Lessons Learned from our ITER Experience

HEPAP Long-Range Planning Sub-Panel

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Outline of Topics for Today

• Fusion as an ‘International’ program
• ITER Project
• My viewpoint
• Lessons internal to ITER
• Lessons external to ITER
• Current situation
• Conclusions
Fusion as an ‘International’ Program

Fusion was born and has remained ‘international’
  • Complex technical problems with attractive goal
  • Limited human and financial resources
  • Military and commercial concerns minimal

• 1950s Initiation amid security concerns
• 1960s Scientist-based collaborative activities-1
• 1970s Program-based joint agreements-2 + (1)
• 1980/90s Government-based ITER project + (2 and 1)
• 1990/00s Trying to recover from US ITER withdrawal
ITER Project

- Quadripartite Project
- Demonstrate scientific and technological feasibility of fusion
  - Construction cost 4 times annual world fusion budget
  - Long gestation time
ITER Collaboration History

- Need for Collaboration Recognized
- Versailles Summit
- Geneva Summit
- U.S. Proposal
- Collapse of USSR
- RF Funding Decline
- US Funding Decline
- US Program Restructuring
- US Terminates ITER Funding
- EDA Completion
- IAEA INTOR Project-forerunner
- Conceptual Design Activities Agreement (CDA)
- Engineering Design Activities Agreement (EDA)

- 1976
- 1980
- 1984
- 1988
- 1992
- 1996
- 2000

- Democrat
- Republican
- Congress
- White House
- Carter
- Reagan
- Bush
- Clinton

White House
Congress

B
Accomplishments on ITER Time Line

- **1977** Initial international idea
- **3/87** QIC starts in Vienna
- **4/88** 4P agree to CDA
- **12/90** CDA ends w/CDR
  - USSR > RF delays EDA
- **7/92** EDA begins
  - Key personnel/roles agreed
  - 3 Co-centers established
- **3/94** New Director appointed
- **12/96** DDR Completed
  - *Science* article on ITER
  - US community backs away
  - EU/JA defer decision to build
- **7/98** EDA Extension starts
  - EU, JA and RF participate
  - Congress objects to extension
  - US doesn’t sign extension
- **9/98** S-1 sets new US policy
- **10/98** DOE ‘out’ of ITER
  - Orderly closeout started
  - GAO audit of closeout funds
  - Completed principally in FY99
- **11/98** 3P pursue ITER-FEAT
  - Lower cost, more advanced design as urged earlier by US
- **5/99** High visibility concern
  - US scientists pulled from ITER physics meetings
- **9/01** Two years later
  - International tokamak physics meetings, with US, re-established
- **2003?-** Construction Agreement
- **2006?-** Building License granted
- **2014?-** Operation begins?
Policy Aspects of ITER Time Line

- **1980s**  
  4Parties have similar programs, start ITER

- **1987**  
  USSR presses reactor start but accepts step-by-step approach

- **1990/2**  
  Not ready for construction, 4Parties take next step on engineering/R&D

- **1993-5**  
  RF in fiscal trouble-slowing down
  US still increasing annual budgets

- **1996-8**  
  4Parties accept need for 3-yr extension
  US restructures its fusion program, cuts budget, ITER role reduced

- **1998**  
  3Parties focus on proceeding alone
  US refocuses on science restructuring

- **1999/01**  
  3Parties + Canada seek US return
My Viewpoint

• Responsible for OFES international activities since 1979
  – Includes bilaterals with JA, RF, EU, PRC, Korea, et alia
  – Includes 8 multilaterals within OECD-IEA
  – Represent OFES to IAEA and IEA

• Was principal staff person on ITER for US ‘86-‘99
  – US Contact Person throughout entire period
  – Chair of Contact Person group throughout US involvement
Lessons Internal to ITER

• Challenge and societal benefits stimulate collaboration
• Technical people can make ‘it’ work!
• Don’t postpone politically difficult choices that are integral to project success
• Project management must be strong enough!
• Disciplined management approach is essential
• Project must be planning ahead many phases
• Dedicated senior staff required in all parties
• Early joint planning from the beginning is essential

International Distributed Scientific/Engineering Collaboration via Wide-Area Networks for ITER
ITER Design and R&D Effort by Party for 6 Year EDA

(Data from ITER Director)

Joint Central Team Design (Professional person-years)

Plan 210
EU 218
JA 202
US 182
RF 117

Plan 188
EU 201
JA 171
US 185
RF 158

Plan 175
EU 193
JA 172
US 126
RF 93

Home Team Design (Professional person-years)

Home Team R&D (Kilo ITER Units Account) (i.e. 1989 M$)
Lessons External to ITER
Observations (from Dean)

• Many Administrative Issues can be resolved*
• Political support must be continually rebuilt, especially at changes
• Erosion of fusion community support arose from financial pressures
• Equi-partite approach is noble, but construction may need a leader
• Economic/political support more important than technical content
• Domestic constituency must not be narrowed
• Longer the project, more uncertain the congressional support
• Management must be sensitive to changing technical views outside
• Major economic impact is felt at local, not national level
• DOE must keep Congress fully informed
• Practical endpoint must be perceived as real goal
Lessons External to ITER

Inherent Problems (from Dean)

- ITER was ‘at’ Head-of-State level internationally, but not domestically in US
- Full scope of project could not be agreed at outset
- Siting activities were continually postponed
- Projects can be caught between Administration and Congress, if/when they are out of phase
- *Domestic legal framework is nationally, rather than internationally, oriented.*
Current Situation

ITER Parties
- Jointly-Completed ITER-FEAT Design
- EU-Ready to Negotiate, considering making site offer
- RF-Ready to Negotiate
- JA-About ready to Negotiate, considering making site offer
- Canada-Ready to Negotiate, proffered site offer

US
- Fusion Community-Addressing burning plasma physics generically
- DOE/Administration/Congress-Not yet focused on ITER
Conclusions

• Advocates can make international project work

• Partnership In Large Projects Remains Possible And Necessary, But:
  – Must Respect Political Realities To Be Successful
  – Must Evaluate Projects For Technical And Political Feasibility
  – Must Develop Early Common Understanding Among Governments