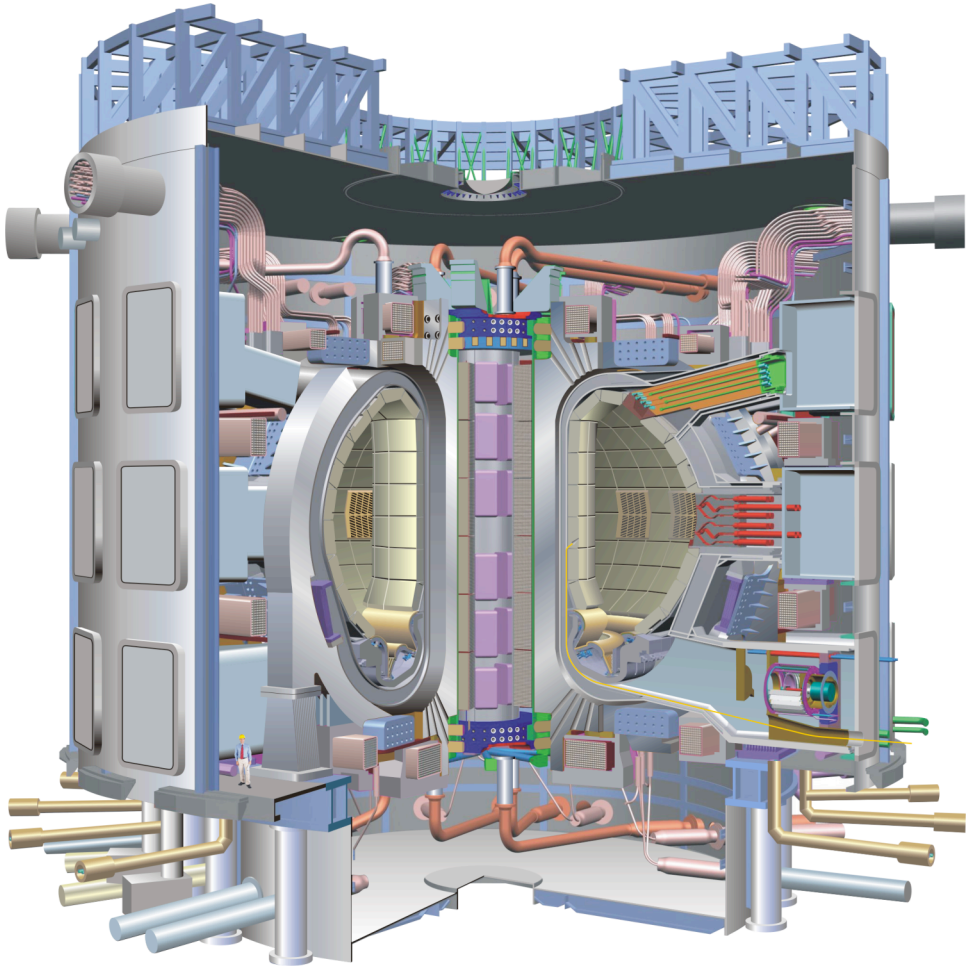
ITER PFC needs -

US Response Overview



Ned Sauthoff

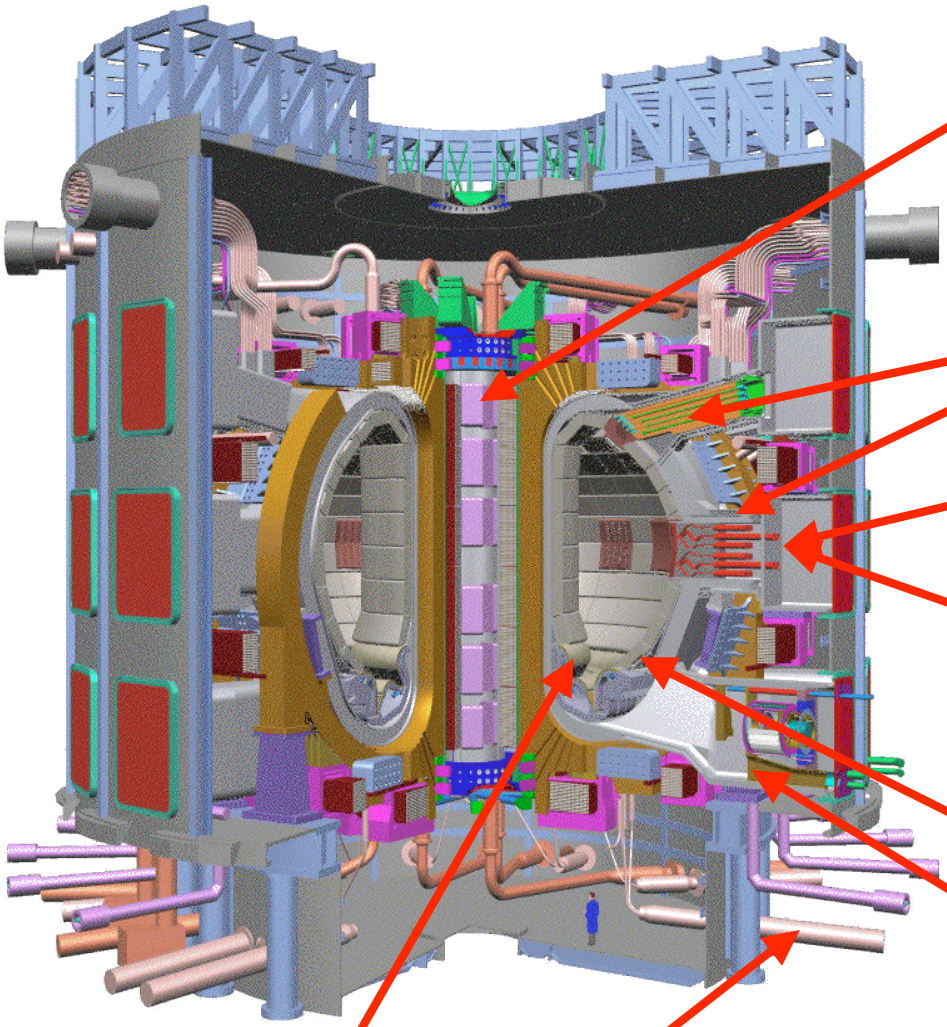
Project Manager, US ITER Project Office

Plasma Facing Components (PFC) Meeting

May 9-11, 2005

Princeton, NJ

U.S. provisional "in-kind contribution" scope



4 of 7 Central Solenoid Modules

Steady-state power supplies

15% of port-based diagnostic packages

44% of ICRH antenna + all transmission lines, RF-sources, and power supplies

Start-up gyrotrons, all transmission lines and power supplies

Blanket/Shield 10%

Roughing pumps, standard components

Tokamak exhaust processing system

pellet injector

Cooling for divertor, vacuum vessel, …

PFC-related ITPA High Priority Research Activities 2004-2005

Divertor and SOL

- Understand the effects of ELMs/disruptions on divertor and first wall structures
- Improve understanding of Tritium-retention and the processes that determine it
- Improve understanding of the interaction of the SOL plasma with the main chamber

Pedestal and Edge

- ELM size and frequency
- Improve understanding of the interaction of the SOL plasma with the main chamber

MHD, Disruption and Control

- Construct a new disruption data base including conventional and advanced scenarios and heat loads on wall/targets
- Develop disruption mitigation techniques, particularly by noble gas injection

Diagnostics

- Develop the basis for estimating the life-times of plasma-facing mirrors used in optical systems
- Develop requirements for measurements of dust, and assess techniques for measurement of dust and erosion

US ITER Tasks: PFCs

- Development of the welded joint for the first wall leg, suited for cut and welding in the Hot Cell
- Qualification of the FW panel fabrication methods and to establish the NDT method for the FW panel
- EM Analysis of modules and dynamic analysis of the key
- Detailed design of blanket modules and thermal hydraulic analysis of the shield block and the total blanket system
- Analysis of erosion of the ITER first wall due to plasma impingement
- ELM simulation on divertor PFC
- Determine capabilities of plasma sprayed 5-10 mm thick Be on the first wall copper surface
- Determine techniques for assuring that Cu to 316LN joining is possible

US ITER Tasks: Physics

- Oxygen baking experiment, which could be possible during Spring 2005 at DIII-D
- Calculation of plasma heating and current drive by ICRF waves (ITA 19-??)
- NTM control in Inductive and Hybrid Scenario in ITER
- RWM in Steady State Scenario in ITER
- VDE, Disruptions and their mitigation in ITER
- Plasma position and shape control with 3D model of vacuum vessel
- Error Field control in ITER
- ITER Plasma Integrated Model for ITER
- Development of Steady State Scenarios in ITER
- Evaluation of Fast Particle Confinement of ITER
- Assessment of Edge Pedestal and ELMs of ITER
- Characterization of thermal energy load during disruption (GA)
- Model development of halo current width during VDEs based (GA)
- Simulations of VDEs in ITER with 3D MHD code (PPPL)
- Disruption mitigation by noble gas injection (GA)

US ITER Tasks: Diagnostics

- Contribute to a Port Engineering Task Force (one or two members per PT) to determine the guiding principles for the design and engineering of the diagnostic ports.

- Support the ITER IT in the writing of procurement specifications for diagnostic port-based procurement packages.

- Support the ITER Diagnostics Design for a range of systems: visible/IR cameras, toroidal interferometer/polarimeter, ECE, divertor interferometer, RGA, LFS reflectometer and MSE on heating beam.

Overall ITER PFC Issues
(G. Federici)

- PFC material choice
- Tritium inventory and control
- Mixed-materials effects
- Power deposition and erosion during ELMs and disruptions
- Use of tungsten PFCs
- PFC design and operation strategy/Risks

High priority issues for ITER that must be addressed in tokamak experiments or laboratory simulations aided by modelling (G. Federici)

- Tritium co-deposition and effective control of inventory
- Plasma operation with a beryllium first wall
- The use of tungsten as a plasma-facing component
- The effects of material mixtures
- The mitigation/suppression of ELMs and disruptions

Contributers to the US response to ITER PFC needs

- **ITER Technology Tasks**
- **ITER Physics Tasks**
- **ITPA and Focused research on**
  - experimental research programs (DIII-D, C-Mod, NSTX, CDX-U/LTX, PISCES, …)
  - technology programs
- **Modeling**

- **The US is committed to contributing to the research on and design of effective plasma-facing components**
- **Thank you for your engagement in this activity!!**