



# The Fusion Energy Science Advisory Committee Sub-Panel on Burning Plasma Physics

## FESACSPBPP

February 27, 28, 2001

Gaithersburg, MD

### Membership:

**Herb Berk**

**Riccardo Betti**

**Jill Dahlburg**

**Jeff Freidberg (Chair)**

**Bick Hooper**

**Dale Meade**

**Jerry Navratil**

**Bill Nevins**

**Masa Ono**

**Rip Perkins**

**Stewart Prager**

**Kurt Schoenberg**

**Tony Taylor**

**Nermin Uckan**

# 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.

$Q, \beta, \rho_1/a, v^*, I, B, P_{AUX}, \text{etc.}$ )

- 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.**



# Report Outline

- 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

# Report Outline (continued)

## 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?