

July 17, 1996

Dr. Martha Krebs  
Director  
Office of Energy Research  
U.S. Department of Energy  
Washington, D.C. 20585

Dear Dr. Krebs:

In your March 25 charge letter you asked FESAC to carry out an Alternative Concepts Review and in particular to “consider the fundamental investment strategy that we should use in funding alternative concept.” You specifically asked that the following issues be addressed:

- 1) Review the present status of alternative concept development in light of the international fusion program:
- 2) Produce an overall plan for a U.S. alternative concepts development program including experiments, theory, modeling/computation and systems studies, which is well integrated into the international alternative concepts program; and
- 3) Provide an interim assessment of the readiness of the spherical tokamak concept to move to “proof-of-principle” level experimentation.

Interim findings and recommendations with regard to the spherical tokamak assessment were provided in a letter to you in May. This letter and the report to be transmitted to you under separate cover respond to the first two alternative concepts charges.

In response to the charges, our Scientific Issues Subcommittee (SciCom) established in March and Alternative Concepts Review Panel, chaired by Professor Farrokh Najmabadi and including seven members of SciCom plus additional experts from national laboratories and universities. Three prominent scientists from the international fusion community served as consultants to the Panel. The panel interacted with proponents of the various alternative concepts through a variety of solicited written input and presentations, and welcomed unsolicited input as well at a sequence of four meetings of the panel. They also set up a world-wide-web home page of alternative concepts assessment papers and input from the community. The FESAC wishes officially to thank the members of the panel for their work, and the alternative concepts researchers who provided such extensive input on relatively short notice.

As pointed out in FESAC's January 27 report on a restructure fusion program, the history of alternative concepts research has been rich in discoveries and innovations of significance to fusion plasma physics in general and tokamaks in particular. In addition, in a science-driven program with a constrained budget in the coming years, research on alternative concepts provides a special niche for the U.S. helping us maintain excellence and leadership in fusion research within the worldwide fusion program.

The Panel finds that a sound investment strategy for the fusion program includes a Concept Development Program (inclusive of tokamaks and alternative) with emphasis on science and innovation. In order to develop an overall strategy, the panel developed four criteria to measure the benefit of the research. They are:

- 1) advancement of general plasma physics;
- 2) advancement of fusion plasma physics;
- 3) contributions to fusion energy development; and
- 4) development on candidates for fusion power plants.

The panel also provides a classification of alternative concept programs based on their maturity and size:

- 1) Concept Exploration;
- 2) Proof of Principle;
- 3) Proof of Performance and Optimization;
- 4) Fusion Energy Development; and
- 5) Fusion Demonstration Power Plant.

They also identified the required mix of experimental facilities, theory and modeling, and concept evaluation and power plant studies efforts at each level. The Panel notes that for programs at early stages of development, the major benefits of research are in advancing general and fusion plasma physics. At more mature stages, the emphasis shifts toward contributions to fusion energy development and power plants.

In devising an implementation of the envisaged strategy for alternative concepts research the Panel finds that such a program must consider many concepts, each of which has its own unique and challenging issues. These concepts span a wide range in terms of level of development. In such a program there is a need to base the program priorities on a strong scientific foundation. To this end, the Panel recommends forming a "Concept Development Panel" (CDP). This CDP can be a subcommittee of the FESAC to provide consensus scientific input and recommendations on the directions and priorities of alternative concepts research. This process is used in part of NSF and NIH, and represents an experiment in community governance. If successful, it can be extended to cover the entire concept development program (including both tokamaks and alternative).

The Panel reviewed the status of alternative concepts and provided detailed reports on five of the more developed ones. Until the CDP is constituted and charged with providing scientific input priorities, the Panel provides the following recommendations for fiscal year 1997 (not in priority order):

- 1) Expansion of the concept Exploration Activities to encourage science and innovation in alternative concepts;
- 2) Initiation of a proof-of-principle program in the spherical tokamak (ST) area, and construction of new ST experimental facilities;
- 3) Strengthening and broadening of the existing reversed field pinch (RFP) program;
- 4) An expanded stellarator program including theoretical studies, concept development, and collaborations on international experiments; and
- 5) Establishment of a vigorous theory activity in alternative concepts.

The Panel reiterates the point made in the FESAC report of January 27, 1996 that any alternative concept experiment "should be operated with healthy funding to operate cost-effectively." This policy coupled with the recommended activities for fiscal year 1997 has the potential to result in exciting scientific discoveries of significance for the mission and goals of the restructured fusion program.

Lastly, the Panel notes that programmatic and cultural distinctions exist between alternative and mainline concepts. These distinctions serve no useful scientific purpose and have caused considerable difficulties. The Panel and FESAC recommend that the OFES and the fusion community eventually remove these distinctions and focus on a seamless concept development program (including tokamaks and alternatives), with the decision to expand or reduce the research effort in any concept based solely on its contributions to the goals of the restructured fusion program.

The FESAC endorses the principles, processes and recommendations cited above and will transmit the full Panel report to you under separate cover.

Sincerely,

Robert W. Conn  
Chairman on behalf of the  
Fusion Energy Sciences  
Advisory Committee