

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

February 27 & 28, 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  
Jeffrey P. Freidberg—Massachusetts Institute of Technology: present on February 27  
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:

William McCurdy—Lawrence Berkeley National Laboratory: absent February 27 and 28  
Marshall N. Rosenbluth—General Atomics: absent February 27 and 28  
Jeffrey P. Freidberg—Massachusetts Institute of Technology: absent on February 28

## Ex-Officio Members Present:

Martin Lampe (Division of Plasma Physics, American Physical Society)—Naval Research Laboratory  
Kathryn McCarthy (American Nuclear Society)—Idaho National Engineering and Environmental Laboratory  
Ned R. Sauthoff (Institute of Electrical and Electronics Engineers)—Princeton Plasma Physics Laboratory: present on February 28

## Ex-Officio Members Absent:

Ned R. Sauthoff (Institute of Electrical and Electronics Engineers)—Princeton Plasma Physics Laboratory: absent on February 27

## Designated Federal Officer Present:

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

## Others Present:

James W. Van Dam (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.

## Wednesday, February 27, 2002

### 1. Call to Order and Opening Remarks

The meeting was called to order by the chair, Richard Hazeltine, at 9:02 a.m. on Wednesday, February 27, 2002.

The chair requested that the meeting begin with a moment of silence in honor of Prof. Harold Furth, former director of the Princeton Plasma Physics Laboratory, recently deceased.

The chair welcomed new ex-officio member, Dr. Martin Lampe, chair of the Division of Plasma Physics of the American Physical Society.

## 2. DOE Office of Science Perspective

The chair introduced Dr. James F. Decker, acting director of the Office of Science, U.S. Department of Energy.

Dr. Decker presented remarks concerning the FY 2003 budget request for the Office of Science. He noted that the confirmation hearing for Dr. Raymond Ohrbach, nominated to head the Office of Science, had been held yesterday.

He described the emphasis of the FY 2003 budget. Setting aside the Spallation Neutron Source and the one-time FY 2002 projects, the FY 2003 budget request for the Office of Science is up 5% from the previous year. This increase would go into science thrust areas, into more operating time and new instrumentation at user facilities (\$1,246M, up \$40M), and into improved infrastructure (\$43M, up \$6M). The science thrust areas are Nanoscale Science, Engineering, and Technology (\$133M, up \$48M); Genomes to Life (\$45M, up \$20M); Climate Change Research Initiative (\$3M, up \$3M); and Scientific Discovery Through Advanced Computing (\$62M, up \$5M).

The FY 2003 budget request for Fusion Energy Sciences includes:

- Science and Enabling Research & Development (\$179M, up \$5M)
- Facilities (\$68M, down \$6M). He explained that this decrease occurs because the TFTR decontamination and decommissioning cost was included in this line item in FY 2002. Hence the effective amount supporting our operating facilities will actually increase. Operating time on the three national fusion experimental facilities will almost double.
- Fabrication, Engineering & Design (\$11M, up \$11M). He noted that this increase includes construction costs for the new National Compact Stellarator Experiment (NCSX) experiment at Princeton.

He discussed the FY 2003 budget requests for Basic Energy Sciences, Advanced Scientific Computing Research, Biological and Environmental Research, High Energy Physics, and Nuclear Physics.

He noted that project engineering and design funding (\$11M) is provided for three Nanoscale Science Research Centers, at Oak Ridge National Laboratory, Lawrence Berkeley National Laboratory, and Sandia National Laboratory/Los Alamos National Laboratory. Constructing funding is provided for the Center for Nanophase Materials Sciences at Oak Ridge National Laboratory, to be collocated with the Spallation Neutron Source.

He noted that project engineering and design are to begin for the Linac Coherent Light Source, a fourth-generation light source (x-ray free electron laser), at Stanford University. He reported that infrastructure issues are a concern, with aging facilities at ten science laboratories. The FY 2003 budget request increases funding for critical infrastructure improvements and also supports removal of excess facilities.

He discussed the President's Management Agenda and the growing importance of good management to the Office of Science's programs. The *President's Management Agenda of August 2001* and the *FY 2003 Budget Request* place priority on budgeting and managing all Federal programs for results. Preparation of the FY 2004 budget will base investment decisions on transparent investment criteria. The Administration does recognize the difference between basic research and applied research. As to how the Office of Science is measuring up in terms of management, he noted that the Office had received a grade of "Effective" in a recent status report on selected programs, along with the commentary "Supports world-class basic research. Effectively operates a large suite of scientific user facilities."

He commented that the Basic Energy Sciences Advisory Committee, with input from all the other Office of Science advisory committees, is issuing a report on performance measurement, which could help the Office of Science integrate its budget with performance measures. It is informing the discussion at a workshop on Investment Criteria for Basic Research, February 27, 2002, sponsored by the Committee on Science, Engineering, and Public Policy (COSEPUP) of the National Academy of Sciences.

Dr. Decker answered questions from FESAC members. Asked how the Office of Science distinguishes basic research from applied research, he commented that currently almost everything the Office does is considered basic research. He noted that, even though the Congress has been struggling with appropriate investment criteria for science, the emphasis on performance measures has been around since 1993 and will continue.

Dr. Decker left the meeting at 9:38 a.m.

## 3. Report from the Office of Fusion Energy Sciences

Dr. Anne Davies discussed recent activities of the Fusion Energy Sciences program.

She quoted Secretary Abraham concerning DOE priorities (October 24, 2001), who had said that one of the two priorities deserving special mention is the unique technological contribution that DOE can make to energy and national security by finding new sources of energy.

She discussed the FY 2003 congressional budget request for Fusion Energy Sciences, which is for \$257.3M (compared to \$247.5M in FY 2002). Highlights of the FY 2003 budget are the following:

- Budget increase of \$9.8M, coupled with TFTR decontamination and decommissioning roll-off (due to be completed in FY 2002).
- Maintain research elements as close as possible to FY 2002 levels.
- Increase operations at major facilities: nearly double compared to 2002; run each facility 21 weeks, at 85% of full single-shift operations.
- Initiate the National Compact Stellarator Experiment project (\$11.8M)
- Pay housekeeping expenses: complete the TSTA decommissioning and clean-up (\$3M); move the ORNL Fusion Energy Division to its new building at the X-10 site (\$1M in FY 2003, total cost \$11M of which OFES will share \$4M over three years).

She described the budget formulation process and performance execution agreements.

She discussed the status of the TFTR decontamination and decommissioning project. This is on schedule to be completed at the end of FY 2002, within the planned cost. The cutting and removal of vacuum vessel segments and the shipping to a waste depository are nearly finished.

She discussed the status of the Tritium Systems Test Assembly (TSTA) stabilization project. The Office of Science plans to transfer TSTA to the Office of Environmental Management in mid-FY03. The DOE-JAERI Collaborative Program at TSTA ended June 2001. She said that it was a very successful program, which had been useful to the tritium campaign in TFTR.

She emphasized the importance of safety in research and operations in the Fusion Energy Sciences program. Universities are encouraged to seek help in assessing their lab safety. For example, General Atomics worked with UCLA in 2001 to assure lab safety. This assessment help will be provided at no cost to universities. The University Fusion Association will publicize this in an upcoming newsletter.

She discussed the results of the recent OFES diagnostics competition. She noted that 32 proposals from universities and industry and seven proposals from national laboratories were submitted. Eleven grants and four lab programs were funded. In institutional impact, four universities and two labs were lost, and one new lab was gained. The distribution of diagnostic efforts has nine programs on large tokamaks, four on innovative confinement concepts, and four on tokamaks in Europe.

She described the possible outline for a Workshop on Energy Security to be held in May under the sponsorship of the Office of Basic Energy Sciences.

She noted that the Office of Fusion Energy Sciences has several staff vacancies. She introduced Esther Ku, who recently joined the Facilities and Enabling Technologies Division.

She described the three new charges to FESAC from the Office of Science:

1. *Burning Plasma Physics Strategy*: The charge is to establish a high-level panel to use the Snowmass results in order to recommend a strategy for pursuing burning plasma physics experiments (see Appendix B). The panel to address this charge will consist of all interested FESAC members, program leaders from major institutions, and selected other persons. The panel will be asked to report by September 2002. The National Research Council will review the FESAC recommendations on this charge by the end of 2002.
2. *Integrated Simulation and Optimization of Fusion Systems*: The charge is to provide a roadmap for a joint initiative with the DOE Office of Advanced Scientific Computing Research (see Appendix C). The initiative would be a five- to six-year program, with a budget of about \$20M, for the purpose of significantly improving simulation and modeling capabilities. The panel to address this charge will consist of FESAC members and experts recommended by the Advanced Scientific Computing steering committee. The panel will be asked to provide a summary report by July 15 and a final roadmap recommendation by December 1, 2002.
3. *Non-Electric Fusion Applications*: The charge is to consider whether the fusion program should be broadened to

include non-electric applications of intermediate fusion devices (see Appendix D). The panel to address this charge will be asked to report by January 2003.

She noted that the terms of the current FESAC members are set to expire on August 1, 2002. For the sake of continuity in dealing with the burning plasma physics strategy issue (Charge #1), she said that the Office of Fusion Energy Sciences will request an extension to the end of the calendar year for the terms of those members who are willing to continue.

She discussed international progress on ITER. Negotiations are under way; two meetings have been held recently (November 8-9, 2001, in Toronto and January 22-23, 2002, in Tokyo). The next major steps to be taken are decisions by Japan and the European Union to offer site candidates and then the reaching of consensus on site, roles, organization, etc. Site offers will possibly occur at the third meeting (April 23-24, 2002, in Moscow), and consensus may be possible at the fourth meeting (June 5-6, 2002, in Cadarache). Concerning US participation in ITER, US Secretary of Energy Abraham told Congress in January that he expects to complete an initial review in the next few months.

She answered questions from FESAC members. In response to one question, she said that new money would be requested for the Integrated Simulation initiative, instead of funds being carved out of the existing budget. Asked whether the non-electric charge could include rocket propulsion, she said that it could, although the charge is aimed at fusion, rather than plasma physics, applications.

#### **4. RFP: Its Confinement Status and Future**

Dr. Stewart Prager (University of Wisconsin) described recent results and prospects for reversed field pinch (RFP) research. He discussed the status of RFP confinement and opportunities at the MST experimental facility to do general science and to become a Proof of Principle device.

He described the recent improvement in RFP confinement on the MST device. The problem with confinement in an RFP is its weak toroidal magnetic field, which leads to strong magnetic fluctuations, hence to stochasticity, and hence to plasma transport. A solution is to control the shape of the current profile, which is the free energy source for instabilities. The first implementation of this was to program an Ohmic electric field ("pulsed parallel current drive") in order to control the current profile. This was found to reduce the magnetic fluctuations in the core by a factor of two to three, as measured by Faraday rotation (a new diagnostic not yet being used on any other experimental facility). The MST beta value increased to 15%, and the electron temperature to 800 eV. The confinement is roughly comparable to that in tokamaks. He noted, however, that this current profile control technique and the corresponding improvement in confinement are transient. Hence the ultimate limit to transport in an RFP is not yet understood, and the confinement improvement is not sustained. Methods for sustained control might be applied RF waves, oscillating field current drive, neutral beam injection, and pellet injection.

He discussed using the MST device for general science studies. A proposal was submitted to the National Science Foundation for a Center for Magnetic Self-Organization in Laboratory and Astrophysical Plasmas. Its purposes would be to study high-temperature plasma issues that are common to the laboratory and the cosmos (e.g., dynamo, magnetic reconnection, magnetic helicity conservation and transport, angular momentum transport, ion heating, and magnetic chaos and transport); to link laboratory scientists and astrophysicists (experimental, theoretical, and computational); and to link four experiments (MST at Wisconsin, MRX at Princeton, SSPX at Livermore, and SSX at Swarthmore). This proposal has so far made it through the pre-proposal selection. He stated that it validates the idea that fusion science contributes to general science.

He discussed the funding situation. The FY 2002 budget for the MST experiment is \$4M. In order to implement the 1999 FESAC recommendation to move forward with a Proof of Principle program in RFP research, the funding profile would need to grow in future years to \$8M.

He answered questions from FESAC members.

#### **5. Recess and Reconvene**

The chair recessed the meeting at 11:33 a.m. for lunch. He reconvened the meeting at 1:38 p.m.

#### **6. Commercialization of Fusion Energy Research Technology Spin-offs**

Dr. Dan Cohn (Massachusetts Institute of Technology) described work on the commercialization of fuel efficiency

and environmental technology spin-offs of fusion energy research.

He discussed waste treatment and energy recovery systems. This work would lead to improved protection of the environment. Commercial units are being sold and installed by Integrated Environmental Technologies, a spin-off company from research at Battelle Pacific Northwest National Laboratory and MIT, in which he is involved. This company uses a proprietary technology called "plasma enhanced melter," which combines plasma heating and joule-heated glass melter technology. The technology could convert various types of waste products (municipal, hazardous, industrial, and medical) into useful products such as recyclable metals, hydrogen-rich gas for fuel and electricity generation, and glass for abrasives, construction, concrete, road base, cinder block, and landscaping material. A plasma furnace for vitrification of solid waste has been built at MIT with initial support from DOE Environmental Management. There are plans to build a larger facility, for demonstrating the technology.

He also discussed onboard hydrogen generation technology for improved internal combustion engine vehicles. A device called a plasmatron fuel converter can replace a conventional carburetor, resulting in a gasoline engine with clean, high-efficiency, hydrogen-enhanced combustion. Pollution from diesel engines can be reduced by exhaust after-treatment. This work is being supported by the DOE Office of Transportation Technologies. He said that the potential impacts of plasmatron-enhanced gasoline engines are reducing pollution at modest cost, reducing the national demand for petroleum by up to 1.5M barrels/day, and increasing US vehicle efficiency averaged over the next 30 years (especially in hybrid vehicles). He noted that the plasmatron fuel converter technology will be commercialized by the Arvin Meritor company through a technology license from MIT.

He answered questions from FESAC members.

## **7. Preparations and Plans for Snowmass**

Jerry Navratil reported about the status of the preparations and plans for the Snowmass 2002 Fusion Summer Study workshop.

He noted that last week the Office of Fusion Energy Sciences had completed discussions with the National Research Council concerning a burning plasma review. This review activity will begin soon. The chair of the review panel has not yet been named.

In July 2001, FESAC had reached the conclusion that there exists the technical readiness to proceed, now, with a burning plasma experiment. The Snowmass workshop, to be held during July 2002, will discuss the scientific issues associated with a burning plasma experiment and conduct a uniform technical assessment of three such next-step options. Its report will be considered by the FESAC Burning Plasma Physics Panel, to meet in August 2002.

The Snowmass 2002 workshop has an organizational structure that consists of an organizing committee and the convenors of the various working groups. About 60 people are involved in the organizational structure. A "Community Issues" working group was also established, whose purpose is to foster communication on non-technical issues. The Snowmass web site is [www.gat.com/snowmass/](http://www.gat.com/snowmass/).

The Snowmass final report will consist of an Executive Summary (9 pages), Introduction (3 pages), MFE section (91 pages), and IFE section (37 pages). This length is about the same as that of a comparable document that was written by the High Energy Physics community.

He discussed issues concerning the participation of international scientists at the Snowmass workshop. The US must be aware of the mature status of the decision-making process in Europe and Japan for construction of a burning plasma experiment.

He answered questions from FESAC members.

## **8. Public Comments**

The chair introduced persons who had expressed a desire to make public comments.

### **Bruno Coppi (MIT):**

He stated that the Snowmass meeting will deal with big issues. Much more resources will be needed in order to do what Navratil described.

He presented equations for the ignition factor  $Q$  of a burning plasma. He pointed out that ITER scaling leads either to a precipice at  $Q = 2.5$  or to ignition for low safety factor.

He noted that modeling of ITER recently showed that an edge temperature of 2 keV leads to a central temperature of 31 keV. He encouraged looking at the ITER parameters and profiles.

**Rob Goldston (Princeton Plasma Physics Laboratory):**

He discussed ITER negotiations. He noted that according to a theorem by John Nash, people will naturally come to the harmonic mean of the values of their back-up plans. He concluded that it is important for the US to have as many options as possible.

He showed record high-beta results obtained recently on the NSTX experiment.

**Glenn Bateman (Lehigh University):**

He said that he wants to urge the US fusion community to decide earlier, even this year, on the construction of a burning plasma experiment. It is already clear that a burning plasma tokamak would produce significant numbers of alpha particles. The effect of alphas on sawtooth oscillations needs to be experimentally investigated. The alphas may drive other instabilities, too. Also, what the confinement will be in a burning plasma is not exactly known. Another unknown is the scaling of the H-mode threshold, which affects the temperature pedestal. A demonstration of significant fusion heating is essential. It would be a bad idea to wait until 2004 to make this decision. (One reason is that it will be a presidential election year). If Ignitor were to be built, it should be done soon enough so that its results could be fed into ITER. If ITER were to be chosen, the US should enter soon enough to affect the design process. The US should have built either CIT or BPX; then these issues would have been resolved by now.

**Miklos Porkolab (Massachusetts Institute of Technology):**

He described his recent experience of attending the AAAS Meeting. 6000 people attended this meeting, held in Boston in February. The title of session in which he participated was "Revisiting Energy Options in Time of Crisis." He gave a talk about recent advances in fusion science and technology. John Holdren gave a talk about a nuclear energy renaissance in the US in the 21<sup>st</sup> century. The session concluded with a panel discussion. He recommended that fusion scientists get into the speaking circuit and put up several talks every year. The next AAAS meeting will be February 2003 in Denver. He proposed that a session be held on burning plasma issues, perhaps with Dale Meade (who also attended the Boston meeting) as the organizer.

## **9. Update about National Ignition Facility**

John Lindl described the current status of the National Ignition Facility. In the early life phase of NIF, four beams will be used (between March and September 2003) in order to gain experience operating the lasers and debug performance. He noted, however, that there is also a plan to devote a fraction of the shots during this early life phase to experiments. The NIF Advisory Committee will provide advice about the experimental allocation. A program plan is being put together for this early phase.

NIF will have two laser bays, each with two clusters of 48 beams. One cluster is already finished except for the optical components.

## **10. Recess**

The chair recessed the meeting at 4:42 p.m. for the evening.

## **Thursday, February 28, 2002**

## **11. Reconvene**

The chair reconvened the meeting at 9:01 a.m. on Thursday, February 28.

FESAC member Ned Sauthoff was in attendance today. FESAC member Jeffrey Freidberg was absent today.

## **12. Briefing on Performance Measurement in Science Programs**

Ned Sauthoff presented a briefing about the activities of the DOE Basic Energy Sciences Advisory Committee (BESAC) on using performance measurement in science programs. The 1993 Government Performance and Results

Acts (GPRA) spotlighted the management of research and development. The current Administration has a focus on measurable performance objectives and accountability.

He is serving as a member of a BESAC subpanel charged with considering the Office of Science's current methods for performance measurement, the appropriateness and comprehensiveness of the methods, the effects on science programs, and the Office of Science's integration of performance measures with the budget process as required by the GPRA legislation.

He reviewed the history of committees, reports, and governmental actions since the enactment of GPRA in 1993. The primary vehicle for science agency implementation of GPRA has been the National Academies' Committee on Science, Engineering, and Public Policy (COSEPUP), which has published several studies regarding GPRA and research: "Science, Technology, and the Federal Government: National Goals for a New Era" (1993), "Evaluating Federal Research Programs: Research and the Government Performance and Results Act" (1999), "Experiments in International Benchmarking of US Research Fields" (2000), and "Implementing the Government Performance and Results Act for Research: A Status Report" (2001). He noted that the President's Management Agenda (FY2002) has a section about R&D Investment Criteria. Also, the Office of Management and Budget has developed a list of Applied R&D Criteria/Metrics.

He commented about how well these things factored into the Office of Science budget for FY 2003. The Office of Science budget contained:

1. Strategic objectives (the strategic plan published in 2000 is now being revised)
2. Program strategic performance goals (3-5 years in outlook)
3. Performance indicator
4. Performance standards
5. Targets (annual milestones)

This structure, combined with the statement of Corporate Context, becomes the basis for annual reviews of the management performance. He noted that the Office of Science FY2003 Budget Submission had been criticized for not meeting some of the GPRA requirements.

He presented the recommendations of the BESAC subpanel:

1. That the Office of Science complete its Strategic Plan as soon as possible.
2. That the general principles of the performance assessment methods that have been used by the Office of Science in the past should continue to be used.
3. That the Office Science's performance measurement criteria be aligned with those that have been developed by COSEPUP and with their ongoing studies.
4. That the discussions between the Office of Science and the Office of Management and Budget as to appropriate criteria for the assessment of the progress of basic science programs be continued, to allow the development of appropriate metrics.
5. That criteria to assess the "world leadership" element in the Office of Science's research should be developed.
6. That work-force issues, including the development of succession plans for the research staff, and the education and training of a technically sophisticated personnel reservoir for the future of the nation, be incorporated into the GPRA goals of the Office of Science.

He attended a COSEPUP Workshop on OMB Proposed Criteria for Federal Agency Basic Research Programs yesterday. He described issues and concerns that has been raised with the OMB proposed criteria for federal agency basic research programs.

He concluded with the following comments. GPRA and the President's Management Agenda are here to stay. GPRA can do good, but must not do harm. A Strategic Plan, including stakeholder involvement, is essential. GPRA program goals must be comprehensive.

## **12. Planning for New Integrated Simulation Initiative**

Steve Eckstrand (DOE/OFES) described a new initiative on integrated simulation and optimization of fusion systems.

The goals of this simulation program would be to identify and characterize the important fundamental processes in fusion plasmas; to characterize the complex interactions that occur in fusion plasmas; and to develop the algorithms and computational capabilities needed to understand fusion plasma systems and predict their behavior.

He noted that the Office of Fusion Energy Sciences is already supporting community efforts to develop some of the components needed for integrated simulation and optimization of fusion systems.

He described the current Fusion SciDAC projects: Terascale Atomic Physics, Magnetic Reconnection, Wave-Plasma Interactions, Extended MHD Modeling, and Plasma Microturbulence.

The National Transport Code Collaboration project has been a demonstration of the development of a community code, for an integrated transport model. This code is being developed as separate modules by separate institutions.

The DOE Office of Advanced Scientific Computing Research (OASCR) is already developing and deploying many of the computational and networking tools that will be required by the integrated simulation initiative. The National Fusion Collaboratory is an OASCR SciDAC project.

He described the decision for a DOE Science Grid, which would enable the routine interactions of people, computing resources, multiple information systems, and instruments, in order to facilitate large-scale science and engineering.

In its new Integrated Simulation charge, FESAC is being asked to recommend a roadmap for a joint initiative on integrated simulation involving OFES and OASCR. This would be a 5- or 6-year program at a total funding level of \$20M per year. The plan is to finish this initiative by 2008. He said that he would like this initiative to become one of the Office of Science's Science Thrust areas.

In response to a question whether this initiative would also include fusion material studies, he said that it would go up to the edge of the plasma. Asked about complementarity with current SciDAC projects, he said that they would run up to 2004 and that the initiative would begin after that; some parts of SciDAC would be absorbed into this new initiative, although there would be a new sorting of efforts in 2004.

### **13. Discussion of New Charge about Integrated Modeling**

The chair led a discussion of the new charge to FESAC from the Office of Science concerning integrated modeling and optimization of fusion systems (Appendix B). A preliminary report is requested by July 15, 2002, with work completed on the final roadmap by December 1, 2002. The roadmap for what should be done and how to go about doing it is to be the product of this charge.

The chair announced that Jill Dahlburg has agreed to chair the panel to address this charge. She and the FESAC chair are developing a list of other panel members. FESAC members were asked to submit suggestions for members.

Vincent Chan noted that Marshall Rosenbluth, who was unable to attend this meeting, had circulated an email message to the FESAC members in which he expressed support for this new initiative and for SciDAC, recommending that they should complement each other.

Anne Davies pointed out that this initiative should be closely coordinated with the Office of Advanced Scientific Computing Research. The chair noted that Jill Dahlburg is a member of the OASCR Advisory Committee.

### **14. Report from DPP Chair**

Martin Lampe, new chair of the APS Division of Plasma Physics (DPP), noted that the DPP Executive Committee has been discussing how the Division is not well coupled to the rest of the physics community and how the exposure of plasma physics could be increased. He reported that one idea is to have the Division participate in a general physics meeting, the obvious choice being the April APS Meeting. About 800 people attend this meeting, which is the primary meeting for Beams and for Astrophysics (both of which are closely related to Plasma Physics) and also for Particles & Fields and Nuclear Physics (less closely related). A DPP subcommittee consisting of Lampe, Jim Drake, and Dave Hammer is exploring this idea. Right now, the DPP has one invited-talk session at the April Meeting, and a small number of plasma physicists go to this meeting. The Division has been encouraging plasma physicists to attend, but with only moderate success. What is needed is a critical mass of plasma scientists at that meeting and an increase in the number of plasma physics invited talks. Lampe said that he had talked to Judy Franz, the APS Executive Office; she is interested and would increase the invited talk allotment if more plasma people attend this meeting. Lampe noted that the DPP is asking the Sherwood Conference steering



committee to incorporate this meeting within the April APS Meeting, with Sherwood maintaining its format and control of its talks. This would bring about 200 plasma physicists to the APS Meeting. However, the Sherwood Conference only involves theorists, so it would be necessary also to bring a block of experimentalists. One idea is to try to interest the Transport Task Force to locate their meeting at the same place—but not to combine with the APS Meeting, since the TTF Meeting is quite different. TTF attendees would be encouraged to register for the APS Meeting and to give some general interest talks at the APS Meeting. Also, the DPP plans to contact management at major fusion institutions and encourage them to send scientists to the APS spring meeting.

Asked how many invited talks would be allocated at the APS April Meeting, he said that currently there is one plasma astrophysics session and one fusion session, and that two more invited-talk sessions would be requested. One session could feature the most important plasma physics developments during the past year.

He noted that since the 2003 Sherwood Conference is already scheduled, the first time that the proposed combination with the spring APS Meeting could be implemented would be in 2004.

### **15. Discussion of New Charge about Burning Plasma Strategy**

The chair led a discussion of the new charge to FESAC from the Office of Science concerning burning plasma physics strategy. The charge letter takes into account decisions made outside the US, e.g., decisions regarding ITER made by Japan and Europe. This charge is a logical continuation from the work of the recent FESAC panel on burning plasmas, chaired by Freidberg. The panel's report is requested in September 2002.

The chair announced that Stewart Prager has agreed to chair the burning plasma physics panel that will address this charge. He and Prager are developing the list of panel members. The membership of the panel will consist of all interested FESAC members, plus a group of program leaders and a group of other experts. The panel will have about 35 members (similar to the size of the panel that wrote the Knoxville report). The panel will meet August 6-8 in Austin, TX.

The chair noted that members of this panel would attend the Snowmass meeting in Colorado in July and hold their own meetings there in preparation for the August meeting in Austin.

### **16. Discussion of New Charge about Non-Electric Fusion Applications**

The chair led a discussion of the new charge to FESAC from the Office of Science concerning non-electric applications of intermediate-term fusion.

The chair announced that Kathryn McCarthy has agreed to chair the panel to address this charge.

### **17. Date of Next Meeting**

The next FESAC meeting was scheduled for Wednesday and Thursday, September 11 and 12, 2002, in Gaithersburg, MD.

### **18. Adjourn**

The chair adjourned the meeting at 11:34 a.m.

Minutes submitted by: James W. Van Dam, FESAC Secretary

Approved by: Richard D. Hazeltine, FESAC Chair

**APPENDIX A: Guest List**

<b>Name</b>	<b>February 27</b>	<b>February 28</b>
Toshiro Asakawa—JAERI	X	X
Jeffrey Auchmoody—DOE	X	X
David Baldwin—GA	X	X
Glenn Bateman—Lehigh U.	X	
Curt Bolton—DOE/OFES	X	X
Jim Callen—U. Wisconsin	X	
Dan Cohn—MIT	X	
Bruno Coppi—MIT	X	
Michael Crisp—DOE/OFES	X	
Rostam Dagazian—DOE/OFES	X	X
Steve Dean—FPA	X	X
William Dove—DOE/OFES	X	
Steve Eckstrand—DOE/IFES		X
Motokuni Eto—JAERI	X	X
Suzy Glucksman—MIT	X	
Rob Goldston—PPPL	X	
Adil Hassam—U. Maryland	X	X
Mark Haynes—GA	X	
Rich Hawryluk—PPPL		X
Dan Hitchcock—DOE/OASCR		X
Bick Hooper—LLNL	X	
Richard Janco—AIP	X	
Tom Jarboe—U. Washington	X	X
David Jones—Inside Energy	X	
Esther Ku—DOE/OFES	X	X
Grant Logan—LLNL	X	
Darlene Markovitch—DOE/OFES	X	
Warren Marton—DOE/OFES	X	X
Dale Meade—PPPL	X	X
Ronald McKnight—DOE/OFES	X	X
Stan Milora—ORNL	X	X
William Nevins—LLNL	X	
Erol Oktay—DOE/OFES	X	
Albert Opdenaker—DOE/OFES	X	X
Tony Peebles—UCLA	X	
Walt Polansky—DOE		X
Miklos Porkolab—MIT	X	X
Stewart Prager—U. Wisconsin	X	
Bob Price	X	
Michael Roberts—DOE/OFES	X	X
Walter Sadowski	X	X
John Sarff—U. Wisconsin	X	
John Sauter—DOE/OFES	X	X
Dick Siemen—LANL	X	X
Ron Stambaugh—GA		X
Francois Waelbroeck—U. Texas	X	X
John Willis—DOE/OFES	X	X

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**APPENDIX B: Burning Plasma Strategy Panel**

February 22, 2002

Professor Richard D. Hazeltine, Chair  
Fusion Energy Sciences Advisory Committee  
Institute for Fusion Studies  
University of Texas at Austin  
Austin, TX 78712

Dear Professor Hazeltine:

In response to our earlier request, FESAC has provided me with clear advice on the scientific status of burning plasma physics. FESAC has recommended that the Department proceed apace toward decisions that would enable the U.S. fusion energy sciences community to address experimentally the important scientific issues involved in burning plasma physics.

In accordance with the FESAC recommendations, we are supporting the Fusion Summer Study later this year, with its focus on a detailed examination and assessment of the benefits to be achieved in the various possible approaches to an experimental program in this field.

The next step in this process is for FESAC to establish a high-level panel that would use the results of the Summer Study to recommend a strategy for burning plasma experiments. This panel's report should show how ITER would fit into the U.S. fusion program, if it were to go forward with our participation. The panel should also indicate how a FIRE or Ignitor type of device would fit in our program, if ITER were not to go forward. The panel's proposed plan should provide flexibility for us to join ITER, should the Administration decide to enter negotiations, and if we are able to negotiate acceptable terms, and that allows us to decline to join if the terms are not acceptable to both the community and the Administration.

Given the importance of a timely decision process, I ask FESAC to have the panel complete its report as quickly as possible after the Summer Study in July. It is important that FESAC itself review the panel report and send me the full Committee's recommendation by the end of the summer, in September 2002.

In parallel, we will ask the National Research Council to prepare to review FESAC's recommendations and report to us with their assessment by the end of 2002.

This set of actions will provide the Department with the essential fusion community view, as well as an external review, on the critical question of how to pursue burning plasma physics.

Thank you in advance for your efforts to provide your report to us on a timely basis.

Sincerely,

/s/

James F. Decker  
Acting Director  
Office of Science

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**APPENDIX C: Integrated Simulation and Optimization Charge**

February 22, 2002

Professor Richard D. Hazeltine, Chair  
Fusion Energy Sciences Advisory Committee  
Institute for Fusion Studies  
University of Texas at Austin  
Austin, TX 78712

Dear Professor Hazeltine:

This letter provides a charge to the Fusion Energy Sciences Advisory Committee (FESAC) to assist the Office of Fusion Energy Sciences (OFES) in preparing a roadmap for a joint initiative with the Office of Advanced Scientific Computing Research (OASCR). Recent reports, such as the FESAC report "Priorities and Balance within the Fusion Energy Sciences Program," the "Report of the Integrated Program Planning Activity" (IPPA), and the NRC report "An Assessment of the Department of Energy's Fusion Energy Sciences Program," have identified a predictive understanding as a measure of the quality of the science and the maturity of the knowledge base of a field. The IPPA report lists several challenging 10-year objectives for the fusion program, including "develop fully integrated capability for predicting the performance of externally-controlled systems including turbulent transport, macroscopic stability, wave-particle physics, and multi-phase interfaces." This objective, as well as several other IPPA objectives related to innovative confinement configurations, will require significantly enhanced simulation and modeling capability. Therefore, the goal of this initiative should be to develop an improved capacity for **Integrated Simulation and Optimization of Fusion Systems**.

The initiative should be planned as a 5-6 year program, which would build on the improved computational models of fundamental processes in plasmas that are being developed in the base theory program and in the SciDAC program. Rough estimates are that an integrated simulation initiative would require a total funding level of about \$20 million per year, with funding for the plasma scientists provided by OFES and funding for the applied mathematicians, computer scientists, and computational resources provided by OASCR. Thus, the roadmap should include not only human resources but also computer and network resources.

Please carry out the preparation of the roadmap using experts outside of FESAC membership, as necessary, including experts recommended by the Advanced Scientific Computing Advisory Committee. The sub-panel of experts should obtain community input through a series of workshops, covering at least the following questions:

- What is the current status of integrated computational modeling and simulation?
- What should be the vision for integrated simulation of toroidal confinement fusion systems?
- What new theory and applied mathematics are required for simulation and optimization of fusion systems?
- What computer science is required for simulation and optimization of fusion systems?
- What are the computational infrastructure needs for integrated simulation of fusion systems?
- How should integrated simulation codes be validated, and how can they best be used to enable new scientific insights?

The ultimate product should be a roadmap document similar to the one developed for the Genomes to Life Initiative (<http://www.doe.genomestolife.org/roadmap/index.html>). Please conduct a workshop on the first two questions above and provide a summary document with overall program goals and objectives, major program deliverables, and a brief description of the OFES and OASCR funded elements of the program by July 15, 2002, so that OFES would be able to include a description of the program in the FY 2004 OMB budget request. Please complete work on the final roadmap by December 1, 2002, in order to provide the detailed information needed by OFES and OASCR to develop detailed program plans, program announcements and grant solicitations.

I appreciate the time and energy that members of FESAC and FESAC sub-panels have provided to the continuing efforts to develop program plans and roadmaps for the OFES program. I am confident that the Committee's recommendations on a roadmap for **Integrated Simulation and Optimization of Fusion Systems** will form a sound basis for beginning a joint OFES/OASCR program.

Sincerely,

/s/

James F. Decker  
Acting Director  
Office of Science

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## APPENDIX D: Non-Electric Fusion Applications Charge

February 21, 2002

Professor Richard D. Hazeltine, Chair  
Fusion Energy Sciences Advisory Committee  
Institute for Fusion Studies  
University of Texas at Austin  
Austin, TX 78712

Dear Professor Hazeltine:

The long-range vision for the world's fusion research programs is the development of power plants in which the fusion process would be used to produce electricity. It is widely acknowledged that realizing this vision will require a long-term development effort to achieve burning plasmas and technology performance levels that are highly advanced relative to today's capabilities.

However, at various times in the past, the Department's fusion program has also explored ways in which the fusion process might be used to meet other needs that would not require the levels of burning plasma and technological performance needed for economical electricity generation. These explorations have noted that fusion devices on the pathway leading eventually to fusion power plants for electricity generation might be useful for other, nearer term purposes. These non-electric uses of fusion might include the production of hydrogen that could be used as a fuel in the transportation sector, and the production of high-energy neutrons that would have a variety of uses, such as the transmutation of nuclear wastes.

I would like the FESAC to consider whether the Fusion Energy Sciences program should broaden its scope and activities to include non-electric applications of intermediate-term fusion devices. During this consideration, FESAC should answer the following questions:

- What are the most promising opportunities for using intermediate-term fusion devices to contribute to the Department of Energy missions beyond the production of electricity?
- What steps should the program take to incorporate these opportunities into plans for fusion research?
- Are there any possible negative impacts to pursuing these opportunities and are there ways to mitigate these possible impacts?

I would like FESAC to report its findings to the Office of Science by January 2003.

Sincerely,

/s/

James F. Decker  
Acting Director  
Office of Science