



May 4, 2015

Dr. Patricia M. Dehmer
Acting Director
Office of Science
U.S. Department of Energy
1000 Independence Avenue, S.W.
Washington, DC 20585

Dear Dr. Dehmer,

With this letter, the Fusion Energy Sciences Advisory Committee transmits the report on the 2014 Committee of Visitors, prepared in response to the charge in your letter on 8 April 2014. On behalf of FESAC, I thank Prof. Amitava Bhattacharjee (COV chair) and his excellent COV for the diligent effort that was directed toward responding to this important charge. I acknowledge and appreciate the schedule flexibility, granted by you, that benefited both the assembly of the COV and the preparation of materials by FES for undertaking this assessment.

FESAC voted unanimously to approve this report.

Sincerely,

A handwritten signature in black ink that reads "Mark E. Koepke".

Mark E. Koepke, Professor,
Chair, FESAC
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cc: Ed Synakowski, Sam Barish, Amitava Bhattacharjee

Program Being Reviewed: FES

Fiscal Years Being Reviewed: FY 2010 through FY 2013

Dates of COV: December 2-4, 2014

COV Chair: Prof. Amitava Bhattacharjee (PPPL)

Date of Approval by the Advisory Committee: March 13, 2015

The 2014 Committee of Visitors (COV) Report to the Fusion Energy Sciences Advisory Committee

Table of Contents

I. Introduction

- A. Charge
- B. COV Members
- C. COV Process
- D. Layout of Report

II. Selected Findings and Recommendations

III. Project Management, including US ITER

- A. Background
- B. Scope of Program Area
- C. Project Portfolio Review, Management Processes, and Documentation

IV. Program on Toroidal Experiments, International Collaborations, and Diagnostics

- A. Scope of Program area
- B. Progress on Action Items from Previous COV Review
- C. Solicitation, Review, and Documentation
- D. Monitoring Active Awards
- E. Breadth, Depth, and Quality of Program Portfolio
- F. National and International Standing

V. Program on Experimental Plasma Research and HEDLP

- A. Scope of Program area
- B. Progress on Action Items from Previous COV Review
- C. Solicitation, Review, and Documentation
- D. Monitoring Active Awards
- E. Breadth, Depth, and Quality of Program Portfolio
- F. National and International Standing

VI. Program on Theory and Computation

- A. Scope of Program area
- B. Progress on Action Items from Previous COV Review

- C. Solicitation, Review, and Documentation
- D. Monitoring Active Awards
- E. Breadth, Depth, and Quality of Program Portfolio
- F. National and International Standing

VII. Program on General Plasma Science

- A. Scope of Program Area
- B. Program on Action items from Previous COV Review
- C. Solicitation, review, and documentation
- D. Monitoring Active Awards
- E. Breadth, Depth, and Quality of Program Portfolio
- F. National and International Standing

VIII. Program on Enabling Technology

- A. Scope of program area
- B. Program on Action Items from Previous COV Review
- C. Solicitation, Review, and Documentation
- D. Monitoring Active Awards
- E. Breadth, Depth, and Quality of Program Portfolio
- F. National and International Standing

Appendices

- A. Charge Letter
- B. Members of the COV
- C. US Representation on ITER Governing and Advisory Panels

I. Introduction

A. Charge

The 2014 Committee of Visitors (COV) was initiated by a letter from Dr. Patricia Dehmer, Acting Director of the Office of Science to Professor Mark Koepke, Chair of the Fusion Energy Sciences Advisory Committee (FESAC) on April 8, 2014. (This letter is included in this Report as Appendix A.) The COV was charged with the consideration and evaluation of:

- The efficiency and quality of the process used by the Office of Fusion Energy Sciences (FES) to solicit, review, recommend, monitor, and document awards and declinations for universities, national laboratories, and industry.
- The breadth, depth and quality of the resulting program portfolio, and providing an evaluation of the program's national and international standing.
- FES's management of its portfolio of line item construction and Major Items of Equipment Projects, including the US contributions to ITER project. Assessment of FES's projects performance, including contractor and Federal Project Director management of projects, is performed by periodic Office of Science Independent Project Reviews, and is not part of this COV.

The 2014 COV was charged with reviewing the entire FES Program for activities during the Fiscal Years (FY) 2010-13, following the last COV which evaluated the program through 2009. The present COV was also charged with on FES's progress in addressing action items from the 2009 COV.

B. COV Members

The Chair of the 2014 COV was selected by Professor Mark Koepke, who also proposed a slate of members of the COV to the Chair (in consultation with FES management). The list was finalized by iteration between Professor Koepke and the Chair. The membership of the COV and the institutional affiliation of the members are listed in Appendix B, and cover the entire range of FES programs covered by the charge.

For the purpose of this COV, the budget categories used were the ones that were existing in FES during the period covered by the review (FY 2010-13), not the ones that have been proposed recently. Specifically, the categories used were:

- Project Management, including ITER
- Toroidal Experiments, International Collaborations, and Diagnostics
- Experimental Plasma Research, and High-Energy Density Laboratory Plasma (HEDLP)
- Theory and Computation
- General Plasma Science
- Enabling Technology

To avoid conflicts of interest, the members of the COV were divided into subcommittees not in their area of funding. Every subcommittee has contributed its own section to the Report, and the text for a section, which the subcommittee was assigned to write, was written by member(s) without conflicts of interest. Every member signed a Conflict of Interest Statement and a Confidentiality Statement. The various members of the subcommittees are given in Appendix B.

C. COV Process

Although the COV was staffed soon after the COV charge was issued, 2014 was a very busy time for the FES as well as the fusion community due to the demands of the Strategic Planning process that was well under way at the time. The FES was busy through most of Fall 2014 as well, and the visit of the COV to Germantown did not occur until December 2-4, 2014. Since the original charge letter required submission of the report on the COV activity by January 2015, an extension was sought and granted until March 2015.

Prior to the visit and after, the COV conducted a number of teleconferences and communicated by e-mail. These deliberations were carried out without direct involvement of FES members. Prior to the visit to Germantown, the Chair met with FES members by teleconference and exchanged e-mail, requesting information on various items required for the review by the COV. This information was provided by FES, and helped prepare the COV members for the visit to Germantown. Preliminary findings and recommendations were developed during the visit to Germantown, and reported to FES in the closing session on the last day of the visit. After the visit, the FES provided additional information requested by the Chair. The COV interacted via teleconferences and e-mail in finalizing the Report.

D. Layout of Report

The Report is organized as follows. The subcommittee findings and recommendations on each of the six categories listed above (in sub-section B) are discussed in Sections III-VIII. Each of the Sections addresses the various elements of the original charge letter.

Section II lists selected 2014 COV findings and recommendations that may be regarded as highlights, and are gleaned from the detailed findings and recommendations discussed in Sections III-VIII. In most cases, these highlights synthesize COV findings and recommendations that appear separately in Sections III-VIII, but have been brought together in Section II for emphasis. They also include aspects of the 2009 COV recommendations not captured in Sections III-VIII.

II. Selected Findings and Recommendations

FINDINGS

- The COV was very pleased with the quality of the information provided, and the openness, accessibility, and professionalism of the FES personnel during the entire process. The documentation and presentation provided by FES management and staff was thorough and well organized.

- The implementation and use of the Portfolio Analysis and Management System (PAMS) has been a huge benefit for the efficacy and quality of FES processes---to solicit and review proposals and applications, to recommend award or declination of funds, and to document these actions. All programs in FES appear to be making effective use of PAMS, reducing drastically irregularities reported by the 2009 COV.
- Despite the regularization of the process made possible by PAMS, the COV was concerned with the statistically insignificant differences in reviewer rankings between proposals approved and declined in some of the programs.
- The COV was impressed with certain efforts introduced to improve the quality of the proposal review process. In the HEDLP program, for example, virtual panel reviews were implemented, allowing group discussion of proposals and, in some cases, clarification of technical issues discussed in the proposals prior to the writing of the reviews. This process appears to be effective and mitigates potential deficiencies in having isolated mail-in reviews.
- In response to the 2009 COV recommendation on defining, collecting, and analyzing metrics of performance for the programs reviewed, FES is beginning to use Information Technology (IT) toolsets (e.g., Web of Science, Web of Knowledge, PAMS etc.) and engage the US DOE Office of Science and Technical Information, located at Oak Ridge National Laboratory (ORNL), to identify, collect, and analyze performance metric and measures. Measures such as prizes and awards are commonly included in reports to Congress and other stakeholders to highlight the quality of the FES portfolio. To date, FES has not directly used metrics relating to refereed publications or citations, as the office is still developing an understanding of how such measures can be used in responsible ways.

While we commend FES for undertaking a preliminary study, much more needs to be done for a thorough evaluation of the national and international standing of the various programs, required by the charge to this COV. Capabilities to monitor active awards, projects, and programs in PAMS seem to be under way, and when implemented, would greatly enhance the monitoring process in the post-award phase. As a possible model, the NSF Fastlane system greatly facilitates the entry and tracking of publications.

- The COV is concerned that FES continues to be under-staffed in both managers and administrative assistants in moving forward with leadership of some its key programs and data collection.
- It was troubling for the COV to learn that there was no community input or peer review sought for the decision to close Alcator C-Mod. The COV notes that this lack of external input to FES is damaging to the fusion community as a whole and has eroded trust between the community and the FES management. The COV recognizes that budget exigencies can and do arise in the program as a whole, but the manner in which the C-Mod process was communicated and handled was cause for concern.
- The COV was concerned that there were no targeted solicitations for research at DIII-D or C-Mod, nor were any proposals with new PI's funded at these facilities over the period reviewed.

- The breadth of the Experimental Plasma Research (EPR) Program is excellent. However, only one solicitation was issued for the period covered by this COV, with one-year extensions granted to key experimental programs for the remaining period. This practice encourages continuation of the status quo, and inhibits innovation in the EPR Program.
- In the Enabling Technology area, since the funding of proposals from the last solicitation on materials, FES has decided to make a change in direction. All of the PIs have been informed by the Program Manager that there will not be a renewal of the awards from the last solicitation. When asked about the processes being followed for the closeout of these proposals, no plan for review was proffered. When asked what the follow on process for funding activities in the materials area would be, it was stated that no decision had been made.
- The project portfolio managed by the Facilities, Operations and Projects (FOP) Division for the FES is not broad and will be limited to the US ITER project, with completion of the NSTX-U project expected in 2015.

RECOMMENDATIONS

- Consider vetting programmatic decisions on the potential shutdown of a major US facility by the peer-review process and community participation in order to maintain the integrity of the US Fusion Program and faith in FES.
- Make sure future plans are well formulated and communicated before canceling a program (e.g., in the Enabling Technology area, and in the closure of Alcator C-Mod). (This echoes a similar recommendation from the 2009 COV, made with respect to the ICC program, regarding transparency in redirection of funds.)
- Restore the Budget Planning Meeting (or variant thereof) that provides the community with a forum to discuss future plans openly, and can inform FES decision-making.
- Continue defining, collecting, and analyzing meaningful metrics, and develop capabilities in PAMS to enable this objective. (This repeats a 2009 COV recommendation.)
- Consider extending the virtual panel review mechanism employed in HEDLP to other programs in FES. Such a mechanism could be useful in mediating cases in the absence of site visits for panelists.
- Offer regular, targeted Funding Opportunity Announcements (FOAs) for research on DIII-D and future major tokamak facilities as well as the EPR program.
- FOP Division should utilize the impending FES strategic plan in conjunction with a series of user and scientific community workshops to develop its project portfolio to further define science and project needs that could be considered for CD-0 (see Section III).

III. Project Management, Including US ITER

A. Background

The Facilities, Operations and Projects (FOP) Division manages the project portfolio for FES. Large projects are initiated with the DOE Order 413.3B (O 413.3B) Critical Decision (CD) process that allows FES to identify a “Mission Need” (CD-0). Support for the mission need is obtained primarily from fusion community advice on the directions and priorities of the field through the FESAC Long Range Plan process. Currently, the FES portfolio of large-scale projects (greater than \$50M) consists of two projects: the National Spherical Torus Experiment Upgrade (NSTX-U) project at the Princeton Plasma Physics Laboratory (PPPL) and United States (US) Contributions to the ITER project. The overall ITER Project is being executed by the ITER Organization (IO), an international collaboration of seven members, and is currently under construction in Cadarache, France. For US ITER, the US ITER Project Office (USIPO), located at ORNL, manages the project.

Major Item of Equipment (MIE) projects (greater than \$2M) and smaller projects (less than \$2M) are often initiatives coming from the community that undergo science and technical reviews to establish the need and requirement for a particular project. FES often conducts scientific and technical reviews to establish the need and requirement for a particular project. This approach is well conceived and an effective approach that nurtures new projects of all scales that are required to conduct the forefront research of the field. New projects and their development are key to scientific advances in the field. The funding of MIE and smaller projects has been diminished by an increasing construction budget for the largest projects.

In the portfolio of small-scale projects, there were two MIE projects that were also delivered during the period of this review, using O 413.3B tailored as appropriate. One is the Neutralized Drift Compression eXperiment (NDCX-II) project, with a Total Project Cost (TPC) of \$11M, at Lawrence Berkeley National Laboratory (LBNL) and the other is the Materials in Extreme Conditions (MEC) project, with a TPC of \$19.97M, at SLAC National Accelerator Laboratory (SLAC), both of which were completed in 2012 using American Recovery and Reinvestment Act (ARRA) funds.

The Office of Science (SC) requested and in 2011 the Deputy Secretary approved an exemption from the requirements of O 413.3B. The exemption was based on SC having satisfactorily met all criteria necessary for exemption set forth in the Order, including an excellent past performance record in the area of project management. The exemption delegates most Acquisition Executive (AE) approval authorities for project CDs down to the SC Director with the ability to further delegate and tailor application of Order requirements. The SC Director then further delegated to Associate Directors including FES some project approval authorities and tailoring of the Order. Also, in December 2012, the Deputy Secretary removed the US ITER project’s designation as a capital asset project under O 413.3B, given that all hardware would eventually be delivered to Cadarache, and delegated AE approval authority down to the SC Director. US ITER remains a Congressional Line Item project.

Prior to the formal delegation, the SC Director acting as the AE in November 2012 approved the Energy Systems Acquisition Advisory Board (ESAAB) decision to authorize execution of FY 2013/FY 2014 activities for the US ITER project, in lieu of having an approved CD-2 and CD-3 for the project. Subsequently, the Acting SC Director as AE in August 2014 approved a revision to the Preliminary Project Execution Plan (PPEP) for US ITER, which called for the AE to approve an

annual Performance Plan (PP) to allow execution of project activities after 2014. This approval process for FY2015 was still being worked at the time of the COV review.

B. Scope of Program Area

The Project Management subpanel identified the key relevant processes in this area as: (a) the DOE Project Management Order (O 413.3B); (b) the SC Office of Project Assessment (OPA) led peer reviews of projects; and (c) the SC Management System (SCMS).

The subpanel reviewed and assessed the application of the methods prescribed above as adequate and successful in delivering projects on schedule, within budget and meeting the baseline technical performance parameters.

A total of 4 projects were reviewed, one Line Item project and three MIE projects, as summarized in Table 1.

FES Project Status and Performance Metrics

Project	Description	TPC	Most Recent CD	Performance Metrics			
				% Complete	Cum CPI	Cum SPI	As Of
U.S. Contributions to ITER (U.S. ITER) -ORNL	Line-Item	\$4.1B	CD-1	25%	0.99	0.97	Nov-14
National Spherical Torus Experiment Upgrade (NSTX-U) - PPPL	MIE	\$94.3M	CD-3	93%	0.96	0.96	Nov-14
Materials in Extreme Conditions (MEC) - SLAC	MIE (ARRA Funded)	\$19.97M	CD-4	100%	-	-	-
Neutralized Drift Compression Experiment (NDCX-II) - LBNL	MIE (ARRA Funded)	\$11M	CD-4	100%	-	-	-

Table 1: Project status as of 14 November 2014, listing "Percentage Project Completion", "Cumulative Cost Performance Index", and "Cumulative Scope Performance Index".

C. Project Portfolio Review, Management Processes and Documentation

Project Management review process description

The subpanel discussed the elements of the charge with the FOP division staff and reviewed records and detailed reports on the projects identified within the scope of the COV. The COV subpanel’s recommendations are noted below.

Metrics and User definitions

Metrics utilized to evaluate the construction projects and MIE component for the COV include standard cost and schedule indexes (Table 1) for the projects that are in progress, and final costs and schedules versus approved baselines for completed projects. For the period of the COV, Table 1 shows that FES met the goals of within 10% for cost/schedule performance.

FINDINGS

- The FES Strategic Planning effort is ongoing and the Plan is expected to be issued in 2015. The COV strongly encourages this effort and its socialization within the FES scientific community when complete.
- For FY15, the FES Program was given a budget of \$464.5M, with 47% devoted to science and 53% supporting facility operations and projects under the FOP Division (US ITER @ \$150M). To date, all projects have met or are meeting baseline delivery objectives.
- The efficacy of the processes to monitor and review active projects, programs and facilities is adequate – four projects were reviewed:
 - MEC – Completed on time, on budget
 - NDCX-II – Completed on time, on budget
 - NSTX-U on track to be completed on time, on budget
 - US ITER - Active, currently at CD-1
- US ITER is the dominant project within FES. US ITER contribution to the ITER IO is fixed at 9.09% of total ITER cost. The US ITER is at CD-1 with a TPC currently estimated at \$4.055B, which is a mix of hardware and cash contributions to ITER IO. US ITER uses a tailored approach to O 413.3B to manage the US ITER project.
- ITER IO has experienced a number of significant management challenges over several years. Recently, a new ITER IO Director General has been nominated to lead the project and if appointed, will be implementing several recommendations from the ITER Council and Management Assessment Report which are intended to improve the cost and schedule performance of the project.
- FES (and FOP and US ITER) is to be commended for its active involvement in supporting the IO and the development of recommendations for improvements. The committee concluded that there is active US representation in the various ITER advisory panels and governing boards including the ITER Council (currently U.S. Chair) as well as active representation in the Management Advisory Committee (MAC), Science and Technology Advisory Committee (STAC), as well as the recent ITER Management Assessment, which was U.S. led. (See Appendix B for detailed representations).
- The COV noted that many ITER IO programmatic issues (e.g., cash contributions, program risks, off-project dependencies including international issues such as the ITER international school, taxation, IO HR policies, French regulatory environment, etc.) are currently being

directly managed by the US ITER project team, which are a distraction from US ITER project execution efforts.

- FES, including FOP Division, focuses on a set of key factors to manage project success, including a strong reliance on qualified and experienced managers in both government and its Management and Operations (M&O) contractor, an integrated project team, risk management, active program involvement with committed management from executing laboratories, adequate budget and schedule contingencies and a stable funding profile when projects are base-lined.
- FOP has implemented over the past 4 years the Office of Science Management System (SCMS), a web-based management tool that provides a comprehensive description of the Office of Science Project Management responsibilities, associated authorities and management approaches designed to deliver the SC projects.
 - FOP implements the principles and practices of O 413.3B tailored to monitor and control projects through a CD milestones approach.
 - FES could benefit from a similar description of responsibilities and management approaches for program management.
 - US ITER Project is reviewed semi-annually through the Office of Project Assessment and the review teams are carefully selected for subject matter expertise and lack of conflict of interest. *The performance of the US ITER Project was not within the purview of this COV.*
- The project portfolio is not broad and will be limited to the US ITER project, with completion of the NSTX-U project expected in 2015.
- While successful in executing projects now, the trend in reduced projects could result in the eventual dilution of project management expertise and possibly jeopardize continued success.

RECOMMENDATIONS

- Consider separating the ITER program from the US Contributions to the ITER Project and managing the program issues from Headquarters.
- Consider developing a defined set of roles, responsibilities, and processes that include metrics for decision making codified in a FES Program Management Plan.
- FOP Division should utilize the impending FES strategic plan in conjunction with a series of user and scientific community workshops to develop its project portfolio to further define science and project needs that could be considered for CD-0.

IV. Program on Toroidal Experiments, International Collaborations, and Diagnostics

A. Scope of Program Area

The *US Program* maintains three large tokamak devices: DIII-D managed by General Atomics (GA) in San Diego, California; the National Spherical Tokamak Experiment-Upgrade (NSTX-U), managed by the Princeton Plasma Physics Laboratory (PPPL) in Princeton, New Jersey; and Alcator C-Mod, managed by the Massachusetts Institute of Technology (MIT) in Cambridge, Massachusetts. These experiments are focused on multiple objectives: developing the predictive science needed for ITER, the exploration of the innovative spherical torus (ST) concept and the capability to test novel plasma-facing components, the operation of plasmas above the ITER design magnetic fields and densities, and exploring steady-state operations. All three facilities mentioned above are operated as user facilities and involve users from Universities and national laboratories who collaborate with scientists at the three facilities.

The *International Collaborations* program supports work on leading experimental facilities from other partner nations in ITER. It was introduced by a FOA in FY2012 targeting collaborative research on international experimental facilities that are not available in the US. Experimental facilities outside of the US constitute a healthy base of internationally funded devices, and offer opportunities to study effects such as long-pulse plasma operation and plasma-wall interaction effects.

The *Advanced Diagnostics* program seeks to support experimental research for the development of innovative and advanced measurement capabilities for magnetic fusion plasmas, leading to improved understanding of plasma behavior in fusion experiments relevant to magnetic fusion energy sciences through validation and verification with theory and simulation, and in developing tools for plasma control.

B. Progress on action items from previous COV review

- FES program managers made considered efforts to address the recommendations of the previous COV.
- At the time of this COV review, FES was in the process of transitioning to PAMS. FES should be commended for making use of a modern IT system as it addresses numerous past COV recommendations. Access to PAMS for the present COV was limited to requesting printouts of individual “folders” from the program managers. Future COV’s will have online access to the system and should then critically evaluate the implementation and efficacy of PAMS.

C. Solicitation, Review, and Documentation

US Program

The funding for the operations of the three large facilities in the *US Program* is typically through 5-year cooperative agreements between DOE and the facility host institutions. The funding for facility operations provides experimental tools such as plasma heating, fueling, and exhaust systems and supports operation costs. Research funding supports collaborative teams to conduct research on these facilities. While the NSTX program has regular FOAs, there have been no targeted solicitations for research at DIII-D or C-Mod over the period reviewed.

The NSTX solicitations are carried out in a three-year cycle with approximately $\frac{1}{3}$ of the collaborations reviewed each year. The process followed excellent review practices. The proposals were reviewed by 3-4 subject matter experts. When comparing the rankings from the reviewers, there was often little numerical difference (likely statistically insignificant) between the proposals that were in the range to be funded. This left significant burden on the Program Manager to delineate, and subsequent decisions followed programmatic considerations that were well documented. The programmatic rating decided by NSTX management was included in the folders for each review. Peer reviewed publications, invited talks, contributions to ITPA, and significant awards were also used as metrics to evaluate the quality of the research and leadership roles within NSTX and were noted as important factors in evaluating renewal proposals.

FINDINGS

- It was troubling for the COV to learn that there was no community input or peer review sought for the decision to close C-Mod. The COV notes that the lack such input to FES is damaging to the fusion community as a whole and has eroded trust between the community and FES management.
- There were no targeted solicitations for research at DIII-D or C-Mod over the period reviewed and it appears that this limits consideration of new proposals. Over the period reviewed by this COV, there were no proposals with new PI's funded at DIII-D or C-Mod.
- The NSTX three-year proposal cycle is effective in minimizing disruption to the NSTX program as only 1-2 collaborations are likely phased out at any time.
- We are concerned about the low number of new proposals overall that are funded for research on NSTX in this COV period. For example, DE-FOA-0000576, "National Spherical Torus Experiment: Diagnostic Measurements of Spherical torus Plasmas," resulted in 15 grant applications with a nearly even split between new and renewal proposals, but only two of the nine funded proposals were new.
- Reviewer rankings were often statistically insignificant between proposals.

RECOMMENDATIONS

- Programmatic decisions on the potential shutdown of a major US facility need to be vetted by the peer-review process and community participation in order to maintain the integrity of the US Fusion Program and faith in FES.
- Offer regular, targeted FOAs for research on DIII-D and future major tokamak facilities.
- Consider more balance between new and renewed proposals when evaluating closely ranked proposals.
- Consider using a virtual panel of reviewers to foster discussion on selected proposals that will further help the Program Managers in selecting the final proposals, particularly when the reviewer rankings do not statistically guide the process.

International Collaborations

FINDINGS

- During the period reviewed by this COV, a single FOA was offered; 13 proposals were submitted and 3 projects were selected for funding. There are now semi-annual reviews, and current projects are due to end in 2016, with a new solicitation expected approximately in December 2015. This is a strong program with depth, but the breadth of projects is limited.
- The research supports projects that complement work on US experiments.

RECOMMENDATIONS

- The move towards a specific FOA and a peer-reviewed process for international projects is an important step forward and should continue. Because of the large number of extremely highly rated projects, a more discerning peer review process should be considered.
- When possible, the targeted experimental facilities should have a chance to give input on the proposed research projects in a way similar to the process used to distinguish between projects proposed for research on US facilities. This should go beyond simply writing a letter of support, but instead should involve asking a panel of international facility experts to give a ranking to the specific proposals.

Advanced Diagnostics

FINDINGS

- The major activity for the advanced diagnostics systems for magnetic fusion energy sciences consisted of a single FOA during 2012. The FOA was developed with input from an *ad hoc* FES Workshop Group in diagnostics and the solicitation was published on June 22, 2012 as DE-FOA-0000744. The close date for receipt of completed proposals occurred on a very short

time frame, with the proposal deadline being August 14, 2012. Despite this, 39 total proposals were received. Thirty-two proposals were sent for review after filtering for redundant or proposals that were not responsive to the solicitation.

- Of the 32 proposals reviewed under DE-FOA-0000744, 14 were described by the program manager as “truly outstanding.” Of these 14, only 9 were funded, primarily due to budgetary constraints. Of these nine, eight were renewal awards and one was new. This ratio was of some concern to the sub-committee which could not properly evaluate its impact on what would constitute an “advanced” diagnostic beginning from the time of the original proposal, through the renewal process, to its eventual implementation as a proven diagnostic.

RECOMMENDATIONS

- Explore alternate ways to ensure that truly outstanding and innovative proposals do not have to wait four years to re-compete.

D. Monitoring Active Awards

FINDINGS

- FES used effective processes to manage the *US Program*. Progress was monitored through annual progress reports, presentations at major meetings, and presentations to Program Advisory Committees. Additionally, detailed and laudable presentations on the Program Governance for each device were given to the COV.
- The monitoring process for *Advanced Diagnostics* awards was not well articulated to the sub-committee.

RECOMMENDATIONS

- See the recommendation on metrics in Section II.

E. Breadth and Depth of Program Portfolio

FINDINGS

- We are concerned that the lack of targeted FOAs for research at DIII-D may prevent growth and innovation for new science. Currently, DIII-D collaborators are funded through both subcontract and direct proposal to DOE (under the standing FOA). Use of targeted FOAs would provide a more open and transparent process for new PIs to become involved in research using the DIII-D facility.
- Both the depth and breadth of the NSTX program are excellent, and are anticipated to grow as the NSTX upgrade is completed.

- During the period reviewed by this COV, a single FOA for International Collaborations was offered; 13 proposals were submitted and 3 projects were selected for funding. This is a strong program with depth, but the breadth of projects is limited.
- For the only *Advanced Diagnostics* solicitation under this COV's review, just 9 out of 14 proposals described by the program manager as "truly outstanding" could be funded due to budgetary constraints. This suggests that the breadth of the program can be expanded.

RECOMMENDATIONS

- The breadth of *International Collaborations and Advanced Diagnostics* programs should be expanded to include more funded proposals.

F. National and International Standing

a. US Program

This program covered a significant amount of research and generated very good results during the period of review. DIII-D and C-Mod covered a broad range of physics issues related to developing the conventional tokamak as a fusion energy source, and NSTX extended the program capabilities to low aspect ratio and high normalized pressure. The research programs on the three devices covered a range of areas, and supported a large number of excellent, highly cited, papers, including some major award winners. There are capabilities within the US program unparalleled elsewhere in the world, which made the US an attractive place to do research.

FINDINGS

- This program showed excellent breadth and depth, and was recognized both nationally and internationally as providing world leadership.
- The program's impact in the future will be constrained by the elimination of one of its three major facilities (C-Mod), one that is truly unique in the world program. This will inevitably diminish the breadth of the program by removing key capabilities from the portfolio. It will also do damage to the US's ability to design and operate future toroidal devices given the reduced capability to train students and young scientists on domestic facilities.

RECOMMENDATIONS

- FES should organize community workshops to hear input on how the program should move forward, and serious consideration should be made for major facilities that will enable this Program to maintain its breadth and depth.

International Collaborations

FINDINGS

- For the Asian collaborations, research is primarily in the startup phase, and modestly funded. Given that, these programs seem to be achieving a reasonable amount. It is too early to judge the international standing of this research. European collaborations are not particularly well supported by FES.

RECOMMENDATIONS

- Promote stronger collaboration ties with the European tokamaks, particularly JET, by rebalancing collaborative efforts between Asia and Europe.

Advanced Diagnostics

FINDINGS

- The U.S. has long held a leadership role in the development of advanced plasma diagnostics. However, this position is being eroded in the face of increased international investments (particularly by the European Union) in diagnostics development with concomitant support of robust workforces. The budget for the U.S. program has decreased from roughly \$3.9M to \$3.5M from FY 2010 to FY2013. The COV is concerned about the long-term standing of the U.S. program given the domestic budget trends.

RECOMMENDATIONS

- FES should assess the long-term health and international standing of this program.

V. Program on Experimental Plasma Research and High Energy Density Laboratory Plasma

A. Scope of Program Area

The Experimental Plasma Research (*EPR*) Program (formerly known as the ICC Program) emphasizes plasma physics and plasma-material interaction studies across a wider range of regimes than those provided by the major tokamak facilities. The EPR Program includes a diverse set of small and medium scale facilities, including stellarators, spherical tori, compact tori and advanced tokamaks. The reorganization of FES has resulted in the division of the EPR Program into three different areas in the new organization structure and it no longer exists beyond the scope of this COV.

The High Energy Density Laboratory Plasma (*HEDLP*) Program comprises the study of ionized matter at extremely high density and temperature, including both matter at order megabar pressures, and warm dense plasmas at somewhat reduced pressures. During the period under consideration the balance of the program has shifted largely toward discovery driven science.

B. Progress on Action Items from Previous COV Review

Program managers were in general responsive to all of the past COV recommendations. While there has been some effort at determining effective metrics to evaluate program quality, it is a nascent tool in program evaluation.

RECOMMENDATION

- See the recommendation on metrics in Section II.

C. Solicitation, Review, and Documentation

EPR

In the EPR Program a solicitation was issued in 2010 and the awards from that solicitation were made during the time span covered by this COV. Both an open (non-DOE laboratory) Funding Opportunity Announcement and a companion laboratory announcement were issued. All details of the evaluation process were supplied to the COV. The COV found no irregularities in the evaluation or selection of proposals. Subsequent to the expiration of the issued awards resulting for this solicitation, the selected projects received continued funding through two one-year extensions.

HEDLP

The HEDLP program has established a goal of issuing solicitations on a yearly basis, with the intent of awarding grants for three-year periods. Active researchers were given opportunities to submit short-term renewal proposals until the advent of a new solicitation in 2011. Another solicitation followed in 2012. None was issued in 2013 due to budgetary constraints.

The review process for HEDLP proposals differs from that of most programs at FES in its use of panel reviews moderated by program managers. Experts engage in discussion of a series of proposals enabling the reviewers of each proposal (who maintain anonymity) the opportunity to resolve their questions or misapprehensions. In some cases clarifying questions may be asked of the proposers themselves before the actual reviews are written. At the present time, panel rankings are not used by FES.

FINDINGS

- Awards in both programs are made considering both numerical rankings and reviewer commentary, as well as programmatic priorities. Thorough justification for award recommendations has been maintained within the office.

EPR

- One solicitation for proposals was issued in EPR during the period under review.

- The review of submitted proposals consisted of a standard mail-in peer review process utilizing both numerical ratings and textual comments.
- Anonymous and redacted copies of the reviews were provided to all PIs after the outcome of the solicitation was finalized.
- For projects not being renewed, closeout funding was provided.
- Subsequent to the expiration of the issued awards resulting for this solicitation, two one-year extensions were used to continue funding of the selected projects. The reason given was that the program elements were to be redistributed under an updated FES organizational structure, and thus it made sense to defer a new solicitation until the reorganization was approved. The COV understood the rationale for such a procedure, yet is concerned about the long duration between solicitations.

HEDLP

- HEDLP has made good progress toward its goal of issuing solicitations on a yearly basis, with the intent of awarding grants for three-year periods.
- Because all current activities are fully funded, existing activities in HEDLP are protected from yearly contractions in the program budget.
- The panel review process appears very effective and mitigates potential deficiencies in having isolated mail-in reviews.

RECOMMENDATIONS

- Regular solicitations should continue in order to allow new projects and ideas to compete for funding in these programs. Within the new FES structure, the projects formerly in EPR would benefit from new competitive FOAs, which would both strengthen existing projects and bring in new ideas. (This recommendation is duplicated under Section V.D, E.)
- The virtual panel review mechanism employed in HEDLP should be considered for use in evaluating proposals under other FES programs.

D. Monitoring Active Awards

Activities in the EPR and HEDLP programs are monitored appropriately. Records of grant monitoring are readily accessible and information was shared freely with the COV.

FINDINGS

- As is standard practice, monitoring in both programs is performed through submission of yearly progress reports, or the annual Field Work Proposal (in the case of national lab projects).

- Subsequent yearly funding is contingent on submission of acceptable progress reports.
- Submitted scientific highlights, publications and direct interactions with the projects PIs at meetings and conferences are also used to monitor the projects.
- Communication between HEDLP program management and PIs appears especially strong, and consists of a mix of email, phone calls, and direct contact at scientific meetings.

RECOMMENDATIONS

None

E. Breadth, Depth, and Quality of Program Portfolio

FINDINGS

EPR

- The breadth of the EPR program has been excellent, resulting in EPR research projects being reassigned in the new FES structure into Foundations (LTX, Pegasus, HBT-EP), Long Pulse (HSX, CTH, theory support), as well as Discovery Science (SSX, HIT-SI, Caltech, and other non-stellarator/non-tokamak confinement research). The EPR community is unique in its representation in three of the new FES categories.
- We are concerned that, due to the rather long period of time that has elapsed since the last solicitation in this area, the program has suffered by not incorporating new ideas and currently relevant topics.
- Since the Program no longer exists in the form that was reviewed during this COV, thought should be given on how effectively it is continuing its mission within the new management framework.

HEDLP

- Significant changes have occurred in the HEDLP program composition since the previous COV, partly in response to serious budget pressures. Using both the output of the 2009 ReNeW process, and the makeup of proposals that were submitted to the recent solicitations in HEDLP, the program has been significantly rebalanced in proportion to the needs of the research community.
- Currently around 50 active projects are supported at universities and labs. There is good utilization of several world-class facilities, including MEC, NIF, Z and Omega.
- A deliberate refocusing of the program onto the MEC instrument occurred during the period under consideration, with cuts announced in other parts of the program. This appears to have

been done in a thoughtful way, and the reasons for the programmatic decisions were communicated to the research community in an open and candid manner. The premier facilities besides MEC remain productive, and represent a good opportunity for program expansion, in the event additional HEDLP funding becomes available.

- A number of mid-scale user facilities have declined in scientific productivity in the past several years, due to reduced investment in facilities. Re-investment in these facilities would have a positive impact on the quality of scientific research performed, and provide critical needs for research and workforce training.

RECOMMENDATIONS

- Within the new FES structure, the projects formerly in EPR would benefit from new competitive FOAs, which would both strengthen existing projects and bring in new ideas. (This recommendation is duplicated under Section V.B, E.)
- Organize a HEDLP community workshop on how best to couple theory and simulation support for shot time on MEC.
- Solicit community input on how best to utilize the portfolio of HEDLP user facilities, should additional funds become available. Special attention should be given to the status of mid-scale facilities and needed investment.

F. National and International Standing

FINDINGS

EPR

- The EPR Program has a long history of innovative and timely research activities. The program has trained excellent scientists working at major domestic and international fusion research facilities, and has an excellent record of peer-reviewed publications and APS-DPP Invited Talks.
- New experimental techniques developed at EPR facilities have been adopted on larger experiments. For example, HBT-EP control techniques are being implemented on DIII-D; LTX lithium-wall research is implemented on NSTX/NSTX-U; HIT and Pegasus non-inductive helicity injection current drive (HICD) techniques have been implemented and studied on NSTX/NSTX-U (as well as HIT's HICD method being implemented on the Japanese QUEST tokamak). The CTH, HSX, and stellarator theory projects are well-recognized both nationally and internationally. The EPR compact torus (CT) community is actively involved in US/Japan CT workshops (with 114 attendees at the most recent August 2014 EPR/CT Joint Workshop).
- Unfortunately, given the long period without new competitive FOAs, there have not been any recent new initiatives in EPR. The COV is concerned that delays in new solicitations have

negative effects on the program's standing. This practice encourages continuation of the status quo, and inhibits innovation in the EPR Program.

HEDLP

- As mentioned in Section V.D, the HEDLP Program decided to focus available funding on MEC activities. This research is recognized throughout the national and international communities as being world-class. However, other areas of HEDLP research have suffered as a result of the reduction of resources.

RECOMMENDATIONS

- When programs are terminated, necessity may require funding redirection on a short-term basis, such as one-time supplements to existing programs. Long term, such funding should be re-competed using the traditional practices of solicitations, reviews and awards.
- Within the new FES structure, the projects formerly in EPR would benefit from new competitive FOAs, which would both strengthen existing projects and bring in new ideas. (This recommendation is duplicated under V.B, D.)
- Consider targeted solicitations in HEDLP, as funding becomes available, to revitalize parts of the HEDLP Program that have suffered during recent budget cutbacks.

VI. Program on Theory and Computation

A. Scope of program area

The Theory and Computation Program manages 57 grants (~\$25M/year) and 8 SciDAC programs (~\$8M/year; 5 solely funded by FES and 3 jointly-funded with ASCR).

Information accessed included:

- Summary information (as spreadsheets) for both Theory and SciDAC, for all solicitations during FY10-FY13
- A sampling of 10 proposals (w/at least one from each solicitation) with 6 approved & 4 declined; including proposals near the approve/decline line
- Pie charts of portfolio distributions (upon request)
- A more complete spreadsheet for FY13, including individual reviewer scores (upon request)
- Three additional declined proposals (upon request)

Theory programs are on a three-year funding cycle (~\$25M/year):

- 57 currently funded grants
- Theory proposals consistently had three reviewers each

SciDAC programs are on a 5-year funding cycle (~\$8M/year):

- 5 solely funded by FES
- 3 funded via partnership with ASCR (1 funded during this FY)
- Five year funding cycles are one year out of phase between FES-only and ASCR partnerships.
- SciDAC proposals consistently had 6-8 reviewers each.

B. Progress on action items from previous COV review

Program managers were in general responsive to all of the past COV recommendations. The development of metrics is ongoing and is repeated as a recommendation below.

C. Solicitation, Review, and Documentation

FINDINGS

- Theory solicitations have been made each year during the period 2010 to 2013.
 - 117 proposals were reviewed (63 new/54 renewals)
 - 57 awarded (9 new/48 renewals)
 - 60 declined (54 new/6 renewals)
- SciDAC solicitations were made in 2010 and 2011 (partnership w/ASCR)
 - 23 proposals were reviewed (18 new/5 renewals)
 - 7 awarded (3 new/4 renewals – 2 (new) partnership with ASCR, 5 solely funded by FES)
 - 16 declined (15 new/1 renewals)
- Review criteria appear to be consistently and appropriately applied to balance between programmatic priorities and long-term continuity of research projects. A sound review process is maintained by recognizing “outlier” reviews, both low and high. Notes on both successful proposals and the highest-ranked unsuccessful proposals are retained.
- The Theory program tends to have higher renewal vs. new approvals than other FES programs.
- However, the renewal programs are of very high quality, which is reflected in the reviewer ratings.

RECOMMENDATION

- If in-person panel reviews are impractical, strongly encourage the use of virtual panels, including input from applicants during review process

D. Monitoring Active Awards

FINDINGS

The Theory and Computation program appropriately follows the general FES-wide guidelines:

- Progress reports required each year before continued funding.
- Standardized reporting as being developed under PAMS.
- Reverse site visits are conducted when appropriate due to DoE travel restrictions.

- SciDAC programs have mid-cycle panel reviews.

RECOMMENDATIONS

- Encourage more site visits as travel budgets allow, or reverse site visits when appropriate.
- If in-person review panels are impractical (due to cost or scheduling), strongly recommend the expanded use of virtual review panels, including applicant feedback during the review process, to further improve review quality and more fairly discriminate between approve/decline decisions.
- Encourage continued metrics development, including a well-defined plan for their usage.

E. Breadth, Depth, and Quality of Program Portfolio

FINDINGS

- Breadth and depth of Theory and Computation Program are excellent.
- Research component funding levels are consistent with the recommendations of the 2005 FESAC report (entitled “Report on Scientific Challenges and Priorities”).

RECOMMENDATIONS

- None.

F. National and International Standing

FINDINGS

US computational work in fusion science continues to be recognized as world class:

- There is continued strong international requests for use of US codes.
- This excellence is recognized by US researchers winning international prizes, such as the Alfvén Prize and the *Nuclear Fusion* journal prize (twice).
- US theorists give the majority of plenary presentations at international fusion conferences.
- International organizations model their programs after SciDAC.

RECOMMENDATIONS

- Encourage the use of open-source codes and open proxy applications in FES-sponsored computational activity.
- Continue development of quantifiable metrics; develop a plan on how to use them.

VII. Program on General Plasma Science

A. Scope of Program Area

One of the key missions of the U.S. Fusion Energy Sciences program is to increase fundamental understanding of basic plasma science beyond burning plasmas. Stewardship of General Plasma Science (GPS) is accomplished through a program consisting of four program elements. These elements include; 1) the National Science Foundation (NSF)/Department of Energy (DOE) Partnership in Basic Plasma Science & Engineering, 2) the DOE National Laboratory General Plasma Science Program, 3) Plasma Science Centers, and 4) the Madison Symmetric Torus intermediate-scale device. The NSF/DOE partnership is focused on individual investigator research of fundamental plasma science and engineering issues awarded through an annual joint NSF/DOE solicitation for universities. This program also supports the Basic Plasma Science Facility at UCLA, the Center for Magnetic Self-Organization, anti-hydrogen trapping for the international ALPHA collaboration at CERN, and the Max-Planck/Princeton Center for Plasma Physics. The DOE National Laboratory Program on GPS supports individual and collaborative research that addresses specific applied plasma, laboratory, space, and astrophysical plasma issues. For example, work on magnetic reconnection, solar flares, flows in magnetic nozzles, plasma sheath and surface interactions are funded under this program. During the review period three plasma science centers were supported. These were the Center for Predictive Control of Plasma Kinetics led by the University of Michigan, the Center for Momentum Transport and Flow Organization led by the University of California, San Diego, and the Center for Plasma Surface Interactions led by MIT. The final element in the DOE GPS program is the Madison Symmetric Torus (MST) experiment at the University of Wisconsin-Madison, which is the only Reversed Field Pinch (RFP) configuration device in the U.S. research at this facility focuses on increasing fundamental understanding of the physics of the RFP magnetic configuration, expanding validated predictive capability of toroidal magnetic confinement, and advancing discovery science and its links to plasma astrophysics.

B. Progress on action items from previous COV review

FES program managers have responded constructively to the previous COV recommendations.

Current travel resources limit the ability of program managers to make site visits, but FES has addressed this limitation by implementing processes such as reverse site visits and teleconferences. Documentation on Plasma Science Center selection processes was improved by inclusion of a written report on the overall process and rationale for funding recommendations. Due to staffing constraints FES did not implement a change to the form letters sent out for unsuccessful applications, but applicants are welcome to contact program managers for additional information. The availability and use of PAMS is likely to improve further the quality of the review process.

FES is currently examining a variety of metrics for evaluating program quality, but a structured process has not yet been adopted.

C. Solicitation, Review and Documentation

NSF/DOE Partnership

Proposals in this research area were solicited in an annual announcement. The announcement was well written and described opportunities in all areas of general plasma science. Reviews were carried out jointly with the NSF. Three to four reviews were obtained for each proposal. Proposals were selected at random for review by the Committee of Visitors. In all cases, the proposal summary review reflected the content of the reviewers' comments. The highest rated proposals were excellent and were funded although the low success rate, about 15%, is a concern since many excellent proposals were not funded. The process was conducted very well and in a fair, consistent and transparent manner.

Laboratory General Plasma Science

In the time period of 2010-2013, there was one solicitation (Lab 12-01) for research on general plasma science at the National Laboratories. The proposals all received three to four reviews. Each proposal received a summary numerical score based on the reviewer ratings. The highest rated proposals were excellent and were funded. Declined proposals received a form letter and the proposers had access to reviewer comments. The Committee reviewed two proposals, one accepted and one declined. The procedures for these two proposals were done correctly. The entire process was very well done and there were no issues. However, there have been no new solicitations since 2012 and a new solicitation seems very advisable.

Plasma Science Centers

There are three Plasma Science Centers within the GPS portfolio, the Center for Predictive Control of Plasma Kinetics (University of Michigan, lead), the Center for Momentum Transport and Flow Organization (University of California---San Diego, lead), and the Center for Plasma Surface Interactions (MIT, lead). The solicitation for these Centers was in 2009 and thus predates the time period covered by this Committee. We can comment that it is important for DOE FES to issue a new solicitation for Plasma Science Centers with allowance for Centers of both smaller size and intermediate size.

Madison Symmetric Torus (MST)

There were no solicitations covering the MST in the time period covered by this Committee of Visitors.

RECOMMENDATION

- Issue new solicitations for National Laboratory General Plasma Science and for Plasma Science Centers.

D. Monitoring Active Awards

FINDINGS

An impressive set of management tools has been developed for monitoring active GPS awards. The specific set of processes used to monitor a particular award depends on the scope and scale of the project or program. Nevertheless all programs are required to submit annual written progress reports. Annual reviews are conducted for the science centers. Many other methods are frequently used at the discretion of the DOE program manager such as regular email contact between DOE program managers and project PIs; focused discussions with facility/center directors; research opportunity forum-type events; scientific highlights submitted by PIs; preprints and reprints of scientific papers submitted by PIs; occasional site visits by program managers or reverse site visits at DOE FES; periodic seminars, which are conducted either in person or by videoconference; and annual appraisals of national laboratory performance evaluations. The COV finds the management tools and processes used for monitoring active GPS awards are adequate and effective.

RECOMMENDATIONS

- Regular site visits by DOE program managers is encouraged, but the COV recognizes that such visits may be problematic due to limited travel funds.
- Visits by PIs and other key program staff to DOE Germantown for reviews are encouraged as a substitute for site visits but these are judged to be less informative for DOE program managers

E. Breadth and Depth of Program Portfolio

NSF/DOE Partnership

The NSF/DOE call for proposals provides an opportunity for proposal submissions in a very wide area of plasma science outside of the area of fusion energy research. The resulting program has an excellent breadth of research activities, as would be expected. The very wide range of universities supported by this program area encourages competition and innovation. This program is widely appreciated for its high quality of research, student training and exciting, innovative research projects.

Laboratory General Plasma Science

The National Laboratory program in GPS is a relatively small program, supporting six research programs. There are five different national laboratories supported by this program, providing good breadth of performing institutions. As stated in Section B, DOE FES is encouraged to issue a new solicitation to increase the breadth of this program.

Plasma Science Centers

The three Plasma Science Centers are organized with a lead institution and a large number of affiliated universities, national laboratories and small businesses. The Centers achieve excellent depth of coverage of their research topics through intensive research by a large team of scientists.

Obviously, with just three Centers, it is not possible to have a broad program. DOE FES is urged to create additional Centers to achieve greater coverage of important topics in General Plasma Science. Such Centers could range from smaller Centers to Centers of a larger or intermediate size. They could also be developed as User Facilities. Another concern is the longevity of these Centers once they are established. A path to continue these Centers for a longer term should be established to take advantage of the mature capabilities of the Center once it is established and performing at a high level; of course, such extensions should be carefully peer reviewed. As stated in Section B, DOE FES is urged to issue new solicitations for Plasma Science Centers.

Madison Symmetric Torus

The Madison Symmetric Torus is a major basic research facility conducting important and unique research. It occupies a unique position within the DOE FES portfolio, being larger than other general plasma science experiments but much smaller than the major facilities such as DIII-D and NSTX. There is no existing plan to review MST.

RECOMMENDATIONS

- DOE FES should provide a plan for a review of this important research program.
- A path to continue the Plasma Centers for a longer term should be established following peer review, in order to take advantage of the mature capabilities of the Centers once they have been established.

F. National and International Standing

DOE FES is working to develop metrics of national and international standing of their programs.

RECOMMENDATION

- See the recommendation on metrics in Section II.

VIII. Program on Enabling Technology

A. Scope of Program Area

The Enabling Technology program includes R&D activities related to development of hardware and materials relevant to existing fusion experiments, ITER, and future facilities. Development areas include RF heating, fueling, superconducting magnets, fusion systems studies, structural materials, plasma-facing components, breeding blankets, neutron degradation, and safety analysis. While the new FES budget structure specifically calls out Materials and Fusion Nuclear Science under the “Burning Plasma Science: Long Pulse” category, the rest of the enabling technology program is expected to be carried forward under the “Advanced Tokamak” sub-category under “Burning Plasma Science: Foundations.”

B. Progress on Action Items from Previous COV Review:

The previous COV (2006-2009) made the following recommendations:

- Use solicitations when initiating new activities.
- Employ carefully designed solicitations to strengthen the program.
- Prepare and have on hand a number of peer-reviewed activities that can be submitted on short notice if funds are made available on short notice.
- Peer review all Enabling R&D activities on a regular basis and document.
- Review the VLT mission and evaluate need and scope.
- Improve the depth of research in materials technology.

FES was responsive to most of the prior COV recommendations in this area. A program manager specific to fusion materials was hired. There was a broad solicitation for activities in development of structural materials, plasma-facing components, and blankets when new funding was made available. Awards were made based on peer review with some consideration for programmatic needs. Procedures were very clear and decisions documented. A review of the existing program is ongoing and mostly complete with documentation of decisions.

The Virtual Laboratory for Technology (VLT) was defunded during the period under review although the structure was retained to facilitate conference calls among program participants to coordinate activities. Retirement of the VLT director left a leadership opening that was filled by the FES program manager, who has acted as a coordinator. This situation is not ideal.

C. Solicitation, Review, and Documentation

During the review period one FOA was issued that covered the areas of Plasma-facing Materials, Structural Materials, and Blankets in 2011. The solicitation was quite broadly defined encompassing the entirety of the fusion materials area. A very large number of pre-proposals (92) were submitted and only four were rejected for being non-responsive. Many actual proposals (79) were submitted indicating wide spread interest in the solicitation. A large review panel (24 members) was assembled and each proposal was assigned a numerical score by three reviewers and the proposals were ranked according to average numerical score. Eight of the proposals were funded (all at the full funding request). All of the top four ranked proposals were funded. The next four were selected from a large number of proposals with high average scores, with a programmatic rationale for each proposal selected. This process appears to have been extremely well run and responsive to the suggestions of the 2009 COV.

RECOMMENDATIONS

None.

D. Monitoring Active Awards

- In response to the previous COV recommendations the program managers have initiated, and very nearly completed, a comprehensive review of the entire portfolio of continuing projects within the Enabling Technologies activity. For each program area a review panel of experts

was formed, with each panel generating a status report. Copies of the reports were made available to the COV review panel. The information in the reviews has been taken into account when making continuing funding decisions. One final review is pending. The processes followed during this review were exemplary.

- These ongoing proposals are being monitored directly with regular conference calls between the program manager and the PIs. No written reports were available.
- Since the funding of proposals from the materials solicitation, FES has decided to make a change in direction in the materials research area. All of the PIs have been informed that there will not be a renewal of the proposals. When asked about the processes being followed for the closeout of these proposals, no plan for a review was proffered. When asked what the follow on process for funding activities in the materials area would be, it was that stated no decision had been made.

RECOMMENDATION

- Make sure future plans are well formulated and communicated before canceling programs.

E. Breadth and Depth of Program Portfolio

- Most of the Enabling Technology program consists of continuing research and, as a result, the overall breadth and depth of the program is not changed much by the new funding decisions. However, during the review period the breadth and depth of the Enabling Technology portfolio has temporarily increased due to the expanded activities in materials research. Some of the researchers were new to fusion materials research, but are highly respected scientists in the materials research community. It is unfortunate to have enticed these researchers into the field for such an abbreviated period and the abrupt end to the funding stream in basic materials research is likely to dissuade further interest from the materials research community. No review of the ongoing activities is planned, nor is there a clearly articulated plan for future activities in this area.
- The loss of community leadership that came with the retirement of the Director of the Virtual Laboratory for Technology has concentrated coordination of the VLT activities within FES.

RECOMMENDATION

- Revise VLT structure to separate program management from project leadership, and move leadership of the program to outside of FES.

F. National and International Standing

- Despite reduced funding the US still has significant international standing in fusion technology. Notable examples include development of technology in coordination with the US ITER Project on the ECH heating system and pellet injection for ELM pacing and disruption

mitigation; development of suitable conductors and joint designs for high current magnets; experiment, simulation, and materials testing in support of breeding blanket design; simulation codes used in ITER nuclear regulatory compliance, neutron heating and activation, and systems studies.

- The materials research program was expanded with a new solicitation in research on structural materials, plasma facing components, and blanket first walls. The impact of this expansion on program quality is unknown due to the recent nature of the awards, but the awardees have been informed that there will be no call for renewals. This decision is not the result of a budget exigency, but rather a program priority redirection towards addressing the challenges of characterizing changes to bulk material properties due to irradiation by 14 MeV neutrons and plasma surface interactions at high heat flux. The planning for this program change has not yet been articulated, but will likely require substantial facilities development. The impact of the recent expansion in materials development activities on international standing is left uncertain due to the lack of a scientific review prior to the program redirection.

RECOMMENDATIONS

- Initiate a scientific review of the closed out materials research. Where appropriate, consider impact of cancellations on future activities.
- Initiate a scientific review for any proposed new facilities, whether or not an open solicitation is offered for a larger experimental materials facility.

Appendix A: COV Charge Letter



Department of Energy
Office of Science
Washington, DC 20585

Office of the Director

April 8, 2014

Professor Mark Koepke
Chair
Fusion Energy Sciences Advisory Committee
Department of Physics – White Hall 203
West Virginia University
1315 Willey Street
Morgantown, WV 26506

Dear Professor Koepke:

I am writing to request that the Fusion Energy Sciences Advisory Committee (FESAC) establish a Committee of Visitors (COV) to review the management processes of the Department of Energy Office of Science Fusion Energy Sciences (FES) program. The panel should consider and provide evaluation of:

- The efficiency and quality of the processes used by FES to solicit, review, recommend, monitor, and document awards and declinations for universities, national laboratories, and industry.
- The breadth, depth, and quality of the resulting program portfolio, and providing an evaluation of the program's national and international standing.
- FES's management of its portfolio of line item construction and Major Items of Equipment projects, including the U.S. Contributions to ITER project. Assessment of FES projects' performance, including contractor and Federal Project Director management of projects, is performed by periodic Office of Science Independent Project Reviews, and is not part of this COV.

The last COV activity evaluated the FES program through Fiscal Year (FY) 2009. Accordingly, in this assessment the COV should review the entire FES program for activities during FY 2010, FY 2011, FY 2012, and FY 2013. The panel should also comment on FES's progress in addressing action items from the previous COV review. The COV panel should be composed of recognized scientists and research program managers with broad expertise relevant to the fusion program. Panel members should be familiar with FES research programs; however, a significant fraction of the COV members should not be involved in research that is being funded by FES. Each panel member will be requested to sign a Conflict of Interest statement and a Confidentiality statement.

The results of this assessment should be documented in a report that clearly articulates findings, comments, and recommendations. FESAC should submit a report on the COV activity by January 2015. COV reviews conducted in this manner have proven highly valuable to the Office of Science in maintaining a high standard of excellence in program execution. I look forward to the panel's report and appreciate FESAC's willingness to take on this important activity.

Sincerely,

A handwritten signature in black ink, appearing to read "Patricia M. Dehmer". The signature is fluid and cursive, with a long horizontal stroke extending to the right.

Patricia M. Dehmer
Acting Director, Office of Science

Appendix B: Members of the COV

The Members of the COV as well as the subcommittees they served on are listed below:

Project Management, including US ITER

Joseph Arango (Thomas Jefferson Site Office)
Mark Reichanadter (SLAC National Acceleration Laboratory)
John Tapia (Los Alamos National Laboratory)

Program on Toroidal Experiments, International Collaborations, and Diagnostics

Dustin Froula (Laboratory for Laser Energetics, University of Rochester)
Alice Koniges (Lawrence Berkeley National Laboratory)
Steven Vincena (University of California-Los Angeles)

Program on Experimental Plasma Research and HEDLP

Jerry Hughes (MIT)
Russ Doerner (University of California-San Diego)

Program on Theory and Computation

William Amatucci (Naval Research Laboratory)
Brian Nelson (University of Washington)

Program on General Plasma Science

Richard Temkin (Massachusetts Institute of Technology)
Richard Kurz (Pacific Northwest National Laboratory)

Program on Enabling Technologies

David Gates (Princeton Plasma Physics Laboratory)
Mark Nornberg (University of Wisconsin-Madison)

COV Chair

Amitava Bhattacharjee (Princeton Plasma Physics Laboratory/ Princeton University)

Appendix C: U.S. Representation on ITER Governing and Advisory Panels

Council

Chair of the ITER Council Robert Iotti, President, CH2M Hill Nuclear Business Group

Representatives

Michael L. Knotek Head of Delegation, Deputy Undersecretary for Science and Energy, DOE
Edmund Synakowski Associate Director FES, Office of Science
John C. Glowienka U.S. ITER Program Manager, FES, Office of Science
Thomas J. Vanek Senior Policy Advisor, FES, Office of Science, DOE

Experts

Marcos Huerta Special Assistant to the Director, Office of Science, DOE
Devon Streit Senior Advisor, Office of Space and Advanced Technology, DOE
Neevy Van Laningha Foreign Affairs Officer, U.S. Department of State
Ned R. Sauthoff Director, U.S. ITER, ORNL

MAC

US Member Adam Cohen Deputy Laboratory Director, PPPL, Princeton University
US Member Thomas Vanek DOE-FES
US Expert John Glowienka DOE-FES
US Expert William Cahill Federal Project Director, DOE
US Expert Mickey Wade Director, DIII-D National Fusion Program, General Atomics
US ITER Ned Sauthoff Director, US ITER, ORNL

STAC

US Member Robert Goldston PPPL/Princeton University
US Member Charles Greenfield DIII-D National Fusion Program, General Atomics
US Expert Jürgen Rapp ORNL
US Expert Earl Marmor Plasma Science and Fusion Center, Massachusetts Institute of Technology
US Expert James Van Dam FES, Office of Science, DOE

In addition, the US presence at the IO is ~6% of total staff. The highest ranking US staff member is Mary Erlenborn, who is Deputy Director General (DDG) and Director of General Administration (HR, Procurement and Document management)