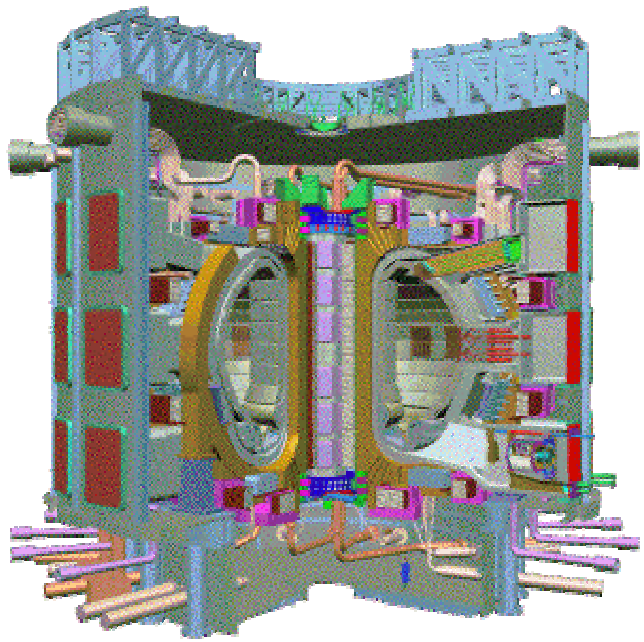
Status of ITER

P Barabaschi

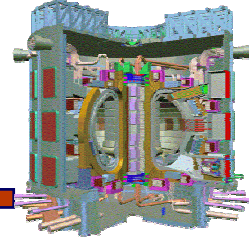
ITER International Team



16th ANS Topical Meeting on Fusion Technology

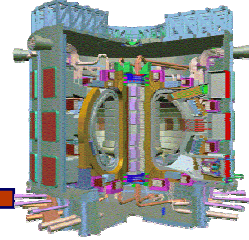
Madison - WI , 14-16 Sept 2004

Synopsis



- Negotiations
- Design activity
- Other Project activities
- ~~R&D~~
- Risk Management

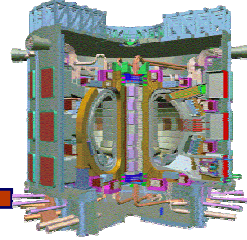
Negotiations



- **Began in July 2001 with the following aims**
  - **draft Joint Implementation Agreement**
  - **select ITER construction site**
  - **agree how the procurement and costs will be shared**
  - **define how the project will be managed**
  - **identify the Director General and senior staff.**
- **Some work done by Negotiators until Dec. 2003**
- **No progress afterwards over choice of construction site.**

Cadarache or Rokkasho

Construction Cost Sharing

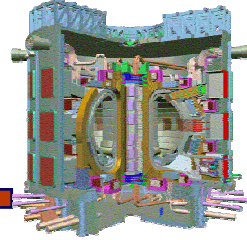


Party	Share	Total
CN-KO-RF-US	10% each	40%
JA + EU	Host: 36%+A Non-Host: 10%+B (A+B=14%)	60%

- Host provides Buildings and Utilities. Remaining allocation (A+B) depends on site and final agreement.
- Fund (10%): Feeders, Shielding, viewing, NB RH, Hot cell eq., cryodist., CODAC, installation and test, other sundry items

- **CN:** magnet supports,feeders, correction coils, conductors, blanket (0.2), cryostat, gas injection, casks (0.5), HV substation, AC/DC (0.35), diag.
- **EU:** TF(0.5), conductors, cassette and outer target, vac.pumps, div. RH, casks (0.5), isotope sep., IC, EC, diag.
- **JA:** TF(0.5), conductors, inner target, blanket RH, EC, diag.
- **KO:** conductors, vessel ports (0.67), blanket (0.2), assembly tools, thermal shield, T storage, AC/DC (0.65), diag.
- **RF:** PF1, conductors, vessel ports (0.33), blanket (0.2), port limiters, flexibles, dome and PFC tests, Discharge circuits, EC, diag.
- **US:** CS(0.5), conductors, blanket (0.1), vac.pumps, pellet inj., vessel/in-vessel cooling, tok exh. proc., IC, EC, diag.

ITER Fusion Energy Organisation



IIFEO

Council

Science and Technology Advisory Committee

Construction Programme Advisory Committee

Director-General (DG)

Auditors

DDGs

Organisation Personnel (professionals + support staff)

Staff of DG

Central Team

Project Manage.

Admin.

Integration Interface

Procure-ment

QA.

Physics

Safety Licensing

Host Relation

Field Team

Field Team

Field Team

Domestic Agency

Domestic Agency

Domestic Agency

Industries and Other Organisations

Industries and Other Organisations

Industries and Other Organisations

Host Country

Organisation/Host Relation

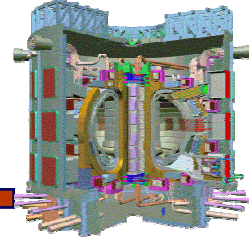
Contract

Supporting Services

Support for
- Project Management
- Computer Network
- Technical work
- Clerical work

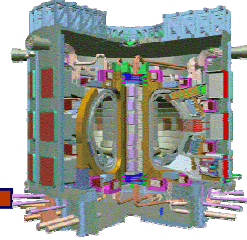
etc.

Main design changes in ITER since FDR

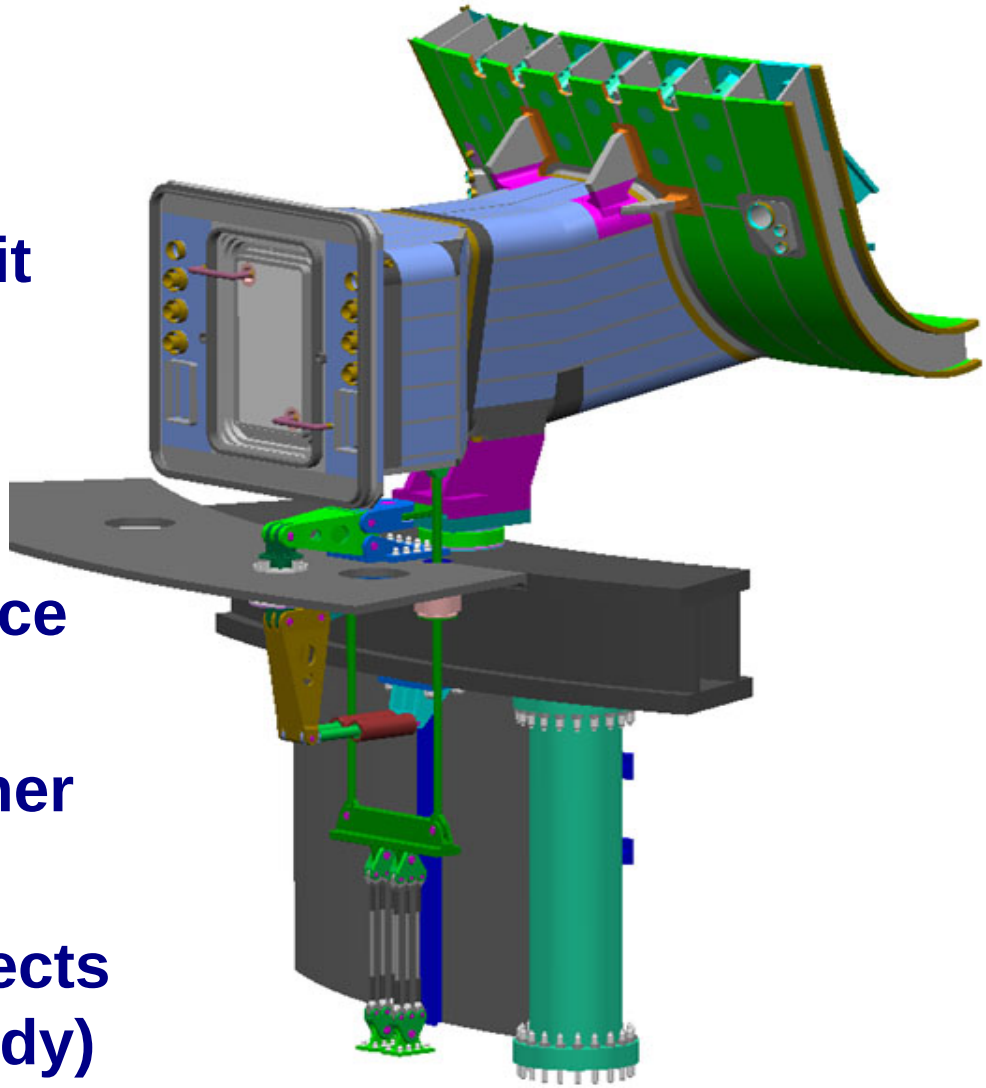


- **Magnets**
  - increased strand critical current density (from ~600 to ~800 A/mm^2)
  - use of stainless steel jacketing in all conductors
  - friction joint in outer intercoil structure
- **Vessel/Blanket**
  - support arrangement simplified
  - nine lower ports
  - blanket module has FW supported from welded central leg
  - improved module arrangement around NB ports
- **Redesign of Cryostat Thermal Shield**
- **Building/Services**
  - port cells confinement
  - Seismic isolation for Rokkasho and Cadarache
  - Layout

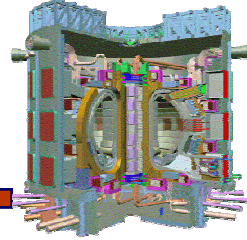
Vacuum Vessel Support System

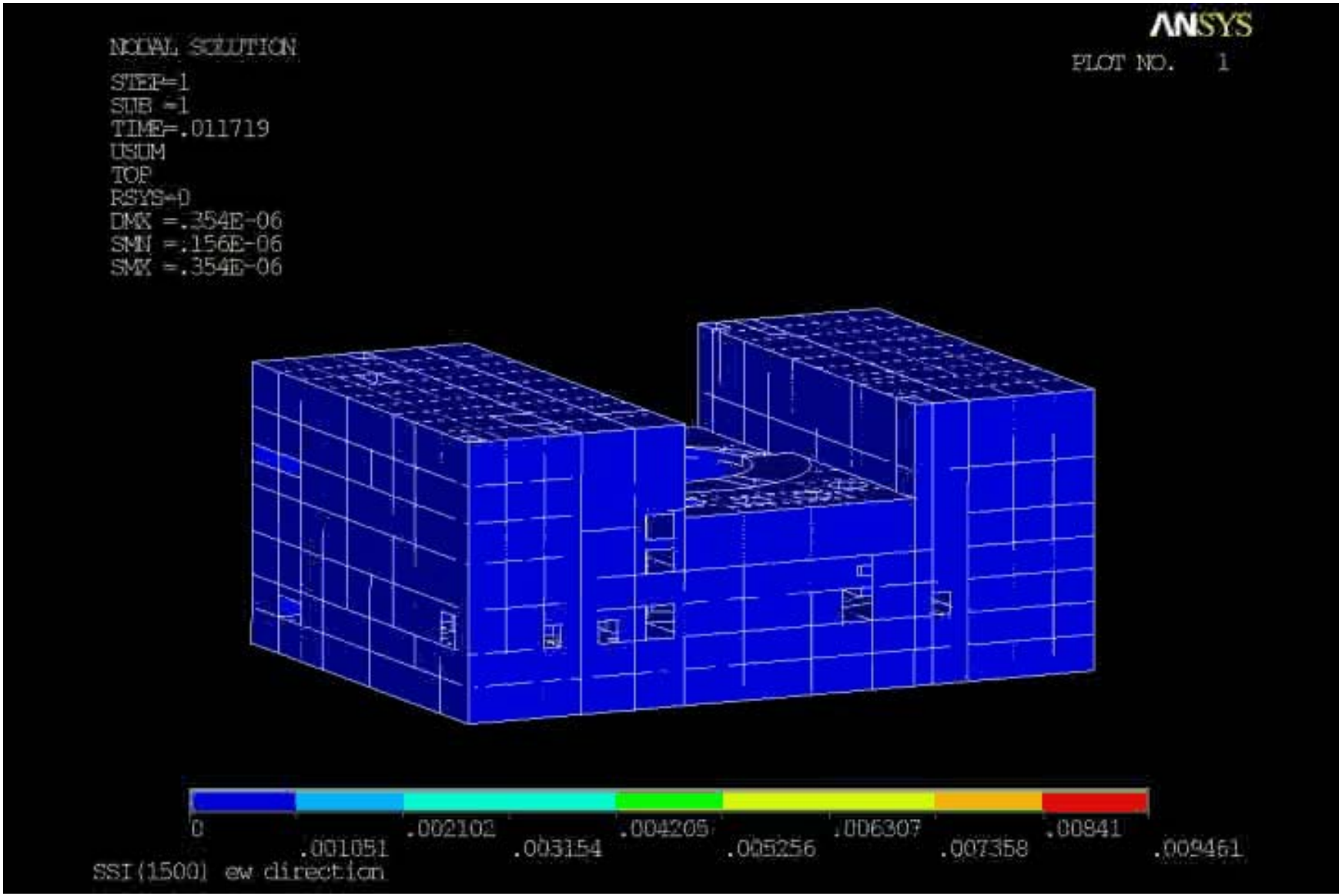


- VV supported independently of magnets at the lower ports.
- Possible to adjust the VV in the pit after welding of the sectors.
- Snubbers used to limit the radial movement during earthquake.
- Locate parts requiring maintenance outside cryostat.
- Seismic isolation will lead to further simplification (under study)
- EM-Structural TF/VV coupling effects found to be <u>significant</u> (under study)

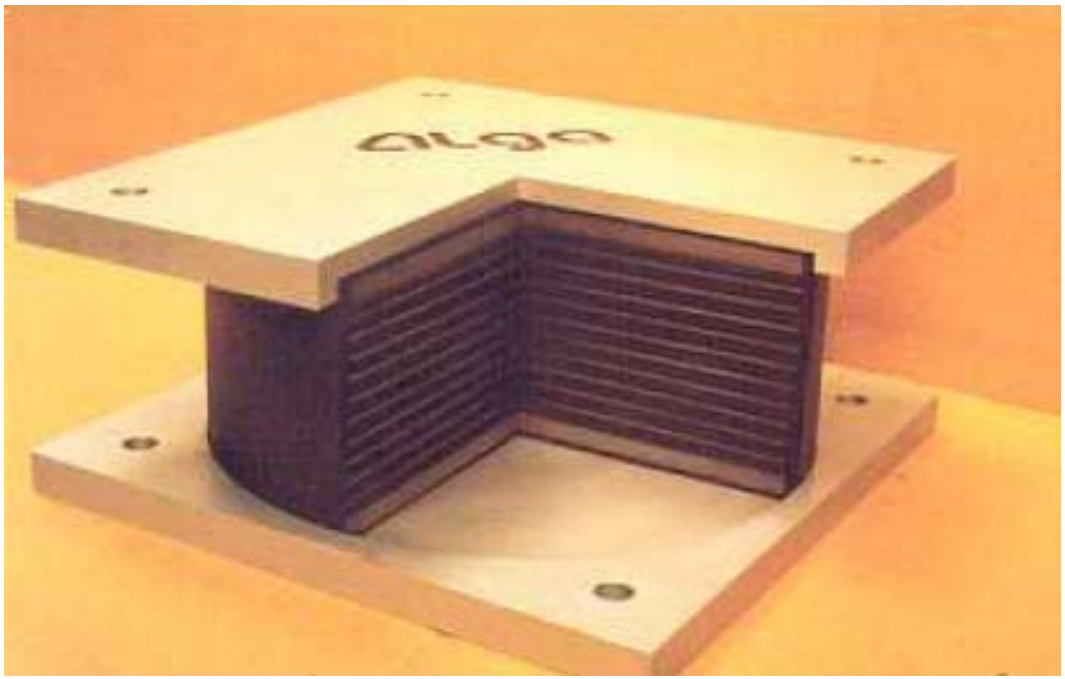


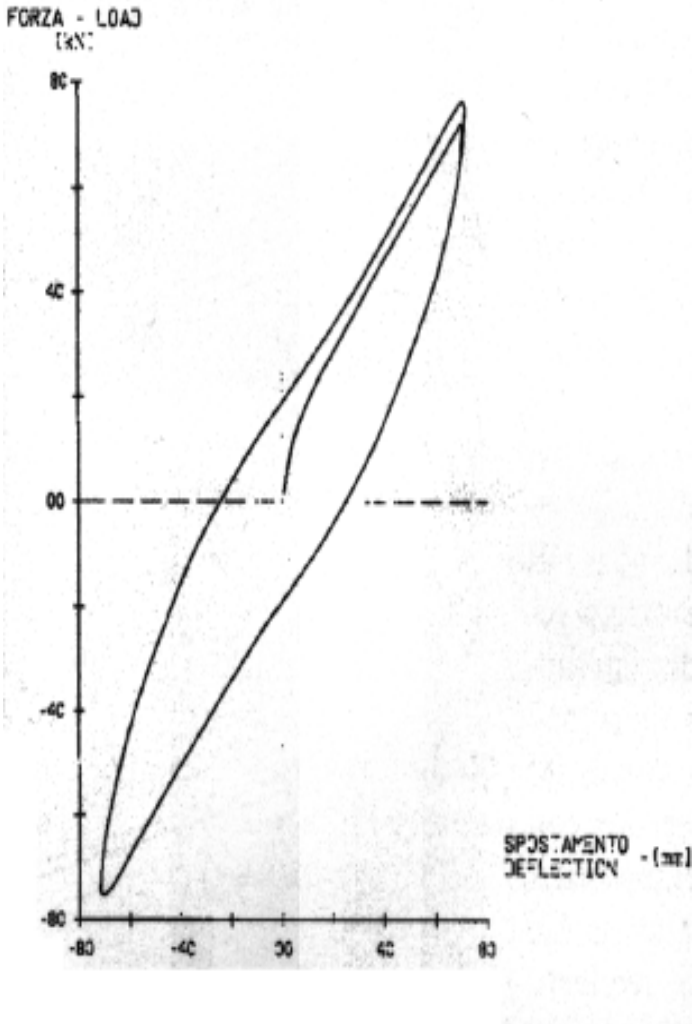
Seismic Effects on Tokamak Complex



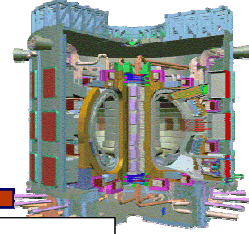


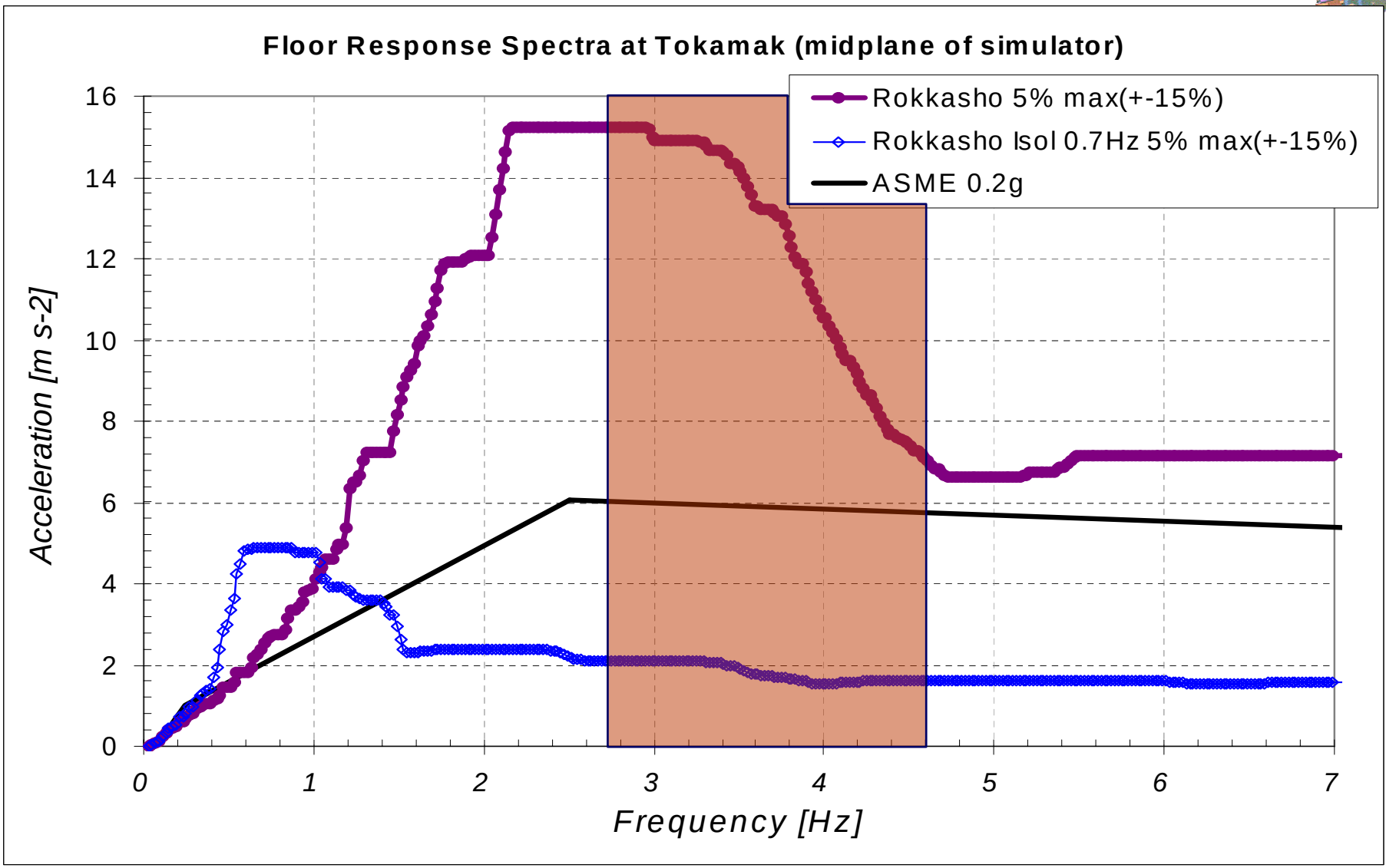
Seismic Isolators



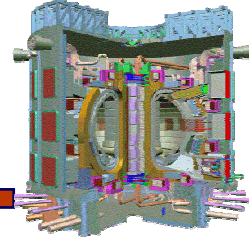


Seismic Isolation effect on horizontal accelerations



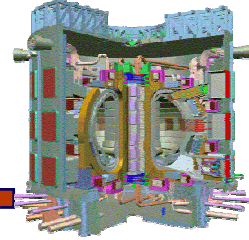


Procurement Specifications



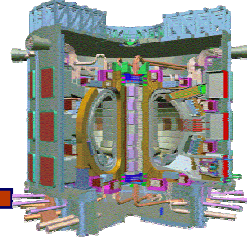
- **Drafting of detailed technical specifications for long lead items:**
  - **Magnets:**
    - » strand and conductor
    - » PF and TF coils
  - **Vessel:**
    - » main vessel and ports
    - » blanket coolant manifolds
  - **Buildings:**
    - » tokamak complex
    - » cryogenic halls used for PF coil winding
    - » service tunnels
  - **Task Forces established with PT/IT membership to complete work in necessary detail and with industrial realism - only partly successful also due to lack of site decision.**
- **Development of other procurement specifications to cover interfaces with long lead items - resource limited.**

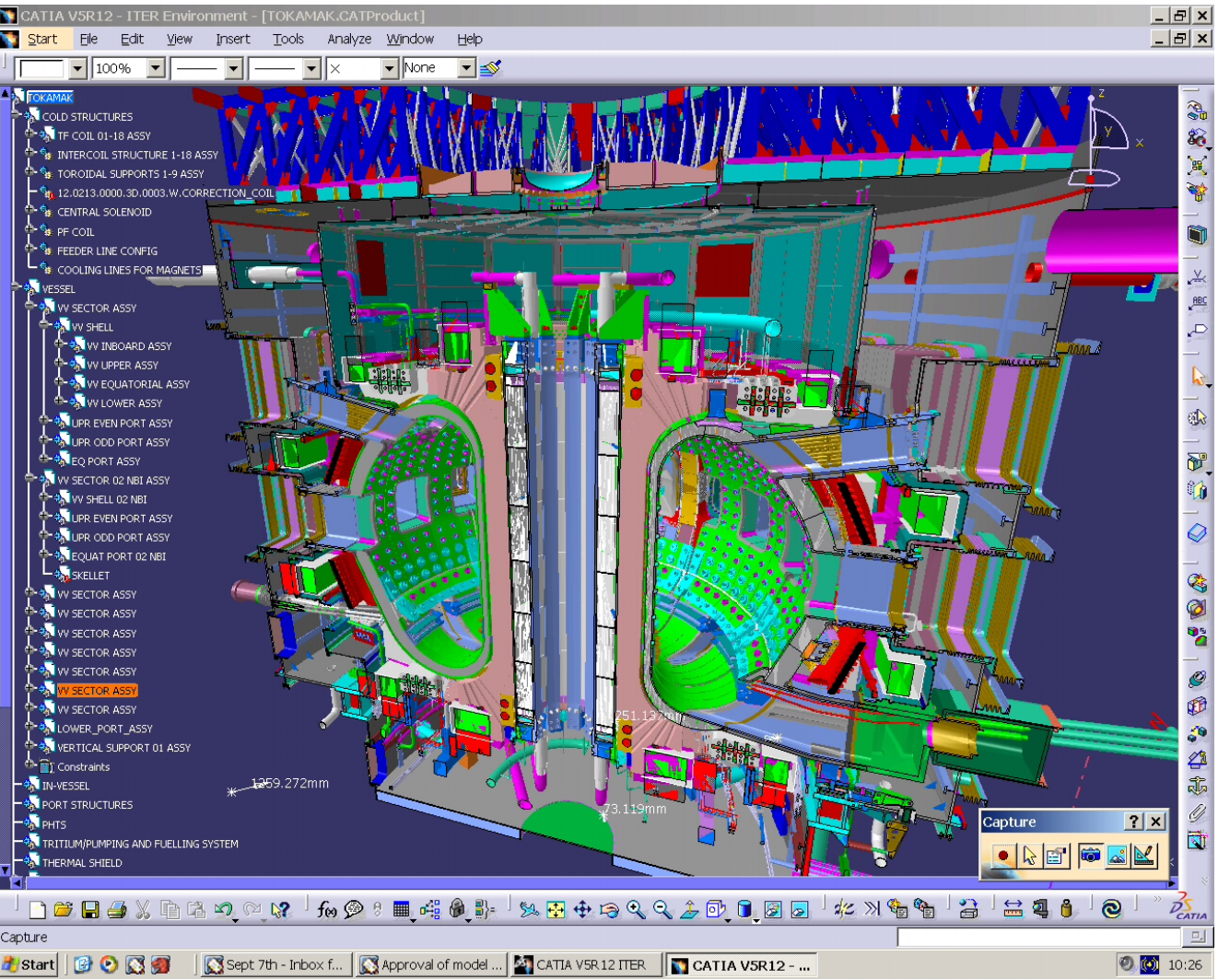
High level documentation revision



- Since July 2001, ITER design evolved in many details to resolve issues, reduce costs, and improve margins.
- To smoothly transfer responsibilities to new organisation, there is now a good opportunity to update documentation.
- Includes what has been done that is still valid, and identifies what now still needs to be done or redone to complete the design work.
- Introduced new configuration control document encapsulating previous top level requirements and key system parameters.
- Revised documentation will be available to Participants via the ITER web site.

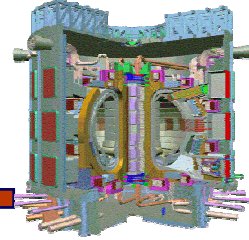
Configuration Management Tools





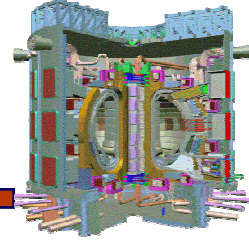
- **ITER IT has implemented Enovia VPM as data manager in conjunction with CATIA V4 and V5**
- **Catia V4 soon to be obsolete**
- **Process well-advanced with a complete switch to production work in CATIA V5 planned for the end of 2004.**
- **New Document Management system also being introduced soon**

Risk Management - The Problem



- **What are the sources of risk that may**
  1. **Hinder the entire project mission**
  2. **Cause large cost or schedule impacts**
  3. **…**
- **IT prepared Risk Management plan but has no manpower today to follow it**
- **During Negotiations IT identified potential risks from ITER agreement**
- **Some example sources of risk:**
  - **inconsistent or incomplete requirements**
  - **design uncertainties and oversights**
  - **multi-Party supply and complex interfaces**
  - **unproven technologies**
  - **interface or integration difficulties**
  - **unforeseen quality and/or safety issues**
  - **Insufficient resources**
  - **Inability to manage the procurement**

ITER-specific risks in procurement



1. **In Kind procurement – only 10% jointly funded**
2. **Large and complex components**

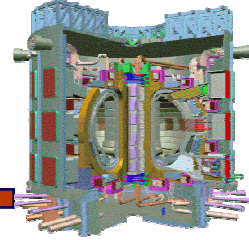
   ⇒ **limited number of potential suppliers**
3. **Very complex interfaces across suppliers and Party – often within same component**

   (I.e. TF Magnet, CS, Blanket, Vacuum Vessel, Divertor..).

   ⇒ **difficult to manage design changes**

   ⇒ **difficult to write tech specs**
4. **Confusion of roles and responsibilities:**
   - **Parties: Stakeholders? or Suppliers?**
   - **Project: Owner? or Prime Contractor?**

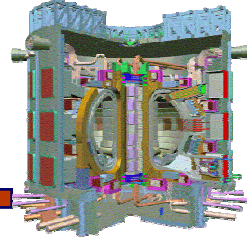
In-kind procurement



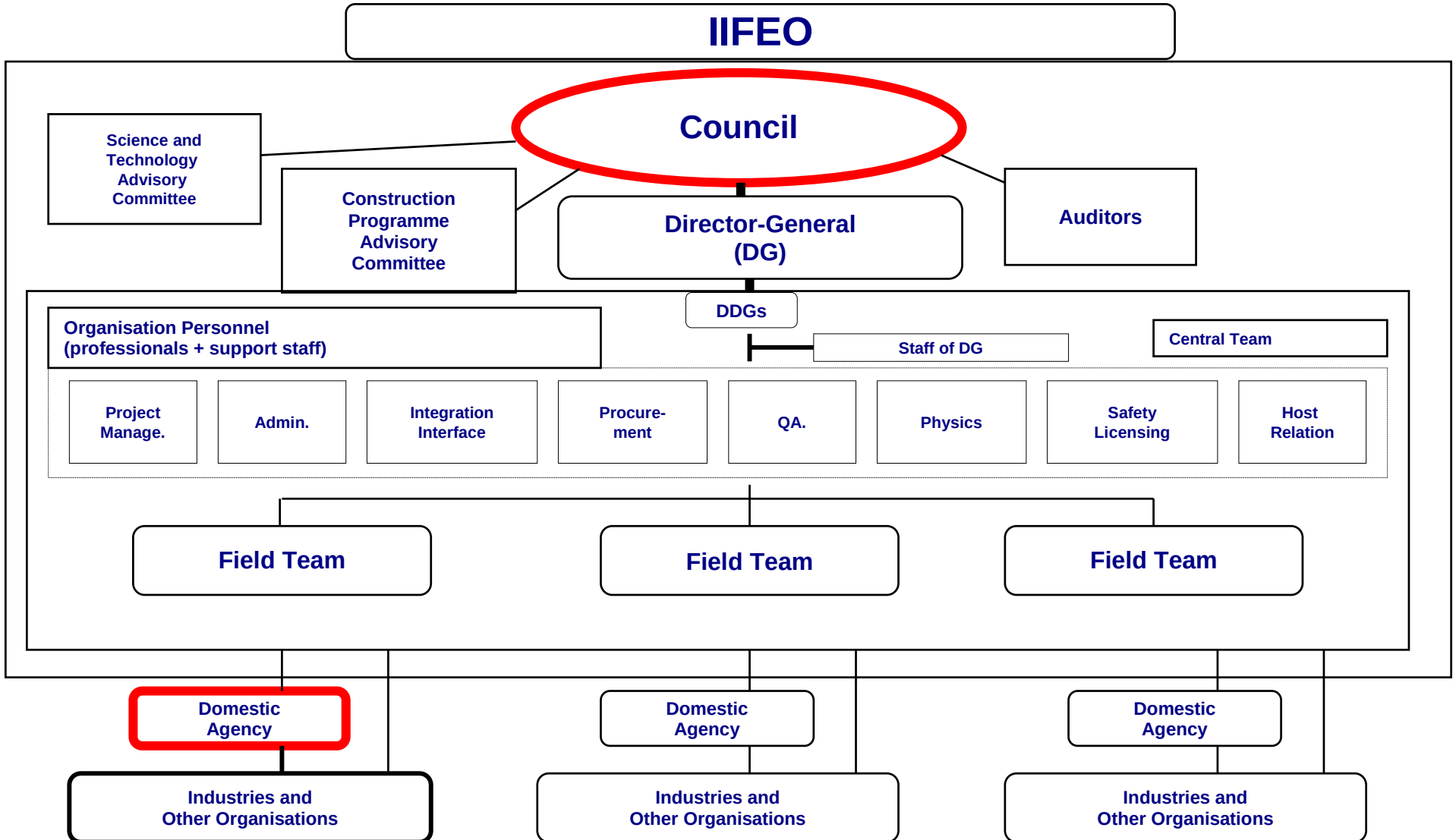
- **Why In-Kind?**
  - ➔ **To ensure involvement of the Parties in key fusion technology areas.**
  - ➔ **To ensure a fair sharing of the cost of the device by 'value' and not by currency.**
  - ➔ **Fair Return**
- **Nevertheless, the procurement system MUST:**
  - **Ensure project control of quality, cost and schedule**
  - **Allow for changes of scope when so needed**

Solutions exist to meet all the above requirements

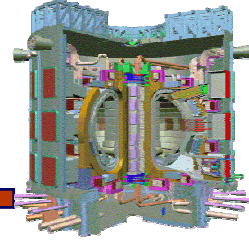
Roles and Responsibilities: The Parties



Cannot be simultaneously stakeholders and suppliers.

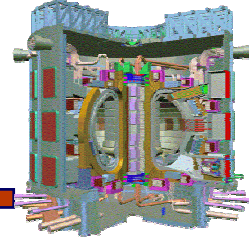


Roles and Responsibilities: the Project



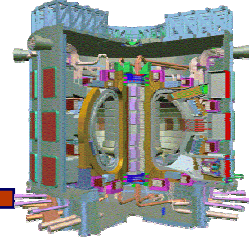
- **The Organisation will act:**
  - **During the construction phase as „Prime Contractor“ . Will focus on construction of machine in time, cost,**
  - **During the operation phase as „Owner“**
- **It is important to recognise the difference between these two roles and take this into account in:**
  - **The Staffing regulations**
  - **The Organisation of the Project Team**
  - **The Involvement of Industry during construction**

What is needed?



- Development of a comprehensive QA program for the construction phase.
- Implement Risk Management Plan
- Clear roles and responsibilities of Organisation, Parties and suppliers of services and components. Do the Parties trust the Organisation or not?
- Sufficient project management control tools given to DG
  - Penalties and other “standard” legal clauses
  - Control on payments as work progress
  - Control on non conformances
  - Minimise design changes but be able to implement when necessary
  - Avoid ITER to become an “Experiment in Project Management”!!!!
- Appropriate staff regulations to ensure
  - Quality of staff from ALL parties
  - Continuity of responsibility during the procurement cycle
  - Capability to work with industrial partners for PM and Integration
- Prime Contractors for some large procurements even if across parties.
- Start with multiple detailed manufacturing study contracts soon

Conclusions



- **The ITER Transitional Arrangements are being used at the project technical level to prepare for the construction phase:**
  - **Detailing of the design as much as possible**
  - **Preparing procurement packages taking account of manufacturing R&D;**
  - **Acquiring experience with tools that are necessary for project and quality control.**
- **When the Site will be selected and a DG chosen very important elements of the agreement will need to be finalised, including:**
  - **Role of Project in the control of procurement**
  - **Role of industry in project management**
  - **Staffing regulations**