THE ITER PROJECT

UPDATING THE BASELINE

Alain Becoulet, DDG Chief Scientist,
on behalf of **Pietro Barabaschi**, Director-General

3 July 2024

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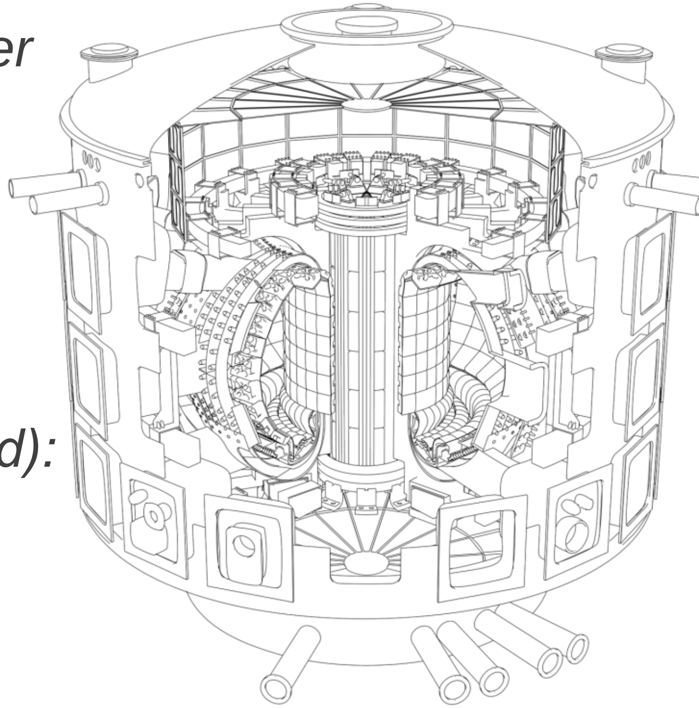
PRESS CONFERENCE TOPICS

- Baseline: what and why
- Comparison of previous and new baseline approaches
- Introduction of the New Baseline schedule

WHAT GOES INTO MAKING A "PROJECT BASELINE?"

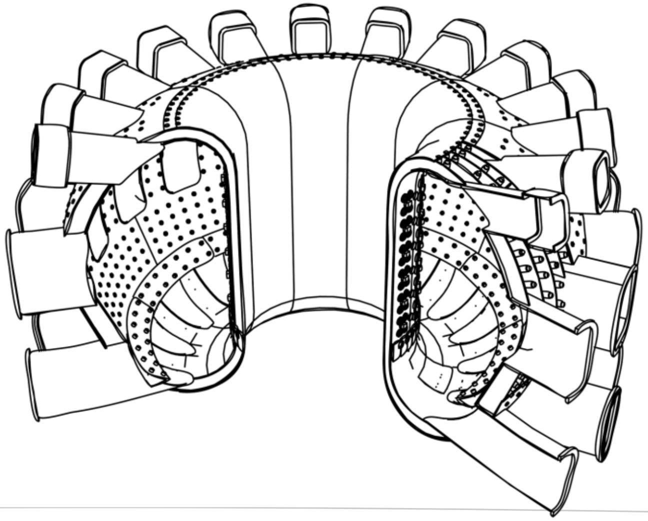
To construct ITER requires us to ***account realistically for the challenges of a First-of-a-Kind machine.***

- *The volume and weight of the ITER tokamak is nearly* ***10 times larger*** *than the largest existing tokamaks.*
- *Example: ITER will feature the largest magnet in the world – by far.*
  - *Atlas experiment (barrel toroid magnet) at CERN Large Hadron Collider*
    - *Guinness world record for largest current magnet*
    - *Cold mass of 370 tonnes*
    - *Operates at 4 Tesla*
    - *Stores 1.08 Gigajoule of energy*
  - *ITER's largest magnet, the combined toroidal field coils (just completed):*
    - *Cold Mass >6000 tonnes*
    - *Operates at 12 Tesla*
    - *Stores 41 Gigajoules of energy*



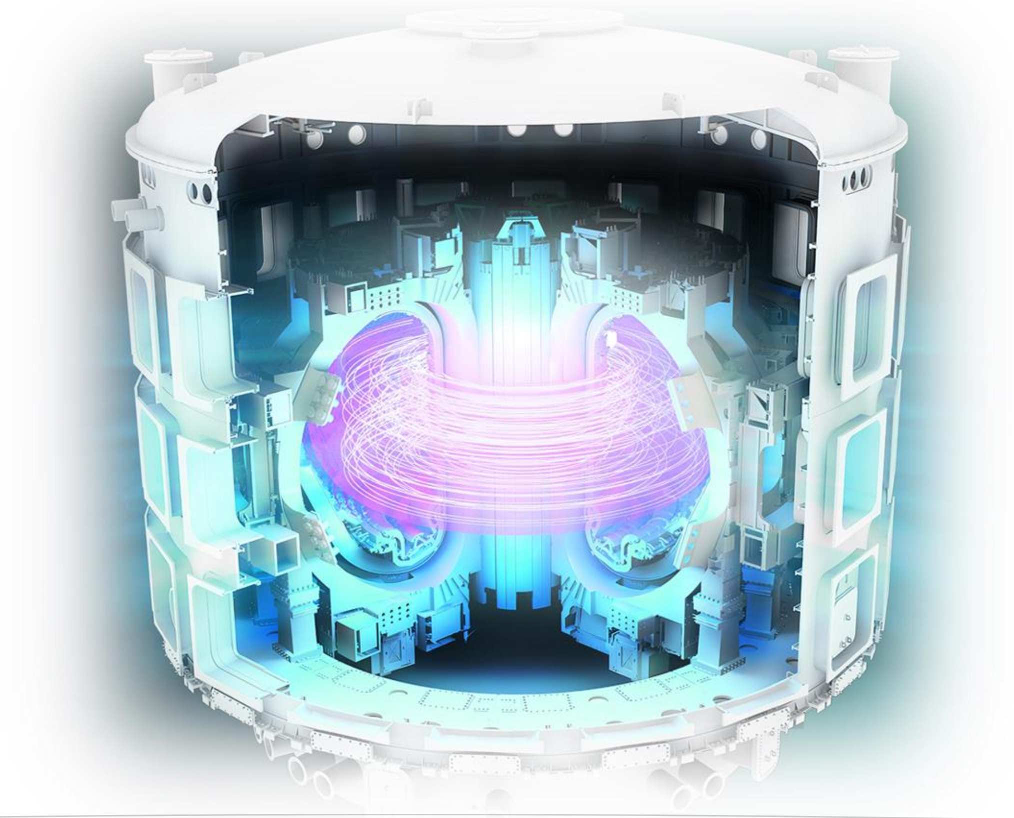
WHY DOES ITER NEED TO UPDATE ITS BASELINE?

- What is a Baseline? A project baseline is a reference project plan that includes agreed scope, schedule, and cost, against which progress and performance are to be measured.
- The previous plan – the Baseline designed in 2016 – has not been feasible for a few years
  - Since October 2020, it was made clear – publicly and to our stakeholders – that First Plasma in 2025 was no longer achievable
- Why?
  - Covid-19 pandemic
    - Shut down some factories, reduced workforce, and triggered other impacts, e.g.: maritime shipping, quality inspection.
  - Challenges of First-of-a-Kind components (as mentioned)
  - Quality issues: in design, manufacturing, project culture
    - Including some key components requiring repairs – as previously reported
  - Planning too optimistically for some aspects of manufacturing and assembly



PRIMARY TECHNICAL GOALS (MISSION ELEMENTS) OF THE ITER PROJECT

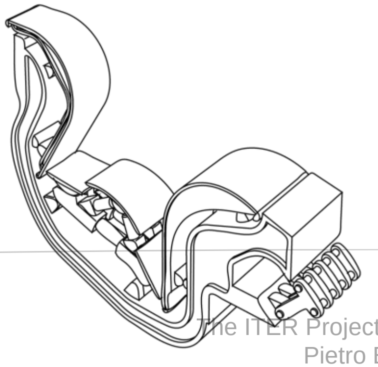
- To demonstrate the **integration of systems** needed for industrial-scale fusion operations
- To achieve **Q≥10**: **500 MW** of thermal fusion power output for 50 MW of heating power input to the plasma, in 400-second pulses, **reaching thermal equilibria in plasma and in structures**
- Over time: to achieve a **Q≥5 at steady state** operation

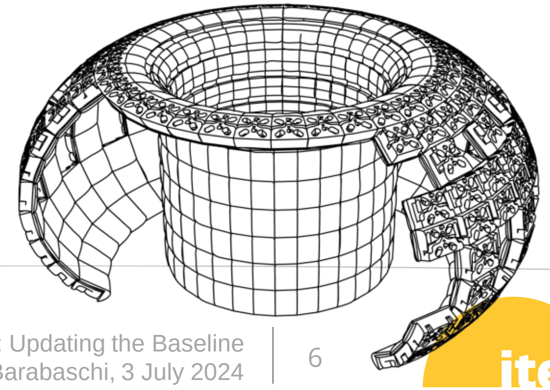


COMPARISON OF PREVIOUS BASELINE AND NEW BASELINE APPROACHES

- 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
  - Sub-optimal result:
    - First Plasma scheduled for 2025: a brief, low-energy machine test (100 kiloAmperes)
    - To be followed immediately by assembly and operation in four successive stages
    - Reaching **full plasma current in 2032-33** (=15 MegaAmperes, 150x higher current than in Baseline 2016 First Plasma)

    - Why? **Key additional components were not available for assembly before 2025**
      - Divertor (absorbing high heat loads)
      - Shield blocks (protecting the vacuum vessel
      - Etc.



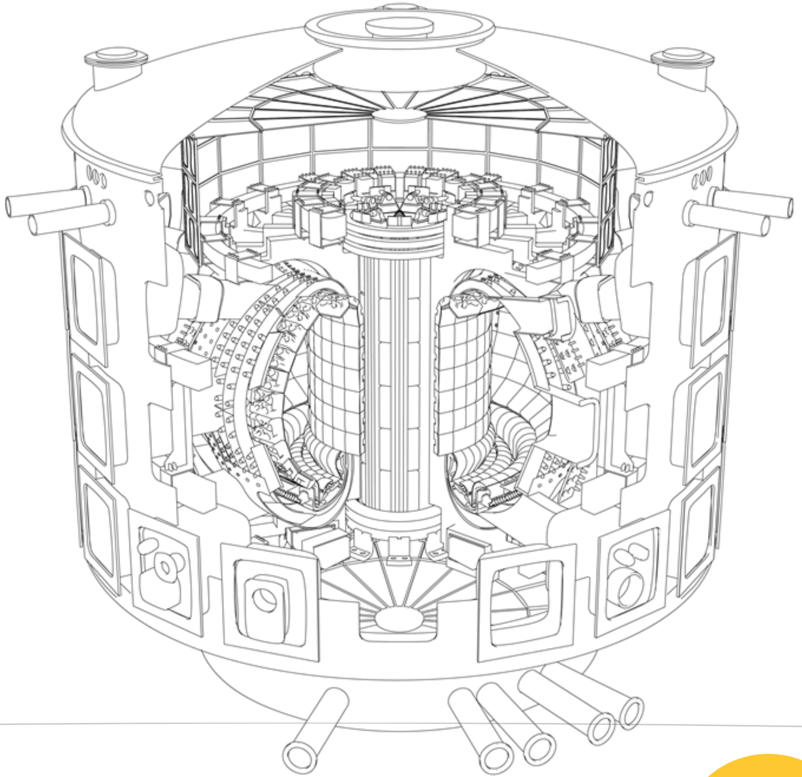


COMPARISON OF PREVIOUS BASELINE AND NEW BASELINE APPROACHES

- Considerations for the New Baseline
  - Could have kept the Baseline 2016 roadmap, but this would have now been illogical
    - *Why?* More components available to construct a more complete machine

  - Therefore: <u>redesign</u> to prioritize the **Start of Research Operations**
    - Make up for past delays, as much as possible
      - <u>Understand and correct the causes of delays</u>
    - Incorporate risk-reducing components
      - <u>Start operation with a more complete machine</u>
    - <u>Reorganize</u> internally to meet the challenges and enhance <u>project quality culture</u>

  - More robust way to achieve ITER's performance goals



HOW DOES THE NEW BASELINE PRIORITIZE PROJECT GOALS?

1. Start of Research Operations (SRO)
   - Installation of key components
     - Divertor: experiences the highest heat loads
     - Shield blocks: part of the blanket that protects the Vacuum Vessel
   - Will feature Hydrogen and Deuterium-Deuterium plasmas
   - Will culminate in operating the tokamak in long pulses at Full Magnetic Energy (FME) and Plasma Current
   - *Will largely demonstrate the integration of systems needed for industrial-scale fusion operations*
2. Overall plan developed to mitigate operational risks, also in preparation for DT Operations, e.g:
   - Additional testing of some Toroidal Field and Poloidal Field coils – full current, at 4 Kelvin
   - More time dedicated to commissioning
   - An initial sacrificial “first wall,” to be used up to full plasma current
   - More heating systems added, simulating in SRO divertor heat loads later expected in DT
   - Fully test all systems, disruption mitigation, etc.

COMPARISON OF SCHEDULES: PREVIOUS BASELINE vs NEW BASELINE

2016 Baseline

- First Plasma 2025: brief, low-energy machine test, minimal scientific value
  - Followed by four further stages of assembly/construction
- Full plasma Current: targeted in 2033

New Baseline

- Start of Research Operation (SRO): now targeted in **2034**
  - More complete machine
  - 27 months of substantive research
- Full Magnetic Energy will be ~3 years delayed from the previous baseline, from 2033 to **2036**.
- Start of Deuterium-Tritium Operation Phase will be ~4 years delayed from the previous baseline, originally targeted in 2035, now **2039**.

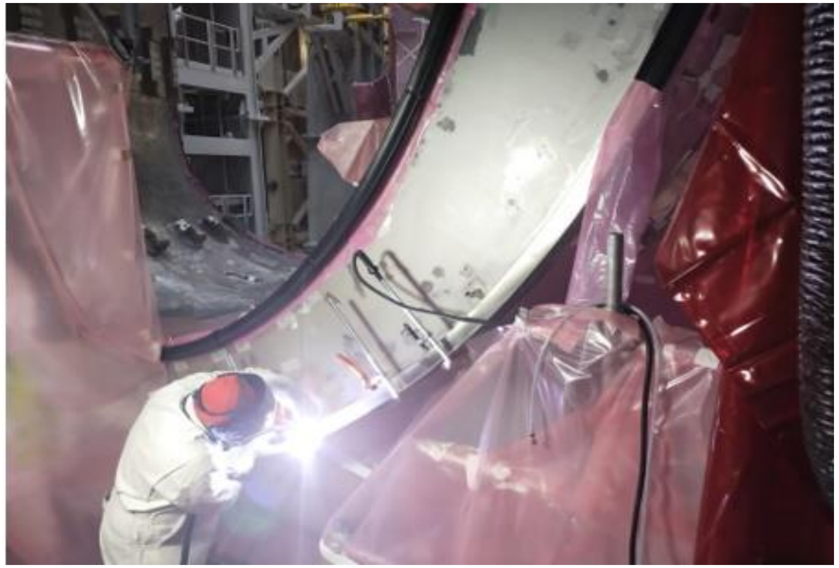
A FURTHER KEY FEATURE OF THE NEW BASELINE

- Will use Tungsten instead of Beryllium for the First Wall (plasma-facing material)
  - Tungsten is more relevant for future “DEMO” machines and eventual commercial fusion devices

- A two-phase “safety demonstration”
  - First DT operation phase (DT-1): Q≥10, but at a low neutron fluence (~1% of project specification).
  - Enables understanding of the profile of neutron distribution and radiation mapping
  - Will facilitate DT-2 operations (at full fluence) with greater regulatory confidence and more realistic safety margins

RECENT (GOOD!) NEWS FROM ITER

- Sector #7 Build-Up + NDE and Machining ongoing



- Sector #5 before starting repair activity (courtesy Mangiarotti)

- Thermal Shields repair/re-manufacturing activities on-going

RECENT (GOOD!) NEWS FROM ITER

- ITER Private Sector Fusion Workshop (27-29 May 2024)

- Celebration of the reception of all EU PF coils (21 June 2024)

- Celebration of the reception of all 19 TF coils (01 July 2024)

Thank you!

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