The 2009 Committee of Visitors Report of its Review of the Office of Fusion Energy Sciences

to the

Fusion Energy Sciences Advisory Committee

April 2, 2010

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I. Introduction

A. Scope

The November 6, 2008 charge letter from then Under Secretary for Science, Raymond L. Orbach, asked the Fusion Energy Sciences Advisory Committee (FESAC) to create a Committee of Visitors (COV) to assist in assessing the efficacy and quality of the Office of Fusion Energy Sciences' (OFES) processes associated with selecting and monitoring activities funded by OFES, and the effect of these processes on the resulting portfolio. The scope was to include the entire OFES program. Earlier COVs had reviewed some elements of the program, but the dates of those assessments ranged from three to five years ago. The charge letter requested that these elements be reviewed for all years since the last relevant COV. No specific period of review was requested for those few elements that had never been reviewed by a COV. FESAC was requested to report the results of the assessment by April 2009.

A February 5, 2009 letter from then Acting Director of the Office of Science, Patricia M. Dehmer, noted the busy schedule for the fusion community and extended the date for the FESAC response until November 2009.

Martin Greenwald, Chair of FESAC, formally asked the COV to carry out the assessment in a July 23, 2009 letter to Rulon Linford, Chair of the COV.

All three letters are in Appendix A of this report.

B. COV Members

The members of the COV were selected by Martin Greenwald and Riccardo Betti, FESAC Chair and Vice Chair, and Rulon Linford, COV Chair, in consultation with OFES management. They are listed in a spreadsheet in Appendix B that also shows their affiliations, geographic regions, and range of expertise. This mix provided the COV with the breadth of experience and expertise needed to carry out its assignment.

C. COV Procedures

The COV held two conference calls in July. Lists of questions and requests were created and submitted to OFES. The Chair of the COV discussed the first set in a conference call with OFES managers. These interactions resulted in a large number of useful documents being sent by OFES to the COV to help its members prepare for the visit.

The COV visit to OFES was conducted on August 17 to 19, 2009. The OFES managers were very responsive and helpful during the visit. Preliminary findings and

recommendations were drafted during the visit and a closeout session with OFES management was held on the afternoon of the third day. The Agenda is in Appendix C.

During the first conference call, the following subcommittees were created to cover the elements of the OFES program for the fiscal years requested in the initial charge letter. Subcommittee chairs and members are listed in Appendix D.

Name of Subcommittee	**Fiscal Years**
Tokamaks and Diagnostics	2006-2009
Enabling Research and Development (R&D)	2006-2009
Innovative Confinement Concepts (ICC)/Plasma Science	2005-2009
High Energy Density Laboratory Plasmas (HEDLP)	2005-2009
Theory and Computation	2004-2009

D. Report Structure

The main body of the report, sections III through IX, contains the findings and recommendations of these subcommittees. The first three of these sections (III, IV, and V) comprise the report of the Tokamak/Diagnostic Subcommittee. Sections VI through IX are the reports of the other four subcommittees listed in the table. Each of these sections begins with a brief description of the program elements covered in that section.

The next section (Section II) was developed by the full membership of the COV to convey some overarching findings and recommendations. The findings and recommendations in this and subsequent sections are grouped within the following outline structure, consistent with the COV Report Template found in Appendix B of the Guidance for DOE Office of Science Committee of Visitors Reviews (Effective May 1, 2009).

A. Efficacy and Quality of OFES Processes

1. Processes to solicit and review proposals and applications, to recommend award or declination of funds, and to document these actions
2. Processes to monitor active awards, projects, and programs

B. Effect of the Award Process on Portfolios

1. Breadth and depth of portfolio elements
2. National and international standing of portfolio elements

II. Selected Findings and Recommendations

This section contains findings and recommendations that the COV selected for special emphasis. Most of them have supporting findings and recommendations in one or more of the subcommittee reports that follow. However, many important findings and recommendations are only found in the subcommittee reports.

A. Efficacy and Quality of OFES Processes

1. Processes to solicit and review proposals and applications, to recommend award or declination of funds, and to document these actions

Findings:
Overall, the processes are sound and improvements are evident. As noted by the last COV Report (Tokamak Research and Enabling R&D, May 2006) earlier COV recommendations have resulted in more complete and useful proposal folders. Substantial additional improvements in documentation and processes were noted during this review. We commend the OFES managers for these continuing improvements. They demonstrate that OFES managers take pride in their work.

We also commend the OFES for the management of stimulus funds provided through the American Recovery and Reinvestment Act. Despite the short timeline, the activities have been or will be peer reviewed prior to award.

However, we found anomalies in the management processes used in some program areas funded through the usual appropriations. Peer review was not always used to evaluate proposals for new starts or extensions.

In a few cases, solicitations were either so broad or incompletely defined that even the reviewers were uncertain about what criteria to use in scoring proposals. Large variances in scores were one of the consequences. Properly focused solicitations allow clear expectations and criteria to be conveyed to both the proposers and the reviewers. Multiple focused solicitations are often better than one overly broad solicitation.

In one program element no solicitations were reported during the review period. We recognize the value of continuity for strong research activities, and that regularly re-competing every activity would not necessarily improve productivity. However, carefully designed solicitations are an important tool for revitalizing or replacing weaker activities, for maintaining the credibility of the program, and for keeping programs focused on the most important tasks, which evolve as knowledge is gained. Every program element would benefit from skillful use of solicitations, even those with shrinking budgets.

Recommendations:

- Use peer review consistently across all program elements to ensure quality, balance, and credibility.
- Employ carefully designed solicitations to respond to the needs within every program element.
- Ensure that all solicitations are properly focused with clear expectations and criteria.

Findings:

The reasons for selection or declination were not found in many folders. This lack was of particular concern when the decision was not obviously based on the ranking of reviewer scores.

In at least one case the documentation for how such decisions were made was not available even in a master file for the solicitation, but had to be obtained from the program manager.

During the recent FESAC discussion of this report a FESAC member recounted how a reviewer of a proposal, who was a direct competitor, ranked a proposal much lower than the other reviewers. The proposer was not notified by OFES how that outlier was counted in the selection of proposals for funding. This incident raises questions about how reviews are screened for bias or incompetence, how outlier reviews are treated during the selection process, and how proposers are notified about the reasons for selection or declination. The COV agrees that OFES managers have the expertise and the responsibility needed to handle these situations appropriately. However, such situations emphasize the importance of detailed documentation of the selection process, notifying proposers of the reasons for declination, including the impact of outlier reviews and of the rebuttal process.

As noted in other sections of this report, rebuttal procedures have been implemented in response to earlier COVs, but the effectiveness and uniformity of these procedures needs improvement.

One OFES manager personally called every proposer to inform them of the funding decision, explaining the reasons for every declination and providing advice for the future. This good practice yields benefits to all involved. However, the more common practice in OFES appears to be sending a form letter that contains neither specific reasons for a declination nor statistics related to the selection process.

Recommendations:

- Document the reasons for a selection or a declination in every folder.
- Implement uniform and effective rebuttal procedures.
- Include reasons for declination and/or some specific context for the selection outcome in the communication to the proposer, including the impact of outlier reviews and of rebuttals.

2. Processes to monitor active awards, projects, and programs

Finding:
Simplifying and standardizing methods of reporting and tracking progress help both the researcher and the program manager. NSF has an on-line progress report mechanism that also facilitates the entry and tracking of publications.

Recommendation:
- Employ web-based tools to facilitate reporting of progress and tracking of achievements.

B. Effect of the Award Process on Portfolios

1. Breadth and depth of portfolio elements

Findings:
Senior management in OFES articulated a clear mission and a set of priorities for the program. These appear to be well supported by the program managers.

Progress toward major program goals is evident and documented. This progress and the technical strength of the program provide a sound basis for supporting ITER and preparing for major next steps in the domestic program in certain areas.

However, some elements of the portfolio have become very weak. Unfortunately these elements are essential for providing the technical understanding needed to make a future decision to build a fusion energy demonstration plant. These include materials and technologies necessary for fusion. This situation puts at risk the ability of the domestic program to benefit effectively from corresponding elements in foreign programs. Relatively modest investment in these areas could substantially improve this outlook.

Recommendation:
- Take immediate steps to strengthen some of the hardest hit areas that critically impact the ultimate success of the domestic program.

Findings:
We discovered at the beginning of the COV visit that OFES and the COV had interpreted the scope of the charge differently with regard to major facility operations and construction projects, including ITER. OFES had prepared for interactions only on their processes regarding research portion of the program while the COV intended to review OFES processes regarding all elements of the program. However, OFES managers in both areas were very willing to interact with the appropriate COV subcommittees and answer questions.

From these interactions it appears that little documentation exists at OFES on the processes used by the US ITER Project Office (USIPO) at ORNL to fund technical work at US institutions. This technical work consists of supporting R&D for various aspects of the design and uses capabilities that are similar to those in the research elements of the US program.

We understand that ITER is an international project that needs to be managed effectively, and therefore the degree of oversight that can or should be exerted from OFES is different than it would be for a US fusion project. However, we assume that OFES should be responsible for keeping track of how US funding is being used, and for monitoring the processes used by the USIPO. That is particularly true for those activities that directly affect the US fusion R&D program. Therefore, this COV believes that it is appropriate for us, and future COVs, to review and comment on processes used by OFES to monitor and document the USIPO activities that affect the rest of the US fusion program, as well as to comment on the impact of those activities on the breadth and depth of the portfolio elements.

We recognize that rapid response is required for some of the R&D requested and funded through the USIPO, making the normal solicitation process impractical. However, for those R&D tasks where a longer timescale to completion is acceptable, carefully targeted solicitations should be used. In addition, the peer review, selection, notification and documentation processes used in the research programs should be used by the USIPO to the extent that it is practical. For R&D tasks that are too urgent to allow solicitations, announcing the needs, and then the selection when it is made, would improve transparency and credibility. The decisions regarding which of the above processes to employ should remain with the USIPO to allow them to manage their scope of the project, but OFES should exert leadership in urging practices that promote credibility and best use of US program capability. In addition, documentation of all such activities, including selection process, funding, resources, and results, is important for future assessments and decisions. These include making program balance and funding decisions by OFES, and assessing the breadth, depth and standing of the US program by OFES and future COVs.

Recommendations:

- Urge the USIPO to announce its R&D needs and the teams selected to meet those needs more broadly to the US community.
- Urge the USIPO to employ solicitations and peer review to assign those tasks that do not require rapid response.
- Maintain records in OFES of the R&D activities funded through the USIPO.
- Provide future COVs a charge that clearly includes the OFES processes involved in selecting and monitoring major facility operations and construction projects, including ITER, as well as the research elements of the OFES program.

Finding:

Enhanced coupling among theory, computations, and experiments would strengthen the research portfolio. Experimentally validated theory and models lead to enhanced

understanding and improved predictive capability. During interviews with OFES managers we learned that it has been difficult to develop solicitations that incorporate all three elements because they would involve more than one part of OFES.

Recommendation:

- Develop effective and streamlined mechanisms to manage solicitations that foster interactions among theory, computations, and experiment.

Finding:

The new Office of Science Early Career Research Program provides a promising path for a new and more diverse group of researchers to participate in OFES programs without jeopardizing existing programs. However, it is important to track its effectiveness in achieving these goals.

Recommendation:

- Collect and analyze data on the Early Career Research Program participants and their institutions, including diversity, achievements such as tenure, and continuation of funding from OFES.

2. National and international standing of portfolio elements

Findings:

OFES managers provided anecdotal information to demonstrate that the US program is valued internationally. Specific requests from ITER for tests to be run on US facilities are examples.

However, some elements of the US program have become weak, as noted above, and their international standing affected as noted in the FESAC report "Priorities, Gaps and Opportunities: Towards a Long-Range Strategic Plan for Magnetic Fusion Energy", DOE-SC-0102.

Collecting and analyzing metrics and measures of outstanding performance would be valuable to program managers in making appropriate decisions. Such activity can also be a motivation for researchers to strive even harder for excellence. Recognizing outstanding work, e.g., through awards, can be an effective means of enhancing the visibility and stature of program elements within the department, among peers in other science disciplines, and in the eyes of the public.

However, data that could be used to assess national and international standing, such as citation rates of published articles or contributions to international collaborations, have not been systematically collected or analyzed. Substantial data exist in reports submitted to OFES, but they have not been assembled and tabulated in ways useful for analysis. OFES managers explained that they do not have the time to collect such metrics. They do not have modern Information Technology (IT) tools to ease such collection and analysis. They have also told COV members that attrition of administrative assistants as

well as managers has increased their workload and contributed to their inability to collect these data. Such data would be very helpful to OFES and future COVs in carrying out their responsibilities.

Recommendations:

- Define, collect, and analyze meaningful metrics.
- Obtain and employ modern IT tools for data collection and analysis.
- Restore the staffing level of both administrative assistants and managers to levels needed to carry out their responsibilities including the collection of data needed to assess the quality of their program elements.

III. Tokamak Program

A. Scope

The Tokamak Program consists of research and operations carried out on the three large US tokamak devices: DIII-D, managed by General Atomics (GA) in San Diego, CA; the National Spherical Tokamak Experiment (NSTX), managed by the Princeton Plasma Physics Laboratory (PPPL); and Alcator C-mod, managed by the Massachusetts Institute of Technology (MIT). The Tokamak program is generally reviewed using a two-tier process:

- The science and facility operations of each device undergo a renewal process at five-year intervals. Approximately halfway through each interval, the OFES also conducts a major program review of the scientific progress of each device.
- The university collaborators on each device undergo a peer-reviewed review process at three-year intervals. It is noted that - for the most part - national laboratory collaborators are reviewed as part of the five year renewal process.

While this two-tiered process provides the broad outline under which the three tokamak programs are managed and reviewed, there are differences in the procedures that reflect the size and scope of each of the devices.

DIII-D program:

- The DIII-D program involves a very strong integration between the General Atomics staff and the collaborators.
- Collaborators are fully integrated into the scientific program management of the DIII-D experiment with representation on the steering and executive committees.
- Approximately 55% of the staff of the DIII-D research program are from collaborators.

NSTX program:

- The NSTX program, from its inception, was designed to involve a substantial participation from outside collaborators.
- Outside collaborators represent approximately 40% of the staff of NSTX.
- Every three years, approximately 1/3 of the outside collaborators undergo a peer-reviewed review process.
    - Year 1: review of proposals from national laboratory collaborators.
    - Year 2: review of proposals from non-national laboratory collaborators for physics projects.
    - Year 3: review of proposals from non-national laboratory collaborators for diagnostic projects.

Alcator C-Mod program:

- The Alcator C-Mod program is primarily a large university program with a strong educational mission and a smaller number of collaborators than the other two tokamak programs.
- External collaborators include national laboratory collaborators, PPPL and Los Alamos National Laboratory (LANL), (reviewed during the 5-year C-Mod program review), and the University of Texas (peer-reviewed every three years).

B. Efficacy and Quality of the Program's Processes

1. Processes to solicit and review proposals and application, to recommend award or declination of funds, and to document these actions

Findings:

The Subcommittee was provided with summary documents that described the overall results of the five-year program reviews for each of the three tokamaks. These documents described the overall score and provided reviewers comments. In general, the Subcommittee was provided more detailed summary information on the peer-reviewed collaborator programs. Over time, from FY06 through FY09, the amount of information provided in the review folders continued to improve, as recommended by one of the earlier COV reports, although this COV Subcommittee found that supporting information on the rationale for declinations was still not included in the folders.

The Subcommittee found that the information provided about the competitive peer-review process for the university collaborators for the NSTX program was well documented. In particular, the three-year review cycle for NSTX offers both advantages and disadvantages to its research program. The main advantage is that there is well-defined process by which the research community can review, provide input, and establish new collaborations with NSTX project. However, one disadvantage of that process is that activities that are near the "borderline" for funding have to wait 3 years for another attempt at funding. The exception has been for projects with good (but not necessarily outstanding) scientific impact, but strong programmatic impact that were then directly supported by the NSTX core program funds.

Recommendations:

- Document OFES program manager rankings and decision rationale for all actions in the folders for all reviewed proposals.
- Include the programmatic rating decided by NSTX management in the folders for all NSTX collaborator packages reviewed.
- Include the notification-of-proposal-disposition letter in each folder.
  - It would be good practice for program managers to personally communicate the decision to proposers before sending out the official letter.

2. Processes to monitor active awards, projects and programs:

Findings:
The OFES has several processes used to monitor the tokamak programs.
The overall 5-year renewal process

- The mid-term (~2.5 year) program review
- Annual reports from each program
- Informal OFES participation in the Program Advisory Committees (PACs) for each device.

The Subcommittee is generally pleased with the processes used to manage and monitor the Tokamak Program.

Recommendation:

- None

C. Effect of the Award Process on Portfolios

1. Breadth and depth of the portfolio elements

Findings:
We are concerned about the "balance" of management efforts devoted to the collaborative projects vs. the primary devices. As noted above, there is substantial and extensive documentation of the review processes used for the university collaborations as compared to the review processes used for the main devices - in large part due to the number of collaborators on these projects. Furthermore, the resource allocation within the tokamak/diagnostics portfolio does not appear to be affected by the review process.

Recommendation:

- None

2. National and international standing of portfolio elements

Findings:
There is clear and compelling evidence that the US tokamak program has a strong scientific reputation in both the national and international community. This conclusion is supported by extensive information provided to the committee by the OFES program manager. Some specific examples noted by the OFES DIII-D program manager include:

- The ITER Organization has requested the U.S. to design the RMP (resonant magnetic perturbation) Coils for ITER, which is based on the DIII-D experiments.
- The ITER Organization has requested the DIII-D Program to carry out experiments on the impact of TBM (test blanket module) ripple on plasma performance.
- The JET Management has asked the U.S. to lead an international team to assess installation of ELM (edge localized mode) Coils for JET.

- GA and PPPL were very instrumental in start up of new superconducting tokamaks in China (EAST) and Korea (KSTAR).

All three devices' programs are strongly integrated into the International Tokamak Physics Activity (ITPA) processes and regularly perform, as part of their core missions, experiments in support of the ITPA. In particular, DIII-D and Alcator C-Mod use a significant portion of their allocated run time in support of ITER activities.

Recommendations:

- Define, collect, and analyze meaningful metrics for the US tokamak contributions to the international fusion program.
- Encourage researchers to report significant contributions to international activities to help document the impact of the US fusion program.
- Acquire and use modern IT systems to assist in gathering this information.

IV. International Programs

A. Scope

The International Programs activity for the OFES involves two major components. The first component is the US participation in the ITER activity. This includes both activities directly funded by ITER as well as dedicated research efforts of the domestic fusion program to aid in ITER physics design and operation. The second component is the US participation with international partners outside of the ITER activity, e.g., EAST (China), K-Star (Korea), JET (EU).

US ITER-related activities:
The US ITER activities are coordinated through the US ITER Project Office (USIPO), managed by Oak Ridge National Laboratory (ORNL), PPPL and Savannah River National Laboratory. The USIPO is in charge of the overall project management for the US contributions to ITER At the present time, much of the USIPO activities related to ITER physics are in response to specific requests to meet the technical and scientific needs of the ITER organization. Additionally, the US Burning Plasma Organization (USBPO) serves as the liaison between the USIPO and the US scientific community. Coordinated burning plasma physics research with foreign programs is enabled by ITPA whose US membership are also members of USBPO.

Other international activities:
The US fusion program is a major participant in fusion research activities throughout the world. Funds for US collaborations with foreign facilities and programs are provided through an international collaborations budget line. These collaborations involve an array of US universities, national laboratories, and industry.

B. Efficacy and Quality of the Programs' Processes

1. Processes to solicit and review proposals and application, to recommend award or declination of funds, and to document these actions

Findings:
The Subcommittee recognizes the importance of the ITER mission to the long-term progress towards the realization of a fusion energy source. Moreover, as the ITER project advances, the Subcommittee understands that it is important for the US to be an active participant at all levels in the project, from the engineering design to diagnostic development and the establishment of the physics mission. The OFES clearly sees ITER as an important part of its portfolio and the Subcommittee commends the office for managing how the ITER program has interfaced with the remainder of the US fusion community. However, the Subcommittee believes that the OFES should document more clearly how US resources and contributions to the ITER activity are decided, monitored,

credited, and funded. Such information would enhance the transparency and credibility of decision processes, assist OFES in making informed decision, and serve as documentation for future reviews.

Specifically, it was not clear how OFES decides on the distribution of the Tokamak Program resources between the major program elements, which are fusion science, core missions (e.g., advanced tokamak or spherical tokamak), and support of ITER. While some information was provided that described the initiation of "voluntary" research activities in support of ITER, outside of those funded directly through the USIPO, the Subcommittee did not receive any quantitative information documenting the resource expenditures in support of ITER, e.g. machine run-time (experimental and operations costs), theory and analysis.

With regard to US ITER work tasks funded through the USIPO and performed by the institutions in the Enabling R&D and Diagnostics programs, some information was provided documenting the solicitation and review procedures used to allocate this work. While the Subcommittee appreciated this information, we believe that the OFES should improve the processes for monitoring and documenting the solicitation and allocation procedures used by the USIPO. For a project of the size, complexity, and duration of ITER, this documentation will provide a record of critical decision-making for future OFES staff and COVs.

Beyond the ITER activity, the US actively participates in a number of bilateral activities with international partners. While these activities are positive and are to be encouraged, the Subcommittee found that there is little documentation on how US partners are selected to participate in these activities.

Recommendations:

- Develop more consistency in monitoring and documenting the processes used by the USIPO in soliciting R&D help from the US fusion community, and in selecting groups to provide that help.
- Urge USIPO to communicate the opportunities for such help in a manner that allows the USIPO to exploit the depth and breadth of expertise throughout the entire US fusion program.
- Develop and implement a formal process for soliciting, awarding, and documenting bilateral, non-ITER, international collaborative activities.

2. <u>Processes to monitor active awards, projects and programs:</u>

Findings:

The Subcommittee acknowledges that the OFES and the Office of Science has a substantial management structure for MIE (Major Instrument or Equipment) projects such as ITER. The US tokamak program is currently receiving requests to provide significant technical, engineering, and scientific support as part of the ITER activities - through the USBPO and ITPA activities.

The Subcommittee did not receive much documentation on how the bilateral international programs are managed or reviewed. It is important to understand and document the technical results being derived from these activities.

Recommendations:

- Account for the resources contributed in support of ITER-related activities by all three tokamak programs for those activities not directly funded through the USIPO.
- Document and evaluate the review and reporting processes for the bilateral, non-ITER, international collaborative activities and implement appropriate improvements.

C. Effect of the Award Process on Portfolios

1. Breadth and depth of the portfolio elements

Findings:

We note that the US tokamak program does have as part of its mission support of ITER-related activities. These activities are becoming a significant portion (e.g., >50% on DIII-D) of US tokamak scientific and runtime activities.

Recommendations:

- Monitor and document the resources needed for all three tokamak programs to ensure that the balance of activities remains appropriate.

2. National and international standing of portfolio elements

Findings:

The Subcommittee notes the very important role that the US tokamak program plays in international programs - both in ITER and non-ITER activities. Additionally, US scientists are making critical contributions to the ITER engineering design activities as well as studies on other devices. In particular, the activities listed in Section III.C.2 of this report (pp 13-14) give examples of the close collaboration between the US and the international fusion research community.

The systematic collection of progress and achievements in both the ITER and non-ITER international programs would provide important information for OFES management use, and for future COVs charged with assessing the international standing of these programs.

Recommendations:

- Develop and implement methods for systematically collecting and analyzing important scientific and technical contributions of the US fusion community to the international fusion research effort. Use modern IT techniques where appropriate.

V. Diagnostics Program

A. Scope

The Diagnostics Program supports the development of new scientific instruments and/or techniques for the fusion program. These are new instruments that were not specifically developed for a particular experimental device. Techniques explicitly relevant to ITER are specifically excluded from funding. Instead, this program seeks to develop fundamentally new methods for making measurements of a physical phenomenon in the plasma. This program involves both computational work and hardware development and often requires a development path of several years. Successful instruments developed by the Diagnostics Program often become fully supported as a diagnostic instrument on one of the tokamaks and/or ICC devices as part of their core budgets. In recent years, the Diagnostics program has been limited by flat budgets.

B. Efficacy and Quality of the Program's Processes

1. Processes to solicit and review proposals and application, to recommend, award or declination of funds, and to document these actions

Findings:

The Diagnostic program is reviewed and funded as described below:

- The university and industrial applicants are reviewed in one year.
- The national laboratory applicants are reviewed in another year.
- No applications are accepted in one year.
- Each group is funded and reviewed on a three-year cycle.

It is noted that a substantial fraction of the reviewers of the diagnostic program come from outside the US. This is seen as a concern by the program manager due to a possibility of a strong international influence on the US diagnostic program portfolio.

For the most part, proposals are funded at the requested level. However, turnover of PI's in the diagnostics program is somewhat limited due to flat budgets in the program.

Overall, the Diagnostics Program was well documented by the program manager and the Subcommittee is pleased with the processes used to manage the solicitations and review processes of the Diagnostic Program

Recommendation:

- None.

2. Processes to monitor active awards, projects and programs:

Finding:
The summary documentation provided by the manager of the Diagnostic Program was very complete and the Subcommittee is pleased with the processes used to manage and monitor the Program.

Recommendation:
- None.

C. Effect of the Award Process on Portfolios

1. Breadth and depth of the portfolio elements

Findings:
As noted above, the flat funding profile has limited turnover of PI's in the Diagnostic Program, as well as limited its depth and breadth. As a result, not many new awards have been initiated. For some review periods only renewal awards were made. This practice limits the ability of this program to develop new and innovative diagnostics.

Nonetheless, there are examples of diagnostic systems that have "graduated" from the Diagnostics Program and become incorporated into the main funding of a fusion experiment.
- The reflectometry system used on DIII-D was originally developed by UCLA as part of the Diagnostics Program.
- The collisionally induced fluorescence and X-ray spectroscopy systems on NSTX were developed by a private company, Nova Photonics, and a university Johns Hopkins, respectively.
- The Heavy Ion Beam Probe (HIBP) used on the Madison Symmetric Torus (MST) was originally developed by members of the MST team as part of the Diagnostics Program.

Recommendations:
- Use the restructured Junior Faculty program as a mechanism to bring new faculty into the Diagnostics Program.
- Move diagnostics that are reliably and effectively operating on a tokamak or an ICC from the Diagnostics Program to a machine's main research and operations budget as soon as possible. This will open up more opportunities for bringing in new diagnostics concepts and researchers into the Program.

2. National and international standing of portfolio elements

Finding:
Although the Program Manager has raised important concerns about the number of international reviewers of the Diagnostics Program, the fact that these persons continue to

provide reviews is indirect evidence of the international standing of the Diagnostics Program.

Recommendation:

- None□□

VI. Enabling Research and Development (R&D) Program

A. Scope

The Enabling R&D program consists of three elements: Plasma Technology, Advanced Design and Materials Research.

The Enabling R&D Program supports the Science and Facility Operations programs by developing and improving hardware, materials, and technology incorporated into fusion research facilities, enabling these facilities to reach their full experimental capability. In addition, the Enabling R&D Program supports the development of new hardware, materials and technology that are incorporated into the design of next generation facilities, thereby increasing confidence that the predicted performance of these new research facilities will be achieved. Enabling R&D is a sizeable program with significant accomplishments. The lack of significant construction activities within the US fusion program over the past decade and strong science mission have resulted in a reduction of budgets in this area. Some programs have been terminated and the some of the remaining programs are marginally supported.

The Enabling R&D program was part of a previous COV review that occurred in 2006.

B. Efficacy and Quality of the Program's Processes

1. Processes to solicit and review proposals and application, to recommend award or declination of funds, and to document these actions

Findings:
During the time period (FY 2006-2009) under review by this Subcommittee, there were no solicitations in the Enabling R&D program. The last solicitation was in 2001. In the lead program manager's view, it is difficult to conduct solicitations when the program is not growing. With a slightly decreasing budget, this implies that nearly all activities are renewals of activities that have been funded for a decade or more.

During this time period, there were only two nominally new proposals that were funded. However, the principal investigators came from established OFES programs at other institutions and the programs transferred with them. The Subcommittee verified the presence of peer reviews in selected university renewal proposals from 2007-2009.

In FY 2009, a new initiative named Advanced Concepts (NHTX, CTF, FDF and VULCAN) was funded at $1.27M. This selection was done without a formal solicitation, without peer review, and without clear communication to the fusion research community.

The Subcommittee is sensitive and sympathetic to the challenge of managing a program with limited resources. However, we believe that solicitations and peer reviews are essential for improving the quality and credibility of the program. Peer reviews of existing programs can identify areas that need new ideas, changes in emphasis, and improvement in quality.

Recommendations:

- Use solicitations when initiating new activities to select the most qualified participants for funding.
- Employ carefully designed solicitations to strengthen the program when peer review indicates that program balance or quality needs to be improved, or that new ideas are needed.
- Prepare and have on hand a number of peer-reviewed activities that can be submitted as "shovel ready" proposals if funds are made available on short notice.

2. Processes to monitor active awards, projects and programs:

Findings:

University and Cooperative Agreements (21 proposals comprising ≈ 40% of the enabling R&D budget) were peer reviewed every 3 – 5 years. Supplemental funding was incorporated into previously peer-reviewed proposals that were originally under funded, even some of significant size (e.g., $450k).

National laboratory programs are reviewed annually by OFES program managers as part of the budget cycle. Peer reviews of national laboratory programs were not carried out on consistently within the Enabling R&D Program. A couple of areas were reviewed in FY 2008 while others were reviewed on a much longer time scale. No documentation of these peer reviews was provided. The Subcommittee was informed that the documentation was stored by individual contract monitors rather than centrally.

Recommendations:

- Peer review all Enabling R&D activities on a regular basis with a 3 to 5 year time scale and document the results so they are available to future COVs.

C. Effect of the Award Process on Portfolios

1. Breadth and depth of portfolio elements

Findings:

The Plasma Technology element's goal is to address the breadth and diversity of domestic interests in enabling R&D as well as international collaborations. The budget is ≈ $14M or ≈ 60% of the Enabling R&D budget. This area is closely linked to the scientific mission of existing experiments and preparation for ITER.

The Advanced Design Activity includes: The advanced design program (ARIES), the Advanced Concept Projects, and the Virtual Laboratory for Technology (VLT).

- The ARIES Activity includes pre-conceptual designs and technical assessments of potential fusion power plants using a uniform set of design guidelines. The US has been the world leader in this area. The budget has been at ≈ constant level of effort for the past 5 years.
- Advanced Concepts is a new activity initiated in FY 2009 with a budget of $1.27M, and consisted of four awards to support the advocacy and design of four potential next step devices (FDF $400k @ GA, CTF $400k @ ORNL, NHTX $400k@ PPPL and Vulcan $75k @MIT). The FY2010 budget includes $1.75M for Strategic Planning and Opportunities Review.
- The VLT Activity has a technology R&D coordination and advocacy mission with an annual budget of ~$740,000. The VLT once had an active Program Advisory Committee (PAC), but their last meeting was in 2004.

The Materials Research budget has declined from $7M to $4.8M from FY2006 to FY2009. This has resulted in narrowing the portfolio in a critical area for fusion. The proposed FY2010 budget includes an increase of $426k in this area as the FES part of a joint initiative with Advanced Scientific Computing Research (ASCR) and Basic Energy Sciences (BES) on materials under extreme environments such as fusion.

Declining budgets over the past decade have narrowed the scope of Enabling R&D and reduced the depth of activities. There has been little turnover in activities as the program manager sought to preserve key core competencies.

The award decision process is a combination of peer review for university activities and annual OFES program manager review and irregular peer review for on going national laboratory programs. There appears to be a strong connection between award decisions and OFES Program goals.

Recommendations:

- Review the VLT mission to evaluate the need and appropriate scope for this activity. Perhaps the VLT could evolve into a Fusion R&D Center similar to the Plasma Science Centers.
- Improve the depth in the materials area. Efforts to engage materials programs in other agencies or offices within DOE such as BES should continue to be pursued to help strengthen the research effort in fusion materials.
- Implement the proposed joint initiative with FES, ASCR and BES on materials under extreme environments using a solicitation and peer-reviewed proposals.

2. National and international standing of portfolio elements

Findings:
The overall OFES budget reduction in 1997, and the decision to focus on fusion science, resulted in a substantial cut in funding for Enabling R&D. This R&D funding was cut again when the US pulled out of ITER in 1998. The Enabling R&D budget continued to decline from $42M to $23M in as spent dollars over the next 10 years.

From verbal discussions with the principal program manager and from the knowledge of individual members of the COV, it appears that the effect on most areas in the R&D Program has been severe.

The Subcommittee agrees with other assessments (e.g. the FESAC report "Priorities, Gaps and Opportunities: Towards a Long-Range Strategic Plan for Magnetic Fusion Energy", DOE-SC-0102) that US competence in these areas is essential to benefit from advances made in these disciplines by the international community, including ITER, and to provide the basis for a possible US decision to build a Demo. The same FESAC report also comments on the international ranking of the US in Enabling R&D areas, among others, and points out areas of concern. Subcommittee members are concerned that further loss of US capabilities in some of these key areas may occur if they are not strengthened soon.

The Subcommittee was not provided documentation, beyond that available in prior FESAC reports, on which to base a detailed assessment of the breadth, depth, and international standing of the various elements of the Enabling R&D Program.

Recommendations:
- Take immediate steps to strengthen some of the hardest hit areas in the Enabling R&D Program that critically impact the ultimate success of the domestic program.
- In addition, peer review as soon as practical the overall Enabling R&D Program to assess breadth and depth, to determine if the balance among the various elements is appropriate, and if the overall funding level for Enabling R&D is consistent with the needs of the fusion program.

VII. Innovative Confinement Concepts and Basic Plasma Science Programs

A. Scope

This Subcommittee reviewed the following two general programs within OFES: Innovative Confinement Concepts (ICC) and Basic Plasma Science. The time period covered is from March 2005 (the date of the last COV report on these two programs) through FY2009. Within the ICC program we also reviewed the decisions, process and procedures that accompanied the early termination of the NCSX Device project and the Quasi-Poloidal Stellarator (QPS) project, and the special termination of the SSPX project. Within the Basic Plasma Science area we reviewed the following programs, distinguished primarily by the differences in funding categories: NSF/DOE Basic Plasma Science Partnership, General Plasma Physics supported at DOE Laboratories, Plasma Science Centers, the Basic Plasma Science Facility (BaPSF) at UCLA, and the "Inter-agency" programs: NIST, and ORNL Atomic Physics. Also reviewed by this Subcommittee was the program that funds Historically Black Colleges and Universities (HBCU).

The Subcommittee spent two half-days interviewing the OFES program managers. In addition, the Subcommittee studied numerous documents summarizing the solicitation, review, and decision-making processes by which funding in these areas is granted (or not granted). The Subcommittee also examined a selected subset of the many proposal "folders", each of which should document the specific proposal, review, rebuttal, decision, and notification. Also studied by the Subcommittee were the results and findings of reviews of funded, on-going projects.

B. Efficacy and Quality of the Programs' Processes

1. Processes to solicit and review proposals and applications, to recommend award or declination of funds, and to document these actions

General Finding:

The previous COV report (2005) made three clear major recommendations.

- OFES should develop a uniform, clearly stated rebuttal procedure for proposal writers
- OFES should implement several relatively simple ideas in the peer review process to improve the accuracy of the final funding decisions.
- OFES should improve the consistency of the information contained in the review folders and improve the "big picture" of the review process by creating summary "overview" data sheets showing all proposals with review scores and funding decisions.

The Subcommittee finds that OFES has implemented these recommendations and commend them for doing so, though full standardization of the rebuttal procedures still appears to be lacking.
We find that these *have* improved the processes by which OFES carries out its mission. The production of summary data sheets makes the job of the COV much easier and should help OFES to compare the quality of OFES discretion used in and across the various solicitations.
No Recommendation with respect this finding.

General Finding:
The office provided the Subcommittee with some excellent documentation of the competitive review rankings and the rationales for making difficult award decisions between closely ranked proposals (e.g. the 2005 ICC competitive solicitation). This documentation appears to be retained by the program manager, but is not maintained in the proposal folders or some master file.
General Recommendation:

- Continue to improve this kind of "decision" documentation, making sure to include the "decision" documentation in the relevant folders. We recommend that this be extended to other parts of OFES where it has not yet been implemented.

General Finding:
In at least one solicitation (for the Plasma Science Centers DE-PS02-08ER08-25), "pre-proposals" were requested and peer reviewed, but the purpose - to reduce the number of proposals or improve final proposals (via the feedback from the pre-proposal) or both - was not explicit. Furthermore no guidance was provided on the length or format of the pre-proposals. This resulted in ~ 30-page pre-proposals.
General Recommendations:

- Specifically state in solicitations whether pre-proposals will be used to reduce the proposal list and/or as a way to strengthen the final proposals.
- Specify in solicitations the maximum length of pre-proposals, and provide a well-defined format and well-defined review criteria.

Findings relevant to the ICC Program:
Based on the ICC material reviewed, it is clear that OFES is strongly committed to and was successful in achieving competitive proposal reviews and awards. OFES utilizes a variety of review processes to accomplish that goal for specific calls and renewals.

The ICC portfolio spans a broad range of budget size, maturity and institutional size and type. The proposal and progress review process is adjusted to accommodate the differences. In general this seems appropriate but the flexibility could introduce real or perceived issues of fairness and transparency.

Recommendations relevant to the ICC Program:

- Improve communication with the community (for example in the solicitations) to make the OFES commitment to competitiveness and transparency more apparent.
- Develop and document the rationale used for choosing the type of review process

(e.g. panel, mail, etc.) for a particular ICC proposal call. This could include defining the boundaries between review choices based on criteria such as institutional type, award size, maturity of research area, and proposal type (renewals or new).

- Disseminate the choice of and rationale for a particular review method to the proposers and reviewers.

Findings relevant to the DOE-NSF Partnership within the Basic Plasma Science program:

Concurring with the 2009 COV review of the NSF Physics Division, this Subcommittee also enthusiastically endorses the continuing partnership.

The Subcommittee reviewed a random sample of proposals funded by OFES via the DOE-NSF partnership for the period 2005-2009. Proposals are solicited through an annual announcement. NSF maintains the complete file of proposals submitted to the program, including declinations and awards. OFES maintains folders only for the subset of proposals funded by OFES.

OFES uses the recommendations from the NSF panel review process to decide on funding priorities for proposals. Program managers from both OFES and NSF participate in the panel reviews, and they use the panel discussions to enlighten funding decisions, especially in the Fund-If-Possible category.

OFES has shown leadership by providing typically about 70% of the funding for this program, except in the 2009 cycle when NSF ARRA funds contributed approximately 50%. The research portfolio appears to have broadened in scope with time and it now covers a fairly broad and impressive range of topics. The 2009 solicitation identified four subject areas: 1) high energy density and laser plasma interactions; 2) turbulence; 3) low-temperature plasmas; and 4) magnetic reconnection, dusty plasmas, double layers and non-neutral plasmas.

The sampled proposal reviews exhibit relatively high reviewing standards and include US and some international reviewers. Thus, to some extent, the quality of the proposals is evaluated against international standards.

The proposal review and selection process appears to be working well. The partnership succeeds in part through the good collaborative relationship between NSF and OFES program managers. The Subcommittee commends their efforts in maintaining a portfolio of highly ranked projects of innovative research in basic plasma physics with applications to fusion, geospace, solar-terrestrial physics, astrophysics, and other areas.

By bringing high-quality proposals to the attention of other NSF program managers who are willing to cost-share funding, the NSF- Partnership manager was able to leverage limited resources allocated to the program to fund more proposals than would otherwise be possible. This leveraging effectively augments the impact of the program for both NSF and OFES.

The nominal proposal success rate of 20% (ARRA funds bumped the 2009 rate up to 40%) results in some "Must Fund" proposals going unfunded. This proposal pressure suggests that the program is attracting sufficient high-quality proposals.

The term of appointment of the NSF rotator who has been responsible for managing the Plasma Physics Program and the NSF/DOE Partnership has now ended and management of the Partnership is currently in transition.

Recommendation relevant to the DOE-NSF Partnership within the Basic Plasma Science program:

- Work with NSF to ensure continuity in management, funding, and vitality of the NSF/DOE Partnership.

Findings relevant to the funding of Plasma Science Centers within the Basic Plasma Science program:

OFES used programmatic needs and past performances as part of the criteria in the final selection among the closely ranked proposals. But the documentation of this deliberation has yet to be written up for the recent decision made in May 2009.

Recommendations relevant to the funding of Plasma Science Centers within the Basic Plasma Science program:

- Document the decision-making process, including discussions and any additional selection criteria that impacted the decisions on proposals on the fund/no-fund borderline, and file that documentation in the proposal folders in a timely manner.
- For the Research-Center-type of proposals, convey more specific information regarding the final selection criteria than what is now contained in the "form" letter declining funding.

Finding relevant to the Historically Black Colleges and Universities (HBCU) program:

There is no formal solicitation process for these awards, and most of the funded projects are renewals. Although there is "word-of-mouth" and outreach advertising for this program, the coverage appears to be limited.

Recommendation relevant to the Historically Black Colleges and Universities (HBCU) program:

- Add a link to a description of this program somewhere on the OFES website.

2. <u>Processes to monitor active awards, projects, and programs</u>

Finding relevant to the ICC Program:

The ICC program utilizes multiple ways to monitor progress.

- In most cases OFES conducts peer reviews of the ICCs at the midway point of the award (1.5-2.5 years). Not all of those reviews were documented in the folders. In some isolated cases they may have been reviewed as often as once a year. In other cases no peer reviews were conducted over > 5 year period.
- Yearly progress reports from the PIs, which are reviewed by the program manager.

- Site visits by program managers sometimes accompanied by subject experts from other institutions.
- Discussions with research staff at conferences, etc.

Recommendation relevant to the ICC Program:

- Insure that standardized and consistent reviews occur at intervals appropriate to the program size and that these reviews are well documented.

Finding relevant to the ICC Program:

The ICC portfolio is spread over a number of program managers. The positive and negative benefits of this approach are not clear.

Recommendation relevant to the ICC Program:

- Foster more consistent management practices.

Findings relevant to the ICC Program:

Within the time period of this COV's review, decisions to terminate three major projects were made. The largest and the one with the greatest impact was the premature termination of the NCSX project. Also, in order of decreasing funding-magnitude, the SSPX project and the Quasi-Poloidal Stellarator (QPS) project were terminated. We recognize and understand the difficulty and upset that accompanied these decisions. We credit OFES in making these difficult decisions. However, most of all the Subcommittee desires that these experiences serve as learning experiences for OFES and the community. We find that the processes leading to and carrying out the NCSX and SSPX terminations were well reviewed and well documented. We commend the commissioning of the internal OFES report (not yet made public) on the "lessons learned" from the NCSX experience. We also commend the processes by which the SSPX shutdown decision and the subsequent disposition of SSPX equipment were carried out.

In these three termination cases the decisions about how the funds were reallocated were made by OFES with varying magnitudes of community input.

Recommendations relevant to the ICC Program:

- Finalize the OFES report on the "lessons-learned" as quickly as possible.
- Include the answers to the following questions in the report:
  - Were there systemic reasons for why the course was not "righted" at an earlier time?
  - Should the current project-management template (DOE 413.3a) be modified to lower the risk of this happening again?
- Circulate this "lessons-learned" document, as well as the one generated by PPPL, among OFES managers and have them reviewed by the next COV.
- When terminations occur in the future, minimize the time period between termination and subsequent peer-review of the projects to which the funds were re-directed, or between termination and competitive application for the funds.
- Ensure that the decision-making process with regard to the re-direction of the funds is as transparent to the community as possible.

Finding relevant to the funding of the Basic Plasma Science Facility (LAPD) within the Basic Plasma Science program:
There are regular processes for monitoring the facility's performance and giving feedback in the form of mid-term reviews and renewal reviews. But follow-up processes have recently been hampered by the lack of travel funding for the OFES managers. This was especially a problem after the 2007 mid-term review raised a concern that required the attention of the program manager.
Recommendation relevant to the funding of the Basic Plasma Science Facility (LAPD) within the Basic Plasma Science program:

- Allocate adequate resources for the managers to follow up on the performance of a facility after a review raises concerns.

Finding relevant to the Inter-agency Program "Atomic Physics for Fusion and Plasma Science" at ORNL:
An onsite review of the program conducted in 2007 rated the quality of the work as outstanding. The review committee observed that years of flat funding have effectively reduced work commitments to the program by ORNL staff. The ORNL program leader indicated that an increase in their 2008 budget "is necessary to maintain the viability of the program."
No Recommendation with respect to this finding.

Finding relevant to the Inter-agency Program: "Determination of Atomic Data Pertinent to the Fusion Energy Sciences Program" at NIST:
A 2006 onsite review of this highly leveraged program found that "the program produces excellent quality data, but [the program] should be more closely tied to the needs of the fusion community." Retirements of key personnel at NIST and changes in management raised concerns among the 2006 reviewers about NIST support for the program and its vitality. The OFES program manager has limited influence over hiring decisions at NIST.
No Recommendation with respect to this finding.

C. Effect of the Award Process on Portfolios

1. Breadth and depth of portfolio elements
2. National and international standing of portfolio elements

General Findings:
The 2005 COV report noted "There is, however, no obvious metric that shows whether or not the actual quality of the research has increased." OFES does not have a self-assessment process in place to evaluate the impacts of the research it funds on the program's national and international standing, or the extent to which its research portfolio fulfills program objectives. Thus the Subcommittee finds that it is not able to meet fully and objectively its charge in "assessing the breadth, depth, and quality of the resulting program portfolio, and providing an evaluation of the program's national and international standing."

The Subcommittee also queried the program managers of the DOE-NSF Partnership Program about national and international standing of this program. The anecdotal replies suggest the program is funding high-quality and high-impact work, but tabulated information and metrics were not available to support these views. One manager highlighted the quality of the research on dusty plasmas and very intense laser plasma interactions as being internationally outstanding. Another manager pointed out that research funded by the partnership has been highlighted on two *Physics Today* covers and that two investigators have been awarded the Maxwell Prize for work funded by this mechanism.

General Recommendation:

- Implement a self-assessment process to evaluate the quality of the OFES program portfolio by instituting systematic collection of a variety of metrics, e.g. prizes/awards, refereed publications, citations, foreign requests for run-time, invited talks, etc. These metrics should be useful for both OFES and future COVs in evaluating the domestic and international standing of the portfolio and the effectiveness of the portfolio in achieving the program objectives.

Finding relevant to the DOE-NSF Partnership Program:

Research into material science issues relevant to burning plasmas is not solicited or supported by this program.

Recommendation relevant to the DOE-NSF Partnership Program:

- The Subcommittee recommends that OFES explore possible opportunities for a similar partnership with the NSF Materials Sciences Division for the purpose of jointly funding research relevant to material-plasma issues.

Finding relevant to the ICC Program:

The proposals and awards within the ICC portfolio cover a broad range of concepts and research topics. However, the breadth, depth, and standing of the portfolio on the national and international communities were significantly reduced by the terminations of NCSX and QPS.

No Recommendation with respect to this finding.

VIII. High Energy Density Laboratory Plasma (HEDLP) Program

A. Scope

The OFES High Energy Density Laboratory Plasma (HEDLP) Program fosters the study of ionized matter that is heated or compressed (or both) to extremely high density and temperature, using intense pulses of lasers, charged particle beams, plasma jets, or magnetic pinches. Near-term emphasis is focused on fast ignition, magneto-inertial fusion, heavy ion fusion, and high Mach-number/ high-density plasma jets or astrophysics in the laboratory. The HELDP program budget proposed for FY10 is $24.5M, an increase of more than $8M from the FY09 budget of $16M, and the FY11 budget is projected to continue at the FY10 ($24.5M) increased level. This Subcommittee reviewed the HEDLP program from FY05 to the present, including the FY09 major HEDLP call for proposals that is leveraging new opportunities arising from the advent of a range of intermediate and large scale HELDP experimental facilities.

B. Efficacy and Quality of the Program's Processes

1. Processes to solicit, review, recommend, and document application, proposal, and award actions

Findings:
The FY09 major new program solicitation was crafted in response to a spectrum of community input. The solicitation identified HEDLP scientific goals, the technical appropriateness of proposals in various sub-disciplines, and the programmatic goal of developing a user base for new facilities. The solicitation was issued jointly by both OFES and NNSA, and was composed of parallel calls to both the national laboratories and the non-national laboratory research communities. Proposals for work on a wide range of scales were solicited: centers of excellence, large consortia, collaborations, and single-investigator research.

The unprecedented breadth of the FY09 solicitation (together with the fact that it had been several years since the last solicitation in this area) created a number of issues on the side of processing. These included: large number of proposals to process, direct competition between center proposals and single investigator grants, difficulty of ensuring adequate time for rebuttals, and difficulty in finding competent reviewers without conflict of interest. Partly by making use of reviewers from foreign institutions, and despite the difficulties of conflict of interest that were not fully resolved, an excellent cadre of competent reviewers was used for the reviews.

The joint nature of the call by two separate offices also generated issues. Chief among them – since OFES and NNSA each have their own programmatic considerations – was

the lack of clarity in criteria that were to be applied by the reviewers to the proposals. For instance, the relative weight of programmatic interest to scientific excellence appears to have been worked out by the panel of the solicitation's eight program managers (four from OFES and four from NNSA) during the review process instead of in advance, the latter of which would have been more straightforward.

The breadth of the solicitation posed problems for the proposing investigators as well, primarily in targeting their proposals.

Following review, PI's were given a week to write rebuttals, which were then passed to the panel of eight program managers who made the funding decisions. These rebuttals were not passed on to the reviewers, so there was no opportunity for individual numerical review scores to be changed. No documentation was provided in the folders of how the (averaged) review scores were used in making the final funding decisions, and on a case-by-case basis the Subcommittee occasionally found worrisome spreads in the scores such as two extremely high scores offset by one very low score. It is not clear that the rebuttal process is standardized, as recommended by the prior COV.

For all proposal rejections, a form letter was used. The prior COV had recommended a brief statement be given to PIs in the rejection letters explaining the decision. This has not been done.

A Selection Report was provided to this Subcommittee that describes in detail the decision process, including the considerable care with which the review process was administered, how the proposals were ranked, and how the award selections were made. For reasons stated above, the evaluation process was not only unusual, but also lengthy and difficult.

Recommendation on solicitation breadth:

- Avoid issuing solicitations that would involve a major fraction of the S&T community apply for funding by further spreading out the renewals and by refining the technical and programmatic scope of future solicitations. For instance, separately timed solicitations for centers and for single investigator grants would clarify the process from proposal initiation through award.

Recommendations on proposal evaluation:

- Clearly explain the decision priority of the program mangers in future HEDLP solicitations and instruct the reviewers to score the program relevance in a separate category. Especially if the solicitation is being run by more than one funding office, it is important to clearly define up front the selection criteria and evaluation priorities, both in the solicitation to the investigators and to the full cadre of reviewers at the time of the review.
- Send rebuttals to the reviewers so that there is an opportunity for the numerical scores across the reviewer pool to be more consistent. The program managers making the funding decisions should also pay attention to the score spread, to avoid the possibility of an outstanding proposal being simply disqualified because

of a reviewer misunderstanding which leads to one anomalously low score. The use of review panels would, further, enable more expert opinions to be given on each proposal, and also foster important normalization of numerical scoring procedures across the broad base (multi-disciplinary and international) of individual reviewers.

- Include notations in the individual folders, particularly when decisions do not follow a simple threshold on the numerical scores. This recommendation is in concurrence with the prior COV.
- Write more informative funding decision declination letters to PIs. This should be standard practice. This recommendation is in concurrence with the prior COV.
- Provide the opportunity for a formal debrief upon request from the proposing investigator.

2. Processes to monitor active awards, projects and programs

Finding:

The lead program manager was very conscientious in requiring written progress reports for continuation funding and in staying personally informed of research progress through conferences, meetings, telephone contact, etc. The evaluation of the status of the programs depended (appropriately) on the program manager's considerable technical expertise in the program area. As noted in other program areas, ready means have not existed to collect and maintain a database of objective measures of progress and stature of the projects.

Recommendations:

- Metrics documentation: Document research achievements, impact of work, and recognition of accomplishments.
- Store this documentation in a straightforward format at the program office level and use it as a decision element in the project renewal process.

C. Effect of the Award Process on Portfolios

1. The breadth and depth of portfolio elements

Findings:

The program addresses an area of strong scientific interest that is highly relevant to the mission of OFES. The program funds high quality science with a balance and award size/duration that is consistent with the current overall funding limitations. The program is joint with other offices in DOE, and all of the program managers are fully cognizant of all relevant laboratory research activities that are external to the DOE program.

The collaboration with NNSA has influenced the evolution of this program both in providing additional funding and in shaping the portfolio of funded research. A major emphasis on developing a user base for new, intermediate, and large-scale facilities has

been implemented through the 2009 solicitation. HEDLP (itself a new label) represents the evolution of an active and multifaceted research area that is a new science thrust.

Recommendations:

- Portfolio balance: Close out programs as appropriate (such as those which, for instance, have next-step goals that are fiscally unrealizable in realistic 20 year timeframes), and launch promising new programs. The Subcommittee notes that the balance between providing sufficient funds to usher an investigation to fruition versus maintaining sufficient breadth is always a challenge with limited overall funding.
- Community input: Continue to make good use of community input (such as the Research Needs HEDLP Workshop 2009) in crafting future solicitations and in fostering excellence in this program.

2. <u>The national and international standing of the portfolio elements</u>

Findings:

The US portfolio of research in HEDLP is internationally prominent and is comprised of many unique elements and facilities. The stature of the principal investigators is excellent.

As noted above, the means have not existed to objectively measure or document the accomplishments of the program across work units within the HELDP program, nor in comparison as a whole with other programs in the OFES or the DOE. Metrics that encourage archival documentation and accomplishments promulgation would be highly beneficial towards cultivating a strong scientific HEDLP cadre within the OFES.

Recommendation:

- Progress measures: Practice effective documentation of objective measures of progress and success at the program office level. This information will help in establishing the standing of the whole program and its merits.

IX. Theory and Computation Program

A. Scope

The COV Theory Subcommittee reviewed the following programs: (1) Theoretical Research In Magnetic Fusion Energy Science (both DOE and non-DOE laboratory components) (2) Scientific Discovery for Advanced Computing (SciDAC) (3) Fusion Simulation Program (FSP), and (4) Junior Faculty Award Program in Basic Plasma Science (replaced as of 2009 by the new Early Career Research Program.).

B. Efficacy and Quality of the Program's Processes

1. Processes to solicit, review, recommend, and document application, proposal, and award actions:

Findings:
The COV Theory Subcommittee found that the Theory program managers have made significant improvements in the proposal solicitation and review process over the past 5 years in accordance with several of the recommendations from the previous COV. This has led to improved transparency in the justification for award actions and helped new investigators to become part of the funded program.

The following actions addressed previous COV recommendations:

- Implementation of a results-oriented scoring system. The reviewer template and instructions now spell out the funding recommendation associated with numerical ratings, eliminating any ambiguity of reviewer intent.
- A standard proposal format is now included in the solicitation instructions, including sections that should be addressed by each proposer.
- The Junior Faculty program was successful in bringing new investigators into the Theory program within the basic plasma science area; the new Early Career Research Program that will replace this program has a broader mandate that should bring similar benefits to other areas as well. These initiatives have helped address issues of diversity and demographics previously raised.
- Inclusion of experimentalists in some cases as reviewers on Theory proposals to help improve connection to experimental work.

We also found that specific award decisions aligned well with reviewer recommendations and that a rebuttal system appeared to be in place. However, there are areas where improvements are needed and there is overlap with the issues raised by the previous COV.

Small, single-investigator proposals and large, multiple-investigator team proposals from single institutions compete with each other for the same funds from the same solicitation. In addition, solicitations do not explicitly define what should be considered as "new" and what should be considered as "renewal". There are several concerns with these current practices. One issue is that, on a per-dollar-spent basis, the large programs are not getting the same level of peer review. A second issue is that the approach may remove some incentive for innovation through new proposals or through pursuing new directions within a team.

A related issue is the way in which funding level is determined. First, there is little guidance given on the solicitation as to the level of funding or level-per-investigator that would be appropriate for a proposal. Second, there has been a tendency to "flat-line" funding levels for renewals, relative to previous years, which often significantly reduces the award level from the proposed amount, rather than tying funding adjustments to project merit. Furthermore, these funding-level decisions are not documented. This practice can unintentionally side-step reviewer recommendations, making it appear difficult for new investigators to "break in" to the program, and may also provide a disincentive for programs to change or to include new components.

As the previous COV recommended, there remains a need for more emphasis on validation of theoretical and computational results. Although inclusion of experimentalists on some proposals is a good first step, the issue has not been addressed with the solicitation wording or letter-of-intent screening.

Recommendations:

- Explicitly define what a "renewal" grant versus a "new" grant is in the solicitation. In particular, make clear whether this distinction applies to the scientific content (independent of personnel) or the personnel (independent of scientific content).
- Consider requiring large proposals (> $1,000,000) be sectioned such that each section can be reviewed with multiple reviewers and ranked separately. This would ensure that these grants are evaluated with a resolution comparable to those of the smaller single investigator proposals in the same program. This would also facilitate decisions on partial funding of the large proposals to be made if certain modules are not of the same standard as others within the same proposal. This would minimize need to flat-line the budget of particularly strong sub-components of large grants, and better document the merit for funding increases.
- Better document funding level decisions.
- Make more use of experimental reviewers as additional reviewers on theory proposals, where appropriate, to offer a perspective on the practical relevance of what is proposed.
- Provide statistics about how often the same reviewers are used for the review of the same program in renewal projects. Ensure that Renewal proposals have at least one reviewer that is different from those used for earlier incarnations of that proposal in the previous review cycle.

- Formally track and document statistics of the Early Career Research Program. In particular, keep data on demographics of investigators and institution diversity, whether or not investigators later received tenure, and whether or not they continued to receive funding from OFES.
- Explicitly emphasize the importance of validation through comparison to experimental data or to established code results as part of the solicitation, and encourage reviewers to consider this in their evaluations.

2. Processes to monitor active awards, projects and programs

Findings:
The OFES Theory program managers are to be commended for their monitoring of ongoing activities, despite severe constraints on available manpower. For large projects on the SciDAC scale, the practice of convening mid-term review panels helps to provide adequate oversight of these programs. For smaller projects, there is not yet a standardized format for submitting and archiving annual progress reports in order to monitor progress. As a result investigators responded with various levels of thoroughness, perceiving the burden differently.

The success of theory and simulation programs at predicting experimental results is not sufficiently gauged in the monitoring process.

The archival systems in use by the DOE appear to make it difficult to retrieve proposal and performance information, and are in need of upgrading. This information should be readily available to reviewers.

The DOE and the U.S. fusion community have recently completed a series of reviews of the program (the tokamak and toroidal alternate panel reviews, and ReNeW), which provided information on overall progress in plasma theory, and a programmatic context for future DOE solicitations in the area of theory and simulation. These workshops involved a large part of the community. OFES was a substantial motivating force in this process.

As noted by the previous COV, program managers regularly attend conferences and workshops at which supported work is reported. However, site visits by the program manager appear to occur primarily in conjunction with the renewals of the largest theory programs, are not a uniform practice, and are lacking if the review is conducted by mail. Increased interaction between PIs of medium or smaller-scale programs and program managers may help to resolve issues such as budget conflicts.

Recommendations:
- Standardize reporting on award progress: adopt an electronic on-line standardized grant reporting system (like NSF's Fastlane) for which specific standard questions can be asked and specific expectations of the length of responses is given.

- For panel reviews of large DOE laboratory and large non-DOE programs, provide panel reviewers access to previous suggestions of past reviewers to evaluate how the laboratories have responded to recommended areas of improvement.
- Standardize the review process for all large DOE supported theory programs.
- Standardize the review process for large non-DOE laboratory theory programs.
- Increase site visits and use of panel reviews for the larger theory programs.

C. Effect of the Award Process on Portfolios

1. Breadth and depth of portfolio elements.

Findings:
The Subcommittee was impressed with the breadth and the depth of the science funded. The allocation of resources was found to be generally appropriate given budget constraints. We did find areas that should be improved.

A particular theme of our focus was again the distinction between renewal grants and new investigator grants. By adopting the changes in the review procedure for the large grants advocated above and below, we think that some of the need to flat-line renewals to funding levels of the previous rounds could be amended: For example, the higher resolution of review of these proposals might dictate not funding a component of a large proposal while increasing the budget of its other components.

We also resonated with a concern of the previous COV, that inertia resulting from the new vs. renewal process may be limiting fundamentally new and innovative directions. Although we unanimously agreed that the specific renewal grants that were funded are of extremely high quality, a theme in our recommendations below and above is to increase the scrutiny on the renewal grants to make their reviews more commensurate with the scrutiny that the new proposals receive as part of the process for the future.

Like the previous COV, we find that the direct connection between theory and experiment continues to be an important area in need of improvement, however we advocate a different approach from the previous COV to improve this situation as discussed below.

We urge OFES to identify "grand challenge" problems highlighted in recent community efforts such as the ReNeW process as high priority targets for future solicitations.

We were overall in agreement with the current preliminary management of the FSP.

Recommendations:
- To better interface theory, computation, and experimental research, establish a new solicitation in which each proposal must have a theory/computation and experimental validation component. The criteria for funding should be strongly

determined by the perceived effectiveness with which the proposed work will validate and constrain predictive theory/simulations.

- Fund a series of small workshops (~30 people) once every ~3 years to identify and report progress on grand challenge problems and to give investigators advanced notice of programmatic priorities of upcoming solicitations.
- To foster innovation, change the review procedure of large proposals as recommended in Section IX.B.1 (p 37).
- Give advanced notice for solicitations that address specific high priority goals and questions (e.g. as identified by the workshops described above or like ReNeW), both at meetings and electronically.
- Encourage and prioritize proposals that incorporate publicly (freely or commercially) available codes and development of codes that offer user-friendly interfaces for easy use and access by the community.
- Include multiple experimentalists for the FSP design review.
- Implement a mechanism to facilitate inclusion of investigators not already in the original team, after the FSP design review.

2. The national and international standing of the portfolio elements

Findings:

As per the other subcommittees of this COV, we do not have enough data to evaluate comprehensively the national and international standing of the portfolio elements.

We perceive that the incomplete tracking and sponsorship of international collaborative programs is a weakness. While we are aware of several bilateral theory exchanges such as the US-Japan Joint Institute of Fusion theory (JIFT), which is monitored by OFES, there are additional substantial theory collaborations between US and various EU labs and universities, and between US and Chinese labs and universities. These provide fruit for OFES involvement. Such involvement can increase awareness of what others are doing around the world and can help attract top international students and postdocs to the USA.

Other than addressing the two previous points, our recommendations are focused on obtaining the information needed for future COVs or another independent committee to evaluate more comprehensively the national and international standing.

Recommendations:

- Identify metrics to measure quality, productivity, and international standing (publications, citations, patents, presentations at international meetings, awards).
- Build a database of publications from DOE funded research. This can be accomplished using the electronic template for grant reporting discussed above (as per NSF).
- Track the number of PhD students supported by program.

- Build on existing international collaborations to increase sponsorship and involvement of OFES that further encourages national and international collaboration initiatives in theory and computation.

Appendix A
Charge Letters

Under Secretary for Science
Washington, DC 20585

November 6, 2008

Dr. Martin J. Greenwald, Chair
Fusion Energy Sciences Advisory Committee
Plasma Science and Fusion Center
Massachusetts Institute of Technology
NW17-107
175 Albany Street
Cambridge, MA 02138

Dear Dr. Greenwald:

I request that the Fusion Energy Sciences Advisory Committee (FESAC) establish a Committee of Visitors (COV) that can assist FESAC in:

- assessing the efficacy and quality of the processes used by the Office of Fusion Energy Sciences (OFES) to solicit, review, recommend, monitor, and document awards and declinations for universities, national laboratories, and industry.

- assessing the breadth, depth, and quality of the resulting program portfolio, and providing an evaluation of the program's national and international standing.

The last COV activity evaluated portions of the program over a three year period. Starting with this COV, I am asking FESAC to review the entire OFES program at the same time. Therefore, the tokamak research and enabling technologies portion of the program should be evaluated from 2006 to the present, the innovative confinement, general plasma sciences, and the High Energy Density Laboratory Plasmas portions of the program should be evaluated from 2005 to the present, and the theory and computations portion of the program should be evaluated from 2004 to the present. This will make it possible for the next COV to evaluate the entire program for a three year period.

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 OFES research programs; however, a significant fraction of the COV members should not be involved in research that is being funded by OFES. Each panel member will be required to sign a Conflict of Interest statement and a Confidentiality statement. Examples of both statements are enclosed.

I believe that the COV reviews conducted in this manner will help the Office of Science maintain a high standard of scientific research. A report on the COV activity should be completed by April 2009.

Sincerely,

Raymond L. Orbach

Raymond L. Orbach

Enclosures

Department of Energy
Office of Science
Washington, DC 20585

February 5, 2009

Dr. Martin J. Greenwald, Chair
Fusion Energy Sciences Advisory Committee
Plasma Science and Fusion Center
Massachusetts Institute of Technology
NW17-107
175 Albany Street
Cambridge, MA 02138

Dear Dr. Greenwald:

The enclosed letter to you from Dr. Raymond L. Orbach dated November 6, 2008, charged the Fusion Energy Sciences Advisory Committee (FESAC) to establish a Committee of Visitors (CoV) to review the Fusion Energy Sciences program. In this letter FESAC was asked to complete the CoV activities by April 2009. However, I have looked once again at the schedule of many special activities in which fusion researchers have been requested to engage during the spring and summer of this year, and as a result I have decided to extend the time for the completion of the CoV task to November 2009. This extension will give the researchers more time to participate in the Magnetic Fusion Energy Sciences Research Needs Workshops, and the other activities that are being scheduled this year.

If you have any questions regarding this issue, please feel free to contact Albert L. Opdenaker, the Designated Federal Officer for FESAC.

Sincerely,

Patricia M. Dehmer
Acting Director
Office of Science

Enclosure

Dr. Martin Greenwald
Senior Research Scientist

Massachusetts Institute of Technology
77 Massachusetts Avenue, Building NW17-107
Cambridge, Massachusetts 02139-4307

Plasma Science & Fusion Center
Phone 617.253.8053
Fax 617.253.0627
Email g@psfc.mit.edu

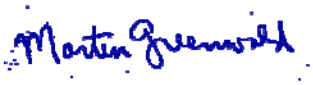
July 23, 2009

Dr. Rulon Linford
1055 Aquarius Way
Oakland, CA 94611

Dear Dr. Linford,

With this letter, the Fusion Energy Sciences Advisory Committee formally conveys the charge from the DOE Office of Science to provide an assessment of OFES management through a Committee of Visitors (COV). Details concerning the scope and schedule of the charge can be found in the accompanying letters. Speaking for FESAC, I would like to thank you for agreeing to chair the COV and to thank the rest of your committee for taking on this important responsibility.

Sincerely,



Martin Greenwald
Chair, Fusion Science Advisory Committee

Cc: Al Opdenaker

Appendix B
COV Membership

Name		Current Affiliation	Type of Institution			Years There	Geographical Region				Expertise							
First	Last		Lab	Industry	University		North East	South East	Central	West	Tokamaks	Diagnostics	ICCs	Theory/Comp	HEDLP	Basic Plasma Sci	Materials	Technology
Bruno	Bauer	U. Nevada			x	13				x		x	x	x	x	x		
Eric	Blackman	U. Rochester			x	8	x							x		x		
Troy	Carter	UCLA			x	8				x	x	x	x			x		
Vincent	Chan	GA		x		34				x	x			x				
Jill	Dahlburg	NRL	x			20	x					x	x	x	x	x	x	x
Chris	Hegna	U. Wisconsin			x	19			x				x	x				
Rulon	Linford	LLNL	x			5				x		x	x					
Bill	Lotko	Dartmouth C.			x	25	x							x		x		
Richard	Majeski	PPPL	x			17	x				x	x	x			x	x	x
Dale	Meade	FIRE		x		4	x				x							
Ellen	Meeks	Reaction Design		x		11				x				x		x		
Joe	Minervini	MIT			x	25	x											x
Dave	Rasmussen	ORNL	x			28		x			x	x	x			x		x
Chuang	Ren	U. Rochester			x	5	x								x	x		
Fred	Skiff	U. Iowa			x	11			x									
Jim	Terry	MIT			x	31	x				x	x						
Ed	Thomas	Auburn U.			x	9		x			x	x	x			x		

Appendix C
Agenda for COV Visit to OFES

Monday, August 17th

9:00 am -- Plenary Session at Germantown with the OFES technical staff. Rm G-207.

9:00 -- Opening and comments on logistics – Al Opdenaker
9:05 -- Welcome -- Ed Synakowski
9:15 -- Overview of program and outline of OFES procedures – Steve Eckstrand
10:00 -- Overview of facilities, BPO, and international collaborations – Erol Oktay
10:45 -- Overview of "system" for grants -- John Sauter
11:00 – Break
11:10 – Discussion of various topics – COV and OFES Staff

12:30 pm -- Lunch in the cafeteria.
1:30 pm – Subcommittees meet separately for additional information gathering from OFES staff and for discussions.
5:30 pm – COV meets to discuss status and plans for Tuesday.
6:30 pm -- Leave to return to the Hotel.

Tuesday, August 18th

8:00 am -- COV meets in hotel for general discussions and then breaks into subcommittees to begin drafting report. COV discusses some draft sections in late afternoon.
9:00 am to 12:30 pm – ICC and Plasma Science Subcommittee visits OFES in Germantown for further discussions with program managers and further review of folders.
5:30 pm – Adjourn.

Wednesday, August 19th

8:00 am -- COV meets in the hotel to review draft sections. Subcommittees refine sections based on feedback from the review.
4:00 pm -- OFE technical staff arrives at hotel and is briefed by COV on selected findings and recommendations. Some OFES technical staff participated by teleconferencing from Germantown.
5:30 pm – Adjourn.

Appendix D
COV Subcommittee Assignments

First Name	Last Name	Subcommittee	L
Ed	Thomas	Tokamaks and Diagnostics	x
Chris	Hegna	Tokamaks and Diagnostics	
Joe	Minervini	Tokamaks and Diagnostics	
Dale	Meade	Enabling R&D	x
Bruno	Bauer	Enabling R&D	
Troy	Carter	Enabling R&D	
Jim	Terry	ICC and Plasma Science	x
Bill	Lotko	ICC and Plasma Science	
Dave	Rasmussen	ICC and Plasma Science	
Chuang	Ren	ICC and Plasma Science	
Jill	Dahlburg	HEDLP	x
Vincent	Chan	HEDLP	
Fred	Skiff	HEDLP	
Eric	Blackman	Theory and Computation	x
Richard	Majeski	Theory and Computation	
Ellen	Meeks	Theory and Computation	
Rulon	Linford	COV Chair	