
Response to FESAC Recommendations

Dale Meade

**FESAC
Gaithersberg, MD
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<http://fire.pppl.gov>

FESAC Recommendations on Burning Plasmas

- **The Fusion Community and FESAC spent nearly three years assessing Burning Plasma Physics and recommending a plan for proceeding on Burning Plasmas.**
 - Burning Plasma Physics Workshops 2000, 2001
 - Snowmass (300 participants) 2002
 - FESAC Burning Plasma Program Strategy, September 2002
 - FESAC Plan for the Development of Fusion, March 2003
 - These plans were strongly endorsed fusion program leaders and FESAC.
 - the fundamental technical assumptions are unchanged
 - the present non-technical difficulty was foreseen, and
 - led to the recommendation for a robust program plan.

FESAC Burning Plasma Strategy Recommendations

Findings:

ITER and FIRE are each attractive options for the study of burning plasma science. Each could serve as the primary burning plasma facility, although they lead to different fusion energy development paths.

Because additional steps are needed for the approval of construction of ITER or FIRE, a strategy that allows for the possibility of either burning plasma option is appropriate.

Recommendations:

seek to join ITER negotiations as a “full” partner

Subject to the considerations including that-

“The Department of Energy concludes, by July, 2004, that ITER is highly likely to proceed to construction and terms have been negotiated that are acceptable to the U.S. Demonstrations of likelihood could include submission to the partner governments of an agreement on cost-sharing, selection of the site, and a plan for the ITER Legal Entity.”

FESAC Burning Plasma Strategy Recommendations (2)

Recommendations included:

“If ITER does not move forward, then FIRE should be advanced as a U.S.-based burning plasma experiment with strong encouragement of international participation.”

Since FIRE is at an advanced pre-conceptual design stage, and offers a broad scientific program, we should proceed to a physics validation review, as planned, and be prepared to initiate a conceptual design by the time of the U.S. decision on participation in ITER construction.

“A burning plasma science program should be initiated by the OFES with additional funding in FY 04 sufficient to support this strategy.”

Where are we on these items?

Significant Progress on FIRE Since FESAC

- Progress in the FIRE Design
 - Advanced “Steady-state” high-pressure tokamak operating modes have increased normalized pulse duration ($3 - 5 \tau_{CR}$).
 - Conventional H-Mode operation repetition rate “tripled”, H-Mode operating range extended up to 200 MW for $2 \tau_{CR}$.
- Continued Progress on Strengthening the Physics Basis of FIRE
 - Confinement analyses reported at EPS and ITPA will improve FIRE projections for both H-mode and AT mode.
 - FIRE choice of high triangularity and DN configuration continues to be validated by results at PSI and EPS on high β , and H-factor while reducing or eliminating Type I elms.
 - Disruption data base and mitigation techniques improving.
- Preparation of IAEA paper on AT Modes in ITER and FIRE

FIRE PVR

- FIRE Physics Validation Review (PVR) was held March 30-31 in Germantown.
- The Committee included: S. Prager, (Chair) Univ of Wisc, Earl Marmor, MIT, N. Sauthoff PPPL, F. Najmabadi, UCSD, Jerry Navratil, Columbia (unable to attend), John Menard PPPL, R. Boivin GA, P. Mioduszewski ORNL, Michael Bell, PPPL, S. Parker Univ of Co, C. Petty GA, P. Bonoli MIT, B. Breizman Texas,

Notes on Committee Comments at the review:

- The FIRE team is on track for completing the pre-conceptual design within FY 04. FIRE would then be ready to launch the conceptual design. The product of the FIRE work, and their contributions to and leadership within the overall burning plasma effort, is stellar.
- **Is the proposed physical device sufficiently capable and flexible to answer the critical burning plasma science issues proposed above?**

The 2002 Snowmass study also provided a strong affirmative answer to this question. Since the Snowmass meeting the evolution of the FIRE design has only strengthened ability of FIRE to contribute to burning plasma science.

FIRE PVR (2)

- The panel identified FIRE-specific areas that can benefit from further pre-conceptual design work including: alpha driven instabilities, generic port plug design, more modeling of particle exhaust, $n > 1$ resistive wall modes and neoclassical modes.
- The panel also identified generic burning plasma areas that can benefit from further work : investigation of the suppression of neoclassical tearing modes (NTM) by RF current drive, development of modified and new diagnostics for burning plasma research, development of an integrated simulation capability applicable to burning plasmas, investigation of effects of ELMs on tungsten divertor components and systematic antenna development. Possible elements in a US burning plasma program.

(Glad to hear that a US Burning Plasma Program is being formed)

Concluding Remarks

- **Push hard to get a favorable decision to construct ITER.**
- **Note NRC BPAC recommendation of:** “ is important to recognize that the ITER negotiations could be unsuccessful, and reasonable contingency planning for that eventuality is prudent until a decision on ITER is reached. ”
- The FIRE preconceptual design is nearing completion, and would be ready for CD-0 and Conceptual Design if needed.
- Do not go back to square One AGAIN on US Fusion Strategy!!!!
 - The fusion community has 3 years of technical assessment and nothing has changed the fundamental technical assessments made at Snowmass. If anything, the need for a burning plasma program and the technical basis for tokamak BP experiment is even stronger now.
- If the ITER decision process remains deadlocked past July 2004, the FESAC Burning Plasma Strategy Panel should be charged to expeditiously reassess the U.S. Burning Plasma Strategy as per NRC BPAC. This recommendation should be the basis for any US international discussion of alternative strategies.