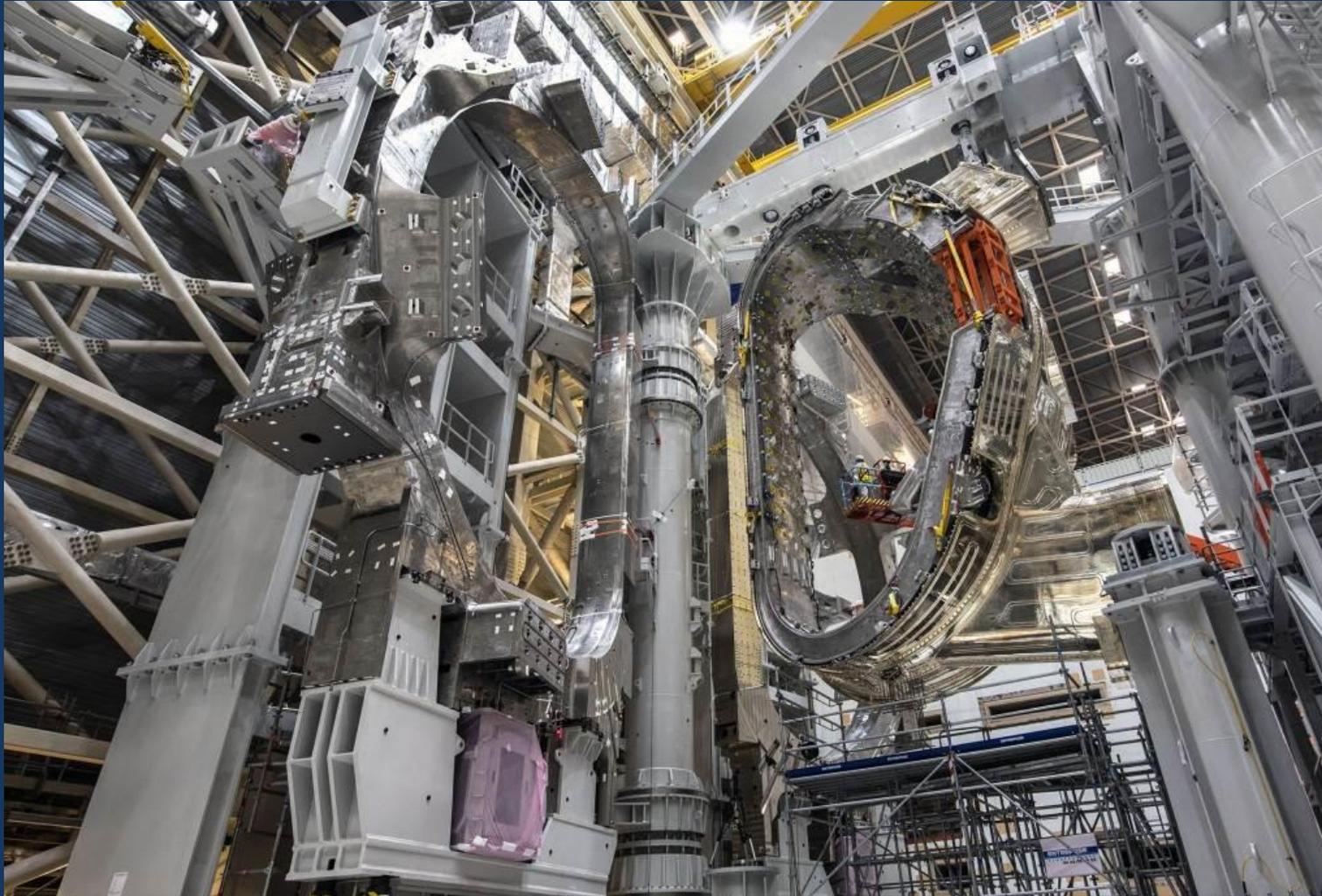


21 April 2021 – Poloidal field coil # 6



16 September 2021 – Poloidal field coil # 5

Toward the first « sub-assembly »



« Sub-assemblies » are the building bricks of the Tokamak's torus. They comprise one 40° vacuum vessel sector, two toroidal field coils and the corresponding thermal shield panels, and weigh in excess of **1,250 tonnes**.

Nine pre-assemblies are required to close the torus.

Final alignment was performed on 17 September within **extremely tight tolerances**:

radial direction 0.14 mm; toroidal direction 0.25 mm; vertical direction 0.58 mm.

Almost finalized: VV sector (# 6) and thermal shield sections from Korea, two TF Coils (# 12 and # 13) from Japan

Components deliveries



Main components delivered in 2020-2021:

- 10 TF coils (out of 18+1)
- 2 PF coils (out of 6)
- 2 vacuum vessel sectors (out of 9)
- 2 Central solenoid modules (out of 9+1)

Main components expected in the coming weeks:

- 1 TF coils

Balance of plant

Towards commissioning



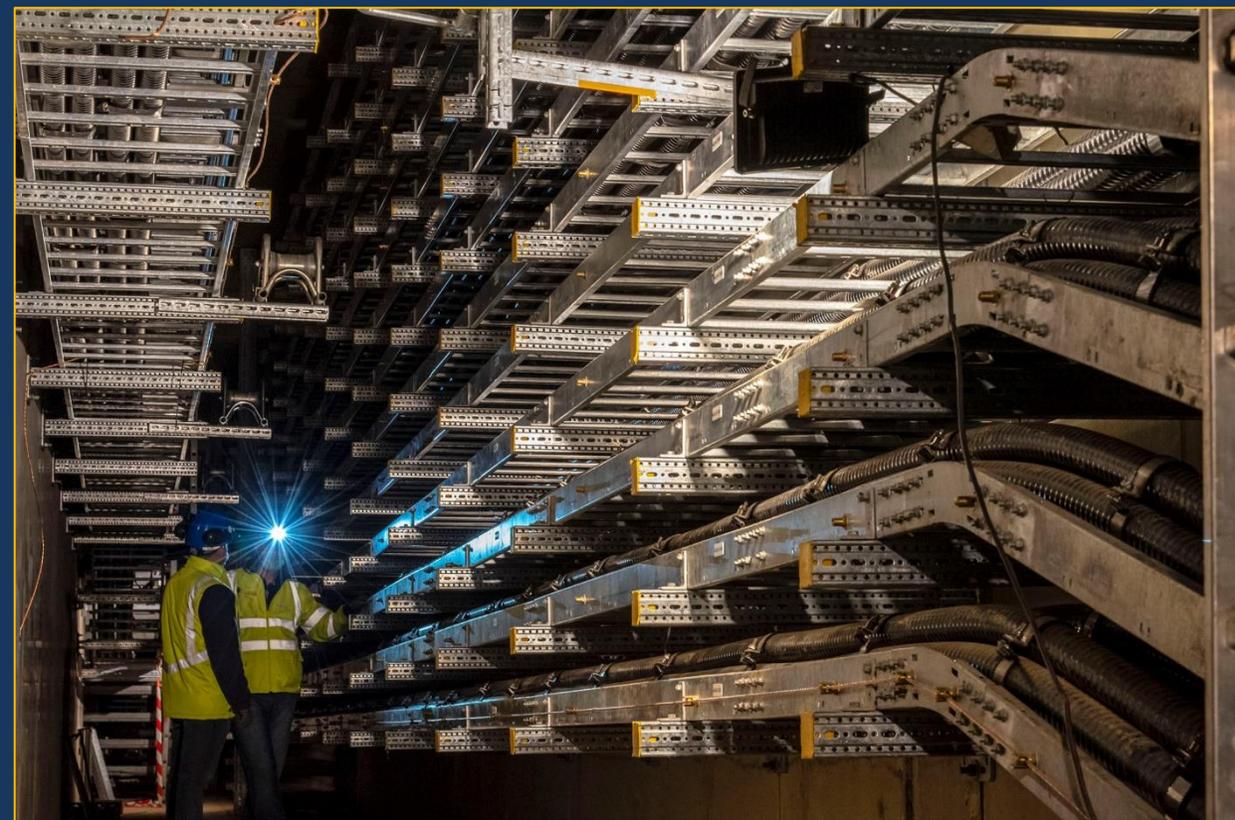
Cryoline
installation



Heat Rejection System

Balance of plant

Towards commissioning



10,000 km of electric cables



AC/DC conversion (8 km of busbar)

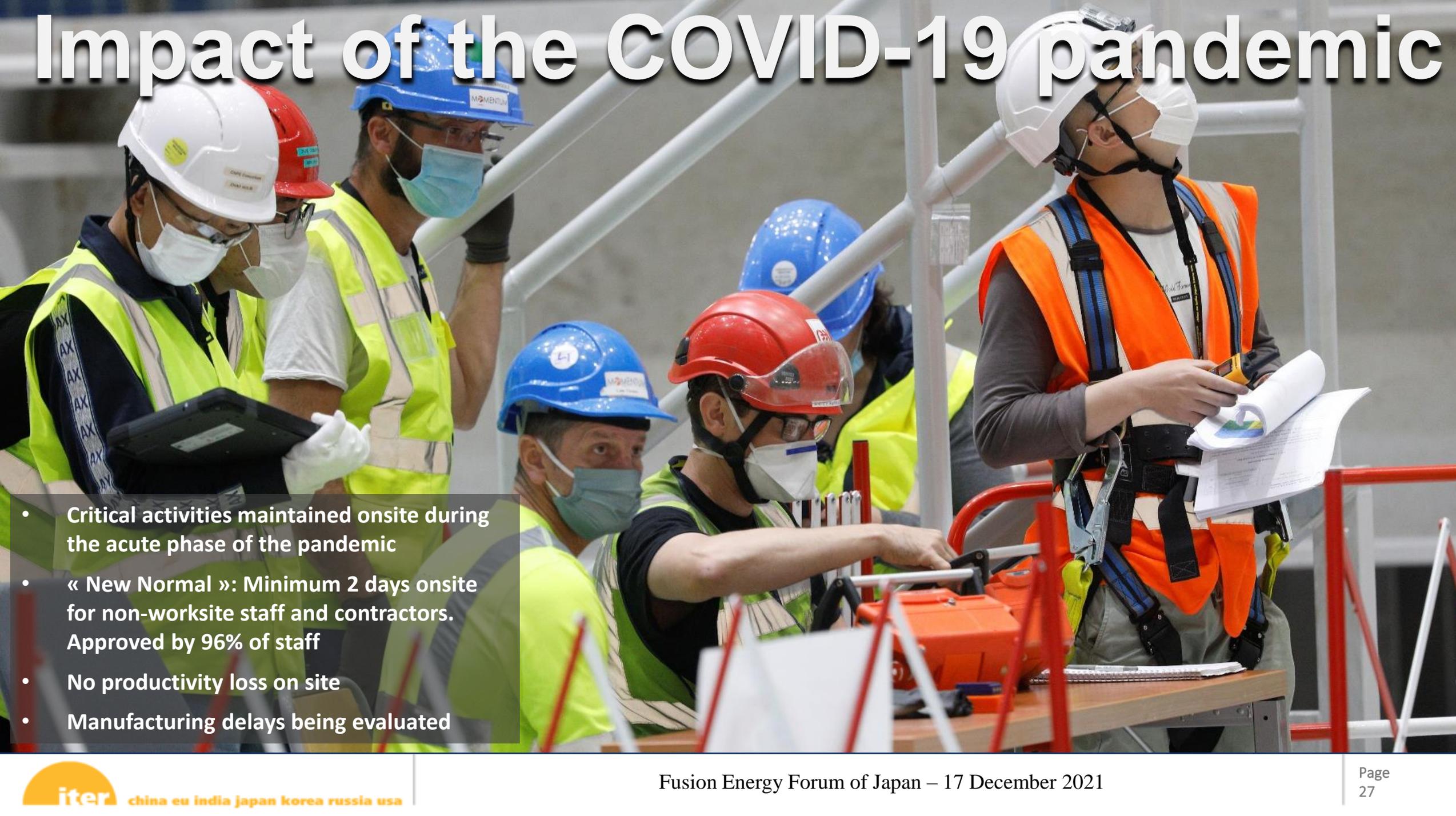
Balance of plant

Towards commissioning



Cryoplant

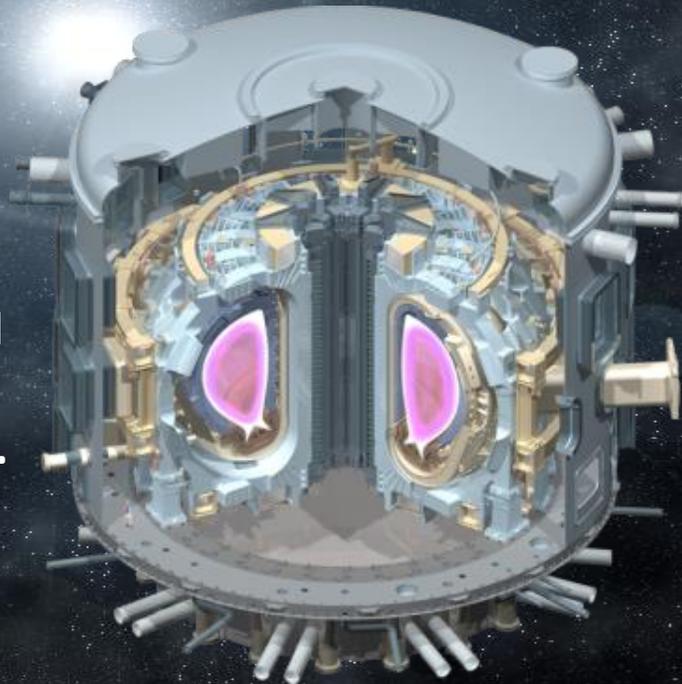
Impact of the COVID-19 pandemic

A group of construction workers wearing hard hats, safety vests, and face masks, working on a large industrial structure. The workers are focused on their tasks, with some looking at documents and others at equipment. The background shows a complex network of white pipes and structural elements.

- Critical activities maintained onsite during the acute phase of the pandemic
- « New Normal »: Minimum 2 days onsite for non-worksites staff and contractors. Approved by 96% of staff
- No productivity loss on site
- Manufacturing delays being evaluated

ITER and beyond

The ITER Members are developing conceptual designs for the « next-step » machine (DEMO).



ITER
800 m³
~ 500 MW th



DEMO, next-step machine
~ 500 MWe, 1 200 MWth