



# **ITER Prospects for the Three Years EDA Extension**

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# ITER: Integrated Demonstration of Fusion Engineering and Physics

Physics: Long D -- T Burn, 1500 MW for the Reference Mode  
Fusion Power >> Additional Heating Power  
Burn Duration > Any Characteristic Time of Plasma

## Engineering

Essential Fusion Technology: Integrated in ITER

Neutron Wall Load/Fluence: About 1 MWm<sup>-2</sup> / 1 MWam<sup>-2</sup>

## DEMO Reactor

Comparable scale to ITER

Technology derived from ITER

Electric power production and tritium breeding based on  
ITER test blanket

Longevity: Reliability, maintainability, lifetime etc.

Material development (Intense neutron source)

ITER: Reasonable Step from the present to DEMO

# **Status of the ITER Activities**

- **July '98 — end of 6 yr. original duration of ITER EDA**
- **Final Design Report and related documents presented to the Parties — approved in July**
  - **complete and detailed engineering design, with supporting assessments**
  - **industrial-based construction cost estimates and schedule**
  - **comprehensive safety/environment assessment**
  - **operation plan**
  - **technology R&D to validate and qualify design**
    - \* **proof of technologies**
    - \* **industrial manufacture and testing of models/prototypes**
    - \* **exploration of operational margins (continuing action)**
- **The purpose of the EDA Agreement is satisfied.**

# **Conclusions**

- 1. The ITER design is at an advanced stage of maturity which contains the necessary technical information to satisfy the purpose of the EDA Agreement.**
- 2. The safety assessment shows that ITER could be constructed and operated without undue risk to health and safety, without significant environmental impacts, showing the favorable safety characteristics of magnetic fusion energy production.**
- 3. The technology R&D validates the key aspects of the ITER design, including verification of industrial techniques in manufacturing components with related QA. It also provides a database for cost estimates. At the same time the project has successfully pioneered efficient modes of international collaboration which could be possible precursors for a collaborative construction of ITER.**

# **Large R&D Projects**

**Central Solenoid and Toroidal Field Model Coil Project**

**Vacuum Vessel Sector Project**

**First Wall/Blanket Module Project**

**Divertor Cassette Project**

**Blanket and Divertor Remote Handling Project**

**Each project includes the development and verification of the full scale manufacturing techniques at the industrial level.**

## **Other Areas**

- **Fueling/Tritium**

Pellet Injector:  $\sim 1$  km/s, 0.22 g/s for 1000 s  
Plasma Exhaust Processing Technology

- **ECH and CD**

Gyrotron, Window, (170 GW, 1 MW, CW)

- **NBI**

Large Negative Ion Source, 1 MeV Accelerator

- **Diagnostic Irradiation Tests**

Feed Through, Magnetic Sensor, Optical Component, etc.

- **Safety Code Validation**

Decay Heat, Chemical Reaction, Thermofluid Dynamics,  
Dust Characterization, Tritium Permeation, Corrosion, etc.

## **Output from R&D**

- 1. Validation of the technologies and manufacturing techniques including QA;**
- 2. Support of the manufacturing cost estimates;**
- 3. Confirmation of the performance;**
- 4. Evaluation of the operation margin; and**
- 5. Valuable and relevant experience in the management of industrial scale, cross-party ventures.**

**The successful progress of R&D gives confidence in the construction of ITER or an experimental reactor.**

# Conclusions

- **FDR delivered the ITER EDA product to the Parties for joint or domestic use**
- **technical readiness for construction decision subject to site-specific adaptations/regulatory assurance**
- **financial constraints require examination of options for reducing costs with lower assured performance**
- **aiming for ITER with ~50% savings would allow:**
  - **still to pursue “one-step” strategy**
  - **optimum use of EDA achievements**
- **Non-technical issues remaining for urgent address:**
  - **siting and overall frame for construction/operation**
  - **overall cost sharing and financing**



# **SWG — Revised Guidelines**

- **Plasma performance**
  - extended burn in inductively driven plasmas @  $Q \geq 10$  for a range of scenarios
  - aim at demonstrating steady-state through current drive @  $Q \geq 5$
  - controlled ignition not precluded
- **Engineering Performance and Testing**
  - demonstrate availability and integration of essential fusion technologies
  - test components for a future reactor
  - test tritium breeding module concepts
- **New requirements still satisfy ITER programmatic objective - permit integrated “one-step” strategy to DEMO**

# **Reduced Cost Design Activities**

- **ITER Council requests:**
  - **establish ... option(s) of minimum cost aimed at a target of approximately 50% of the direct capital cost of the present design with reduced detailed technical objectives (the SWG technical guidelines)**
  - **use existing design solutions and associated R&D**
- **existing EDA technical output — design choices, technologies R&D results — generally directly applicable to reduce design**
- **Outline Design Report: December 1998**

# **Proposed Work Programme for the ITER EDA Extension (7/98-7/01)**

## **Technical Activities**

- 1. Site(s) specific design adaptation(s) and their cost estimates**
- 2. Technical support, including safety analysis, to Parties (within whose territories, sites for possible construction are situated) for their preparation of applications for the licence to build and to operate ITER**
- 3. Extension of prototype testing to provide further data on operational margins and the performance of additional R & D, including physics studies**
- 4. Design option(s), the cost of which would be reduced by decreasing the detailed technical objectives and possibly the technical margins**

## **Project Milestones**

- 2/98 Following TAC review, acceptance by the Parties of the Outline Design Report for the reduced cost option. From this date, only this option is retained**
- 7/20 Detailed Design Report on the reduced cost option for Parties' Joint Assessment**
- 7/01 Final Design Report on the reduced cost option of ITER**

## **Working Assumptions**

- **Appropriate resources (as previously indicated, including JWSs) will exist**
- **Parties providing site characterisation data will participate in site-specific activities**
- **Voluntary physics activities will continue**
- **High priority effort will go toward establishing a design with a cost aimed at approximately 50 % direct capital cost of the present design (and with reduced detailed technical objectives), satisfying the programmatic objective of ITER**
- **The present design (FDR) will serve as the reference to initiate the joint, site specific technical activities (including informal interactions with regulatory authorities)**

## **General Considerations**

- **A closer integration between HTs and JCT, especially in relation to CAD, is required**
- **Enhancement of the main design tools, in particular, CAD, is required**
- **As part of the readiness to proceed to construction, appropriate project management tools and systems should be in place**

## **Design Effort**

**The global distribution of JCT/HTs design effort should be as follows:**

- |   |             |
|---|-------------|
| • <b>Site specific adaptations</b>  | <b>7 %</b>  |
| • <b>Technical support of preparation for licence applications</b>                            | <b>13 %</b> |
| • <b>Design work (including the preparation of procurement packages, planning, R &amp; D)</b> | <b>80 %</b> |

## **Site Specific Adaptations**

**The following are required:**

- **Full physical site characterisation**
- **Codes and standards to be applied to the various installations**

## **Technical Support for the Preparation of Licence Applications**

- **Resolve all technical issues which will have a bearing on the licensing process, including informal interaction with the regulatory authorities)**

## **Technology R & D (including possible qualification tests or experiments to validate safety codes)**

**Priority 1: Complete activities committed before 7/98**

**Priority 2: Other R & D needed**

## **Voluntary Physics R & D**