The Fusion Energy Science Advisory Committee
Sub-Panel on Burning Plasma Physics
FESACSPBPP
February 27, 28, 2001
Gaithersburg, MD

Membership:

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Charge to Panel

- What scientific issues should be addressed by a burning plasma experiment?
- How much alpha heating is required to understand each issue?
- Which scientific issues are generic and which are valid for only one concept (i.e. the tokamak)?
- What are the pro’s and con’s of using various magnetic confinement concepts to study burning plasma physics?
- How can the New Step Options program help in the 2004 assessment recommended in the Priorities and Balance report?
- Our report is required at the end of July 2001.
The Plan

The Easy Part:

• We focus on a near term tokamak burning plasma experiment.

• Make use of volumes of information already available on burning plasma science and technology.

• Make use of summaries of two UFA workshops, one on burning plasma science, the other on burning plasma technology.

• Identify a minimum set of critical physics and engineering parameters necessary to characterize a burning plasma experiment, e.g.

\[ Q, \beta, \rho/a, v^*, I, B, P_{\text{aux}}, \text{etc.} \]

• This should allow us to summarize the basic science and technology issues facing a burning plasma experiment.
The Medium Part:

- **Identify the critical physics and engineering parameters required to address each issue.**

- **Identify those issues that can be carried out on existing experiments.**

- **Name the experiments (e.g. DIII-D, C-Mod, JET, JT60-U, etc.).**

- **Identify those issues that require a burning plasma experiment.**

- **Correlate these issues with existing burning plasma experiment design (e.g. CIT, FIRE, IGNITOR, ITER, etc.).**
Details of Getting the Job Done

- Develop an outline for the report that addresses the charges to the sub-panel.
- First meeting took place at the UFA Burning Plasma Science Workshop, December 10, 2000.
- Write up first section of the report.
- Second meeting to take place at the Sherwood Theory Conference including a public discussion, April 3 and 4, 2001.
- Write up second section of the report.
- Third meeting to take place at the UFA Burning Plasma Technology Workshop including a public discussion, May 1-3, 2001.
- Write up third section of the report.
- Iterate and wordsmith until the due date.
- Mix in hundreds of e-mails and several conference phone calls.
I. Introduction - Defining the context of a BP Expt
II. Simple description of a tokamak
III. Science issues in a burning plasma
   A. Overview of science issues
   B. Alpha particle issues in a BP experiment
   C. MHD phenomena in non-BP and BP
   D. Heating and current drive in non-BP and BP
   E. Transport phenomena in non-BP and BP
   F. Edge physics in non-BP and BP
IV. Technology issues in a burning plasma
   A. Overview of technology issues
   B. Magnets
   C. First wall materials
   D. Divertors
   E. External heating and CD sources
V. Existing versus a new experiment
   A. Capabilities of existing experiments
   B. Requirements of new experiments
   C. Comparisons and importance of synergy

VI. Reaching consensus
   A. Issues on which we reach consensus
   B. Raise some really tough questions

VII. Recommendations
   A. Role of the NSO program
   B. Issues for FESAC
Some Really Tough Questions

- Are we technically ready for a burning plasma experiment?
- If no, what are we waiting for? More theory? A new alternate concept?
- If yes, can the critical issues be addressed on existing experiments or do we really need a new facility?
- Should we rejoin the international burning plasma effort or instead aim for a pure US experiment?
- How important is it for a burning plasma experiment to have advanced tokamak capability?
- What is the priority of a burning plasma experiment with respect to other options in the program?
  - a. A new alternate concept
  - b. Increased operational time on DIII-D, C-Mod, and NSTX
  - c. A rejuvenated technology program
  - d. International collaborations
- Can the US program prosper over a long period in the “science mode” without a flagship facility on the horizon?