Status of the ITER Project

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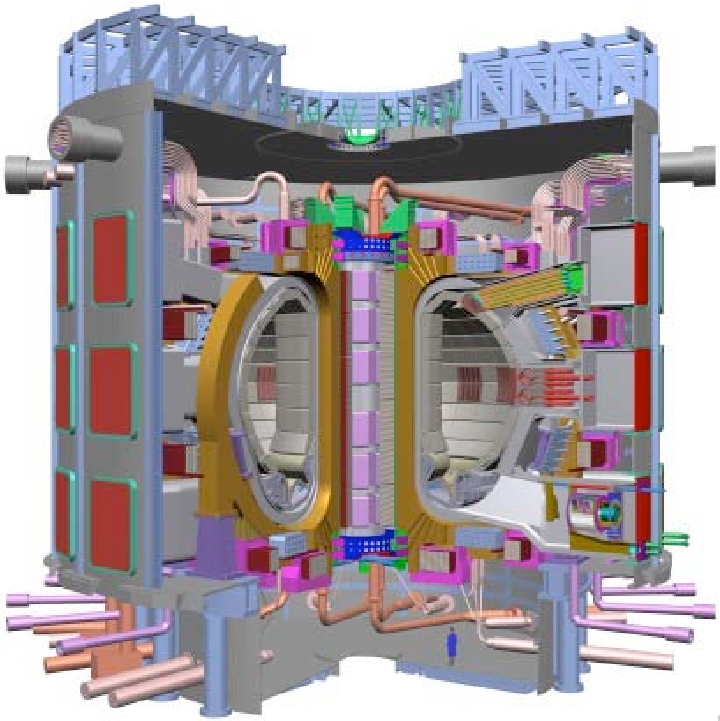
What is ITER Today?

- ITER ("the way" in Latin) is the essential next step in the development of fusion.
- Objective - to demonstrate the scientific and technological feasibility of fusion power.
- The world's biggest fusion energy research project.
- An international collaboration.



The Mission

- Up to steady state fusion power production.
- Plasma makes 10x more power than needed to run it.
- Optimise plasma behaviour.
- Have dimensions comparable to a power station.
- Produce about 500 MW of fusion power.
- Demonstrate or develop all the new technologies required for fusion power stations, except materials endurance.
- Obtain license for construction and operation.
- Operate for about 20 years.
- Cost about €5bn to construct (over 9 years) and €5bn to operate (about 20 years) and decommission.

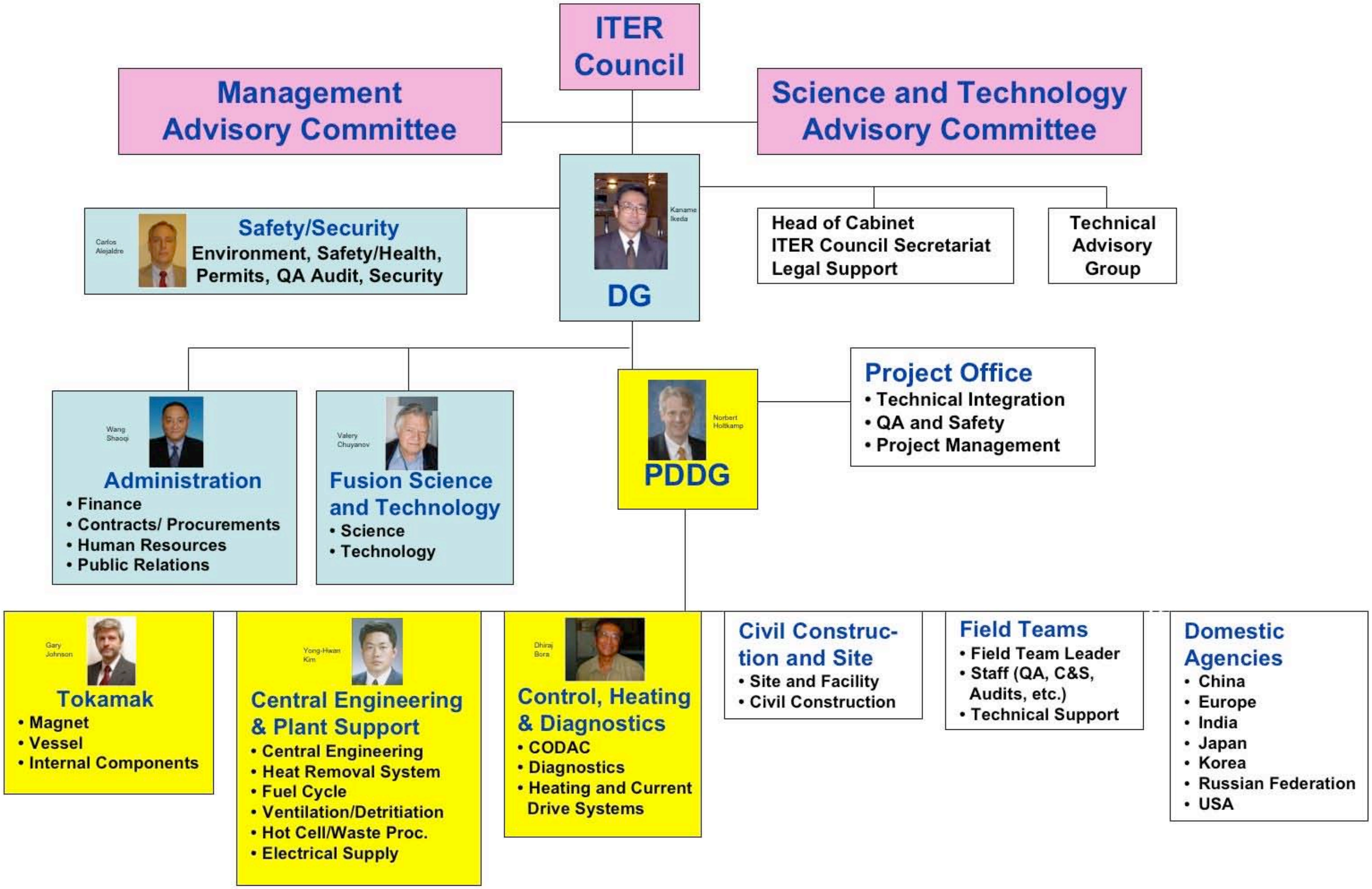
Cadarache Site

The ITER building

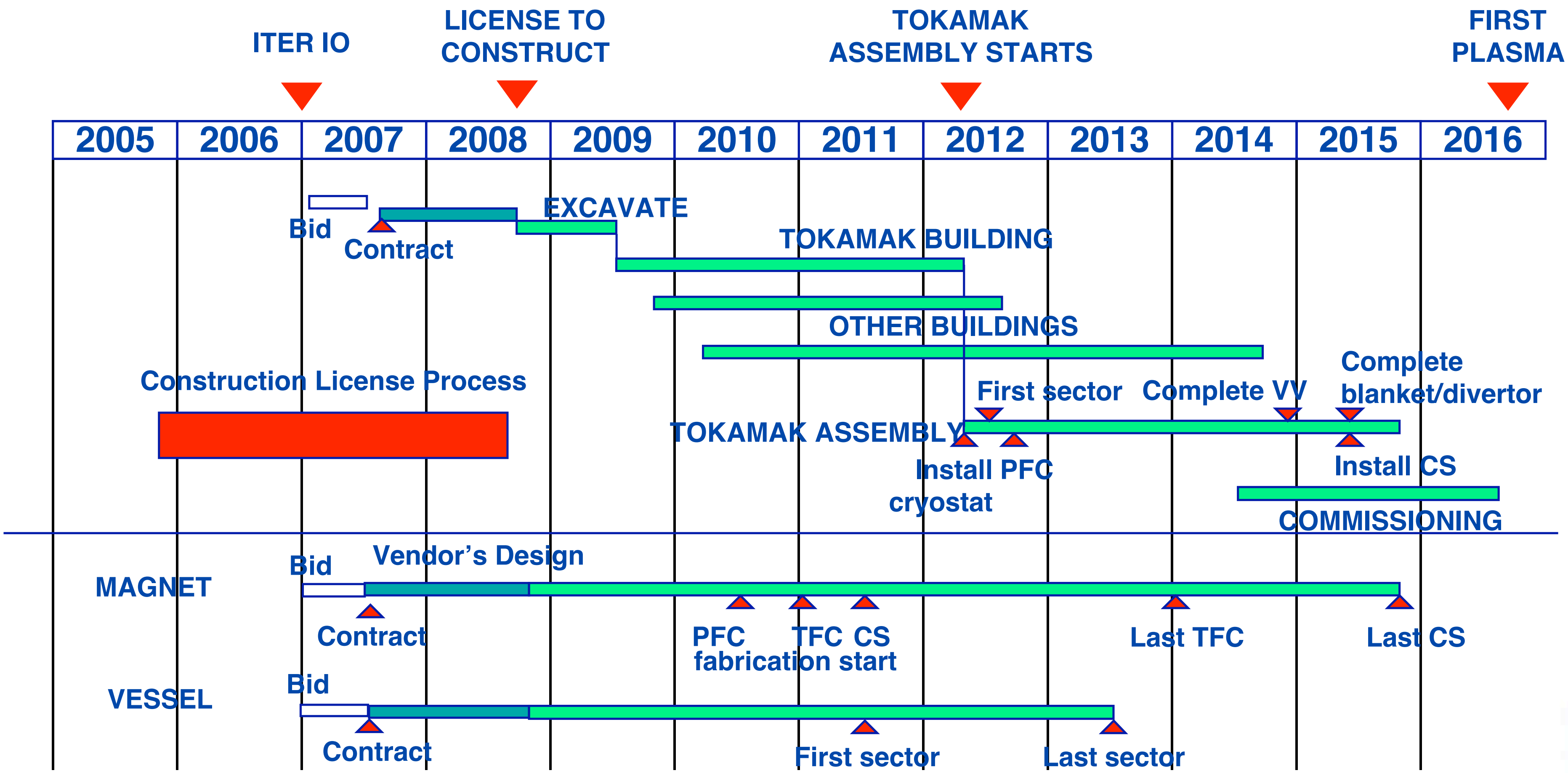
Status of the ITER Organisation

- Presently there are still three JWS: IPP-Garching, JAEA-Naka and CEA-Cadarache
  - Garching, Naka, will be closed by the end of the year.
  - Many people already transitioning to Cadarache on an interim basis with the intent to become employees as soon as possible.
- Final ITER agreement underway:
  - Agreement accepted by negotiators April 1st.
  - Documents were initialed May 24th.
  - Documents should be signed on Nov 21st.
  - After that ITER should become an (interim) legal entity and should execute all functions of a legal body.

ITER Organisation



Integrated Project Schedule

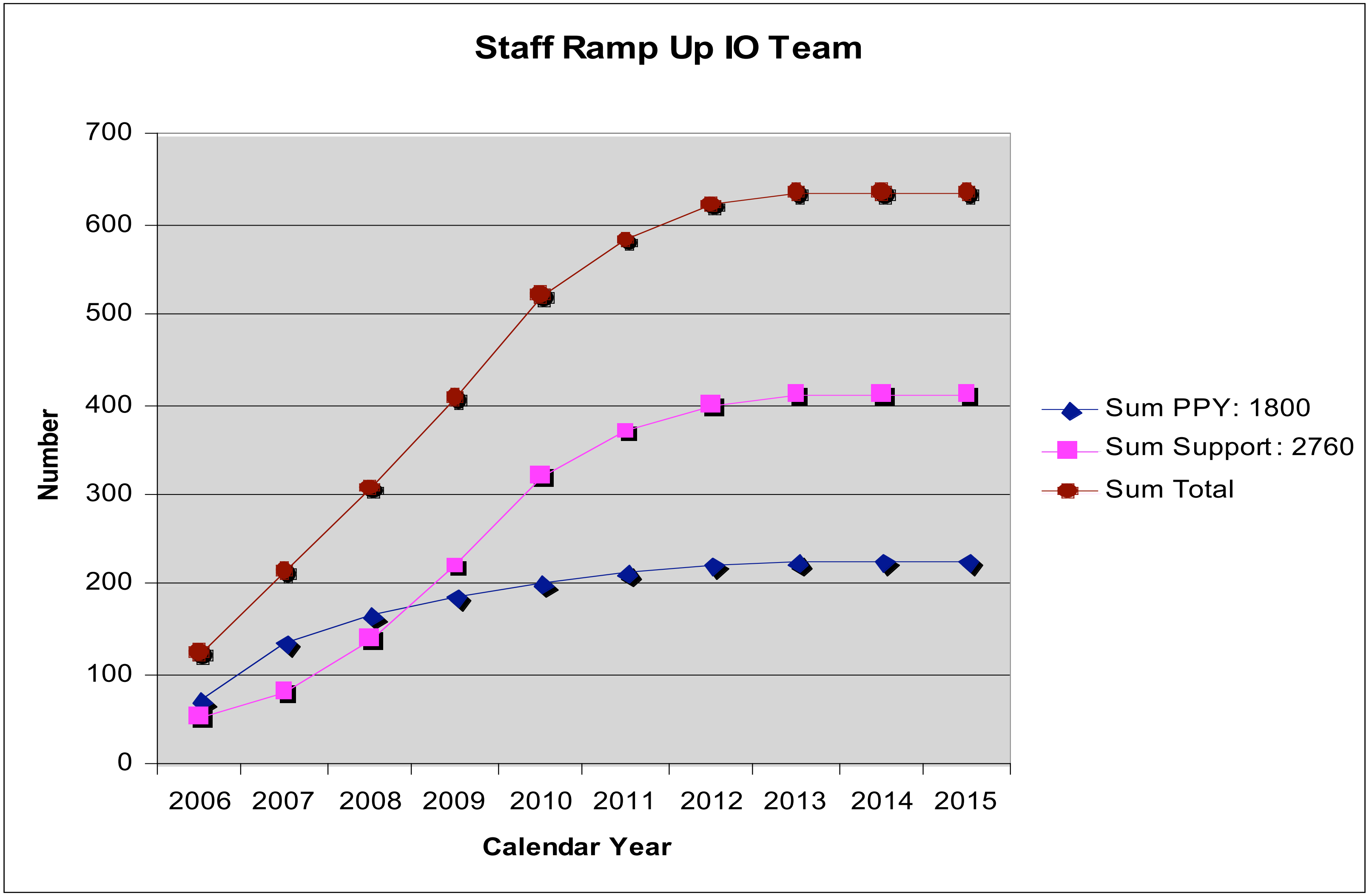


Near Term Targets

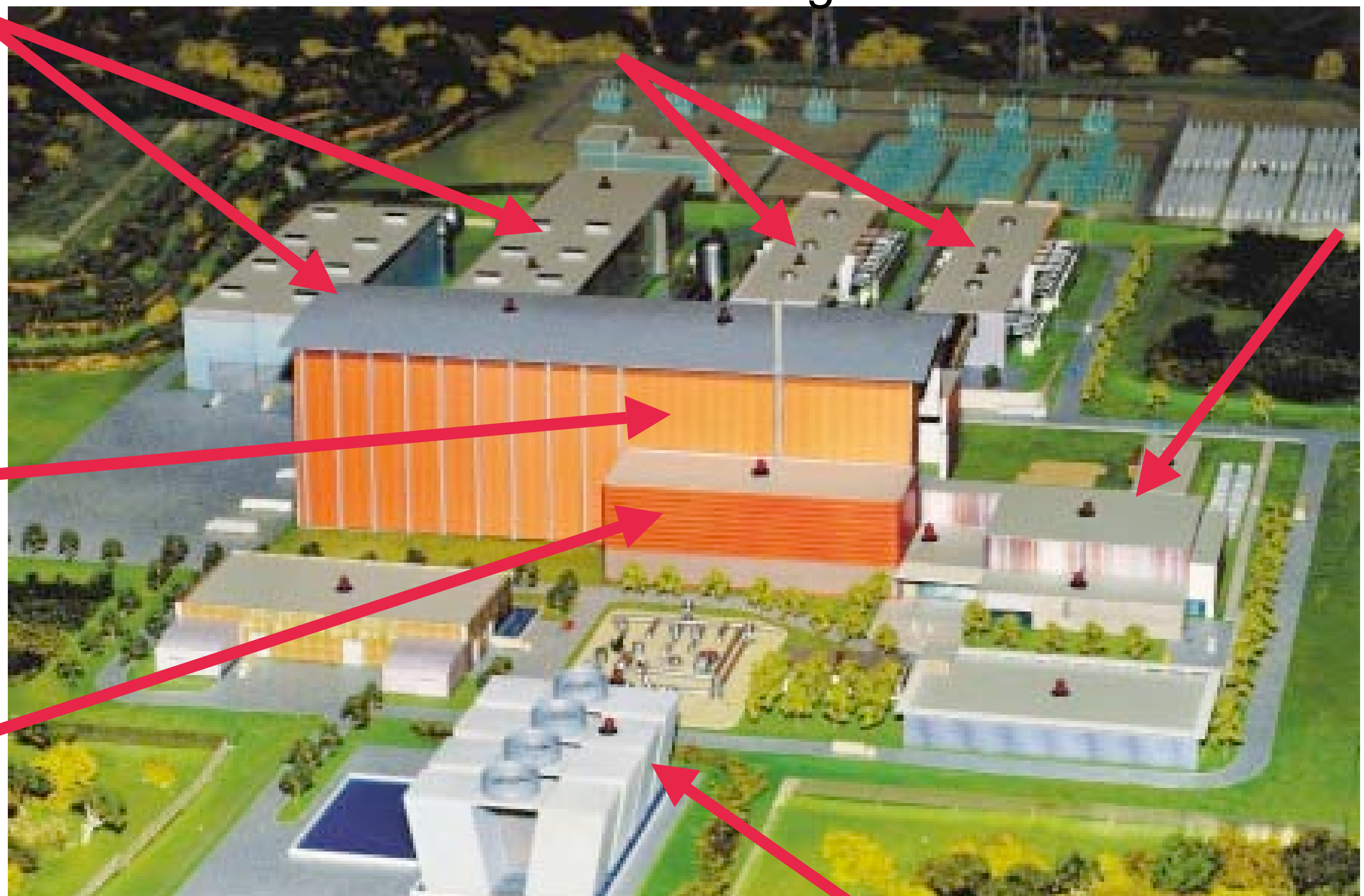
- ❖ Clearing of the construction site and preparation for road and utility connections (Spring 2007).
- ❖ Design review also involving physics community leading to revised baseline in Spring 2007 for approval by ITER Council.
- ❖ Finalising technical specifications for calls for tender for vacuum vessel, superconducting coils, building & excavation design.
- ❖ Submission of Preliminary Safety Report (by end 2007).

- Development of a consistent Integrated Project Schedule (IPS) and Procurement/Party Funding Commitment schedule.

Staff Ramp Up Projection

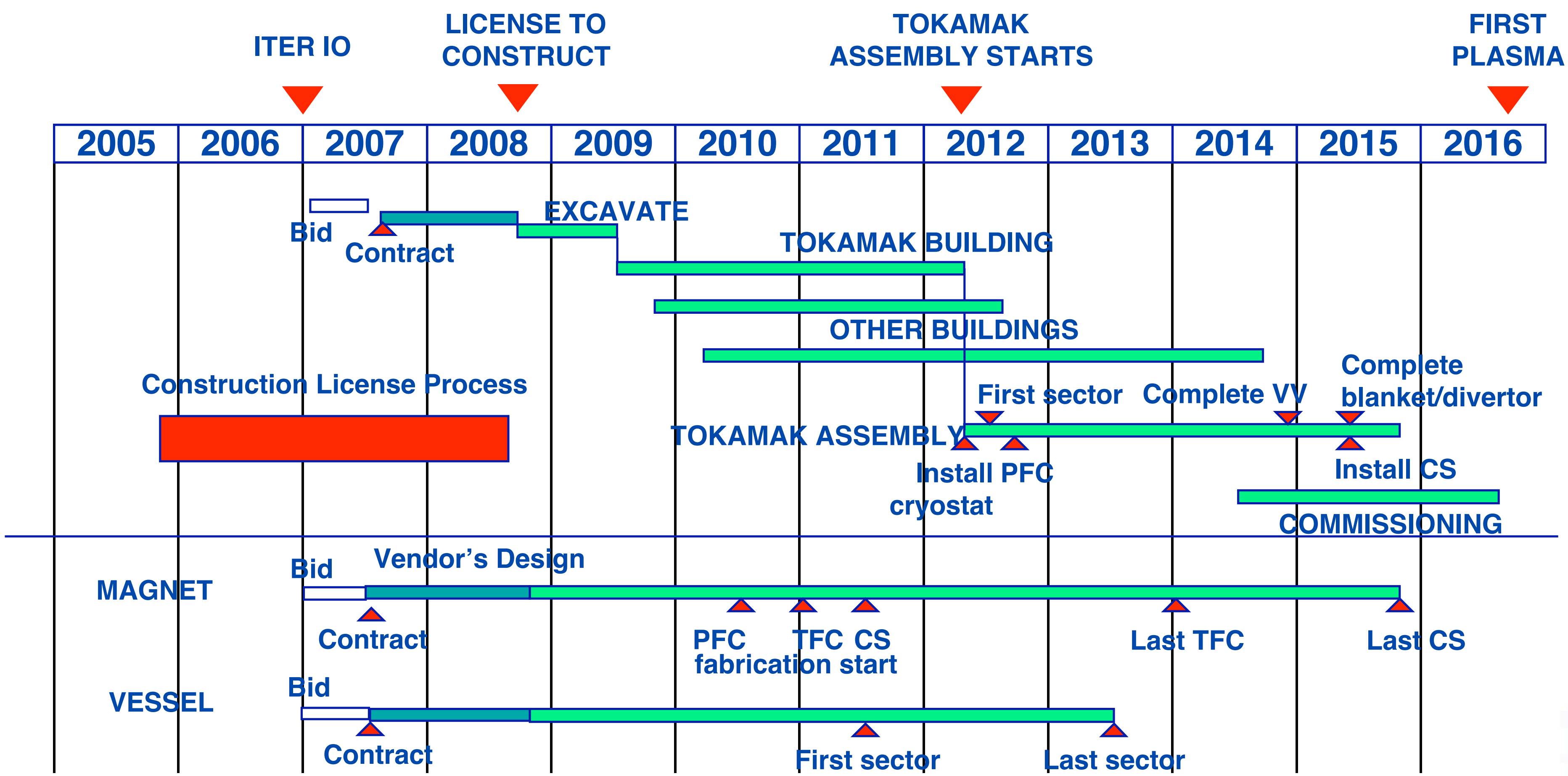


The ITER Scope



- Will cover an area of about 60 ha
- Large buildings up to 170 m long
- Large number of systems

Integrated Project Schedule



The Scope, the Schedule and the Cost of ITER

- The Scope: is clear.
- The Schedule: is clear
- The Cost: 3.578 kIUA (~5.000 M€)
  - including 80 kIUA R&D
  - including 477 kIUA Project Team
  - + 188 kIUA Operation/year
  - + 281 kIUA for deactivation
  - + 530 kIUA for decommissioning

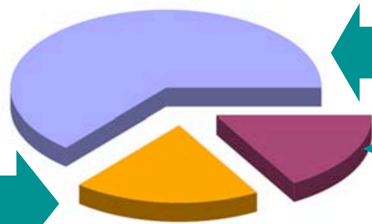
Construction Cost Sharing

C

"Contributions in Kind"
Major systems provided directly by Parties

A

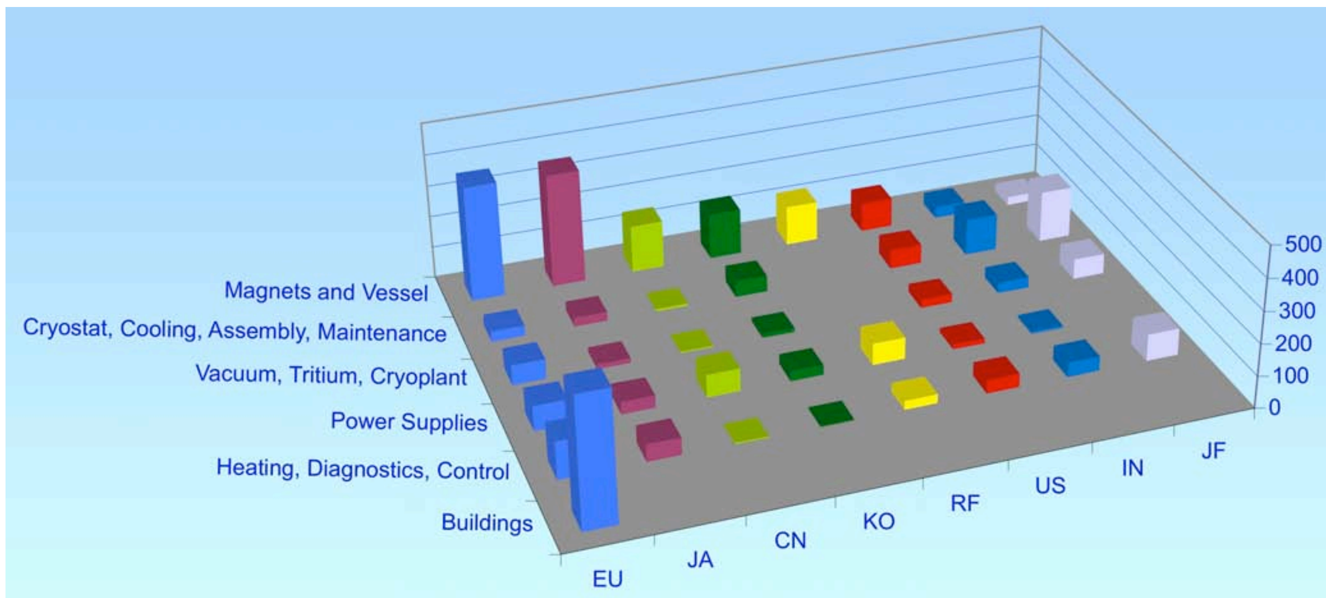
Systems suited only to Host Party industry
- **Buildings**
- **Machine assembly**
- **System installation**
- **Piping, wiring, etc.**
- **Assembly/installation labour**



Overall cost sharing:
EU 5/11, Others 6 Parties 1/11 each,
Overall contingency up to 10% of total.

B

Residue of systems, jointly funded, purchased by ITER Project Team



Overall costs shared according to agreed evaluation of A+B+C

Procurement Sharing

Example for the Procurement Sharing Agreements

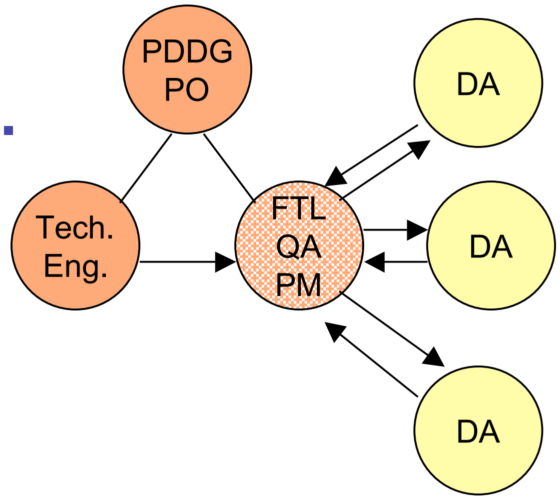
PACKAGE			kIUA	ALLOCATION	REMARKS
1.1 Magnet	Toroidal Field Magnet W indings	1A	85.2	EU=100%	1A for 10 TF (including 1 prototype) and 1B for 9 TF (including 2.5 kIUA for fabrication verification)
		1B	82.3	JA=100%	
	Toroidal Field Magnet Structures	2A	51.4	EU=10% , JA=90%	Fabrication of whole structures by JA and Pre -compression ring (0.6 kIUA) by EU. Final assembly of 10 TF coil cases by EU (10%)
		2B	47.7	JA=100%	
	Magnet Supports	2C	22.85	CN=100%	
	Poloidal Field Magnet 1 & 6	3A	13.6	EU=50%, RF=50%	PF 1 by RF and PF6 by EU
	Poloidal Field Magnet 2 to 5	3B	33.6	EU=100%	
	Correction Coils	3C	2.6	CN=100%	
	Central Solenoid Magnet	4A+4 B	39.6	US=100%	
	Feeders	5A	26.15	CN=100%	
	Feeders Sensors	5B	18.05	FUND=100%	
	Toroidal Field Magnet Conductors	6A	215	EU=20%, JA=25%, RF=20%, CN=7%, KO=20%, US=8%	See Note-1
	Central Solenoid Magnet Conductors	6B	90	JA=100%	

General Roles & Responsibilities for Construction

- ITER IO
  - Planning/Design
  - Integration / QA / Safety / Licensing / Schedule
  - Installation
  - Testing + Commissioning
  - Operation
- Parties – DA
  - Detailing / Designing
  - Procuring
  - Delivering
  - Support installation
- IO and all Parties plus Fusion Community work together on ITER. ITER IO coordinates and participates in the program (e.g.: TBM).

Roles & Responsibilities for Construction

- The Field Team Leader (FTL) is part of the IO but works mainly with the DA.
- Interfaces between DA and IO.
- Submits cost, schedule and performance info each month to the project office (PO).
- Uses technical expertise from IO to resolve production issues within the DA (if necessary).

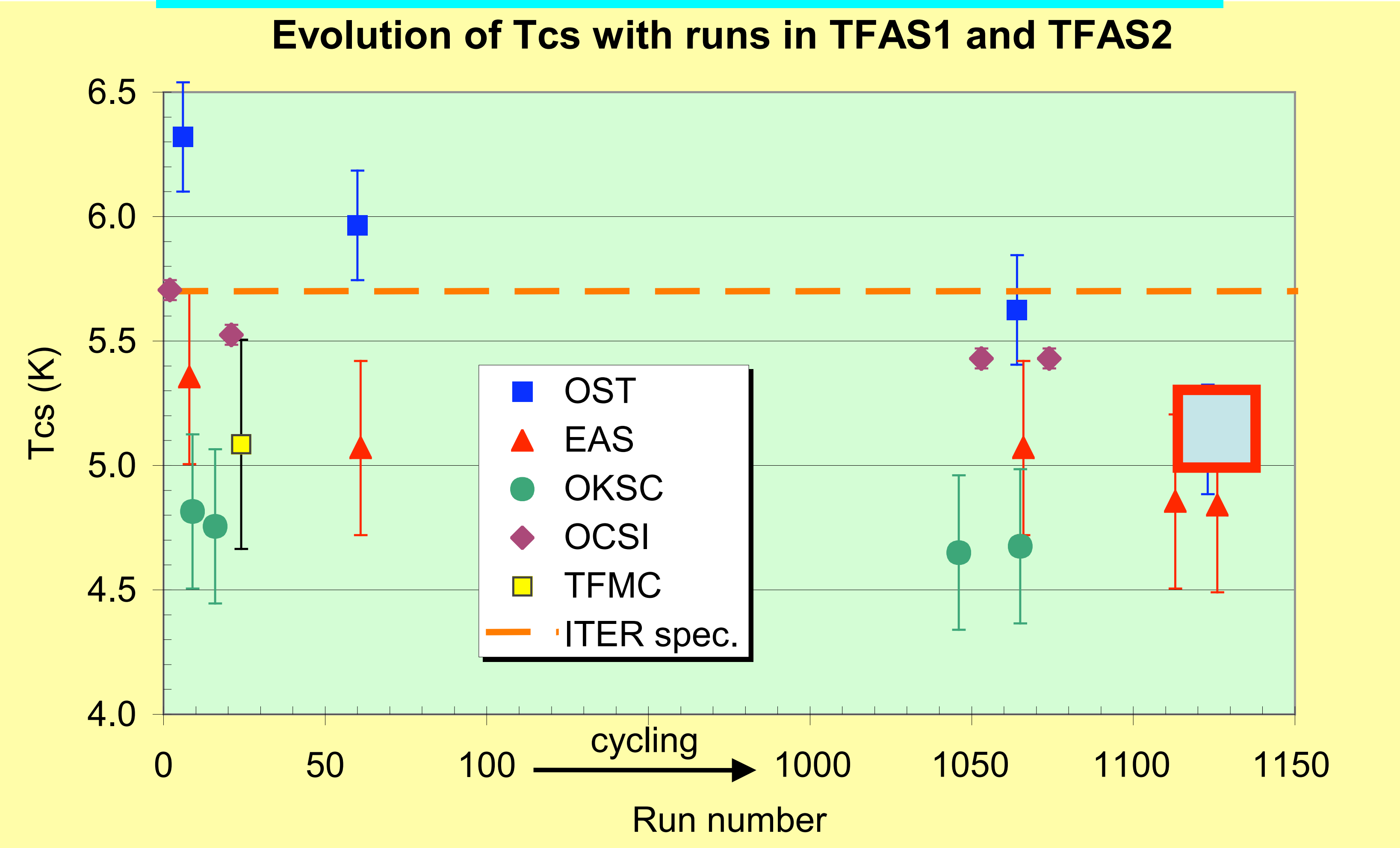


Urgent R&D Goals & Engineering Challenges

- Urgent R&D needed in several areas that have been identified already:
  - Nb_3Sn strand-in-cable performance
  - NbTi conductor performance
  - Neutral beam development
  - Flexibility during operation (example: first wall material choice)
- Long list of technical risks, that has been addressed in earlier R&D programs and is not quite finished.
- List of R&D items that will come out as the result of the design review.

Recent Results from EU Strands

Performances under ITER TF operating conditions



PF Coil Test (JA, EU, RU, CH)

- PF Coil test proves stable operation of long (40m) conductor length under ITER operating conditions. Program started in 2000.
- Test on short samples not adequate for qualification of NiTi cable.
- First test of ITER-PF-type joint @ high B and relevant dBZ(t), dBR(t)

- Confirmation of design criteria of the NbTi conductor and joint design.
- At present the coil is in the UK awaiting revival of the JA test facility.
- Negotiation on cost sharing is ongoing.

Neutral Beam System

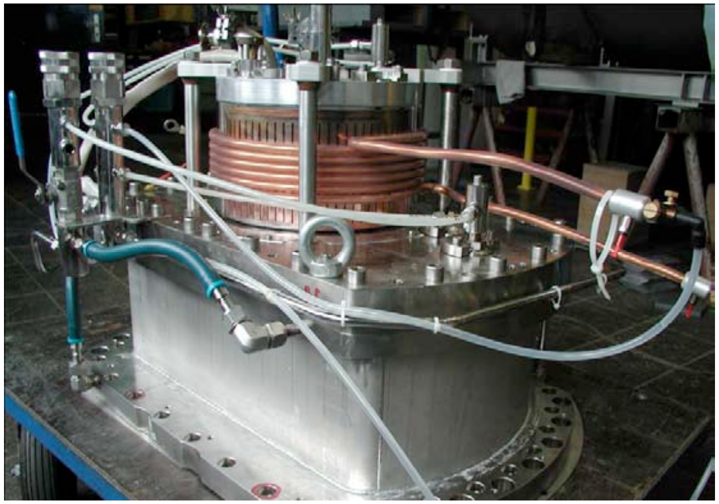
Two NBI – 16.5 MW each (40A, 1 MV)

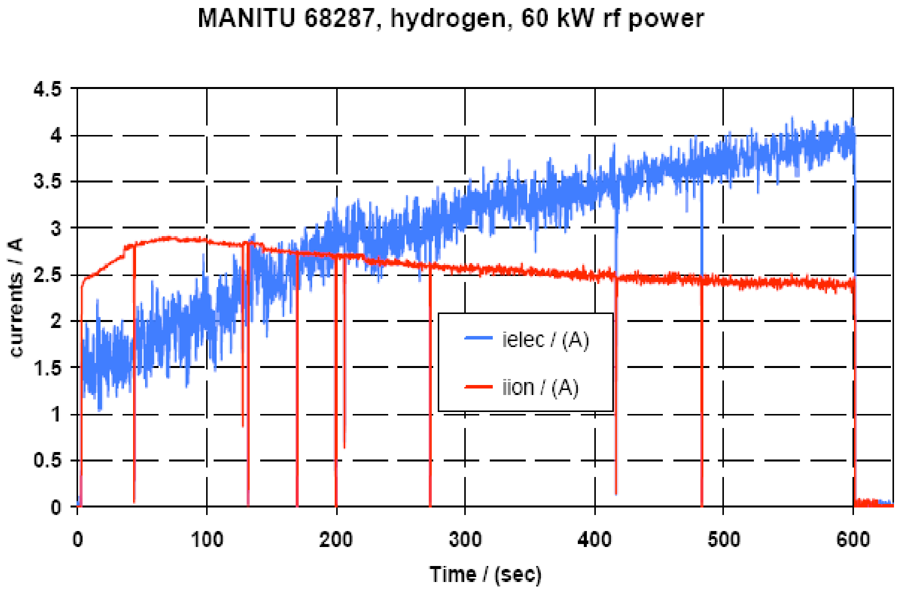
Ion Beam source:

- W filaments
- Radio frequency

Accelerator:

- SINGAP (EU)
- MAMUG (JAPAN)

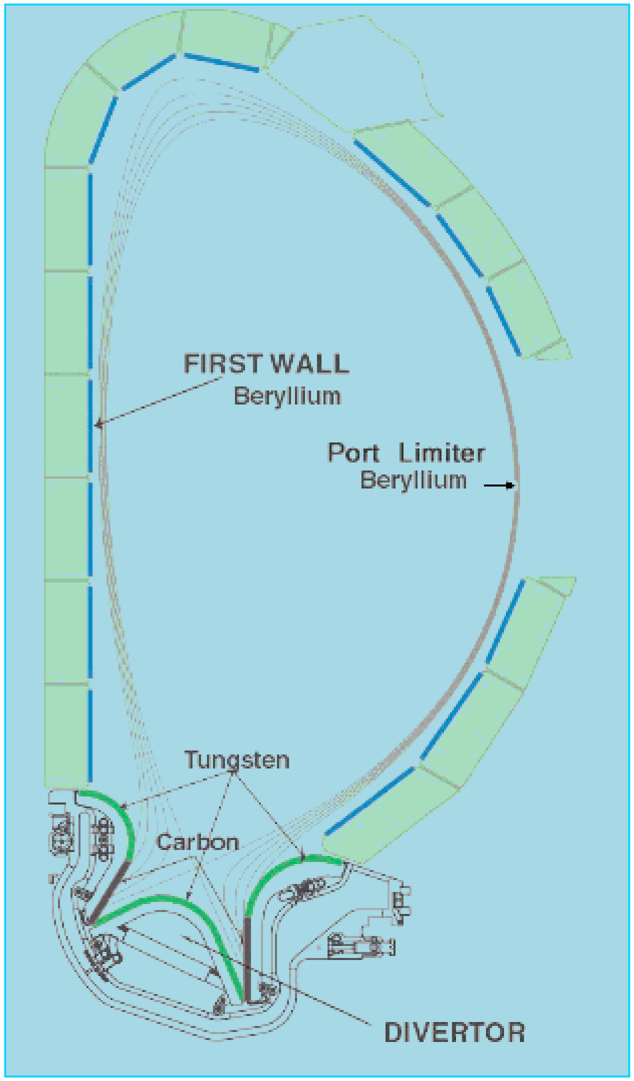




- Electron and ion current for 600 s beam pulse; current density 250 A/m_ in D. Small scale source at IPP Garching
- Full scale test facility will have to be built at RFX Padova

Flexibility: First Wall Material Choice

- Present reference design of ITER uses beryllium FW, tungsten divertor throat, and carbon target plates.
- ITER should be designed to be flexible enough to allow divertor cassette plasma-facing components and blanket module FW to be replaced.



The Design Review

- Since 2001, when last full baseline design was set, further R&D has been carried out.
- Improvements need to be fully reflected into overall design, and issues, if any, need to be clearly identified and resolved.
- All Parties will participate in the process through involvement of the PT leaders and their experts in the working groups of the design review.
- Senior management decision-making will be aided by a Technical Advisory Group.
- As a result of the design review, the allocation of the 80kIUA R&D funds (minus already defined high priority R&D) will be determined.

Initial Working Groups

1. Design Requirements and Physics Objectives
2. Safety Issues and Licensing
3. Buildings, especially the Tokamak building
4. Magnet system
5. Vacuum Vessel and its interfaces
6. Neutral Beams
7. Tritium Plant

- The first group will check whether the design requirements are consistent with the ITER objectives with input from ITPA.
- The other groups will check that the design to be implemented conforms to its requirements.

Change Process

- Design change process was so far limited to IO.
- Documentation was updated in 2004 but not approved.
- The ITER issue card system is now being used as the tool for documenting open questions and for tracking their resolution.
- The WGs will go through the issue cards, prioritize and recommend solutions to management.
- IO will coordinate integration into new baseline.
- The revised documentation will be submitted to the ITER Council in Spring 2007 for approval of the new baseline.- Probably followed by external review.

Design Change Integration

- General approach
  a) Quantify the monetary, scope or schedule impact of the change, as well as the man-hours needed for integration and who is supposed to provide them.
  b) Clarify the impact on other WBS elements as precisely as possible.
  c) Clarify whether the cost increase is a result of changes/conditions imposed by a Party.

- Overall budget is fixed -> changes which lead to cost increases, work or designs identified as not finished or any other task that requires budget and was not foreseen before, need to be offset:

  – proposed offsets in kind to keep the Total Project Cost (TPC) constant.
  – proposed offsets in terms of scope (scope increase in one WBS versus scope decrease in another).
  – proposed offset using contingency.
  – flagging of imposed changes and information management in order to contact the Party.

Summary

- ITER Organisation is still in a transitional phase.
- Very important to establish legal entity as soon as possible to effectively execute all tasks of the construction project.
- Recruiting and strengthening the team is a prime concern.
- Holding cost and schedule is important to gain thrust for the project.
- Executing the Design Review effectively to establish new baseline and involve world community is necessary
- A whole bunch of luck will be required too…