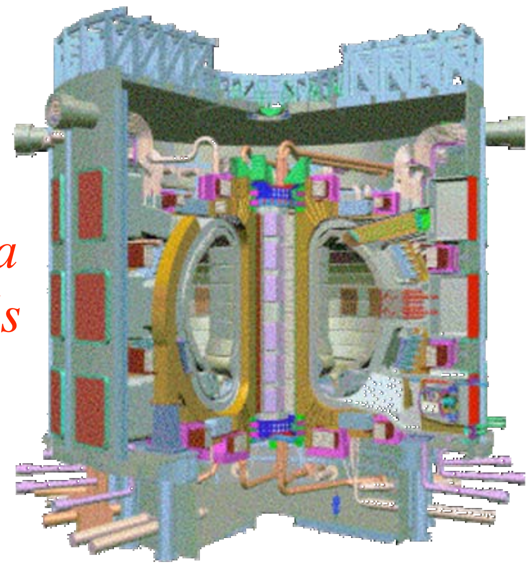
# An Overview of US ITER Project Activities

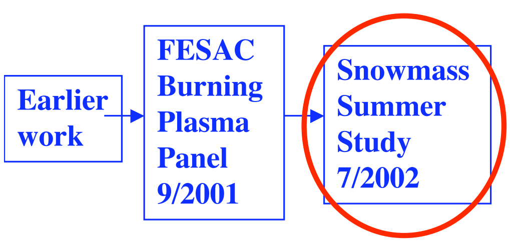


*Achieving US Burning Plasma Science and Technology Goals on ITER*

**PPPL Colloquium**

**Ned Sauthoff**
**U.S. ITER Project Manager**
**10/6/04**

## The path to the US decision on Burning Plasmas and participation in ITER negotiations



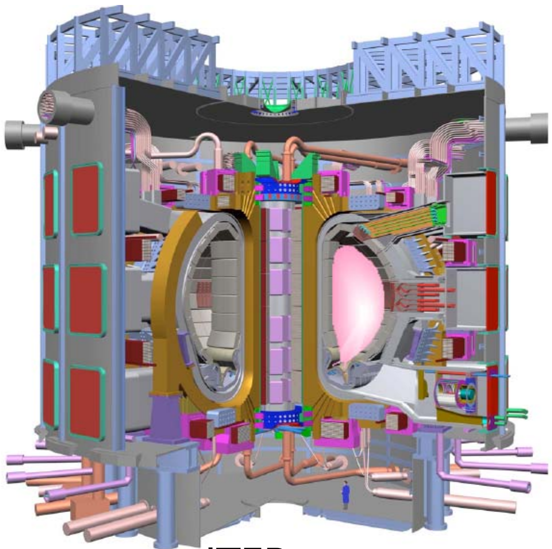
# Snowmass identified issues and assessed burning plasma experiments

| | Normal conductor Tokamak<br>FIRE IGNITOR | Superconducting Tokamak<br>ITER | BP contributions to ICCs |
|---|---|---|---|
| Physics | Argue for scientific and technological benefits of approaches | | Assess benefits of a tokamak BPX to ICC path |
| Technology | Identify key scientific, technological, and path issues<br>Determine assessment criteria<br>Perform uniform assessments of approaches | | |
| Experimental Approach and Objectives | | | |


# Major MFE Conclusions of Snowmass

1. Why a burning plasma
2. Burning plasma options
3. Assessment of contributions of the options
4. Assessment of the feasibility of the options
5. Assessment of fusion development paths
6. Relation to the national program

# Experimental Approaches to Burning Plasmas

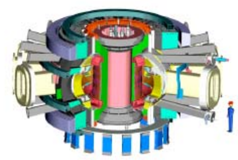


ITER

International Thermonuclear Experimental Reactor

Integrates burning and steady state

International partnership (~ $5B)



FIRE

Fusion Ignition Research Experiment

Burning, but integration later

US-based (~ $1B)

# Snowmass: Key Benefits of ITER

**PHYSICS**

1. Capability to address the **science of self-heated plasmas in reactor-relevant regimes of small ρ* (many Larmor orbits) and high $\beta_N$ (plasma pressure)** , and with the capability of **full non-inductive current drive sustained in near steady state conditions**.
2. Exploration of **high self-driven current regimes** with a flexible array of heating, current drive, and rotational drive systems.
3. Exploration of **alpha particle-driven instabilities in a reactor-relevant range of temperatures**.
4. Investigation of **temperature control and removal of helium ash and impurities** with strong exhaust pumping.

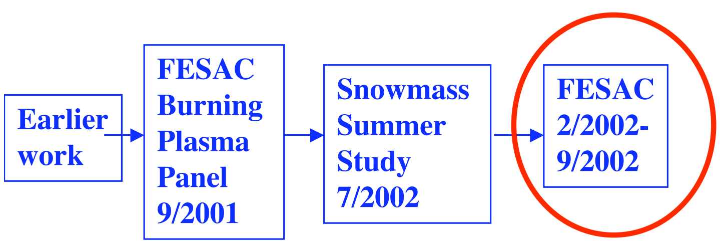
**TECHNOLOGY**

5. **Integration of steady-state reactor-relevant fusion technology**: large-scale high-field superconducting magnets; long-pulse high-heat-load plasma-facing components; control systems; heating systems.
6. **Testing of blanket modules** for breeding tritium.

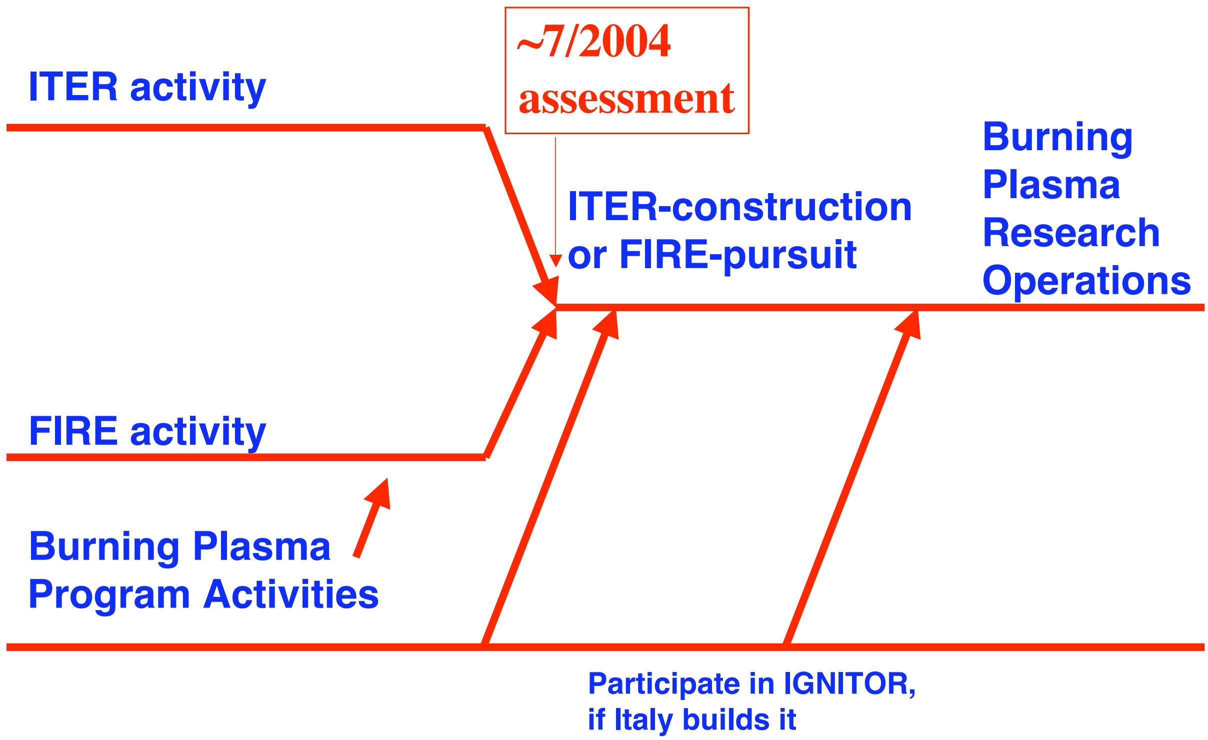

## General Observations from Snowmass 2002

- **Strong sense of excitement and unity in the community for moving forward with a burning plasma step**
- **Overwhelming consensus that**
  - Burning plasmas are opportunities for good science --- exploration and discovery
  - Tokamaks are ready to proceed -- the science-technology basis is sufficient
  - Other toroidal configurations (ICCs) would benefit from a burning tokamak plasma
  - The base program and the ICC elements play critical roles

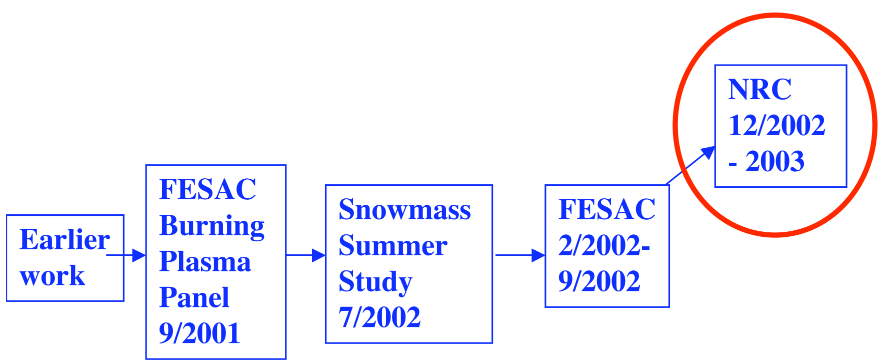
## The path to the US decision on Burning Plasmas and participation in ITER negotiations



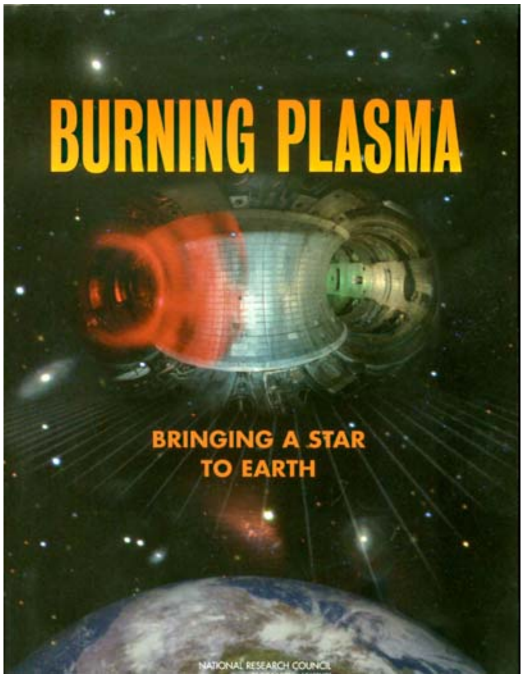
## FESAC: A US Burning Plasma Strategy




## The path to the US decision on Burning Plasmas and participation in ITER negotiations



# NRC: “Burning Plasma: Bringing a Star to Earth”




- **“The United States should participate in ITER. If an international agreement to build ITER is reached, fulfilling the U.S. commitment should be the top priority in a balanced fusion science program.”**
- **“The United States should pursue an appropriate level of involvement in ITER, which at a minimum would guarantee access to all data from ITER, the right to propose and carry out experiments, and a role in producing the high-technology components of the facility consistent with the size of the U.S. contribution to the program.”**


# Scientific Benefits from “Burning Plasma: Bringing a Start to Earth” (NRC)

- **Contributions to Understanding for Fusion Energy Science**
  - Behavior of Self-Sustaining Burning Plasmas
  - Plasma Turbulence and Turbulent Transport
  - Stability Limits to Plasma Pressure
  - Controlling Sustained Burning Plasmas
  - Power and Particle Exhaust
- **Contributions to Understanding for Basic Plasma Physics**
  - Magnetic Field Line Reconnection
  - Abrupt Plasma Behavior
  - Energetic Particles in Plasmas


## Scientific Readiness from "Burning Plasma: Bringing a Start to Earth" (NRC)

- **Areas assessed:**
  - Confinement projections
  - Operational boundaries
  - Mitigation of abnormal events
  - Maintenance of plasma purity
  - Characterization techniques
  - Plasma control techniques

- **"It is clear that ongoing research can be expected to adequately address issues requiring continued attention, but no issues remain that would undermine the fusion community's assertion that it is ready to undertake a burning plasma experiment."**


## Technological Benefits from "Burning Plasma: Bringing a Start to Earth" (NRC)

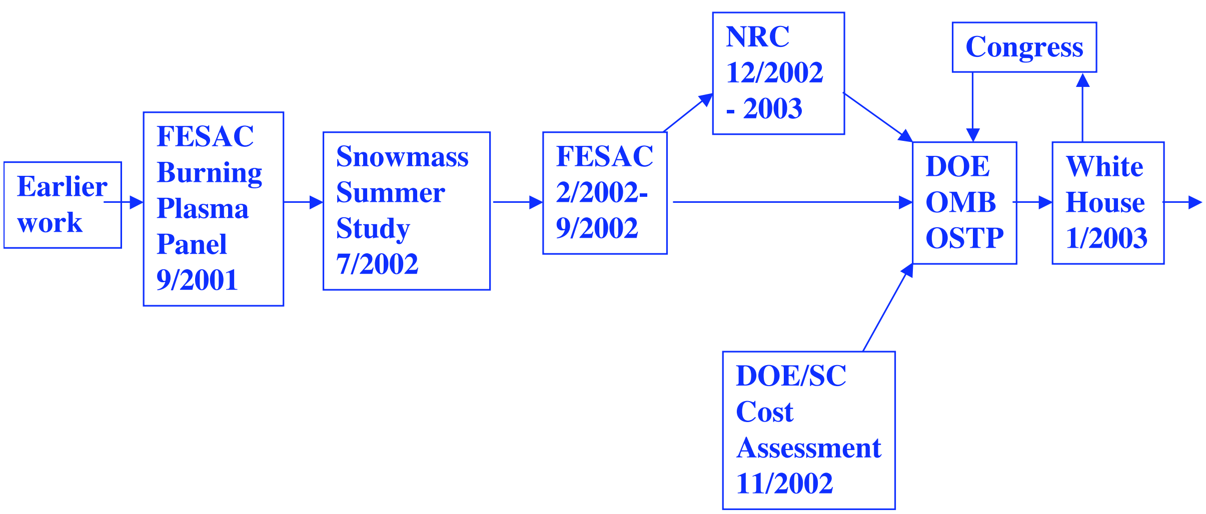
- **Breeding Blanket Development**
- **Tritium Processing**
- **Magnet Technology**
- **High-Heat-Flux Component Development**
- **Remote Handling Technology**


## Technological Readiness from "Burning Plasma: Bringing a Start to Earth" (NRC)

- **Areas assesed:**
  - Fabrication of necessary components
  - Component lifetime in a nuclear environment
  - Lifetime of plasma-facing components
  - Tritium inventory control
  - Remote maintenance
  - Fueling, heating, and current drive control

- **"It is clear that ongoing research can be expected to adequately address issues requiring continued attention, but no issues remain that would undermine the fusion community's assertion that it is ready to undertake a burning plasma experiment."**

## The path to the US decision on Burning Plasmas and participation in ITER negotiations



## US decision on joining ITER Negotiations (1/30/03 )


"Now is the time to expand our scope and embrace international efforts to realize the promise of fusion energy.

Now it is time to take the next step on the way to having fusion deliver electricity to the grid.

The President has decided to take that step.

Therefore, I am pleased to announce today, that
President Bush has decided that the United States will join the international negotiations on ITER."

(Energy Secretary Abraham at PPPL)

## President Bush on hydrogen and fusion (2/6/03)

# DOE/SC Facilities Plan (11/03): ITER #1


"ITER is an international collaboration to build the first fusion science experiment capable of producing a self-sustaining fusion reaction, called a 'burning plasma.'

It is the next essential and critical step on the path toward demonstrating the scientific and technological feasibility of fusion energy."

## ITER-related statements by the US Presidential Candidates

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**BUSH:** ITER is a critically important experiment to test the feasibility of nuclear fusion as a source of electricity and hydrogen…. (Nature)

I remain committed to building the ITER project….
This project is one of the four "transformational technology" pillars of my climate change strategy, which focuses on building the emissions-free technologies of the future.
From an inexhaustible and entirely clean fuel source, a fusion plant could generate huge amounts of electricity to power megacities and to produce hydrogen for transportation needs with no emissions of greenhouse gases. (Science)

**KERRY:** I support a strategically balanced U.S. fusion program that includes participation in ITER to supplement a strong domestic fusion science and technology portfolio.
As president, my first priority internationally on this and other energy issues will be to engage other nations to find areas of cooperation and common ground. (Science and Nature)

## Negotiations…

- **December 2003:**
  - Vienna meeting (Orbach) achieved 100% coverage of costs at 2 sites
  - Washington meeting (Abraham) failed to choose site; assigned homework:
    - Increasing understanding of the sites
    - Exploring broader approaches
- **February 2004**
  - Vienna meeting (Orbach) failed to choose site; assigned homework:
    - Understanding of site characteristics in common units
- **… mostly bilateral discussions between Japan and Europe**
- **Enhanced offers by JA and EU…**

## EU Presidency "Conclusions" 9/24/04 (1 of 2)

- **The Council reaffirmed its strong support to the current efforts undertaken by the Commission to find a solution in the negotiations with the international partners for the still unsolved question of the host site of ITER, and to the European candidate, Cadarache, bearing in mind its advantageous position both from the scientific and environmental point of view.**
- **Because of the global importance of fusion research, there is a consensus that international cooperation should be on the broadest possible basis and involve as many partners as possible. It would be advantageous to pursue a broader approach and the fast track method involving an accompanying programme of research and technological development such as materials research, in addition to ITER, as the means for advancing fusion research.**

## EU Presidency “Conclusions” 9/24/04

- **“The Council reaffirmed its strong support … to the European candidate, Cadarache, bearing in mind its advantageous position both from the scientific and environmental point of view.”**
- **“… international cooperation should be on the broadest possible basis and involve as many partners as possible.”**
- **“It would be advantageous to pursue a broader approach and the fast track method involving an accompanying programme of research and technological development such as materials research, in addition to ITER, as the means for advancing fusion research.”**

## EU Presidency “Conclusions” 9/24/04 (2 of 2)

***With a view to enabling the rapid commencement of the ITER project on the European site in line with the European Council conclusions of March 2004, the Council has invited the Commission to:**

- elaborate a clear roadmap in respect of the final phase of the international negotiations,
- take every initiative, also counting on Member States’ support, to explain Europe’s proposal and its position to its partners and make a strong effort to preserve the global character of the project;
- examine the respective financial implications of the possible scenarios for ITER and related activities, it being understood that the share of the cost of ITER construction to the Community budget should not exceed the present estimate, and present the results of this examination as soon as possible to the Council;
- provide the necessary input in due time to enable the Council to arrive at an appropriate decision in November.

## EU Presidency "Conclusions" 9/24/04 (2 of 2)

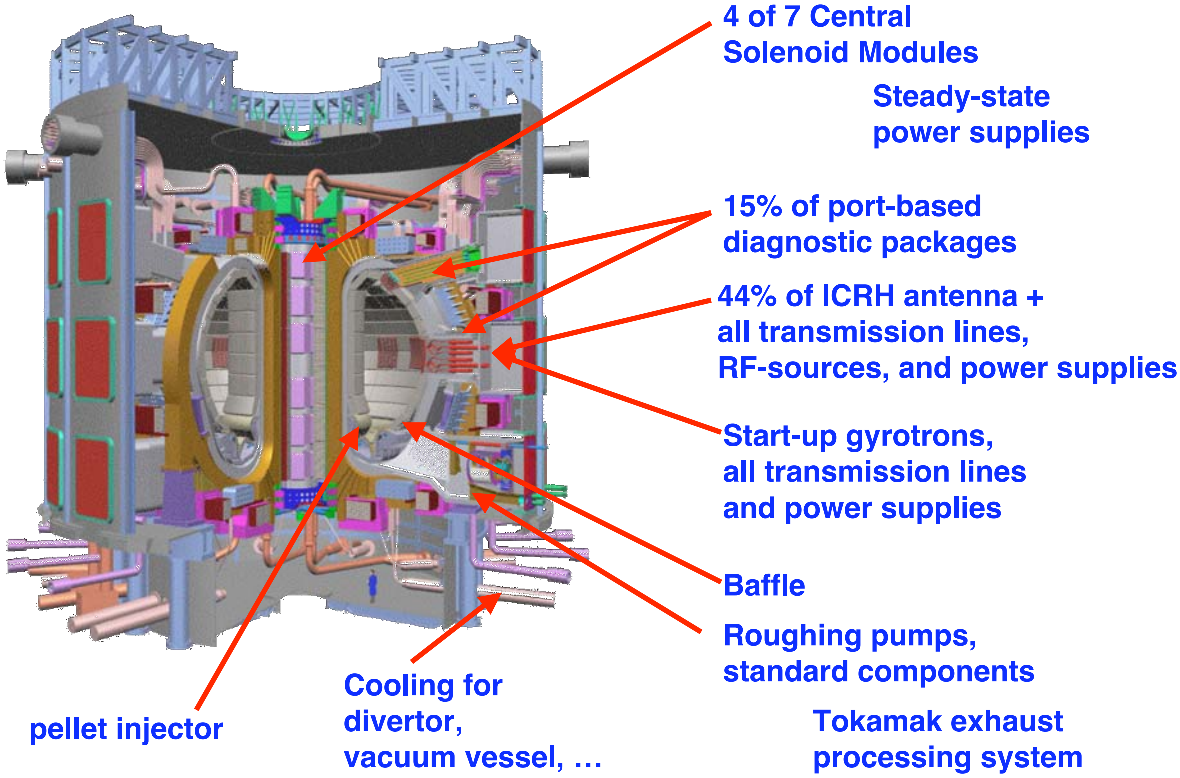
**"… the Council has invited the Commission to:**

- elaborate a clear roadmap in respect of the final phase of the international negotiations,
- … explain Europe's proposal and its position to its partners and make a strong effort to preserve the global character of the project;
- examine the respective financial implications of the possible scenarios for ITER and related activities…;
- provide the necessary input in due time to enable the Council to arrive at an appropriate decision in November."

## Scope of the ITER Transitional Arrangements*

- **"Joint technical preparations directed at maintaining the coherence and integrity of the ITER design and at preparing for an efficient start of ITER construction"**
- **"Organisational preparations directed at enabling the ITER Legal Entity to enter into effective operation with least possible delay following the entry into force of the ITER Joint Implementation Agreement"**

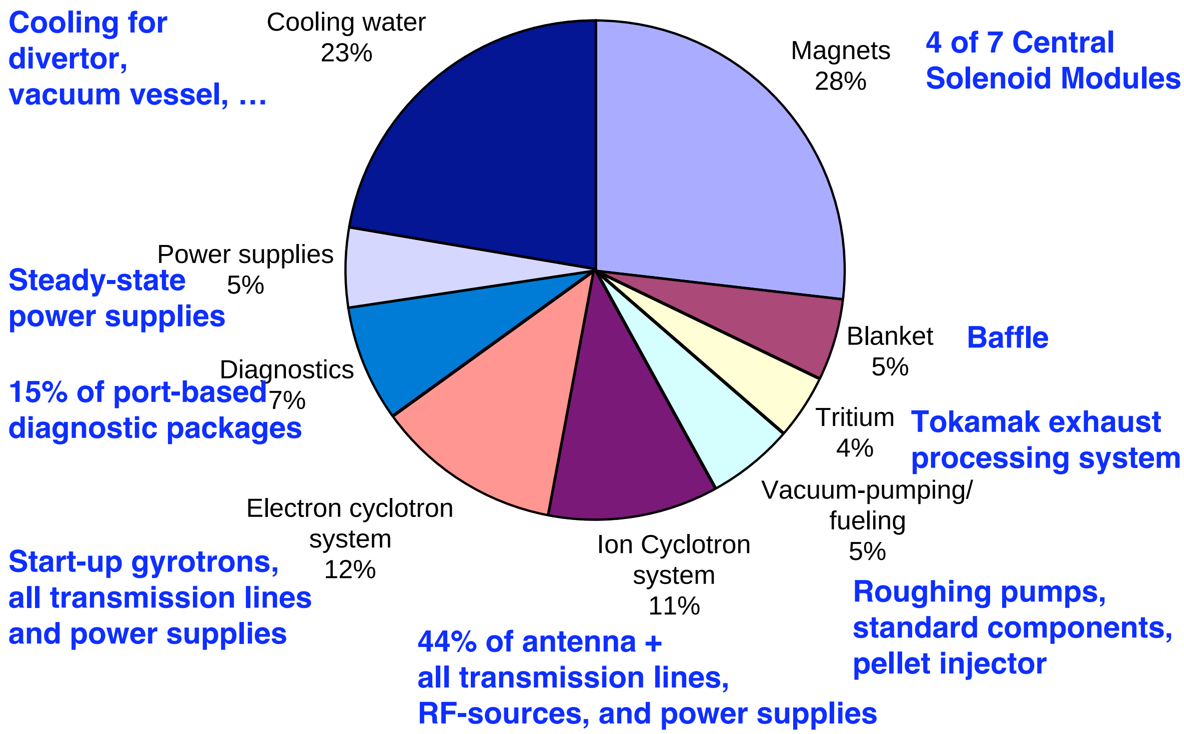
## US In-kind Contributions to ITER




## Overview of tentative US in-kind contributions

| System | Description of US portion |
|---|---|
| Magnets | 4 of 7 Central Solenoid Modules |
| Blanket/Shield | Module 18 (baffle) |
| Vacuum-pumping/ fueling | Roughing pumps, standard components, pellet injector |
| Tritium | Tokamak exhaust processing system |
| Cooling water | Cooling for divertor, vacuum vessel, ... |
| Power supplies | Steady-state power supplies |
| Ion Cyclotron system | 44% of antenna + all transmission/RF-sources/power supplies |
| Electron cyclotron system | Start-up gyrotrons, all transmission lines and power supplies |
| Diagnostics | Tentative allocations under consideration |

## Tentative US in-kind contributions by Value (total US in-kind contribution ~ 10%)

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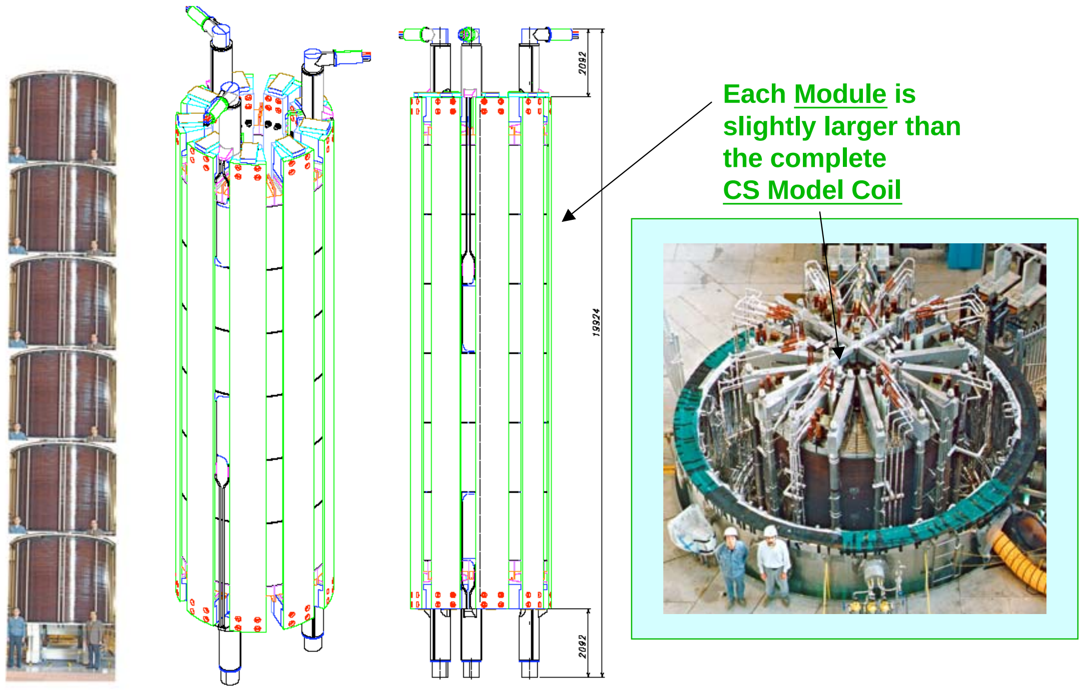
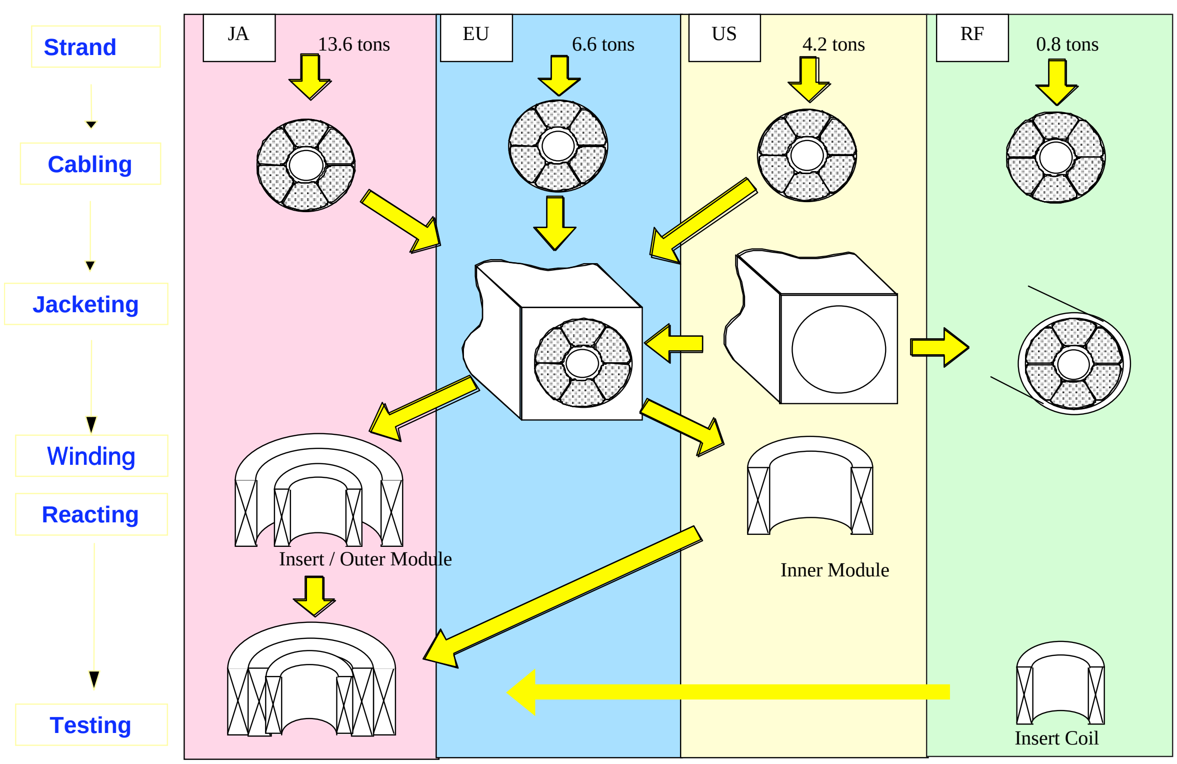
# Magnets: Central Solenoid

| Description of US portion | US fraction of system (by ITER value) | US Value (kIUA) [$M] |
|---|---|---|
| 4 of 7 Central Solenoid Modules | 9% of full magnet system; 57% of central solenoid | 74.2 [$107M] |

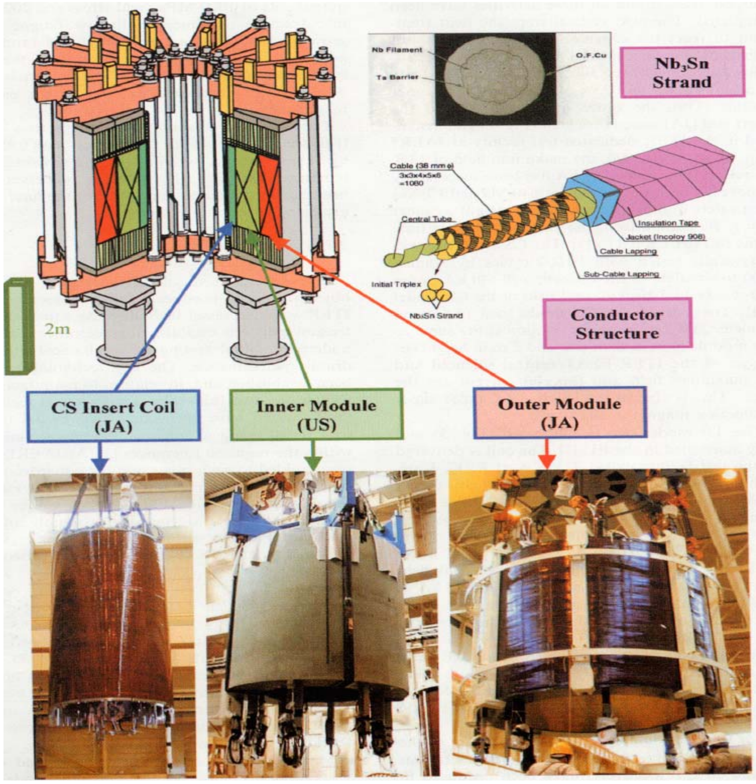
## CS Coil is Composed of 6 Pancake Wound Modules




## International Fabrication of the Central Solenoid Model Coil



# Central Solenoid Model Coil

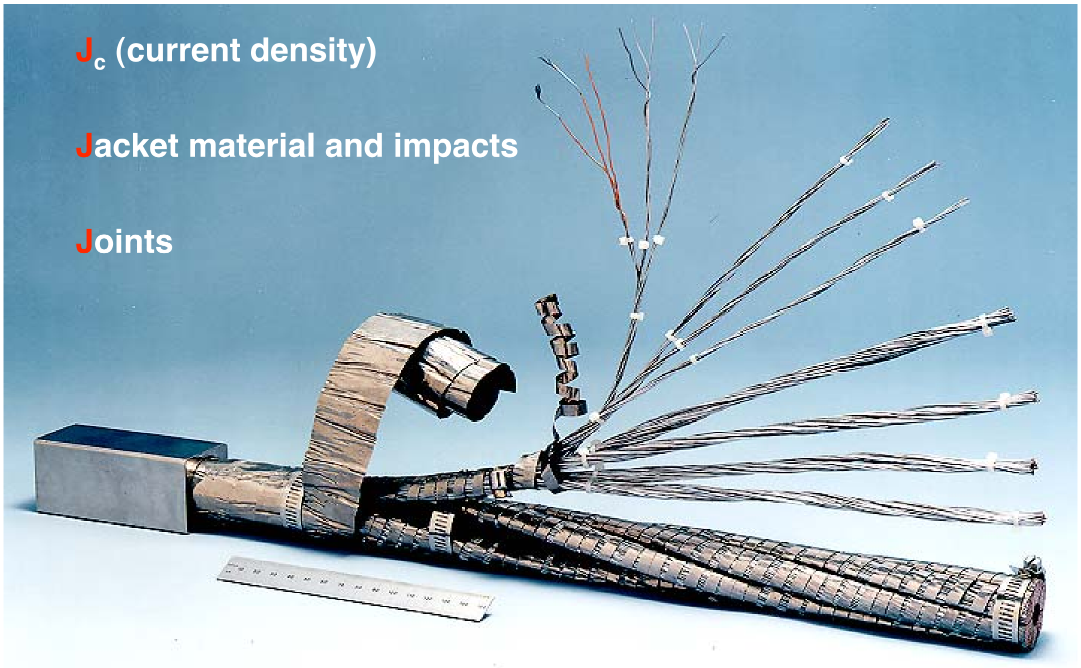



# Central Solenoid Model Coil

**Max. field 13.5T, max. current 46kA, stored energy 640MJ (max. in $Nb_3Sn$)**

**Ramp-up 1.2T/s (goal 0.4) and rampdown rates of -1.5T/s (goal -1.2) in insert coils, and 10,000 cycle test.**

# Central Solenoid Conductor




## US ITER Tasks:
## Magnets

- ✔ • Qualification of industrial supplies of $Nb_3Sn$ strands with increased Jc
- ✔ • Stress analysis of the helium inlet regions
- ✔ • Conductor performance and design criteria (transverse load effects)
- ✔ • CS jacket weld defect assessment
- – • Joint Tests
- – • Mechanical Characterization of CS Jacket Materials

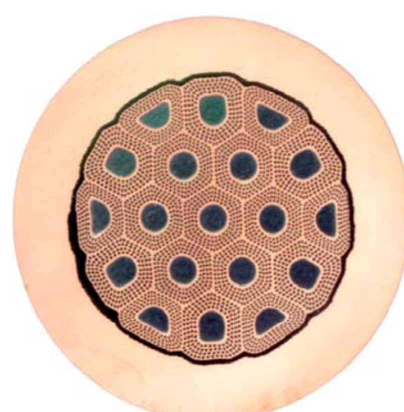
# Mitigating the CS Magnet Technical Risks

| Risks/Issues | Tasks and Secondee Assignments |
|---|---|
| Strand performance and supply | ✔ Qualification of industrial suppliers of Nb3Sn strands with increased Jc |
| Conductor performance and temperature margin | ✔ Conductor performance and design criteria (transverse load effects) |
| Fatigue life of Conductor Jacket | • Jacket Materials characterization<br>✔ CS jacket weld defect assessment |
| Failures of Butt-joints | • Joint Development and Tests (butt-type and lap-type) |
| Integrated performance of the CS | • Mechanical Characterization of CS modules, pre-compression structure and support structure |
| Incomplete CS design and procurement specifications | ✔ Secondees: Completion of CS Specifications and Procurement Package |
| Stresses in the high-field regions of CS Modules | ✔ Stress analysis of the helium inlet regions |

✔ Indicates an approved task or secondee-assignment

# Qualification of industrial suppliers of Nb3Sn strands with increased value of Jc (ITA 11-18)

- A Request For Proposal (RFP) was issued in May to 4 US strand vendors for the development and qualification of >100kg of superconducting strand meeting a US-proposed CS specification.
- Offers were received from
  - Oxford Superconducting Technology
  - Superconducting Systems, Inc.
  - Supercon Inc.
  - Outokumpu Advanced Superconductors.



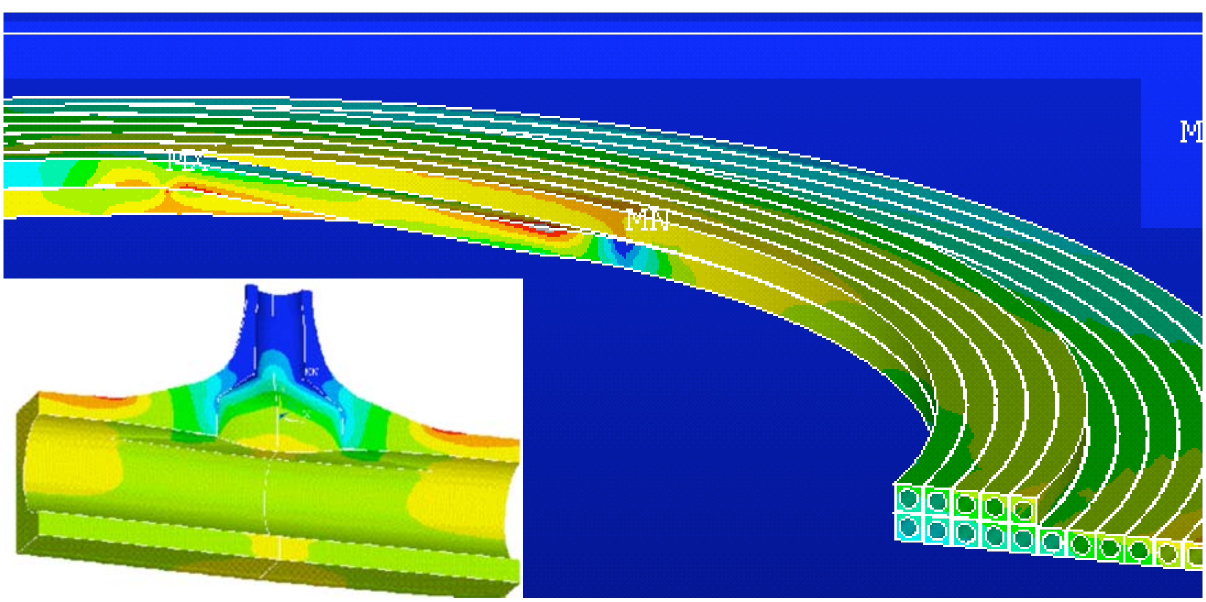
Typical strand layout as proposed by OST. Diameter is ~0.8 mm.

## Conductor Performance and Design Criteria (ITA 11-22)

- Sub-size jacketed CICC samples are undergoing testing in the Sultan facility. Both SS and Ti jacketed samples are included to help understand effects on conductor performance.
- The adequacy of the present conductor design and cost/performance ratios for design alternatives have been evaluated.
- A higher performance conductor design has been recommended and the result has been used to specify the strand for the development contracts.

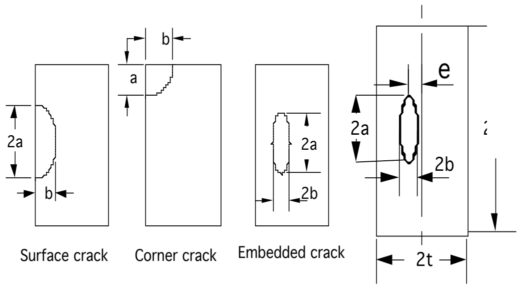
## Stress Analysis of Helium Inlet Regions (ITA 11-20)

A preliminary analysis using a non-asymmetric 3D ANSYS model of the CS winding pack has been carried out to assess the stress in the helium inlet region.
Suggestions for redesign of the welded helium inlet have been made to lower the stress concentration in this area

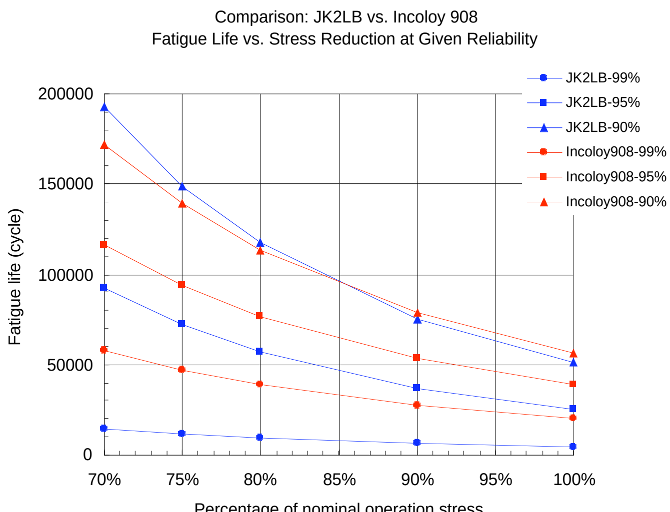


# CS Jacket Weld Defect Assessment (ITA 11-23)

Weld plate samples provided by JAERI



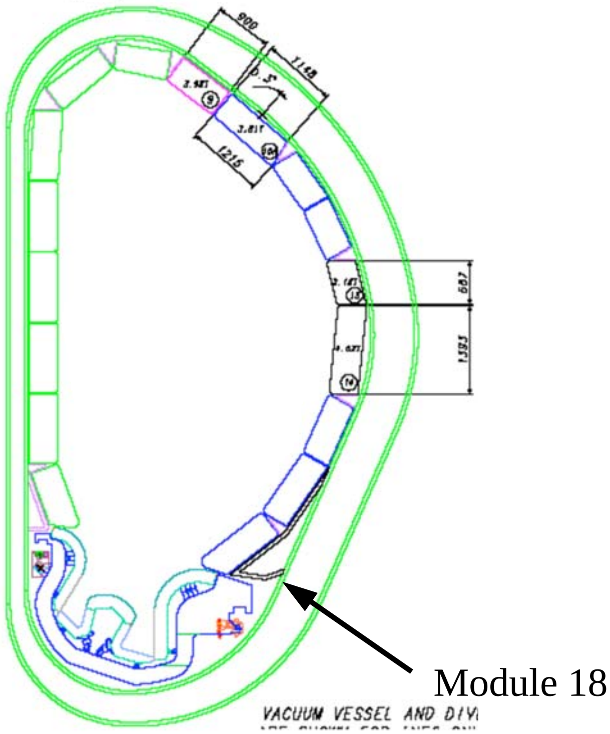

Fatigue crack growth prediction using a statistical approach in order to estimate lifetime fatigue probability for the CS.




# Plasma-Facing Components: Baffle

| Description of US portion | US fraction of system (by ITER value) | US Value (kIUA) [$M] |
|---|---|---|
| Module 18 (baffle) | 10% of full system; 8.6% of full blanket | 14.5 [$21M] |

## ITER FW/Shield Design

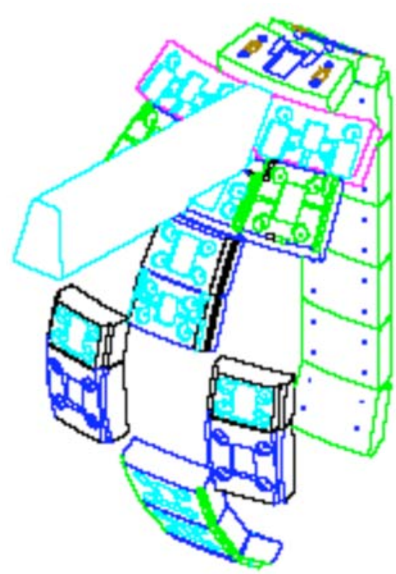



**Module 18 of the FW/Shield**

- 36 modules around torus
- Shield module weight 3.6 Tonnes (316 LNIG steel)
- PFC area 1.6m$^2$
- PFC weight 0.8Tonnes (Cu+316)
- 10% of the first wall area
- 45 cm thick (PFC +shield)

## US ITER First Wall Tasks

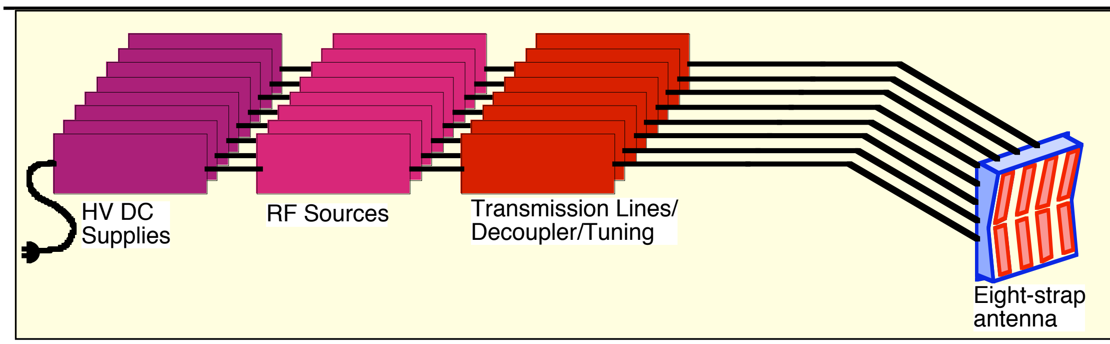
- **Qualification of the FW panel fabrication methods and to establish the NDT method for the FW panel.**
- **EM Analysis of modules and dynamic analysis of the key.**
- **Detailed design of blanket modules and thermal hydraulic analysis of the shield block and the total blanket system.**
- **Development of the welded joint for the first wall leg, suited for cut and re-welding in the Hot Cell**
- **Analysis of erosion of the ITER first wall due to plasma impingement**



# Ion Cyclotron System

| Description of US portion | US fraction of system (by ITER value) | US Value (kIUA) [$M] |
|---|---|---|
| 44% of antenna + all tranmission/RF-sources/power supplies | 91% of full system | 31.1 [$45M] |

## Overview of the ITER IC system



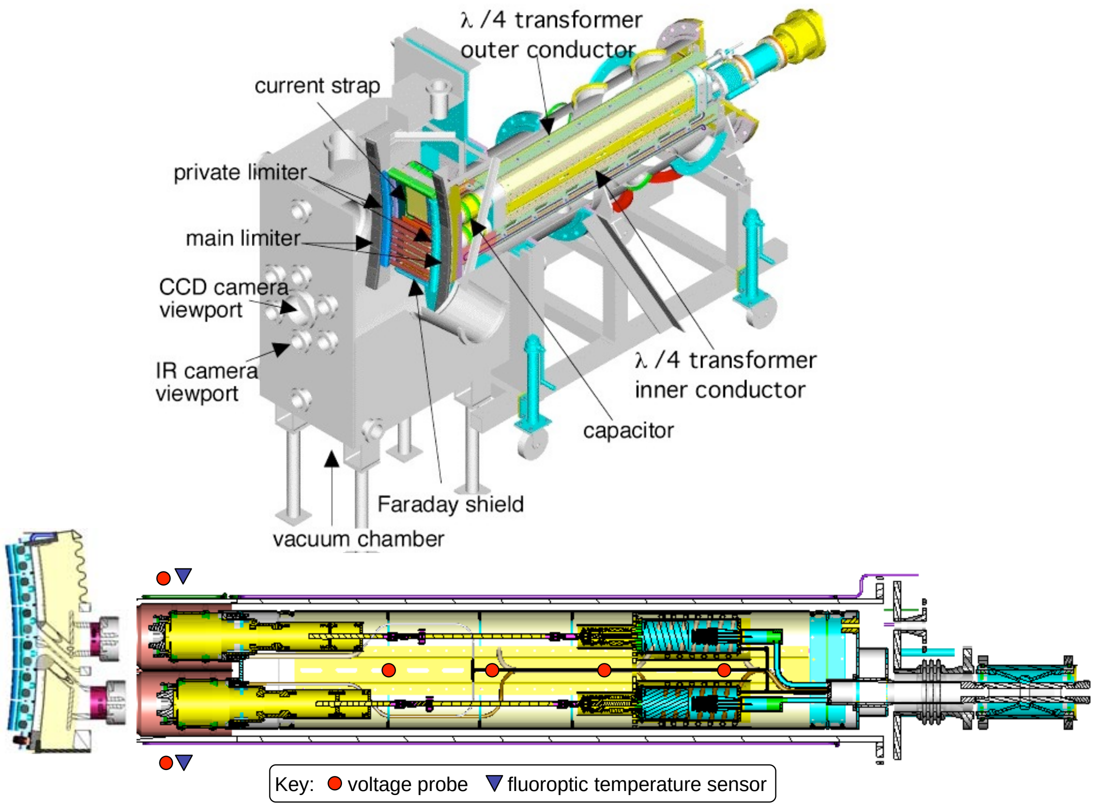

ITER ion cyclotron system block diagram

**What it is:**

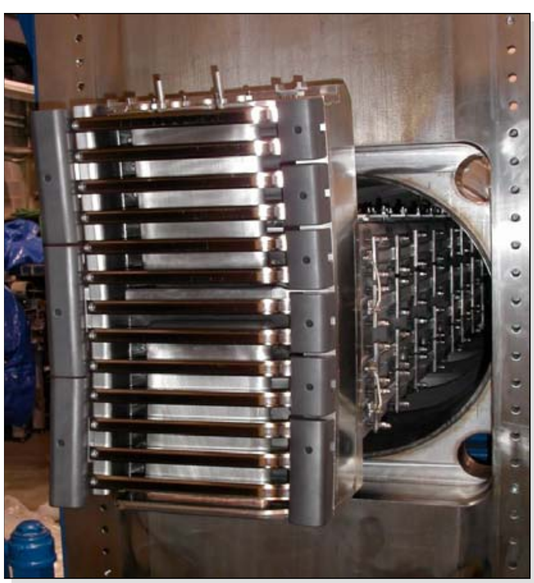
- One antenna, eight current straps
- Eight rf sources, each feeding one strap in the antenna
- 35-65 MHz
- 20 MW total power to the plasma
- Variable phasing between straps

**What it can be used for:**

- Tritium ion heating during DT ops.
- Minority ion heating during initial ops.
- Current drive near center for AT operation
- Minority ion current drive at sawtooth inversion radius



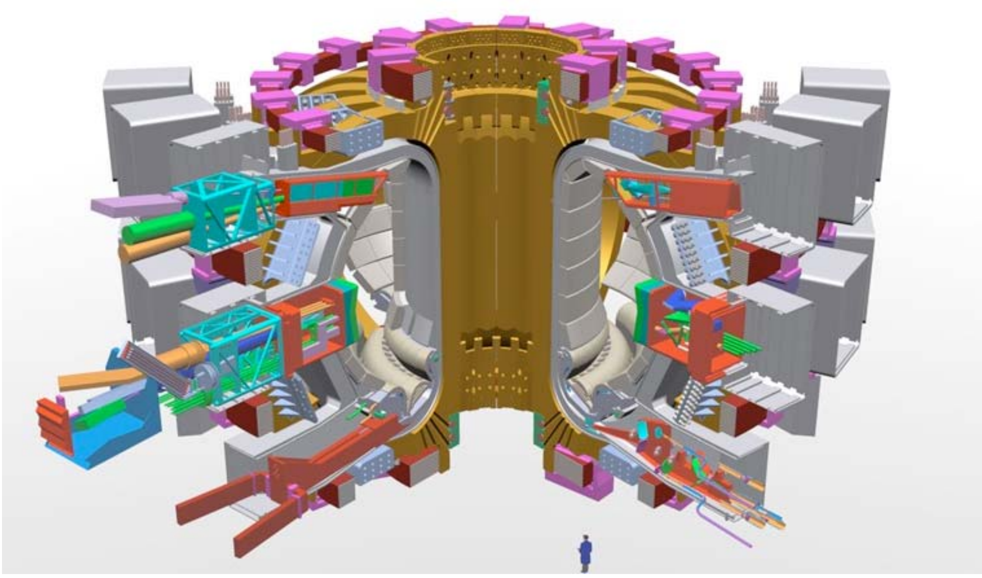

# ICH High Power Prototype Fully Assembled



# Electron Cyclotron System

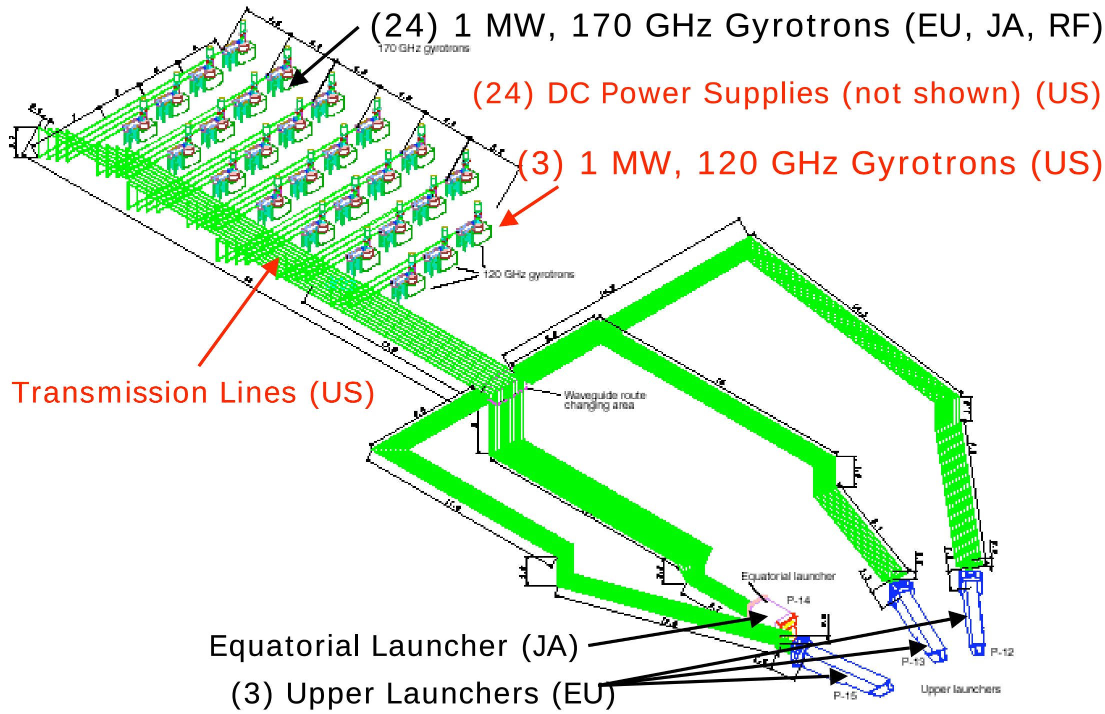
| Description of US portion | US fraction of system (by ITER value) | US Value (kIUA) [$M] |
|---|---|---|
| Start-up gyrotrons, all transmission lines and power supplies | 40% of full system | 32.3 [$47M] |

## ECH on ITER



- EC Current Drive (ECCD), off-axis.
- EC Heating (ECH), including start-up.
- Neoclassical Tearing Mode (NTM) stabilization.

## ECH System / Allocations

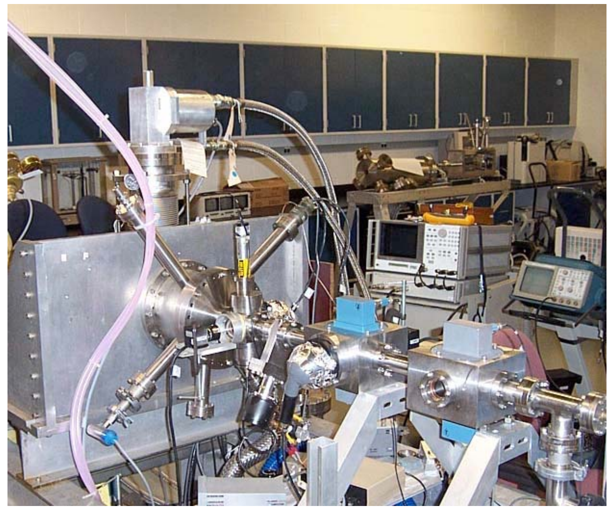



# Vacuum Pumping and Fueling

| Description of US portion | US fraction of system (by ITER value) | US Value (kIUA) [$M] |
|---|---|---|
| Roughing pumps, standard components, pellet injector | 37% of full system; 88% of selected subsystems | 15.0 [$22M] |

## Pellet Injection and Pumping: R&D is starting

- **US starting R&D work for ITER Pellet Injection System**
  - significant R&D to meet throughput and reliability needs
  - pressing issues have been identified with IT
  - ITER pumping packages require no R&D
- **ITER Pellet Injection workshop attended in May 2004**
  - Injectors to produce ~4.5mm pellets at up to 32 Hz
  - ORNL test of ITER guide tube mockup is underway
  - Gas gun approach for injector is under investigation

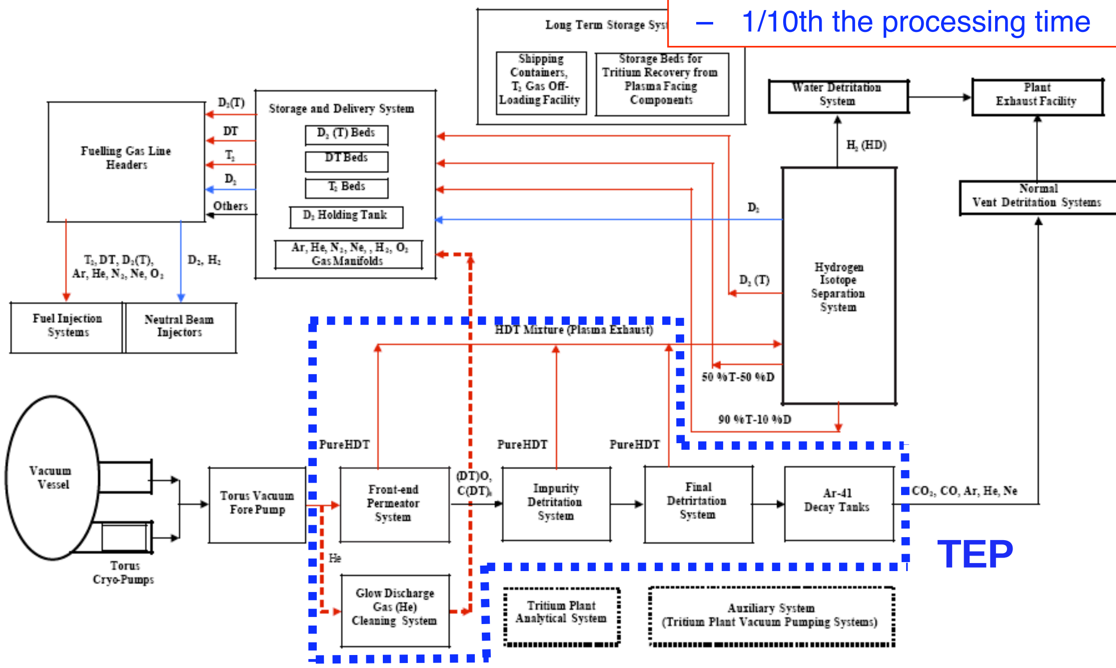


# Tritium:
# Tokamak Exhaust Processing System

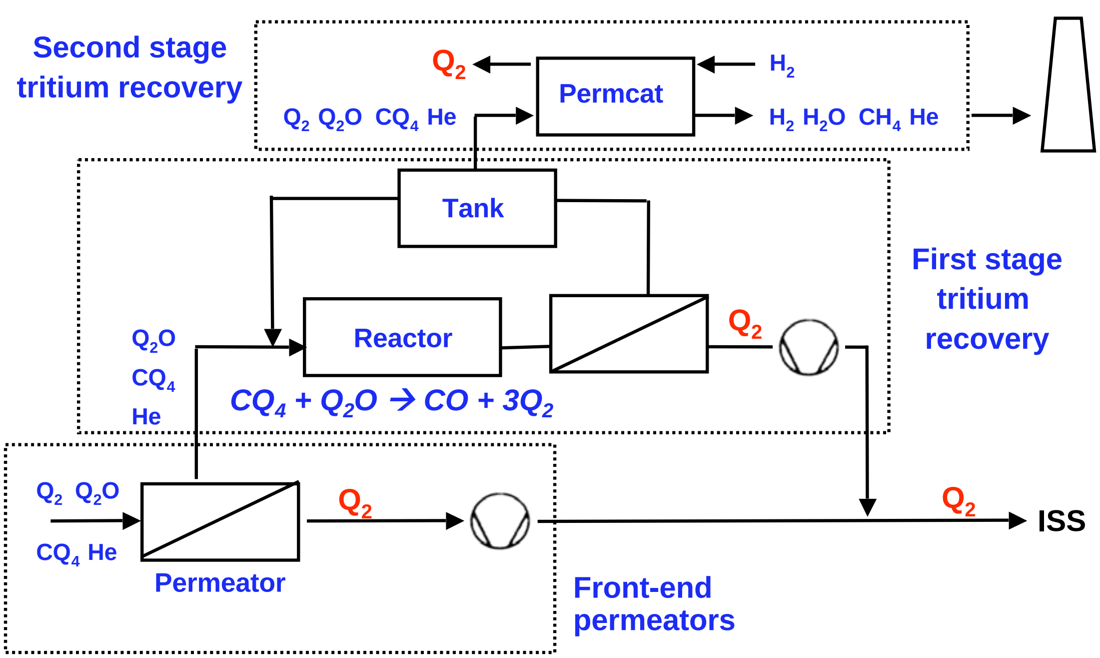
| Description of US portion | US fraction of system (by ITER value) | US Value (kIUA) [$M] |
| --- | --- | --- |
| Tokamak exhaust processing system | 14% of full system; 88% of selected subsystems | 11.4 [$16M] |

## Overview of ITER Tritium Plant

- 20x's flowrate
- 10x's inventory (initial ITER charge of tritium ~1000 gm, expensive, and ~5% of available supply)
- 1/10th the processing time



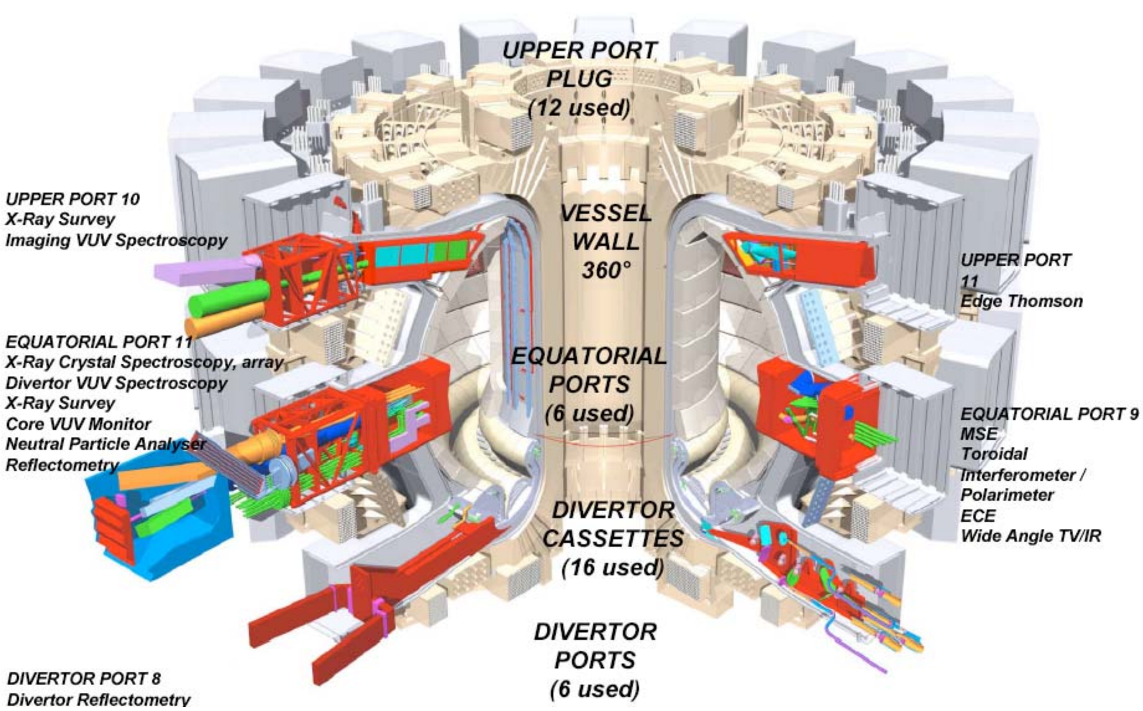

## TEP process flow diagram



# Diagnostics

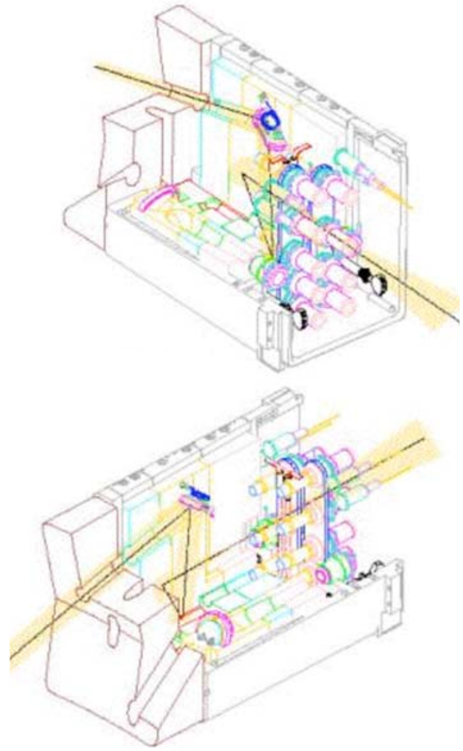
| Description of US portion | US fraction of system (by ITER value) | US Value (kIUA) [$M] |
|---|---|---|
| Allocations being discussed | 15% of full system (not including DNB) | 20.6 [$30M] |

## ITER diagnostics landscape



## US-assigned Diagnostics

- Visible/IR Cameras (upper)
- Reflectometer (main plasma – LFS)
- MSE
- ECE (main plasma)
- Interferometer (divertor)
- RGA

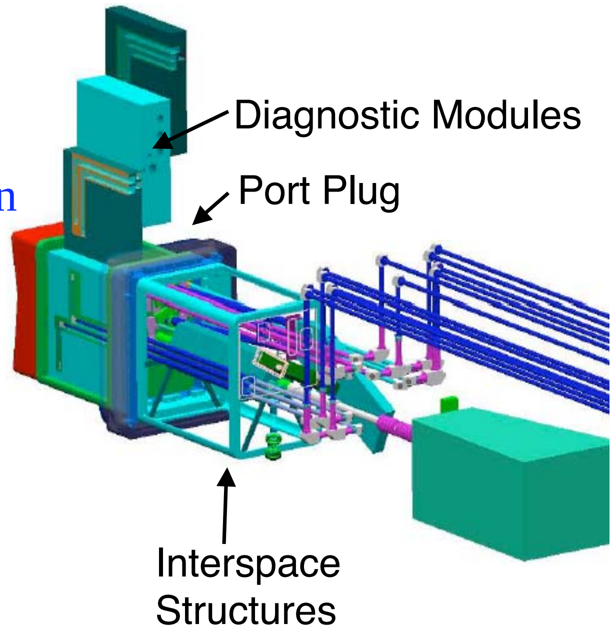


## Overview of tentative US in-kind contributions: Diagnostics

| System | Subsystem | US Percentage |
|---|---|---|
| Diagnostics | Visible/IR Cameras (upper) | 1.8% |
| | Reflectometer (main plasma – LFS) | 2.5% |
| | MSE | 2.4% |
| | ECE (main plasma) | 4.6% |
| | Interferometer (divertor) | 2.5% |
| | RGA | 2.1% |
| TOTAL | | 16% |

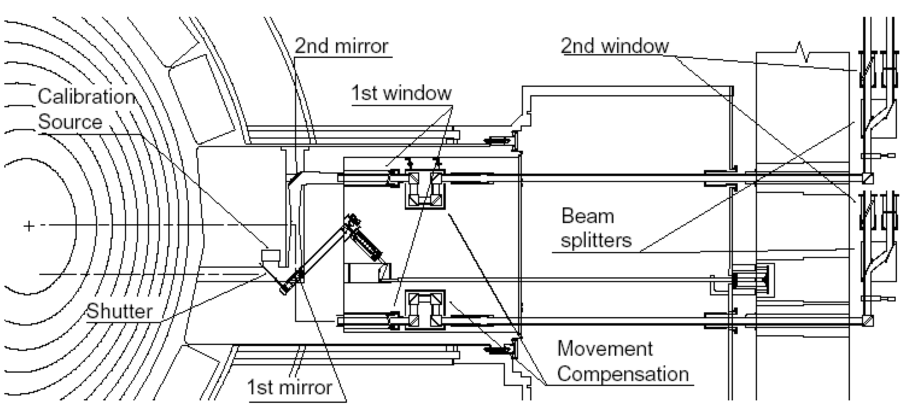
## As Proposed, the US will Provide a Divertor, 2 Midplane and 2 Upper Ports

- PPPL's Doug Loesser has begun working with the ITER International Team on port design, and on helping to organize a "Port-Plug Task Force".



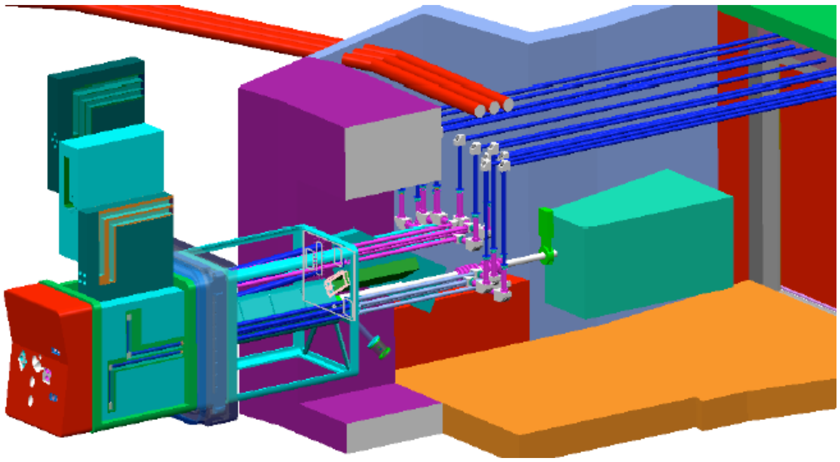

## Electron Cyclotron Emission

- Two receiving antennas, vertically offset to provide core measurements for a variety of plasma shapes.
- Mature design, microwave system robust in ITER environment.



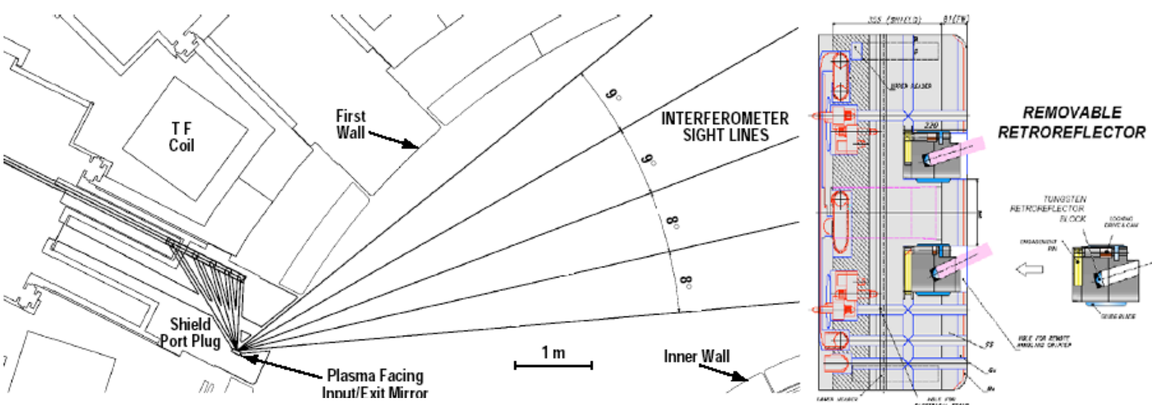
# Main Plasma Reflectometer (LFS)

- X and O mode launchers provide SOL and pedestal density profiles, MHD mode information and density fluctuation measurements.
- Mature design, microwave system robust in ITER environment.



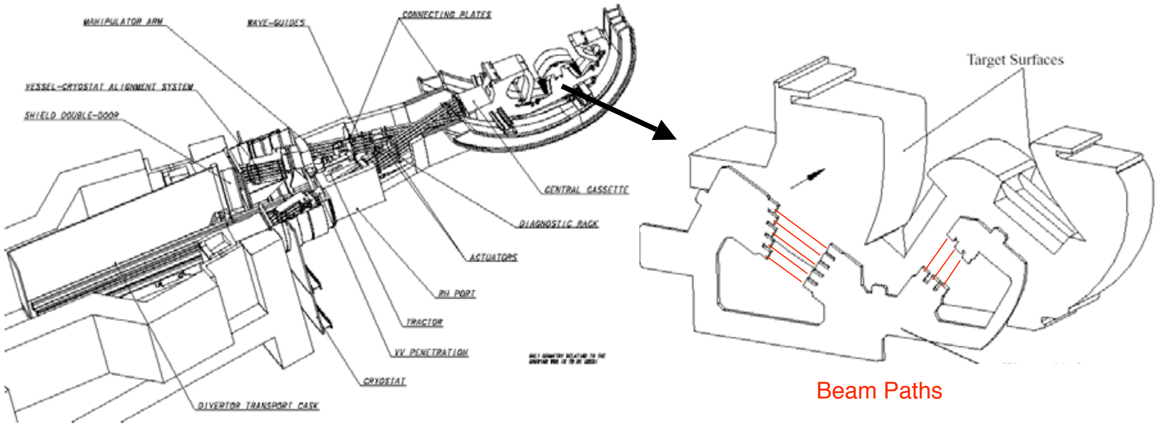
# Tangential Interferometer/Polarimeter

- This system is a two-color $CO_2$ laser interferometer with retro-reflectors on the outer midplane wall.



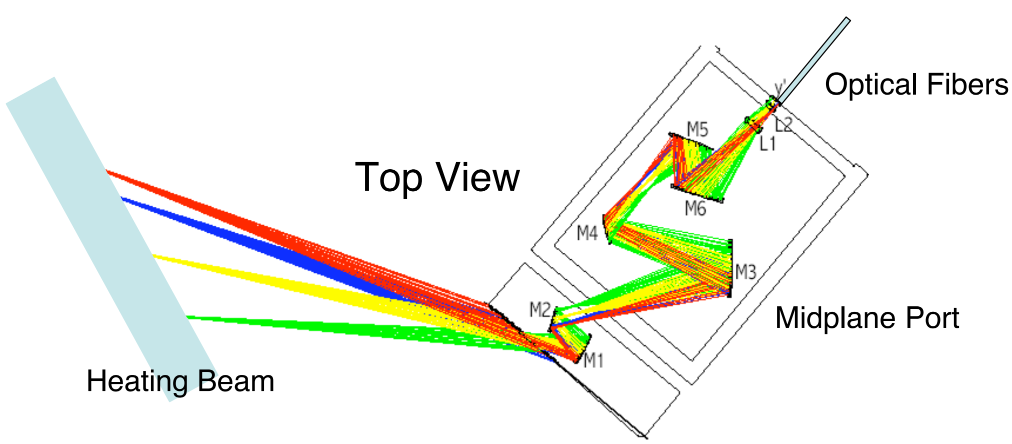
# Divertor Interferometer

- Originally conceived as a microwave system, this system will more likely be an $CO_2$ laser interferometer system.
- Degradation of IR optics in divertor region due to deposition is a significant concern.  Deposition studies are underway at several existing devices to understand this phenomenon.
- Maintenance of alignment along complicated beam path is also a challenge, perhaps requiring real-time feedback control.



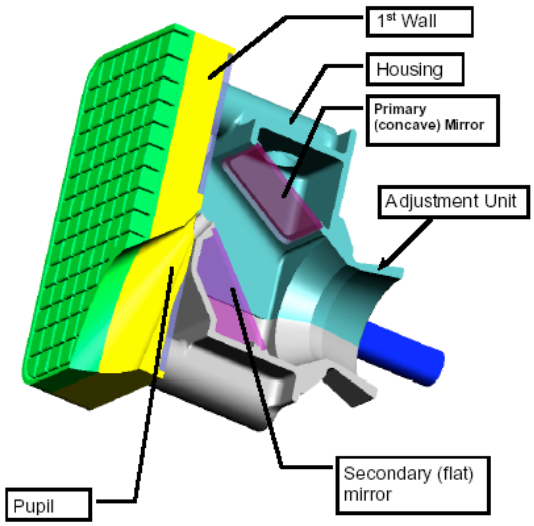

# Motional Stark Effect Polarimeter

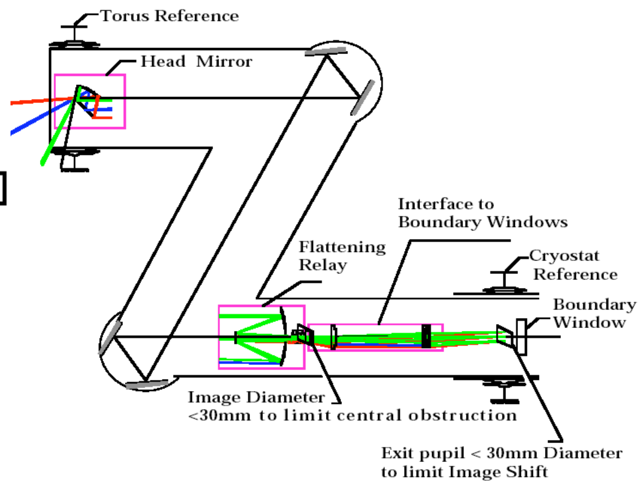
- Six mirror optical labyrinth will make precision polarimetry difficult.
- Optical degradation of mirrors, due to charge- exchange erosion and re-deposition of ablated wall material, represents a significant risk.
- In-situ, real-time calibration may be necessary
- This system will use optical fibers near outboard end of port plug.



# Upper Visible/IR Cameras

- Six camera systems in every other upper port provide complete coverage of divertor region and provide nearly full coverage of inside wall along with 4 equatorial systems.
- Well integrated design, prototyped on JET.




## Other US ITER Tasks

- **Safety (D. Petti/INEEL)**
  - ✔ Support and analysis for the latest fusion versions of computer codes MELCOR and ATHENA
  - ✔ Magnet safety
  - – Dust Characterization including mobilization and transport
- **Materials (S. Zinkle/ORNL)**
  - ✔ Support of materials activity
- **Test Blanket Working Group (Abdou)**

## FY04 US Secondees/Visiting Experts (~3 FTEs) paid by ITER-Direct

- **The present ITER international team consists of 69 persons:**
  **31 from Europe,**
  **21 from Japan,**
  **13 from Russia,**
  **3 from the US, and**
  **1 from China,**

- **US "Secondees":**
  - Magnets [Naka, Japan]
    - Nicolai Martovetsky (LLNL) and Philip Michael (MIT)
  - First Wall/Blanket [Garching, Germany]
    - Dr. Richard Nygren (Sandia) and Mr. Thomas Lutz (Sandia)
  - Ion Cyclotron [Garching, Germany]
    - David Swain (ORNL) and Richard Goulding (ORNL)
  - Port Plugs/diagnostics [Garching, Germany]
    - Douglas Loesser (PPPL)

## US ITER action items from the 6/04 IT/PTL and PC-3 meetings

**consider providing IT staff in the following areas:**

- **codes and standards**
- **scheduling/project management**
- **risk management**
- **integration of heating systems**
- **CODAC**
- **tritium plant layout**
- **(Head of ITER Naka Joint Work Site and Head of Nuclear Technology [9/7])**
- **(Head of the Safety Group [9/7])**

**name U.S. contact person on CAD, IT and networking**

**participate in review of the IT's draft Risk Management Plan**

**work with the IT risk-mitigation and risk-management for the magnets.**

**respond to IT-initiated requests physics R&D and physics-design tasks**

## Physics Task discussions at the Preparatory Committee meeting (6/04)

- **The ITPA is doing an adequate job in addressing many of the physics R&D needs**
- **However, there are several areas in which the ITPA is not addressing key questions that affect the designs**
  - In these areas, the International Team Leader will propose specific physics tasks to the Participant Team Leaders
  - These tasks would entail joint development of the scope with the IT responsible officer, including a clear specification of:
    - communications channels
    - refinement of proposed experiments to maximize ITER-relevance
    - a report to document the outcomes
- **The US can propose tasks to the IT Leader for his request to us**

## Physics Tasks requested by the International Team Leader [need clearer specifications and integration with ITPA]

- **Magnets and PFCs (power and particle-handling, including tritium inventory):**
  - Characterization of thermal energy load during disruption
  - Model development of halo current width during VDEs based on experiments
  - Simulations of VDEs in ITER with 3D MHD code
  - Disruption mitigation by noble gas injection
  - Oxygen baking experiment
- **Heating and Current-drive and advanced control:**
  - ITER Plasma Integrated Model for ITER Control
  - Validation of enhanced confinement models and application to ITER.
  - Feasibility study of ITER SS scenarios with high confinement, NBCD, ECCD, LHCD, ICCD and fueling by pellet injection.
  - Development of Steady State Scenarios in ITER
  - RWM in Steady State Scenario in ITER
  - RF launchers
  - Evaluation of Fast Particle Confinement of ITER
- **Diagnostics:**
  - Specific diagnostic design tasks, including updating procurement packages for diagnostics for which the US is responsible

## Scope of the ITER Transitional Arrangements*

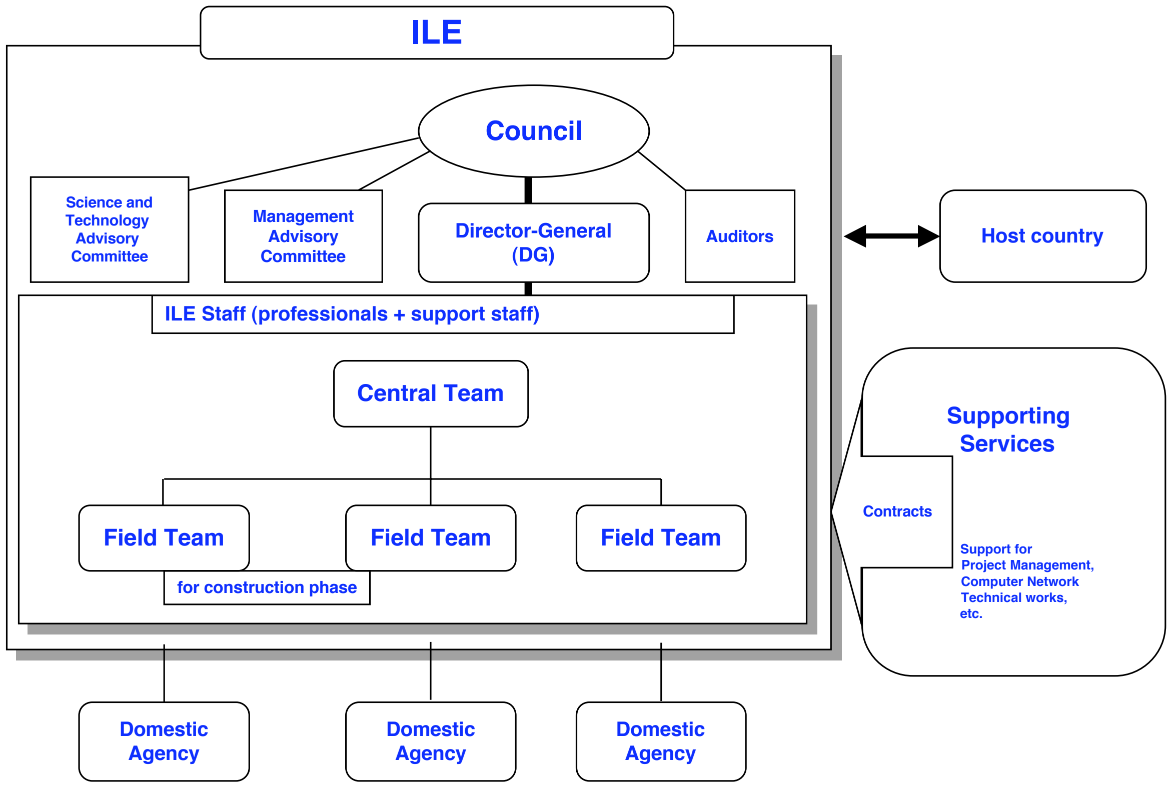
- "Joint technical preparations directed
  at maintaining the coherence and integrity of the ITER design and
  at preparing for an efficient start of ITER construction"

- "Organisational preparations directed
  at enabling the ITER Legal Entity to enter into effective operation
  with least possible delay following the entry into force of the ITER
  Joint Implementation Agreement"

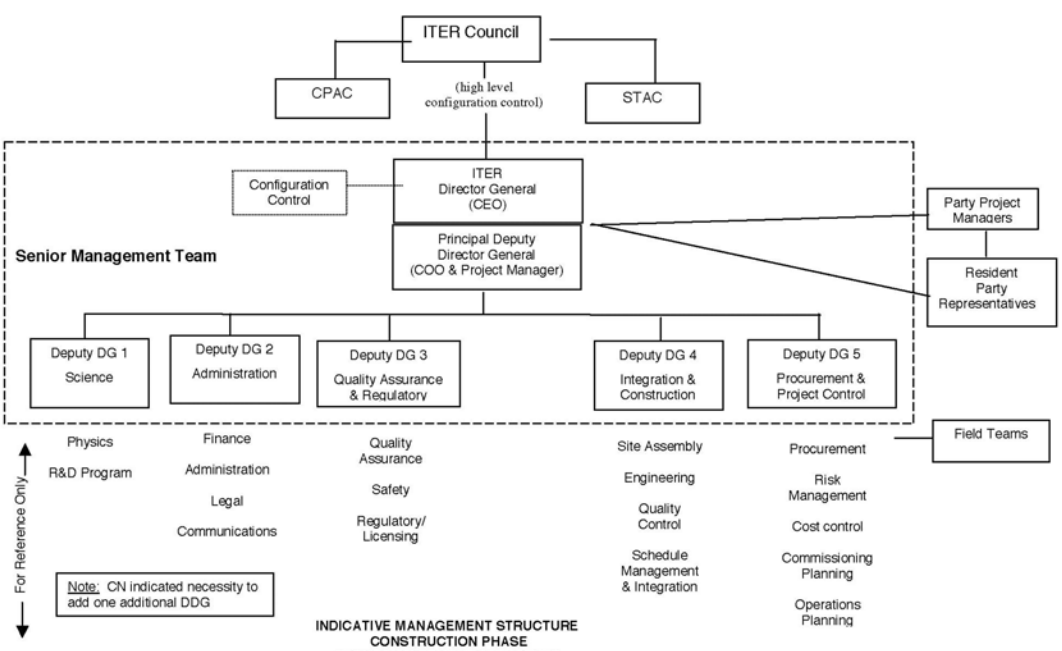
## Overview of NSSG-Groups

| Area | US emphasis |
|---|---|
| • Management Structure | *effectiveness* |

# Conceptual ITER Organizational Structure




NSSG-9 ROM Attachment 7

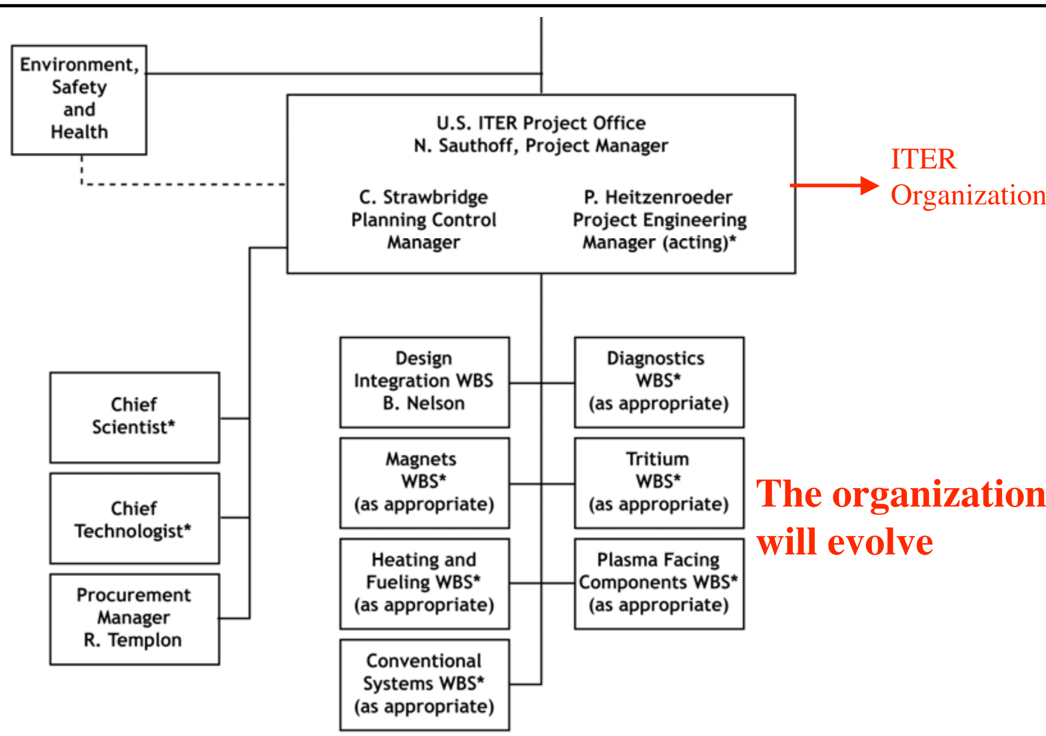



INDICATIVE MANAGEMENT STRUCTURE
CONSTRUCTION PHASE
FROM MANAGEMENT STRUCTURE
WORKING GROUP NSSG-9

# Overview of NSSG-Groups

| Area | US emphasis |
| --- | --- |
| • Management Structure | *effectiveness* |
| • Staffing | *accessibility* |
| • Procurement Systems/Methods | *in-kind/in-cash; changes* |
| • Procurement Allocations | *project success and US interests* |
| • Resource Management Regulations | *visibility and changes* |
| • Risk | *recognition and management* |
| • Intellectual Property | *benefits and protection* |
| • Decommissioning | *amount and timing of the funds* |

# U.S. ITER Project Office

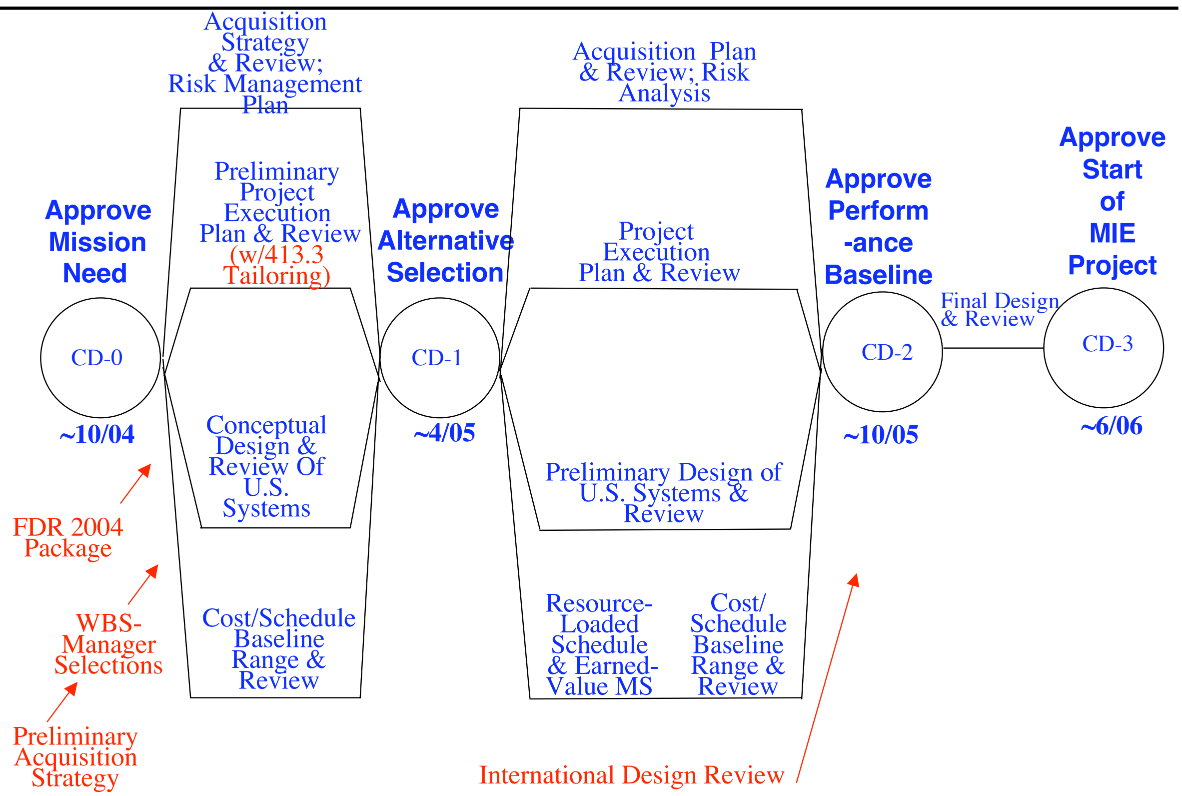



** National search will be conducted to assure best qualified individual is available to the project.*

# MIE Critical Decision Milestones

| | |
|---|---|
| • **Critical Decision 0 – Approve Mission Need** | **October 2004** |
| – Approve Acquisition Strategy (S2) | December 2004 |
| – Approve Prelim Project Execution Plan | December 2004 |
| – Conceptual Design Review Documentation | January 2005 |
| – Cost/Schedule Baseline Range Review | February 2005 |
| • **Critical Decision 1 – Approve Alternative Selection and Cost Range** | **April 2005** |
| – Complete all Project Documentation | May 2005 |
| – Preliminary Design Review Documentation | June 2005 |
| – Resource Loaded Schedule & EVMS System | June 2005 |
| – External Independent Review (OECM) | July 2005 |
| – SC Baseline review (Lehman) | September 2005 |
| • **Critical Decision 2 – Approve Performance Baseline** | **October 2005** |
| – Update/complete all Project Documentation | February 2006 |
| – Final Design Review Documentation | March 2006 |
| – Execution Readiness Review (Lehman) | April 2006 |
| • **Critical Decision 3 – Approve Start of MIE Project** | **June 2006** |

# US ITER PROJECT CRITICAL DECISIONS



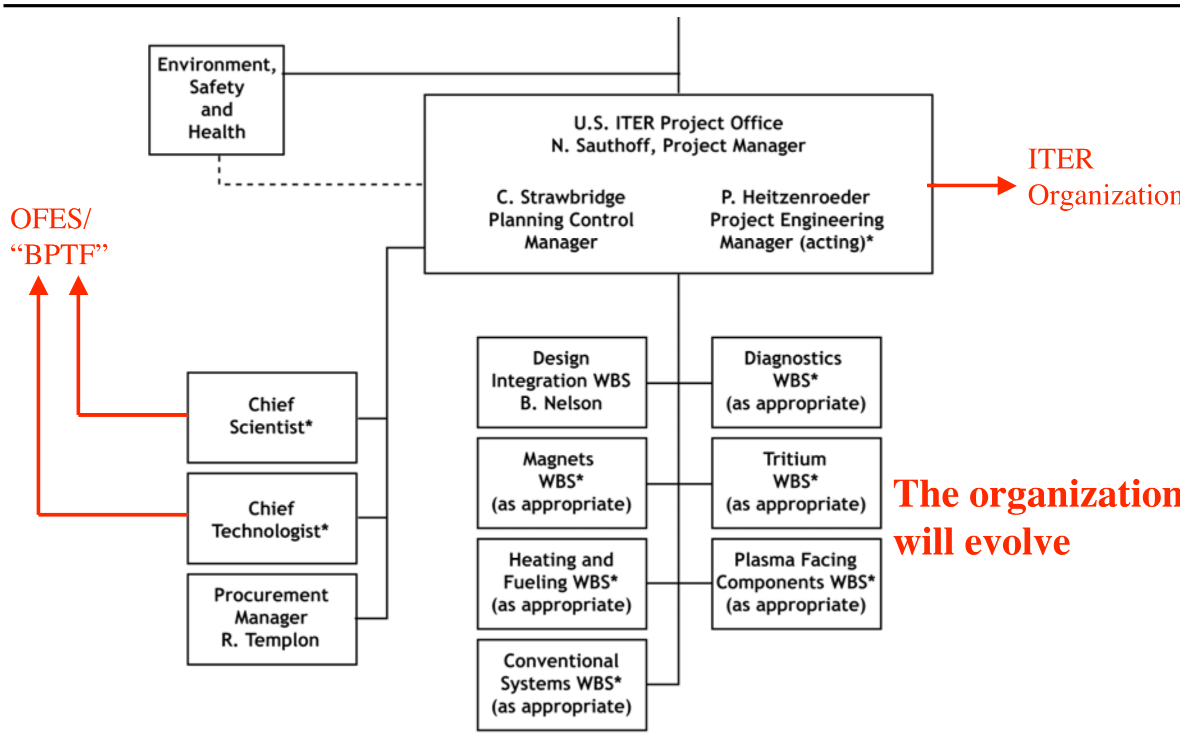
## Some Principles for
## U.S. Actions to Optimize the ITER Project

- **A strong central ITER Organization, closely linked to the Participant Teams, is essential.**
  - U.S. to emphasize effective project management and transparency

- **The U.S. ITER Project should be focused on ITER success and on cost effective construction of the U.S.-assigned in-kind components.**
  - utilizing state-of-the-art project management tools, integrated design tools, and innovative procurement methods linked to the ITER Organization
  - focusing on risk management
  - employing open merit-based competition to get the best and most experienced performers
  - optimizing the roles of the broad fusion community and industry
    - ~ 15 - 20% of ITER construction effort to be done by groups in the MFE program and DOE-SC Labs
    - ~ 80 - 85% to be done by industry

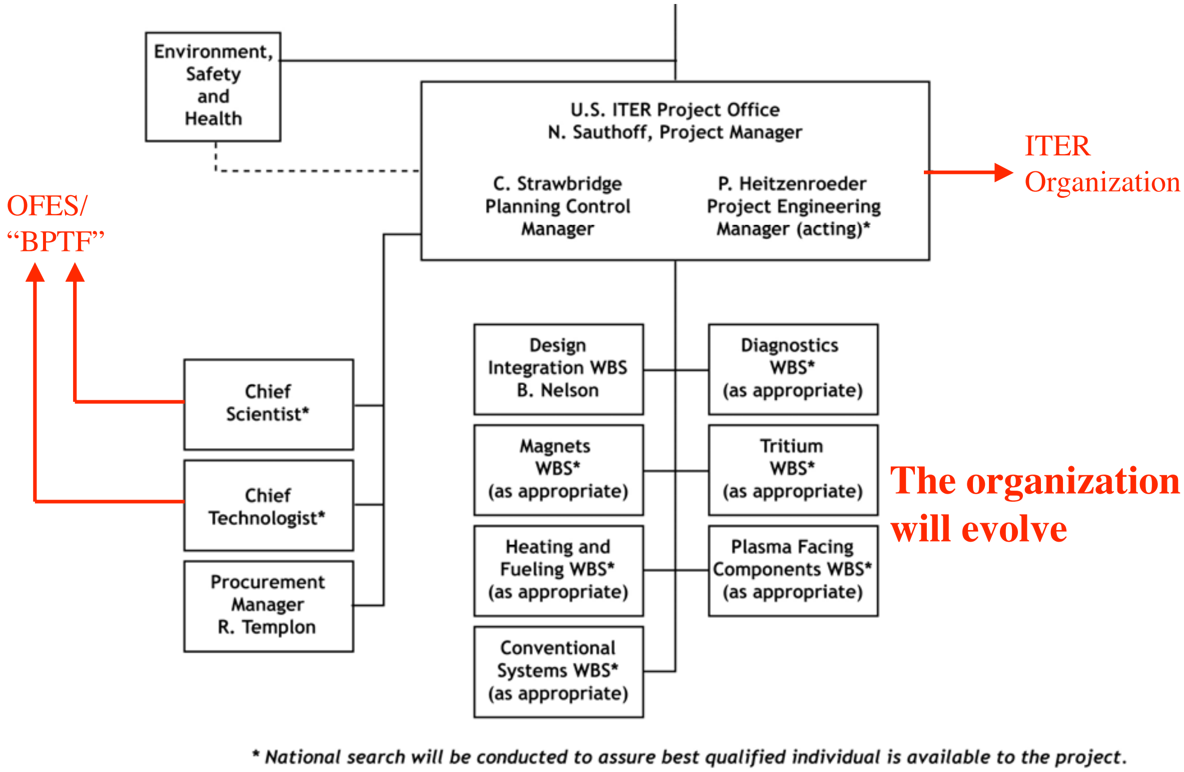
- **ITER's success reaches beyond fusion, as a possible paradigm for future large-scale international science.**

## U.S. ITER Project Office




* *National search will be conducted to assure best qualified individual is available to the project.*

# U.S. ITER Project Office




# US Burning Plasma Program (coupled but complementary to the project)

- **The primary US motivation for ITER-participation is research into the physics of burning plasmas and into the enabling technology**
- **Elements of the Burning Plasma Program:**
  - Research on the science and technology topics to:
    - Enable project design and manufacturing of US in-kind contributions
    - Enable project decisions on plasma control tools and other configurations
    - Accelerate exploitation of ITER by increasing research effectiveness (tool-building for experiment-design, research-planning and data analysis by remote participation)
  - Establishing the tools and culture for multinational topical research tools
  - Creating a successful precedent for large-scale international large-science activity

## US Actions to Establish the US Burning Plasma Program

- **Recognition of burning plasma research and establishment of enabling networks and structures**
- **Strong participation the ITPA and its successors**
- **Performance of physics tasks on**
  - key R&D and
  - application to design
- **Building tools and culture for multinational topical research teams**
  - prototyping and maturing international topical research teams
  - topical and integrated models/simulations/data-analysis tools
  - team-oriented remote participation tools

## The Bottom Line: Objectives and Opportunties

- **Objectives**
  - To conduct leading burning plasma research both now on existing facilities and in the future on planned facilities
  - To demonstrate the feasibility of fusion energy
  - To exploit and expand core competencies in enabling technologies
  - To develop and demonstrate a paradigm for large-scale science by strong international collaborations
- **Opportunities**
  - Exploiting and expanding both understanding and research capabilities
    - especially U.S. expertise in modern plasma control, advanced plasma instrumentation, and computational simulation
  - Playing key roles in the R&D/design/fabrication/test/assembly of US in-kind contributions
  - Devising international and national structures, policies and procedures to enable and achieve successful large-scale science by strong national and international collaboration