ITER: performance under the new Baseline

Pietro Barabaschi, Director-General, ITER

QST Annual Symposium on ITER and the Broader Approach

Tokyo, 19 January 2026

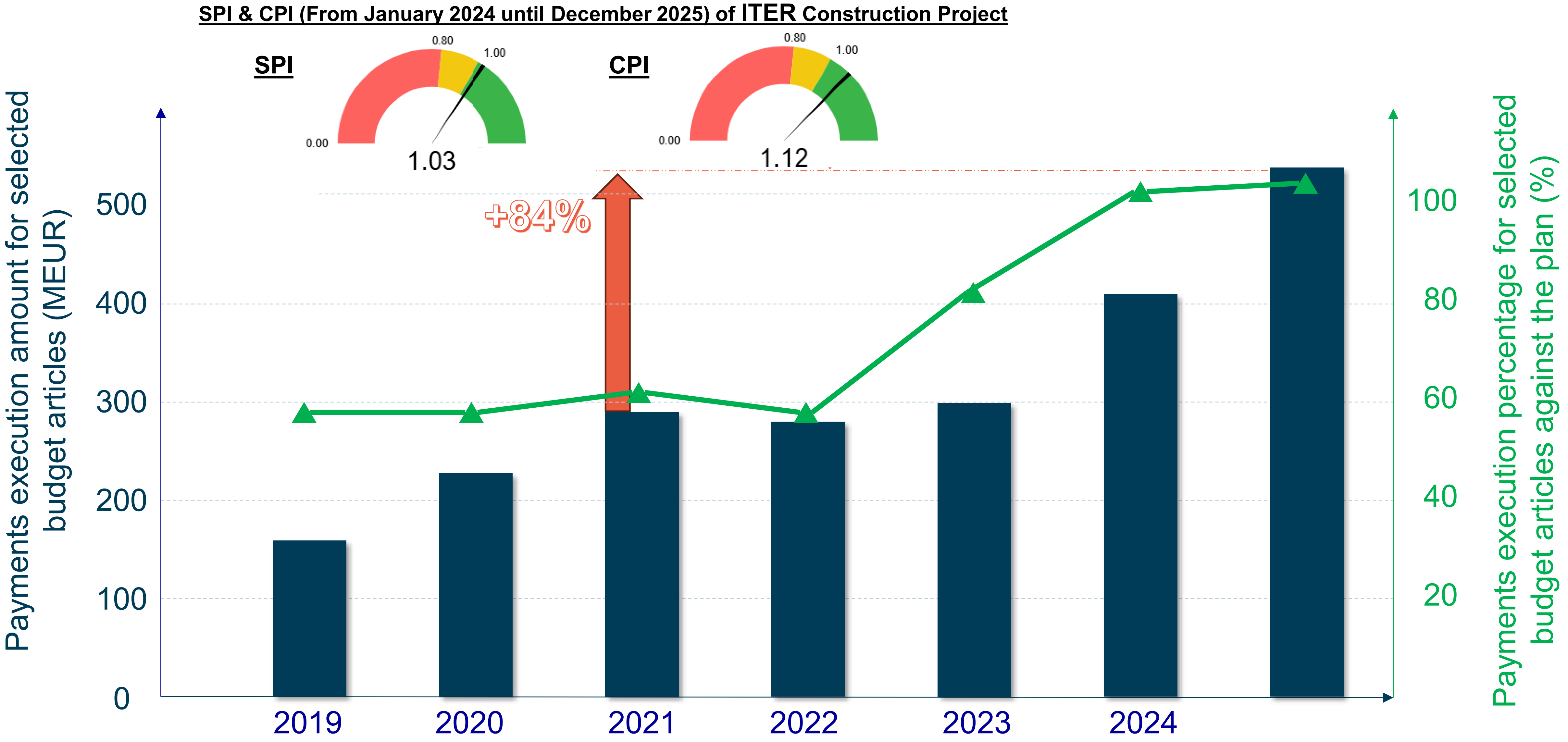
china eu india japan korea russia usa

ITER Performance and Construction Progress

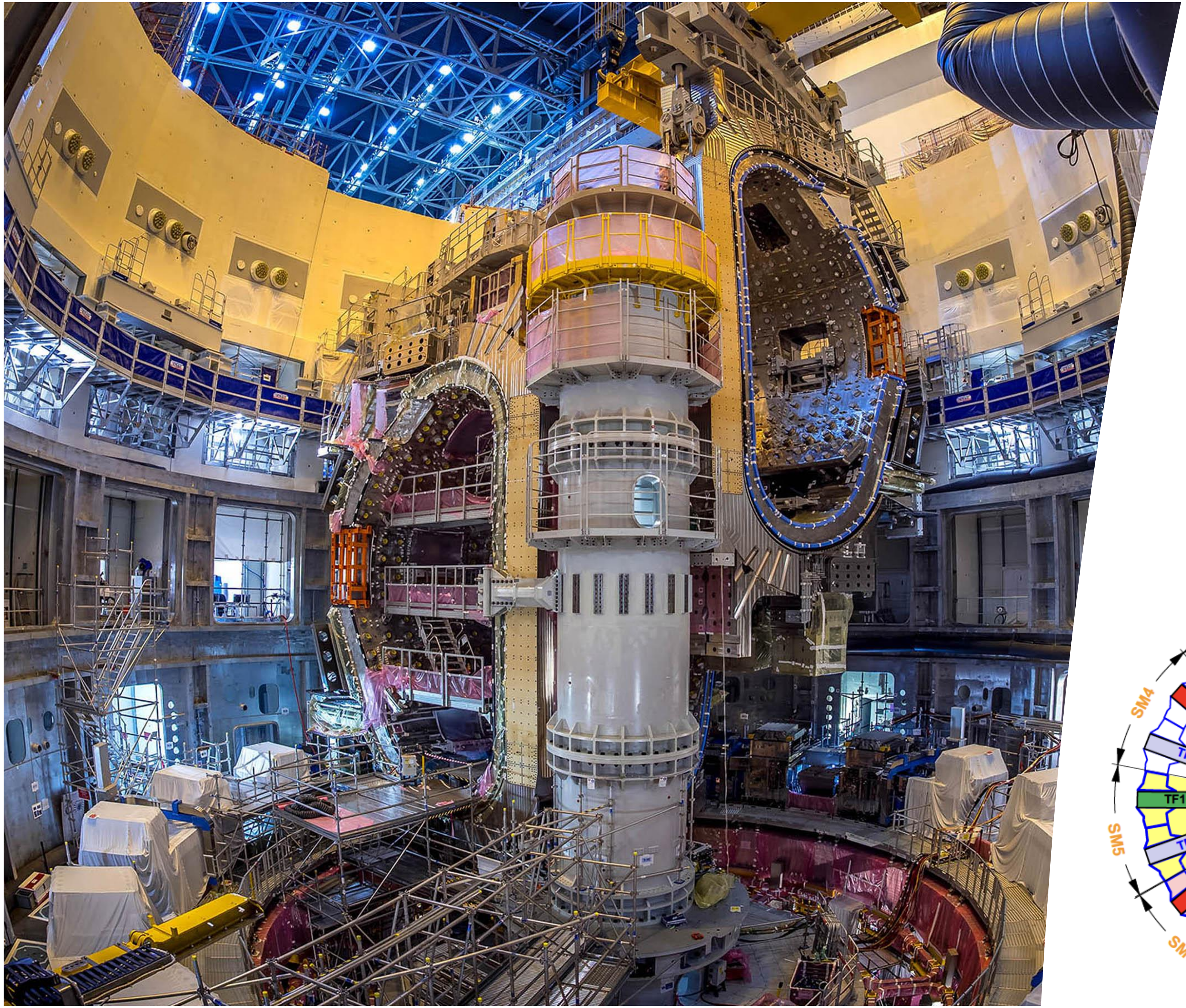
FROM THE TURNAROUND YEAR IN 2023, THE ITER PROJECT HAS PERFORMED AT RECORD RATES OF EXECUTION IN 2024 AND 2025

- Major restructuring of organisation;
- Recovery of trust with the French Nuclear Regulator, and initiation of important simplifications;
- Restructuring of assembly contracts;
- Repair of components;
- Development of the 2024 cost and schedule Baseline, incorporating many new concepts;
- Improved project and design control processes;
- …while achieving record (>100%) execution for construction
    - SPI = 1.03
    - CPI = 1.15

ITER has achieved 100%+ of planned Construction capital growth



Note: Construction Related articles includes:*
A111 (Direct Investment), A112 (Test Blanket Module) , A321 (General Services), A323 (Equipment)



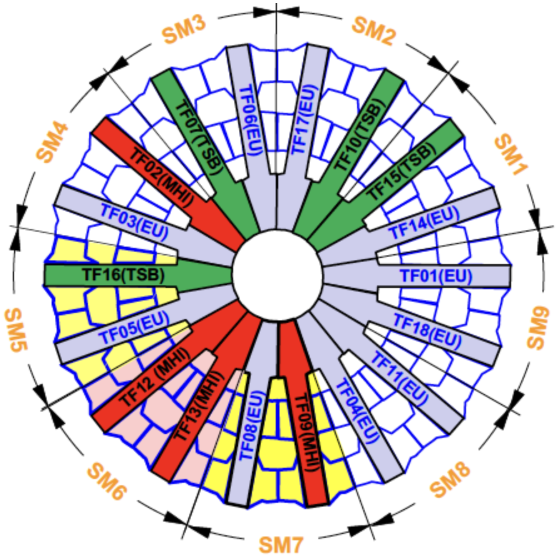
TOKAMAK MACHINE ASSEMBLY

Assembly contracts and organization reset in 2023.

Sector Module 7 installed in Tokamak Pit, April 2025.

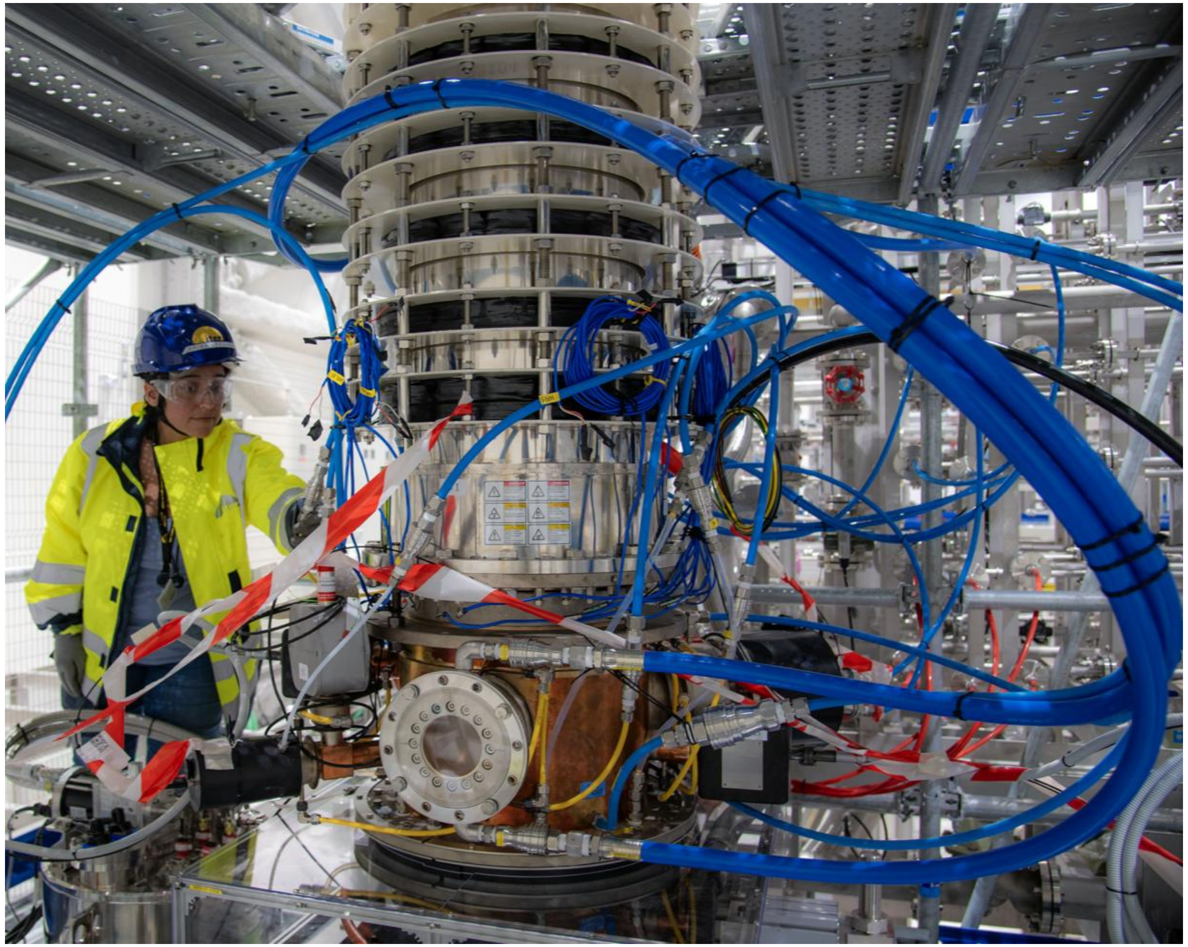
Sector Module 6 installed in the Tokamak Pit, June 2025.

Sector Module 5 installed in Tokamak Pit, November 2025.



4 TF coils from Japan is now in Tokamak Pit

Progress related to JA Contributions:



ELECTRON CYCLOTRON HEATING

2.7-metre high gyrotron installed in September.

DIVERTOR

Outer vertical target in series production

- ITER as center ground for fusion workforce
  - Post graduate program
  - Increase of secondments
- Private sector fusion support
  - Supply chain
  - Access to ITER knowhow
  - Open-sourcing major software
  - Participation in ITPA committees
  - Staff exchanges
  - ..

Introducing ITER

Design Foundations of ITER and Perspectives on Fusion

- Developments in privately funded and competitive fusion research are leading to healthy competition, but at times also generating hype and unrealistic promises which lead to excessive expectations.
- Policy makers sometimes question ITER's relevance, and are unaware of the challenges that the commercialization of fusion energy still face: physics, technical and financial.

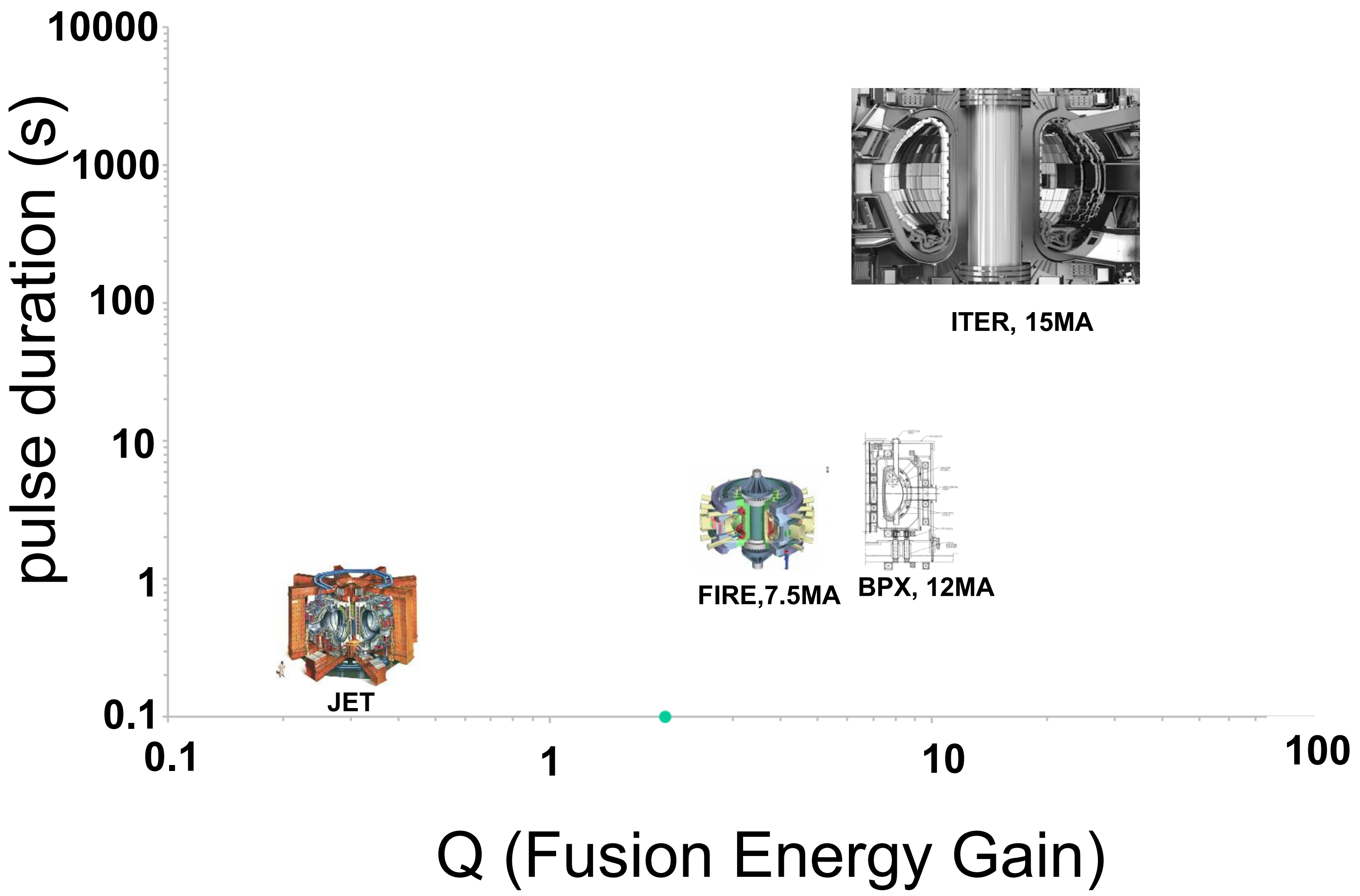
<u>Regarding ITER, typical questions are:</u>

1. Why ITER designed the way it is, e.g., why is it so large?
2. Would it be different if designed now?
3. Why does ITER cost so much? Why does it take so long?
4. Is ITER enough?

There's a global need to align communication around accurate, scientifically based, and grounded information

Q1: Why R~6m?

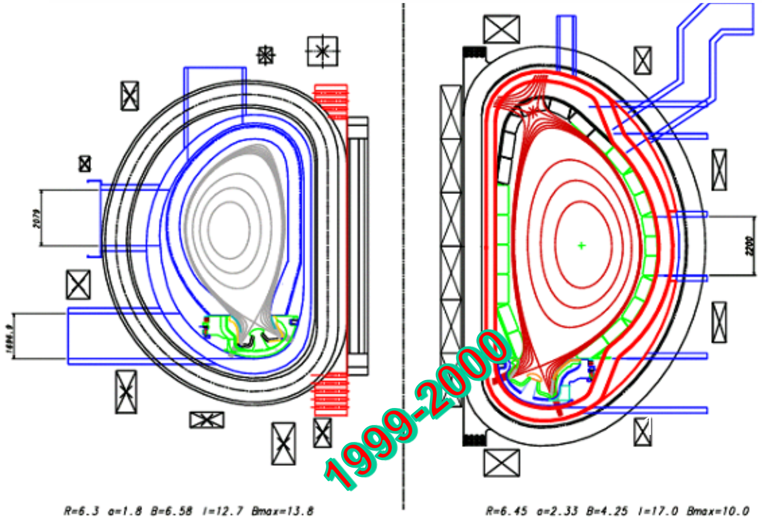
- nTt with conservative assumptions -> 15MA
- Thermal equilibrium of structures
- Shielding blanket sized to operate for long pulses AND allowing for potential breeding (>1.2m between magnet and plasma edge)



Q2: and what if…we designed ITER today?

- Nothing fundamentally new in confinement
- Power flux still an issue
- Still need a FW and a breeding blanket would require >1,2m
- And what about Field? Would it change if we would use HTS?
- Nb3Sn can work at fields >>12.5 T
- In ITER Nb3Sn takes only 4% of inboard cross section.
- Already in 1990s was well understood: For a burning plasma experiment, lasting a few seconds, that may work… i.e. CIT, BPX, CIT, FIRE, Ignitor are past design which, even if not at 15MA, were intended for that purpose (e.g. BPX, 1992, ~JET size, Ip~11MA) … but in transient conditions.

- ITER's field is not chosen on some cliff edge J in magnet at 12.5T…in 1999-2001 high(er) field version of ITER. Marginal reduction of size, albeit increase in cost and power flux.



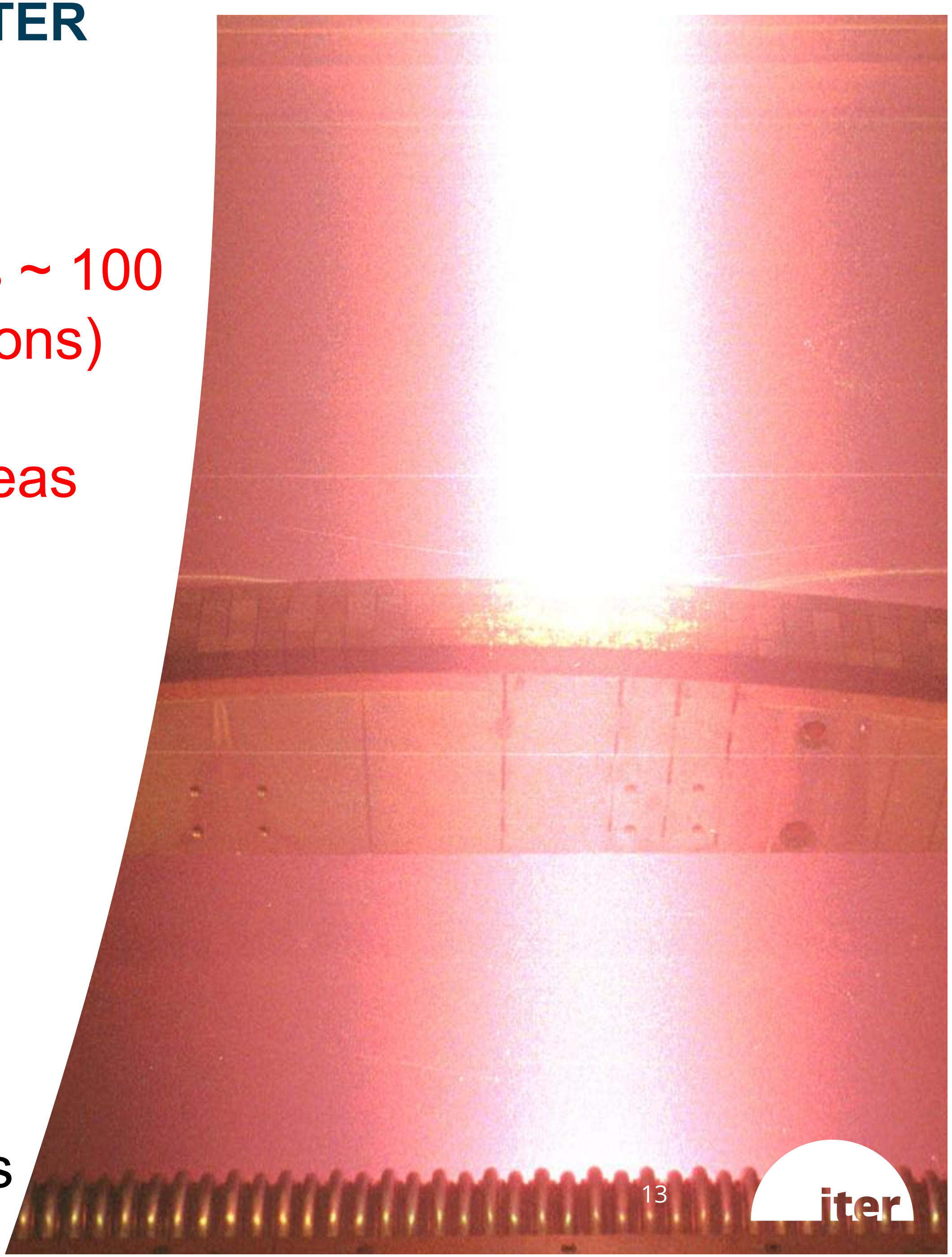
Q3: what about the cost? Not just size ... But largely driven by:

- Organizational complexity and political compromises
- Technical complexity
- Escalation of requirements
- FOAK issues

- Could we do it faster, and cheaper? Yes
  - Avoid problematic sharing of deliveries
  - Early industry involvement: Engaging suppliers during the design phase ensures manufacturing processes are reflected in design choices.
  - Appropriate quality grading: Over-specification should be avoided to prevent unnecessary costs.
  - Practical loading conditions: Mechanical and thermal loads (and stresses) must be kept within ranges that do not force overly complex solutions, tolerances, material specs, etc..
  - Simplified system interfaces, well-controlled: Avoiding tightly packed or overly interdependent subsystems reduces costly and cascading design changes.
  - Assembly-aware design: Allowing adequate space for assembly and maintenance prevents expensive complications; “smaller” is not always cheaper.

Q4: FUSION'S REMAINING CHALLENGES beyond ITER

- Cost
- Surface Heat Flux management
  - Heat flux is far from uniform - peaking factors ~ 100
  - Transients (MHD instabilities, ELMs, Disruptions)
- Materials resistant to extreme conditions
  - Intense flux of high-energy neutrons, over areas with enormous surface heat flux
  - Erosion
- RAMI, e.g.
  - Remote handling for maintenance
  - Reliability against Leaks
- Tritium breeding and fuel cycle
  - Lithium 6, large amounts needed
  - Breeding challenging, even with ~1m blanket
  - Small burn %, large circulation
- Overall efficiency, due to large circulating powers
- Current Drive in Tokamaks



Thank you for your attention

iter
china eu india japan korea russia usa