

# **Minutes of the Meeting of the Fusion Energy Sciences Advisory Committee**

**September 11 and 12, 2002  
Gaithersburg Marriott Hotel, Gaithersburg, Maryland**

## **Committee Members Present:**

Richard D. Hazeltine (Chair)—University of Texas at Austin  
Charles C. Baker—University of California, San Diego  
Vincent S. Chan—General Atomics  
Jill P. Dahlburg—Naval Research Laboratory  
Joseph A. Johnson, III—Florida A&M University  
John D. Lindl—Lawrence Livermore National Laboratory  
Kathryn McCarthy—Idaho National Engineering and Environmental Laboratory  
George J. Morales—University of California, Los Angeles  
Gerald A. Navratil—Columbia University  
Cynthia K. Phillips—Princeton Plasma Physics Laboratory  
John Sheffield—Oak Ridge National Laboratory/University of Tennessee

## **Committee Members Absent:**

Jeffrey P. Freidberg—Massachusetts Institute of Technology  
William McCurdy—Lawrence Berkeley National Laboratory  
Marshall N. Rosenbluth—General Atomics

## **Ex-Officio Members Present:**

Martin Lampe (Division of Plasma Physics, American Physical Society)—Naval Research Laboratory  
Wayne R. Meier (American Nuclear Society)—Lawrence Livermore National Laboratory  
Ned R. Sauthoff (Institute of Electrical and Electronics Engineers)—Princeton Plasma Physics Laboratory.

## **Ex-Officio Members Absent:**

None

## **Designated Federal Officer Present:**

N. Anne Davies (Associate Director, Office of Fusion Energy Sciences)—U.S. Department of Energy

## **Others Present:**

Francois L. Waelbroeck (FESAC Secretary)—University of Texas at Austin

**Names of guests who were present at the meeting are listed in Appendix A at the end of these minutes.**

## **1. Call to Order and Opening Remarks**

The meeting was called to order by the chair, Richard Hazeltine, at 8:30 a.m. on Wednesday, September 11, 2002.

The chair requested that the meeting begin with a moment of silence in memory of the tragic events of September 11, 2001.

The chair welcomed Dr. Raymond Orbach, director of the DOE Office of Science.

## **2. FESAC Panel on Burning Plasma Physics (S. Prager)**

Prof. Prager began by describing the charge to the panel, the antecedents (Freidberg report and Snowmass meeting), and the organization of the Austin meeting. He stated that the panel report was accepted by a vote of 40 out of the 41 members in attendance. He then proceeded to describe the report.

Following Prager's presentation, Dr. R. Orbach opened the discussion by thanking the FESAC and panel members for their work and praising the timeliness of the Snowmass meeting. A discussion followed regarding the need to justify the choice of a more costly option by presenting development paths more clearly. This was motivated in the context of presenting the report to legislators. Prager replied that development paths and costs are speculative and constitute a controversial issue, and that addressing this issue was not part of the charge to the panel. He made the point that the report avoided passing judgement on which machine offers the best development path. Hazeltine commented that he had advised the panel to avoid looking ahead to a power plant, since reaching a consensus on the burning plasma experiment would be difficult enough. Navratil described his reasons for supporting the report despite his support for FIRE.

There followed a discussion of the possibility of engaging international participation in FIRE should ITER be abandoned. Comments were made to the effect that engaging international participation in an already designed machine would be unlikely to meet with success.

## **3. DOE Office of Science Perspective (R. Orbach)**

The chair next introduced Dr. Raymond Orbach, director of the Office of Science, U.S. Department of Energy.

Dr. Orbach began by stating that the program must look at where are we from the point of view of putting power on grid. He pointed out that the more compelling drive for developing fusion is environmental. Projections show oil and gas are plentiful. A lot more needs to be done to address the problem of CO<sub>2</sub> emissions. If we target a particular CO<sub>2</sub> concentration, deficiencies are glaring and appear in almost any 100-year scenario. Dr. Orbach reminded the committee that the Secretary of Energy has expressed strong support for fusion, and stated that the president is also very interested in the fusion program.

Dr. Orbach next expressed his wish that FESAC produce its burning plasma report by the end of the month, and that the NRC review of the program be completed before December 1. He explained that he wants to give the president the full scientific view by mid-December. Such an aggressive timeline is motivated by the following considerations.

ITER site selection will begin in January 2003. It is desirable for the US to be an ITER partner at the time the site is selected. This is consistent with the panel recommendation that we participate in governance. It would also be very useful if the US decision were made before the beginning of the Japanese fiscal year in April 2003. All these factors point towards early entry.

Dr. Orbach emphasized the necessity of giving assurances to Congress that construction costs are contained. European cost estimates lack a contingency. DOE is working to get the persons who build large multinational facilities to devise an internationally agreed-upon costing procedure.

Dr. Orbach reminded the committee of Congressional skepticism regarding fusion. He explained that his office's view is that the situation has changed in recent years. The progress on diagnostics, simulations and plasma control has given new credibility to the ITER design. Dr. Orbach said that the importance of the Snowmass meeting and the burning plasma panel report is that it provides him with concrete evidence of the changed situation that he can present to Congress. It enables him to argue that the fusion community now has a well-defined path.

#### **4. FESAC Discussion of Panel Report**

The members of FESAC near-unanimously expressed strong support of the burning plasma physics panel report. Several members commented that the report represented remarkable progress over where the community was a few years ago. The discussions centered on whether the report adequately justified its conclusion to recommend rejoining ITER, and whether the executive summary should be modified to convey a greater sense of enthusiasm. Some members suggested that enthusiasm would best be expressed in the cover letter. Others were concerned that the cover letter would not retain as much presence in the collective memory as the report. Hazeltine stated that the issue of enthusiasm was considered in Austin but that Stewart Prager chose to take the approach of emphasizing the rationality of the deliberations and resulting recommendations. The dispassionate tone of the document is thus intended to indicate its nature as a reasoned strategic plan.

#### **5. BESAC Panel on Energy Research Needs (C. Baker)**

Dr. C. Baker presented a report on the BESAC Panel on Research Needs to Assure a Secure Energy Future. The panel chair is John Stringer (EPRI) and its co-chair is Linda Horton (ORNL). The charge of the panel is to consider what are the 21<sup>st</sup> century fundamental scientific challenges that BES must consider in addressing DOE's mission. Dr. Baker was asked to chair a topical group on fusion. Its other members are M. Abdou (engineering sciences), R. Bangerter (inertial energy science), J. Dahlburg (theory and simulation science), P. Efthimion (basic plasma science), and S. Zinkle (materials science). Topical group will prepare recommendations for BES-sponsored research related to fusion energy. A workshop will be held in a month (Oct. 21-25, Gaithersburg, Marriott).

## **6. Report from OFES (Ann Davies):**

Dr. Davies began by introducing Francis Thio who will be responsible for innovative concepts. She then summarized recent developments affecting the budget. She reminded the committee that the House reduced the budget from the presidential request, the reason for this being the TFTR D&D roll-off money. Congress also took some Office of Science money for water projects. A continuing resolution is expected to be in effect at least through November. DOE is asking that Congress refrain from directing funds, in order to leave the Office some flexibility. IFE target fabrication is being moved from Science to Enabling R&D.

Dr. Davies announced that she has asked PPPL to lead the ITER costing effort. The NRC review will begin next week (first meeting Sept. 17-18). Its chair is John Ahearne, and its co-chair is Ray Fonck. The grant review process is working well. The procedures for evaluating the review process are described on the OFES web site.

Dr. Davies reported that the U. of Wisconsin has expressed interested in hosting the IAEA meeting in 2006. There followed a discussion of whether it was time for an IAEA meeting in the U.S. The absence of "hospitality funds" for a diplomatic dinner is a problem, however. IAEA does not allow registration fees to be assessed. M. Roberts stated his conclusion from the discussion that cost issues weighed against the US hosting an IAEA meeting. Dr. Davies ended her presentation by informing the attendees that the position of Head of Physics at IAEA, formerly held by Tom Dolan, is open.

## **7. Public Comments:**

The Chair next opened the meeting to public comments. UFA president T. Jarboe (U. Washington) welcomed Dr. Orbach's challenge to put power on the grid in 35 years, while noting the difficulty of meeting this challenge. He pointed out that we often tend to overestimate the time necessary to complete large tasks because of the nonlinear growth of knowledge (e.g. the genome project). He concluded by emphasizing that we need to increase progress in all areas, and strengthen the entire program.

The Chair next recognized Dr. L. Sugiyama (MIT). Dr. Sugiyama stated that the IGNITOR group is very pleased by the recommendations made by the burning plasma experiment panel. She noted, however, that Prof. Coppi was the only member of the panel who did not sign the report, and explained that this resulted from his opinion that the assessment of the experiments was not uniform. In support of this opinion, she stated that the final report omitted a statement regarding MHD stability, and used unfair methods to compare the current diffusion time. She further objected to the statement in the summary that IGNITOR would be unable to investigate burn control. Lastly, she expressed the view that the report takes as a goal that DEMO is extrapolated from ITER Q=5 in the AT regime, again biasing the debate to the disadvantage of IGNITOR.

The Chair thanked Drs. Jarboe and Sugiyama for their comments.

## **8. Vote on Panel Report and Cover Letter:**

FESAC proceeded to vote on the panel report. The vote was 10-2 in favor of accepting the report, with G. Morales and M. Lampe dissenting. Dr. Sauthoff expressed regret that the motion had failed to pass unanimously, and moved that a second vote be held to

accept the recommendations of the report. Drs. Sheffield and Dahlburg seconded this motion. A second vote was held, and the conclusions were adopted unanimously. Chairman Hazeltine presented a draft of a cover letter addressed to R. Orbach and intended to accompany the panel report. He described the ideas that guided the composition of the draft letter. These were to avoid restating the conclusions of the panel, and avoid using the letter as an opportunity to promote fusion. The committee suggested several improvements to the letter and the revised letter was accepted.

### **9. Status Report on ISOFS Panel (J. Dahlburg)**

The Chair next invited ISOFS sub-committee chairman J. Dahlburg to present a report on the fusion simulation initiative. Dr. Dahlburg reported on the progress of the FESAC panel studying integrated simulation and optimization of fusion systems. She informed the committee that a workshop was held in San Diego and a sub-committee meeting was held in Oak Ridge. A second public meeting in San Diego is planned for Sept. 17-18.

The final report is due to DOE on Dec. 1. In order to meet this deadline this, the ISOFS sub-committee must submit its report to FESAC by Nov. 7.

### **10. Status Report on Non-electric Applications Panel (C. McCarthy)**

Dr. K. McCarthy reported on the progress of the panel on non-electric applications of fusion. The committee has compiled an exhaustive list of applications. It is developing a set of criteria for evaluating applications. A speaker for each group of applications has been identified and invited to a meeting to be held on September 23-24 in San Francisco. Evaluation criteria have been developed, and families of applications categorized. An opportunities document is being prepared. An outline has been prepared for each application, with a description of the application as well as the corresponding results. The final report will be ready for distribution to FESAC in November.

### **11. New Charge: Feasibility of Putting Power on Grid in 35 Years**

The Chair announced that he had asked R. Goldston to chair a panel to address Dr. Orbach's new charge to the committee and summarize its findings in a report. He next presented the draft of a second letter to Orbach acknowledging receipt of the charge and endorsing the reasonableness of the 35-year frame with sufficiently increased funding. The discussion of the letter centered on how best to avoid the possibility that the community might be held accountable for the 35-year promise even in the absence of increased funding, as has occurred in the past. This concern was balanced against the need to avoid the appearance of asking for an unlimited tap into the public coffers. A motion to retain the existing wording passed 8-5. The Chair asked G. Navratil to seek alternative wording that might satisfy a broader majority. The problem was solved by interchanging words to move "sufficiently increased funding" foremost. The amended letter garnered unanimous approval.

The meeting ended with a discussion of the date for the following meeting. Steve Dean generously offered to modify his FPA meeting (3 and 4<sup>th</sup> December) to accommodate the FESAC meeting. C. Baker pointed to the difficulty of reaching consensus on the question

of development paths and the necessity for allowing time for the process to occur while meeting Dr. Orbach's deadline.

The Chair adjourned the meeting at 4 PM.

### **Appendix A: Partial list of attendees**

Bill Tumas, LANL	R. Stambaugh, GA
Scott Willms, LANL	Toshiro Asakawa, JAERI
Michael Moloney, NRC	Tim Meyer, NRC
James S. Graben	Bob Vallario, SC5
Patrick Looney, OSTP	Tom Jarboe, U. Washington
Bob Price	Nermin Uckan, ORNL
Ehsau Khan, SC	R. Orbach, SC
Don Dautovich, ITER Canada	Moto Eto, JAERI
Geoff Brunfiel, Nature	Dimitri Kuznetsev, DOE/NNSA
Ralph Schneider, DOE/NNSA	R. Hawryluk, PPPL
L. Sugiyama, MIT	John Sethian, NRL
Stan Milora, ORNL	Charles Seik, Science Magazine
Stan Staten, BES	Mike Holland, OSTP
Warren Marten, OFES	T. V. George, OFES
Steve Obenschain, NRL	Steve Dean, FPA
Rob Goldston, PPPL	C. Koehnke, Embassy of Japan
G. A. Shannon, Princeton	Dave Jones, Inside Energy
R. Mirande, DOE-BES	D. O. McArthur, DA
A. Hassam, U. Maryland	A. Kritz, Lehigh U.
D. Baldwin, GA	M. Porkolab, MIT
Curt Bolton, OFES	Francis Thio, OFES