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March 20, 2017

Dr. J. Stephen Binkley
Acting Director
Office of Science
U.S. Department of Energy
1000 Independence Avenue
Washington, D.C. 20585

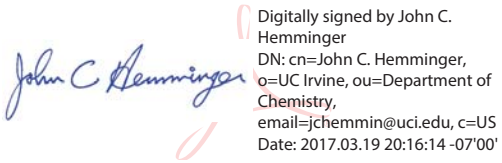
Dear Dr. Binkley:

On behalf of the Basic Energy Sciences Advisory Committee (BESAC), I am forwarding to you the report of the 2017 Committee of Visitors (COV) for the Energy Frontier Research Centers and the Energy Innovation Hubs. The COV met for three days in November 2017, to address the charge to BESAC to review the procurement and management processes for the EFRCs and the Energy Innovations Hubs. Professor Sylvia Ceyer of Massachusetts Institute of Technology chaired this subcommittee.

The recommendations of the COV and the contents of this report were unanimously accepted and endorsed by the members of BESAC at our February 2017 meeting.

I would like to thank you for the opportunity to involve BESAC in this very important review process.

Sincerely,



John C. Hemminger
Chair
Basic Energy Sciences Advisory Committee

Enclosure

cc: Dr. Sylvia Ceyer, MIT
Harriet Kung, SC-22
Katie Runkles, SC-22

Committee of Visitors Review Report
2013-2016

Energy Frontier Research Centers
and
Energy Innovation Hubs

Basic Energy Sciences
U. S. Department of Energy

to the

Basic Energy Sciences Advisory Committee

Sylvia T. Ceyer, chair
Ernest L. Hall, co-chair
James K. McCusker, co-chair
Richard M. Osgood, co-chair

Gaithersburg, Maryland
November 15-17, 2016

EXECUTIVE SUMMARY

A Committee of Visitors (COV), under the auspices of the Basic Energy Sciences Advisory Committee (BESAC), reviewed the procurement and management processes of the Energy Frontier Research Centers (EFRCs) and the Energy Innovation Hubs (JCAP and JCESR) that are supported and managed by the Basic Energy Sciences (BES) program within the DOE Office of Science. Twenty members of the COV met in Gaithersburg, MD on November 15-17, 2016. The charge from Professor John Hemminger, chair of BESAC, was to assess efficacy of these processes as implemented from 2013 through the 2016 fiscal year, as well as to assess the breadth, depth, and national and international standings of the portfolio elements. Professor Sylvia T. Ceyer chaired the COV.

The COV unanimously judges that the world leading fundamental science that has emerged from the EFRCs and Energy Innovation Hubs presents a compelling case for the role of fundamental research in addressing our nation's energy needs. Much of the success stems from the high quality of BES's management of the center and hub construct, through which investigators organize as teams to solve broad-reaching problems in basic energy science.

The COV finds that the BES program management team has constructed rigorous and disciplined processes, commensurate with the scope of the EFRCs and Hubs, for proposal solicitation, review, documentation and award. In addition, BES has grown remarkably in its ability to oversee and manage projects on these scales. In particular, it has instituted mechanisms to make effective management within a center or a hub a top priority, instilling best practices from the outset, and developed effective mechanisms to ensure timely communication to all stakeholders, from the general public to Congressional staffers to a broad cross-section of energy researchers. The success of their management strategy is demonstrated, in part, by the high impact of the EFRC and Energy Innovation Hub research.

The COV recommendations include:

- exploration of mechanisms to reduce the number of full EFRC proposals that must be evaluated simultaneously,
- an increase in the minimum time period for an EFRC award to 5 years,
- addition of a required final 5-year summary at the end of a hub contract, written in language that is widely accessible and focusing on the "retroactive measure of transformational impact,"
- institution of a process to gauge the international standing of the hubs,
- additional guidance to the EFRCs, hubs and reviewers to produce more concise report and review documents, and
- an increase in travel funds for BES program managers to attend site visits, to stay engaged with the community and to keep abreast of rapidly evolving fields.

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I. INTRODUCTION

This report describes the findings from a Committee of Visitors (COV) that was assembled under the auspices of the Basic Energy Sciences Advisory Committee (BESAC) to evaluate the processes and standings of the Energy Frontier Research Centers (EFRCs) and the two Energy Innovation Hubs (Joint Center for Artificial Photosynthesis (JCAP) and Joint Center for Energy Storage Research (JCESR)) managed in the Office of Basic Energy Sciences (BES) of the Department of Energy (DOE).

The Energy Frontier Research Centers are integrated, multi-investigator centers conducting fundamental research focusing on one or more of several "grand challenges" and use-inspired "basic research needs" identified in major strategic planning efforts by the scientific community (https://science.energy.gov/bes/community-resources/reports). The aim of the EFRCs is to integrate the talents and expertise of leading scientists in a setting designed to accelerate research that transforms the future of energy and the environment. These centers involve universities, national laboratories, nonprofit organizations, and for-profit firms, singly or in partnerships, and are selected by scientific peer review. The EFRC program was launched with the award of 46 EFRCs on August 1, 2009. They were funded at $2 to $5 million per year for a total DOE commitment of $777 million over a five year period. In September 2013, a second EFRC Funding Opportunity Announcement (FOA) centered on topical areas described in 13 Basic Research Needs reports resulted in renewal awards to 22 of the initial EFRCs and ten new awards that commenced in August 2014. These 32 EFRCs were funded at $2 to $4 million per year for a total DOE commitment of $400 million over a four-year award period, subject to congressional appropriations. A third FOA narrowly focused in the topical area of nuclear waste and issued in February 2016 resulted in the award of four new EFRCs that commenced in August 2016 and were also funded at $2 to $4 million per year for a total DOE commitment of $40 million over a four-year award period, subject to congressional appropriations.

Established in 2010, the Energy Innovation Hubs are multi-investigator centers that integrate the talents and expertise of leading scientists and engineers at universities, national laboratories, nonprofit organizations, and for-profit firms, singly or in partnerships, and are selected by scientific peer review. However, their aim is to advance promising areas of energy science and engineering from the earliest stages of research to the point of commercialization -- technologies that can move to the private sector. BES committed an initial award of $122 million over five years to the Joint Center for Artificial Photosynthesis (JCAP), led by the California Institute of Technology, in partnership with the Lawrence Berkeley National Laboratory, SLAC National Accelerator Laboratory, and the University of California campuses at Santa Barbara, Irvine, and San Diego. Its aim was to build critical foundational knowledge for the design of solar energy-to-fuel conversion systems that use earth-abundant elements and to demonstrate their efficiency, scalability, sustainability, and economic viability for the production of carbon-neutral fuels. In February 2012, a FOA was issued that targeted a battery and energy storage hub and culminated with the award of $120 million over 5 years to JCESR in

December 2012. The JCESR hub is led by Argonne National Laboratory and is partnered with four other DOE national laboratories, five private sector partners and ten universities. The aim of JCESR is to understand materials and chemical processes at a fundamental level that will enable exploration of new technologies that move beyond traditional lithium-ion batteries and store at least five times more energy than today's batteries at one-fifth of the cost and to achieve this objective within five years. In November 2014, BES-DOE issued a FOA specifically for the renewal of JCAP, which resulted in a $75 million award over five years effective June 2015, subject to congressional appropriations. JCAP's mission in this renewal award is to create the scientific foundation for a scalable technology that converts carbon dioxide into renewable transportation fuels, under mild conditions, with only solar added energy.

The EFRCs and the JCAP and JCESR hubs are selected by scientific peer review and are actively managed by a team of BES program managers. The current program managers are in the Materials Sciences and Engineering Divisions (JCESR and EFRCs), and the Chemical Sciences, Geosciences and Biosciences Division (JCAP and EFRCs).

This report is the second COV review of the procurement and management processes of the EFRCs and the JCAP Energy Innovation Hub and the first COV review of the same for the JCESR Energy Innovation Hub. It builds on the May 2013 COV report that evaluated the award selection and management processes for the EFRCs and the JCAP Energy Innovation Hub since their initiation in 2009 through the 2012 fiscal year.

The COV met at the Hilton Hotel in Gaithersburg, MD for two and one-half days from November 15-17, 2016.

II. CHARGE TO THE COMMITTEE OF VISITORS

The charge to the COV was established in a letter from the chair of BESAC to the chair of the COV. The letter is attached as Appendix I. The charge was to assess the procurement and management processes for the Energy Frontier Research Centers (EFRCs) and the Energy Innovation Hubs from the 2013 through the 2016 Fiscal Year. The specific components of the programs that the COV was asked to review were: 2014 and 2016 EFRC award selections, the 2012 JCESR award selection, 2015 JCAP renewal award selection and the management of the EFRCs and Energy Innovation Hubs by BES. The COV was also asked to assess the breadth, depth, and national and international standing of the portfolio elements.

III. COMMITTEE MEMBERSHIP

The COV membership was selected and approved by the COV chair, Professor Sylvia T. Ceyer, in consultation with BES staff and the co-chairs. Professors James McCusker and Richard Osgood served as co-chairs of the EFRC panel of the COV and Dr. Ernie Hall served as co-chair of the hub panel of the COV. Given the size of the EFRC and Energy Innovation Hub programs and the breadth of programmatic areas, a sizable committee was assembled. The COV consisted of a total of 20 members, including the chair. The members were chosen to represent a cross-

section of experts in their particular scientific field and for their expertise in managing large research programs. The COV consisted of the following balances: between researchers who were academics, national laboratory staff, and industry scientists (15, 4, and 1, respectively), between those who had previously served on a COV and those who had not (6 and 14, respectively), and between those academics with current BES funding and those who do not (10 and 5, respectively).

The 19 members were divided into an EFRC (12) and a hub (7) panel. The COV members are:
Sylvia T. Ceyer, J. C. Sheehan Professor of Chemistry, MIT, chair of COV

EFRC Panel

James McCusker, Professor of Chemistry, Michigan State, co-chair of EFRC Panel

Richard Osgood, Professor Emeritus of Electrical Engineering and Applied Physics, Columbia, co-chair of EFRC panel

Susan Babcock, Professor of Materials Science and Engineering, University of Wisconsin, Madison

Alan Darvill, Professor of Biochemistry, Molecular Biology and Plant Biology, University of Georgia; UGA Lead, DOE BioEnergy Science Center

Melissa Hines, Professor of Chemistry and Director of the Cornell Center for Materials Research, Cornell University

Cliff Kubiak, H. C. Urey Professor of Chemistry and Biochemistry, UC San Diego

Laura Pyrak-Nolte, Professor of Physics, Purdue University

Greg Rohrer, Professor and Department Head of Materials Science and Engineering, Carnegie Mellon University

Greg Schenter, Laboratory Fellow in the Physical Sciences Division, Pacific Northwest National Laboratory

Greg Scholes, Professor of Chemistry, Princeton University

Bob Westervelt, Professor of Applied Physics, Harvard University

Michael White, Senior Chemist, Brookhaven National Laboratory, and Professor of Chemistry, SUNY at Stony Brook

Hub Panel

Ernest Hall, GE Global Research, co-chair of hub panel

Clyde Briant, Professor of Engineering, Brown University

Laura Greene, Professor of Physics, Florida State University and National High Field Magnetic Laboratory

Robert Hamers, Steenbock Professor of Physical Science, University of Wisconsin, Madison

Tom Lograsso, Deputy Director, Division of Materials Science & Engineering, Ames Laboratory

Eric Schwegler, Quantum Simulations Group Leader, Condensed Matter and Materials Division, Lawrence Livermore National Laboratory

Mary Beth Williams*, Professor of Chemistry and Associate Dean for Undergraduate Education, Penn State University, *unable to attend

Members of the hub panel were not involved with any hub proposal and are currently not employed at any institution connected with a hub proposal or award. Members of the EFRC panel who were involved with an EFRC proposal or who are members of a current EFRC were not allowed to view files associated with that proposal/award. In addition, EFRC panelists were not given access to files related to a proposal or award associated with their home institutions.

IV. REVIEW PROCESS

The agenda for the COV is attached as Appendix II.

Prior to convening, each COV member was supplied with the link to the EFRCs and hubs COV website containing a comprehensive set of information pertaining to: the COV process, report templates and checklists, Funding Opportunity Announcements (FOAs), technical summaries, facts sheets, web links to each of the programs, the 2013 COV report on the EFRCs and hubs and the responses, and the Secretary of Energy Advisory Board 2014 Hubs+ Report. The availability of information relevant for the review in advance greatly assisted the COV in being well prepared and organized to assess a large amount of material very efficiently. Additional information was also supplied to each member during the COV review in Gaithersburg, including copies of the plenary presentations and an overview of the EFRC and hub programs. The majority of the COV review focused on electronic files, including proposals, award selection, management and science reviews, annual reports, meetings, and program statistics.

The COV meeting began with a reiteration of the charge to the committee given by BESAC chair, Prof. John Hemminger. Dr. Harriet Kung, Director of BES, presented an overview of the EFRC and hub programs within BES. Dr. Gail McLean, acting director of the Chemical Sciences, Geosciences and Biosciences Division then presented an overview of the JCAP Hub, followed by an overview of the JCESR Hub presented by Dr. Linda Horton, director of the Materials Science and Engineering Division and an overview of the EFRCs presented by the Team Lead for the EFRCs, Dr. Andrew Schwartz. These presentations were followed by detailed instructions about the review procedures and schedule by Prof. Sylvia Ceyer, chair of the COV.

The COV then broke up into the two panels for a detailed orientation of the electronic files available for review. Discussion of EFRCs and hub procedures continued through a working lunch with COV members and BES staff. Each panel member was supplied with electronic copies of proposals to evaluate the award/decline/monitor process and subsequent management operations. Files included declined proposals, awards, documents describing review and management procedures, and management/review notes and activities following the selection of awardees. Each panel member also had a tracking list of all the available electronic files so that each panelist could keep track of the material examined.

Following lunch, BES program managers left the rooms but were on hand to answer questions and provide additional input as needed. The panels were also free to request additional information that they judged would be helpful in their evaluation process.

The first reading of the files occupied most of the remainder of the first afternoon. Both panels concentrated on the award processes, along with addressing the question of the breadth and depth of the successful EFRCs and hubs, as shown on the EFRC and hub checklists attached as Appendices III and IV. Discussions regarding the preliminary findings about the award processes and results were held within each panel and then were shared with the entire COV in an executive session. Finally, the COV met with BES program managers to clarify some issues that came up during the first read. The tracking lists from each panel member were collected and compiled by BES staff. The compiled list was made available to the co-chairs so that they could determine if essential material had not been read. The day concluded with a working dinner that included BES staff.

The second read took place during the morning of the second day. Both panels concentrated on BES's management processes, along with addressing the question of the national and international standings of the funded EFRCs and hubs, again as shown on the EFRC and hub checklists attached as Appendices III and IV.

Following a working lunch, the panels began the final read. The final read was intended to review material that had not been covered in the two previous reads or to read material with an eye to refining preliminary conclusions. Writing assignments were also made during this session and writing commenced. Report templates for the EFRC and hub panels are included in Appendix V and VI. At the end of the afternoon, the entire COV convened to review the findings of both panels and to begin to solidify the recommendations. The COV did not find it necessary to meet with BES staff for the purpose of addressing questions at the end of the second day.

During the evening, the chair drafted a document discussing the major findings and recommendations that was circulated electronically to the panelists.

On the morning of the third day, the panels initially met separately to finalize the writing of the panel reports and then the COV met in executive session to finalize the major findings and recommendations before presentation of such to BES leadership and the EFRC and hub program managers. The meeting adjourned at noon on November 17, 2016.

The major conclusions and recommendations drawn from the executive session are discussed in Sections V and VI, while the detailed written reports from the panels are provided in Sections VII and VIII.

V. MAJOR FINDINGS

The COV finds that the world leading fundamental science that emerges from and has the potential to emerge from the EFRCs and Energy Innovation Hubs presents a compelling case for the role of fundamental research in addressing our nation's energy needs. Much of the success stems from the center and hub construct, through which investigators organize as teams to solve broad-reaching problems in basic energy science.

A. Award Processes

1. EFRC

The BES team has constructed rigorous processes for proposal solicitation, review and award of EFRCs. The program staff has demonstrated remarkable efficiency in handling a very large number of simultaneous proposal submissions and reviews, and excellent judgment in the final awards. It is clear, however, that the reviewer pool is deeper in expertise and the reviewing process is more thorough when a smaller number of simultaneous proposals are evaluated. Fewer simultaneous proposals may also lead to more comprehensive justification of declined proposals.

2. Energy Innovation Hubs

The COV found that the decision to restrict eligibility for the renewal proposal of the Fuels from Sunlight Hub was made using a disciplined process that included recommendations of the SEAB 2014 Hubs+ report and careful consideration by DOE leadership. For the Electrical Storage Innovation Hub, the solicitation processes were thorough and conducted well. The pre-FOA informational meeting was a good practice; the FOA clearly defined the elements of a hub and the necessary components for a hub effort: a multidisciplinary team, definition of transformative solutions, an effective and successful management structure, quality assurance plans, and capability to span basic research to engineering and technology development. The review plan for the proposals was rigorous and commensurate with the scope and breadth of an Innovation Hub.

B. Management Processes

1. EFRC

The BES management process ensures effective stewardship of federal resources by providing detailed, expert feedback to both center participants and BES-DOE leadership, enabling timely redirection of funds towards the most promising lines of investigation both within and across centers. In particular, it has instituted mechanisms to make effective management within a center a top priority, instilling best practices from the outset. The cornerstone of the EFRC evaluation process is a daylong midterm review. It provides BES management and center directors with the data and advice needed for effective asset reallocation and course adjustment. The success of this management strategy is demonstrated, in part, by the high impact of the EFRC research.

The EFRC program has also developed effective mechanisms to ensure timely communication to all stakeholders, from the general public to Congressional staffers to a broad cross-section of energy researchers.

2. Energy Innovation Hubs

Overall, the hub management processes are extensive, logical, and disciplined. Tools and documentation include a detailed oversight plan, monthly teleconferences, quarterly reports, and an annual report. The effectiveness of the oversight process was demonstrated during the first phase of the JCAP Hub, when, in response to on-site review feedback and BES-DOE oversight, changes were made in its leadership and research direction to emphasize a more disciplined project plan and more innovative, high-risk research. This transition was accomplished effectively while maintaining project momentum that has continued into JCAP-II.

BES has shown growth in its ability to oversee projects on the scale of a hub, as demonstrated by the fast start-up and excellent productivity of the JCESR Hub. In response to BES review guidance, JCESR has introduced effective measures, such as the SPRINT process and interaction with ARPA-E, EERE, and the related EFRCs.

VI. MAJOR RECOMMENDATIONS

1. The COV recommends that BES explore mechanisms to reduce the number of full EFRC proposals that must be evaluated simultaneously as the result of broad FOAs.

2. The COV unanimously believes that the minimum time period for maximal output from the EFRCs is 5 years.

3. The COV recommends that a final 5-year summary, written in language that is widely accessible, be required at the end of a hub award, irrespective of renewal. The final report should focus on the "retroactive measure of transformational impact," as urged in the SEAB Hubs+ report.

4. BES-DOE should develop a process to gauge the international standing of the hubs.

5. The COV recommends that the EFRCs, hubs and reviewers produce more concise and clear report and review documents, respectively. In particular, reports should include, for example, executive summaries and succinct descriptions of major accomplishments, and have page limits.

6. Currently, insufficient travel funds are available for BES program managers to attend site visits, to stay engaged with the community and to keep abreast of rapidly evolving fields. This issue must be addressed.

VII. EFRC PANEL REPORT

A. EFFICACY AND QUALITY OF PROCESSES FOR EFRC SELECTION AND BES MANAGEMENT OVERSIGHT

1. BES Processes to Solicit, Review, Recommend and Document Proposal Actions

a. Findings

As noted by the 2013 COV, the 2016 COV found that the EFRC procurement processes resulted in the funding of research centers of extraordinary quality, led by internationally recognized and highly accomplished scientists, and that possess high potential for substantive scientific impact in areas relevant to the BES-DOE mission. The high quality and productivity of the centers selected for funding are clearly evident in the documentation of the initial review process and, more importantly, in the mid-term reviews of centers selected for support.

The COV evaluated two different Funding Opportunity Announcements: a broad call in 2014 and a more targeted one in 2016. The COV recognized that the benefit of a broad call is the possibility of funding a diverse palate of research that addresses a broad range of problems critical to energy science. However, this positive attribute has an associated disadvantage of a large number of simultaneous proposal submissions that results in a significant reduction in the size and depth of the reviewer pool available to evaluate proposals. Despite the considerable challenge of reviewing such a large number (229) of proposals, the COV panel notes that the BES staff expertly managed the review process. The COV commends the BES staff for responding to the 2013 COV suggestion to implement a 2-stage review process (mail review as first stage, panel review as second stage), and to provide additional documentation for the rationale underlying the funding decisions of proposals evaluated by the panel. In particular, the COV noted that the 2-page summaries of the results of the panel reviews were extremely useful. There was less documentation and in many cases no documentation for the rationale for some proposals not being advanced to the second stage of review, despite achievement of competitive ratings in the first stage.

Given the constraints on the domestic reviewer pool, the COV found that the balance of international and domestic reviewers in the 2014 FOA review teams was reasonable. The reviewers constituted a broad spectrum of researchers who possessed sufficient expertise to evaluate these complex proposals. The perspectives offered by the international reviewers were valuable.

The topics for the 2016 FOA were well focused and the rationale for the topic choices was clearly explained. References to the key related Basic Research Needs Reports were listed in the call with built-in links to the documents. A nice feature of targeted FOAs is the inclusion of specific guidance about research that is considered outside the scope. The 2016 FOA document stated multiple times in boldface, that certain research was outside of the scope of the call, thereby eliminating tangential proposals that would have added to the review burden.

The revised scope of research and associated budget documents were informative. Of those sampled, there was considerable variation where documents describing the revision of scope

ranged from one to eight pages. The COV considered the former too brief and the latter too detailed. Most documents were reasonably clear with respect to which activities would be cut. Some of them included a justification for the reduced scope based upon the reviews. However, a comparison of the eliminated activities to the entire effort was generally lacking. A simple graphic illustrating the activities retained versus those terminated would be useful.

b. Comments

When possible, all targeted FOAs should clearly delineate research areas that are outside of the scope of the call, as was done for the 2016 FOA.

The time allotted between the FOA and the full proposal due date may tend to favor individuals already engaged with DOE and/or institutions with substantial support for preparation of proposals on the scale of an EFRC. Center proposals require significant effort to craft a synergistic team to attack challenging, critical topics relevant to the mission of BES, and to produce a high quality document for submission. The COV suggests that BES look for ways to alert broadly the community of impending EFRC calls that include the focus of the FOA in terms of grand challenges and the potential time frame.

The questionnaire provided to the mail reviewers contained considerable detail. Although the instructions were clear to the COV, too many reviewers took the approach of providing yes/no answers to each of the individual questions, instead of providing a more detailed perspective. By contrast, the questions posed for the mid-term review questionnaire led to deeper and more thoughtful answers. We suggest that some simplification of the mail review questionnaire may lead to more substantive written opinions.

More thorough documentation for the declination of proposals after the first stage of mail reviews is necessary.

No statistics concerning representation of women and minorities as PIs in submitted or awarded proposals or amongst reviewers were available to the COV. The DOE might consider asking for voluntary self-reporting of gender and ethnicity to track and evaluate participation of members of these groups in its programs.

c. Recommendation

The COV recommends that BES explore mechanisms to reduce the number of full proposals that must be evaluated simultaneously as the result of broad FOAs. The goal of this recommendation is not to limit the opportunity but rather to scale the review workload to a more manageable size and to enhance further the efficacy of the review process, including more thorough documentation of declinations. As stated by the 2013 COV, possible options are inclusion of a pre-proposal stage, institutional limitations on the number of proposals that can be submitted, or more extensive use of targeted FOAs. Of these options, the COV favored the creation of a pre-proposal process. It would significantly benefit the reviewers and BES by (1) reducing the number of full proposals to be reviewed, (2) improving the quality of the reviewer

pool by reducing the number of conflicted reviewers, and (3) providing BES with an opportunity, if desired, to imprint programmatic needs at an early stage in the proposal development process. In this context, one possible approach discussed by the COV was a reversal of the order of the panel and mail-in reviews, i.e., have a panel evaluate pre-proposals, followed by more detailed mail-in reviews for those proposals chosen to advance to the second stage of review. A relatively small number of individuals would be required to review the pre-proposals, opening up a much larger pool of highly qualified reviewers for the more time-consuming task of reviewing full proposals.

The COV believes that it is important to provide BES staff with sufficient flexibility to craft approaches that balance all factors involved in this process. Therefore, we are not recommending a specific approach but simply wish to stress the importance of the end-goal, namely addressing the problem of too many proposals having to be reviewed simultaneously by BES personnel and the scientific community.

2. BES Management Processes for EFRCs

a. Findings

The panel commends the entire EFRC team within BES for their excellent and meticulous management of this large BES-DOE program. The EFRC team clearly has a deep and sophisticated understanding of management issues along with the ability to weigh multiple peer reviewer comments in perspective.

The management of the EFRC program has, in part, facilitated a very successful research portfolio. These centers enable multi-PI efforts essential in many areas of use-inspired research, producing outcomes that are more synergistic and unique than what might be expected from a collection of individual projects. Overall, it is noted that EFRCs' achievements are outstanding and include an exceptional number of high-impact breakthroughs by excellent scientists.

BES has carefully described the scope and character of good management practices to be used in the EFRCs. Such continuing direction and feedback differentiate EFRCs from many standard regular projects and ensure that the DOE investment will have the maximum possible impact and success. This oversight is clearly reflected in EFRC summaries, reports, and overviews.

In particular, BES developed, initially for the 2009 EFRC management and operations review, an excellent "EFRC Management Reference Document" that describes management best practices. While this document recognizes that there is no one best way to run a center, it gives examples of and rationales for useful activities, processes and procedures.

The early management review is particularly effective. Based on the expert reviews and presentations by EFRC teams, BES provided helpful and specific feedback on management practices that included mandatory action items to which the EFRCs rapidly and substantively responded.

The success of EFRCs is strongly enhanced by its effective management structure, as noted by peer reviewers. Management structures and advisory boards provide ongoing internal feedback to EFRCs and BES program managers on research thrusts and successful outcomes. The COV panel found that EFRCs tend to respond nimbly to such advice by modifying teams (including PIs) and exploring new research directions. This approach has improved impact and reinforced the trajectory of EFRCs towards their missions.

i. Communications to and among EFRCs: Findings

BES has developed effective mechanisms within the EFRC program to ensure timely communication between all stakeholders, from the general public, to Congressional staffers, to a broad cross-section of energy researchers, and to and from the BES staff and the EFRC directors. These communications are tailored to different communities, ranging from one-page highlights of recent discoveries to two-page technical summaries of the vision of individual centers to in-depth annual reports of specific research thrusts. In particular, the annual EFRC Fact Sheet is particularly useful in understanding a center's impact over time while the two-page technical summaries, which start with a concise mission statement followed by a high-level overview of center activities and personnel, are a very effective means of conveying the breadth of a center's program. The COV panel was impressed with the clarity and utility of these summaries.

In addition, the EFRC program maintains an effective website that contains a wide range of useful information, including a booklet of current technical reports. This website also links to all current centers, which provides an easy portal for the public, other EFRCs, and interested researchers. The panel found this site provided an easy means to examine activities in the EFRC community and to obtain short listings of PIs, recent discoveries, publications, etc. It would be useful to widely disseminate this web site resource to other BES scientists.

The BES program managers have communicated regularly and effectively with EFRC directors. Feedback to EFRC directors has been clear and constructive. Communication and engagement has included some site visits in addition to the regularly scheduled reports and reviews.

Nevertheless, ongoing restrictions on DOE staff travel, due to both the recently implemented near-complete ban as well as the longer term cut backs, will have deleterious effects on the efficacy of BES's program management. The panel is concerned that this behavior is "penny wise and pound foolish." As one example, mid-term site visits have a number of advantages over the current mid-term reverse site visits. First, the lowered travel costs inherent in a site visit would be fiscally advantageous while also enabling the participation of a broader cross-section of center participants. Instead of the handful of PIs and students/postdocs who are currently involved, a site visit would enable near-complete participation of an entire EFRC. Second, both the panel and program officers would gain a greater understanding of the center environment and operations through, for example, facility tours. Third, a site visit would enable the panel to be tailored to an individual center's research thrust, instead of the current configuration, in which each panel reviews multiple centers over the course of a few days. The

tailored panel could potentially offer more useful feedback, and the reduced workload per reviewer may encourage broader participation by busy peer researchers.

The travel restrictions also impact BES program management outside the context of the mid-term reviews. To be effective stewards and advocates for the EFRC program, the program officers need a broad view of activities within their programs as well as timely information about new developments in the broader community. For this reason, program officers must be able to attend national and international conferences to stay abreast of these rapidly evolving fields, and they must be able to pay informal visits to centers under their jurisdiction, particularly to the secondary campuses of active centers.

The biennial PI meetings were judged to be an important value-added component to the program. These multiday meetings enable dissemination of new ideas and approaches across the EFRC program while also serving as an important means for stimulating cross-EFRC collaborations. These meetings are also important training venues for graduate students and postdocs, enabling these young researchers to develop their communication skills and their professional networks, as well as ideal venues for one-on-one discussions between center leaders, enabling frank discussions of common concerns. The panel recognizes that the current PI meetings cannot involve all PIs, for both logistical and financial reasons.

The panel had mixed feelings about the value of the monthly conference calls between BES program officers and EFRC leaders. On the one hand, these calls undoubtedly create a sense of unity amongst the EFRCs and serve as an important means by which program officers stay up-to-date and conversant with recent EFRC advances — something that is surely to be encouraged! On the other hand, the value of these phone calls to the EFRC directors was somewhat less clear. While some panelists thought these calls might be a good venue for the discussion of management issues (*e.g.,* reallocating resources, less productive PIs), others thought that such issues were best discussed through one-on-one conversations with the program manager.

Generally speaking, there is ample communication, both oral and written, between BES program directors, EFRC directors, and EFRC researchers. While no one communication task is onerous, the panel did have some concerns that — when taken as a whole — the multitude of reporting requirements may be diverting resources that could be more effective elsewhere.

ii. Annual Report: Findings

Each year, EFRC directors are required to file an annual report that serves as a dynamic vehicle for BES to accumulate comprehensive annual data for each EFRC. Specific and detailed instructions, including templates, spreadsheets and FAQs, are provided to directors to help make the reports informative and consistent. All EFRC's are also asked to enter their publications, with acknowledgments, on the EFRC website. However, many annual reports are extremely long and filled with technical details perhaps more appropriate to publications. Missing from many annual reports is a limited-page-length executive summary (requested in

the BES annual report instructions prior to 2016) and a slightly longer summary. Inclusion of such would be useful for program officers, future review panels, as well as the center leadership. The summary should include a brief mission statement, highlights of notable results from the previous year, summary statistics (*e.g.,* publications, diversity), as well as a brief description of any planned changes, including significant personnel changes, for the coming year.

iii. Peer Reviews: Findings

For ease of administration, the EFRCs are divided into thematic-based color groups, chosen as a mechanism to conveniently organize the large number of centers. Each color group was evaluated simultaneously in two important reviews: the management review and the two-year mid-term review. The panel found that both the technical and management expertise of the selected reviewers was excellent. The *Panel Review Debrief* slides for the mid-term review nicely captured a clear summary of both the reviewers' comments and program action items and recommendations.

2015 Management Review

Peer scientists and engineers, selected for their experience in research management, evaluate the management plans of each new EFRC shortly after it begins operation. The early review process reinforces the importance of effective management to new center managers and provides a mechanism by which new centers obtain needed advice and feedback before problems arise. The COV panel deemed the quality of the management review panel members to be high. The questions posed of the management reviewers by BES were appropriate and on target. Evaluations written by the reviewers were thoughtful, and provided specific and practical advice. The review process appears to offer critical and timely feedback.

After evaluating the reviews, BES program managers send a guidance letter, which may contain a list of recommendations and/or specific action items, to the EFRC directors. Recommendations are meant to provide useful advice, but do not require a response, while a response is required for each action item. The system works well. Of the 10 new EFRCs, BES requested responses to action items from six centers and received them.

In summary, BES has made effective management within an EFRC a top priority by developing a constructive management review that instills best practices at the outset.

2016 Midterm Review

The midterm scientific reviews were well organized and effective in ensuring the success and quality of the centers. Review panels were charged with evaluating about three EFRCs within a common or related area of scientific focus. The identification of common scientific focus allowed selection of reviewers with greater scientific expertise in that focus area. It also allowed the reviewers to more effectively evaluate cross-fertilization among the centers.

The COV panel found that the *Panel Review Debrief* slides were very effective and focused. Strengths and concerns were clearly articulated, as were recommendations and action items.

There was a noticeable improvement in the quality, scientific stature and effectiveness of the reviewers over those in the 2014 competition/selection stage. Following the review, BES sends a guidance letter recapitulating the comments and recommendations. It was apparent that course corrections to personnel and scientific focus are effectively addressed at this mid-stage of the center's award. Modification of funding in response to this review allows BES to emphasize the importance of collaborative and synergistic activities associated with the EFRC effort, thereby enhancing the impact and quality of the work.

b. Comments

Comparison of management techniques between EFRCs through electronic and/or in person meetings is very useful. Problems encountered in one center may have been successfully solved in another, and dialogs about management techniques, as well as ongoing research, speed the startup process.

The scientific community might find the EFRC Management Reference Document useful at the EFRC proposal development stage, and the panel encourages BES to make this document available to proposers (*e.g.,* through the EFRC website).

Each EFRC must clearly state their goal and plan of action. However, a variety of different but overlapping terms are used in BES guides, *e.g.,* vision, aims, major goals, scientific objectives, research strategies, research plan, and mission. To avoid possible confusion, a simpler set of well-defined terms might be used.

An effective center should balance high-risk, innovative projects with a steady, system-based mode of operation. The panel noted that the EFRCs include relatively few seed projects, despite the fact that this funding modality is noted in the management best practice document provided to all EFRCs. Seed funding is an effective mechanism to bring in new ideas and people, particularly young PIs.

c. Recommendations

i. Communications

Currently, insufficient travel funds are available for BES program managers to attend site visits, to maintain engagement with the EFRC and scientific community, and to keep abreast of rapidly evolving fields by attending conferences. This issue must be addressed.

ii. Annual Report

The COV recommends that the EFRCs produce more concise and clear annual reports, including, for example, executive summaries, concise descriptions of key accomplishments in the form of brief summaries, and page limits.

B. IMPACT AND STANDING OF THE EFRCs

1. Breadth and Depth of EFRC Awards

a. Findings

The proposals funded as a result of both the 2014 FOA and the 2016-targeted FOA represent research areas that are central to the mission of DOE and BES. The COV felt that there was an appropriate mix of fundamental research targets as well as "use-inspired" topics that resulted in a balanced portfolio. The scope of topics addressed by funded EFRCs is impressive. Topics include cellulose in plant walls, applications of metal-organic frameworks, plasmonics, photosynthesis, energy storage, geochemical carbon sequestration, uranium recovery, and innovative applications of two-dimensional materials. It is commendable that a wide range of fields are represented, each contributing in a meaningful way to advancing basic energy science.

In general, the proposed EFRCs were ambitious and had mission statements that challenge the forefront of fields. The successful proposals convinced the reviewers, panel, and BES staff that there was a realistic path towards these ambitions. Reviewers generally commented on innovation and risk, but specific requests for evaluation of these elements were obscured in the complexity of the review form. The FOA asked for Grand Challenges to be addressed, but this goal was not clearly evaluated in the reviews. Instead, key words like "merit" and "appropriateness of methods" are emphasized, which tend to suggest a more conservative approach to the science.

The 2014 awards were characterized by a reduction in both funding level and award duration. Specifically, EFRCs funded in 2014 and 2016 are supported for 4 years instead of the 5 year duration of the 2009 awards and at an anticipated level of $2-4M/year as opposed to the previous level of $2-5M/year. BES staff members were helpful in explaining the rationale behind this change to the COV panel. The reduction in funding was resource-limited, whereas the shortened duration of the award was based on the desirability of having a new call every 2 years as a means of keeping the program vibrant and allowing the community to remain actively engaged in pursuing new research ideas of relevance to DOE and BES.

b. Comments

Proposers of EFRCs should be challenged to conceive innovative directions, and explicit reviewer comments or a score on "balance of innovation and risk" would be appropriate in future evaluations.

The rationale behind the topical choice for the 2016-targeted FOA was clearly described. However, BES staff might want to consider whether it would be useful to provide some guidance for broad calls moving forward with regard to scientific thrusts that they believe are either over- or under-represented in the current EFRC portfolio. Presently, the community is likely making this decision on its own in terms of anticipating the level of competition for EFRCs focused on topics that are already well represented within the program.

The COV appreciated the points raised by BES staff and indeed praised BES for their desire to have recurring opportunities to improve and/or expand the highly successful EFRC program. However, given the time required for the development of the complex, multi-disciplinary projects that are inherent to the very nature of EFRCs, concern that the four-year duration of the funded grant was not optimal for maximum scientific impact was voiced.

c. Recommendation

It was the unanimous opinion of the COV that BES consider mechanisms to maintain the recurrence of new FOAs within the context of a 5-year funding model.

2. National and International Standing of the EFRCs

a. Findings

The PIs of the funded EFRCs are generally well recognized as national and international leaders in their respective fields, with many of the lead PIs having experience managing large groups, team projects, or other organizations. This impression is reinforced by the generally strong, positive comments from the mid-term review committees concerning the EFRC personnel. Due to the interdisciplinary nature of EFRC research, the range of expertise of the participating PIs is also immense and has generally broadened the participation of the scientific community involved in energy research funded by DOE.

There are now 36 EFRCs, including 22 of the original 46 EFRCs that were initiated in 2009 and renewed in 2014, 10 new EFRCs that were initiated in 2014, and 4 new EFRCs dealing with nuclear waste that were added in 2016.

The renewed EFRCs have superb track records and, as a result of their maturity, could articulate strong mission statements backed up by compelling research plans, tremendous records of impact and proven management structures. The challenge for renewal proposals was to differentiate the next phase of the EFRC from the first iteration to make a strong case for innovation and risk.

While it is too early to assess the scientific impact of the 10 EFRCs that were established in 2014, the general impression at the two-year mark is that the PIs and their co-workers are coming together well. There is clear evidence of jointly authored publications in high impact journals, and we expect that the productivity and measured impact of these centers will continue to increase. All of the younger EFRCs appear to be fully staffed with principal investigators and their graduate student and postdoctoral co-workers.

The EFRCs are making impressive contributions to the advancement of the fundamental science that enables the development of promising new sources of energy. The research portfolio of the EFRCs also addresses many of the Grand Challenges that have been identified by BES as key to fundamental and transformative discoveries. In general, the EFRCs represent research efforts that tackle scientific problems of a scope and degree of complexity beyond what could be accomplished by small group collaborative efforts, and most often involve the combination

of both university and DOE-supported national lab resources. Integration of theory as a guide to experimental design is also a hallmark of most of the EFRC programs, which has the benefit of pushing theory to increasing levels of complexity.

In terms of measureable productivity, the EFRCs have generated over 1000 publications since 2014 (>2800 since 2009) that are fully attributable to EFRC funding (over 7600 papers with multiple funding sources), with many appearing in high impact journals, which in turn leads to widespread dissemination of the results. Many highly visible and important discoveries have been reported. Examples include ground-breaking advances in binding and releasing CO_2 from metal-organic frameworks, new solar cells with record power conversion efficiencies, advances that influence the future of thermoelectrics, new kinds of materials for advanced energy storage, and effective ways to fabricate electrodes for energy-efficient organic electronics. The technology impact of the EFRCs is evident by the large number of patent applications (>550), licensing agreements (>80), and start-up companies that are off-shoots of specific EFRC research in areas such as biofuels and solar energy conversion.

The EFRCs are also contributing to the training of the next generation of scientists with over 1000 graduate students and post docs participating in EFRC funded research (FY 2016). Of the student and post doc alumni, about 30% now hold university faculty and staff positions, 50% are employed in industry, and 20% are employed in national laboratory, government and not-for profit positions.

b. Comments

None

c. Recommendations

None

VIII. HUB PANEL REPORT

A. EFFICACY AND QUALITY OF PROCESSES FOR HUB RENEWAL/SELECTION AND BES MANAGEMENT OVERSIGHT

1. BES Processes to Solicit, Review, Recommend, and Document Proposal Actions

a. JCAP

i. Findings - JCAP

The COV found that the decision to restrict eligibility for the renewal proposal of the Fuels from Sunlight Hub was made by using a disciplined process that included the recommendations of the SEAB 2014 Hubs+ report and careful consideration by BES-DOE leadership. This decision was justified with several points. While it was recognized that JCAP's initial five-year period had not been as productive as desired, BES felt that progress had been substantial in the final two years of the initial award under new leadership. Furthermore, the investment made in the existing hub and the time and effort that would be required to start a new hub argued for the continuation of JCAP. JCAP's decision to emphasize photochemical CO_2 reduction was appropriately justified as an area that would leverage their five-year experience in infrastructure building, while also requiring greater creativity and a focus on a very challenging problem.

The Funding Opportunity Announcement (FOA) was considered adequate, as was the response to the FOA. The review process was also adequate and appropriate. Six reviewers, three from national labs and three from universities, including two women and one international representative, provided very extensive and thoughtful reviews in some cases that were generally supportive of the renewal and provided many specific recommendations. However, it was noted that the overall group of six reviewers is quite small for an effort of this size. While a few reviews mostly reiterated what was in the proposal, several very high quality reviews pointed out strengths, weaknesses, and made specific recommendations both to the PIs and to BES. BES distilled the reviewer input into specific action items in the Renewal Notification Letter, including addressing staffing concerns, the need for a "ramp-down" transition plan, and a requirement for a detailed project plan with clear technical milestones. The proposers were responsive to this letter.

ii. Comments - JCAP

With regard to the review, it was surprising that there did not appear to be anyone on the review panel with experience specifically with CO_2 reduction. Two scientists experienced in this area and invited to participate as reviewers declined. As a result, while the reviewers chosen are well-known scientists, there was no one on the review committee with specific expertise in the core area of the hub. It was also surprising to see two business school faculty on the suggested reviewer list (neither of whom participated), and while such participation might well be valid, it was not clear if these individuals had sufficient scientific knowledge. It was noted that the time between proposal submission (due date December 29) and a merit review panel (January 12-13) was extraordinarily short.

The Merit Review Evaluation Plan for JCAP and JCESR called for "not fewer than 3" reviewers. For a program of the size of a hub, BES practice is to have significantly more reviewers than this, and so it would seem appropriate to modify the language in the plan document to reflect this practice.

Because many of the written reviews are very extensive and dive deeply into technical issues, we recommend that the merit review forms be modified so that each reviewer provides an executive summary of the review, such as enumerating the three most positive aspects and three most significant concerns.

b. JCESR

i. Findings

The FOA clearly defines the elements of a hub and the necessary components that will define a hub effort: a multidisciplinary team, definition of transformative solutions, an effective and successful management structure, quality assurance plans, and a span from basic research to engineering and technology development. Scientific and technical objectives with defined goals in application space are clearly stated (e.g., "…accelerate the discovery of new electrochemical energy storage concepts and incorporate these into prototypes…"). Additionally and prior to the solicitation being released, an informational meeting on the current research portfolio across DOE's Science and Technology Offices allowed potential proposers to understand how an Innovation Hub science and technology program would fit into the overall energy storage strategy. Given the size and scope of an Innovation Hub, we found the informational meeting to be a noteworthy practice.

The solicitation process for the Electrical Storage Innovation Hub resulted in 10 applications. Five of the applications were found to be responsive to the FOA. The FOA clearly identified the scope and technical goals for a hub and the non-responsive proposals either did not address the technical topics or failed to be compliant with the FOA terms and conditions for eligibility.

Given the scope and nature of the FOA, a merit review plan was approved that used a two-step process: a mail-in review and a panel review. The COV found the review plan to be rigorous and commensurate with the scope and breadth of an Innovation Hub. Overall, the mail-in reviewer team was well balanced (university, national laboratory, and industry; domestic and international; gender) and was judged to have the appropriate expertise for the breadth of the scientific and technical objectives. Each proposal was evaluated by 11-13 reviewers except for one proposal that was evaluated by 8 reviewers. A subset of the mail reviewer team served as panel review members. The COV panel found that the instructions and guidance to the panel reviewers on selection criteria and process was adequate and that the review process was well documented. The panel review team membership was also well balanced and had broad, excellent expertise. All reviewers (mail-in and on-site panel) produced a single average score and these scores were consistent with the award result. There is a good spread of scores from

the highest to the lower rated proposals, indicating that the reviewers made good differentiations.

Of the five proposals, the Joint Center for Electrical Storage Research (JCESR), led by Argonne National Laboratory, received the highest ratings, far above the ratings for the other applicants. Most comments from reviewers followed BES guidance, highlighting strengths and weaknesses in each of the selection criterion. The overall ranking of the applicant was consistent with the relative strengths/weakness for each criterion. For a given proposal, individual reviewer rankings spanned the range of available choices indicative of the critical nature of the reviews.

The JCESR proposal presented a visionary and compelling scientific plan for transformative development of new battery systems. An ambitious goal of increasing power density by a factor of 5, at 1/5 the cost, and in 5 years (5-5-5), was set for transportation and grid applications. The research strategy uses a multidisciplinary and integrated approach, focused on three areas: multivalent intercalation, chemical transformation, and non-aqueous redox flow that would lead to prototype demonstrations. A strong industrial component was considered advantageous to transition the technology. Overall, the management structure was judged to be very strong.

The procedures and actions taken throughout the process of soliciting and selecting the JCESR Innovation Hub were carefully documented. BES provided detailed information on its policies and procedures for these activities in the FOA, Merit Review Evaluation Plan (MREP), MREP Implementation Plan, and DOE Oversight Plan. In all of these documents, BES expectations were clearly defined and appropriate guidance was provided to the review team and hub leadership, in both oral and written communications.

ii. Comment - JCESR

The COV found that the informational meeting in the pre-FOA stage to be an excellent practice, allowing DOE to identify and delineate the research topic areas in the Electrical Storage FOA with respect to DOE's existing research portfolio.

c. Recommendation – JCAP

The BES processes used for the renewal of JCAP were judged to be excellent. They took into account past investment, past performance and potential for new discovery and followed the recommendations of the SEAB Hubs+ Report. It is recommended that these processes be well documented for the record so that similar ones can be used for future hub renewals.

2. BES Management Processes for Hubs

a. JCAP

i. Findings - JCAP

Overall, the management processes used by BES-DOE for the JCAP Hub were extensive, logical, and disciplined. Tools and documentation included monthly teleconferences, quarterly and annual reports, and on-site reviews. BES feedback was generally thorough and helpful.

The core document for oversight is the DOE Oversight Plan, modified slightly in 2013. It includes well-defined vision, mission, and goals; clear roles, responsibilities, authorities and accountabilities; and comprehensive performance metrics. Oversight mechanisms are also discussed. This document was judged to be excellent.

Both the JCAP management and BES-DOE management of JCAP has evolved significantly during the time period covered by this review. In 2013, a new director took over leadership of JCAP, in a smooth transition for which they are to be commended. It is clear that these changes were in part motivated by feedback from the on-site reviews organized by BES-DOE, which speaks to the power and usefulness of these reviews.

Because of these critical reviews, BES-DOE also recognized the need to institute changes in their management/oversight of JCAP. They requested clear milestones from JCAP for both the previous grant and for the renewal. In addition to monthly telephone calls and quarterly reports, self-assessment reports were instituted following the 2013 on-site review. All of these changes appear to have had a positive effect on the management of JCAP.

The new research focus of the JCAP renewal brought a corresponding change in the JCAP-II director and the addition of two co-directors. The project plan for JCAP-II was formulated in terms of specific high-level milestones, with additional milestone levels for more detailed tracking. This plan was seen as a very good format for judging progress. Quarterly reports in JCAP-II are specifically focused on tracking progress versus these milestones, based on template guidance from BES. The executive summary in the quarterly reports also seems to be a best practice. However, it was not clear from the documents presented to the COV whether there is a regular effort to jointly examine the milestones or progress measures to see if renegotiation, redefinition, or modification is necessary.

ii. Comments - JCAP

The current JCAP organization chart, included in many reports, shows a JCAP Integration Team and a JCAP User Facilities Expert Team. The document also describes an Instrumentation Committee that seems to be separate from the User Facilities Expert Team. Since each report is an independent document, it would be good to have some description of the makeup and role of these teams in the organizational chart. The chart also shows that JCAP is governed by a board of directors with representatives from Caltech and UCB/LBNL, but the composition of the board was not well described in the documents that were available to us.

The JCAP-I project-planning document for 2013 is somewhat overwhelming with a Gantt charge listing 750 identified tasks, which made it difficult to identify progress toward the most important milestones. JCAP-II changed the project planning document to a more effective one based on a much smaller number of milestones.

In 2013 Q4, there was a specific “summary analysis by BES” of the quarterly report. This evaluation was viewed by the COV as a good practice that BES may wish to continue. The COV

also commends the changes, including an executive summary and progress reported versus milestones, made to the quarterly reports beginning in the renewal period.

Finally, the committee feels that the milestones or progress measures should be examined at regular intervals to see if renegotiation, redefinition, or modification is necessary.

b. JCESR

i. Findings - JCESR

There has been extensive communications between BES and JCESR in teleconferences, memos, quarterly, and annual reports. BES has shown growth in its ability to manage projects on the scale of a hub, evidenced, for example, by their introduction of biweekly teleconferences. Before they were recently instituted, communication was not as regular. In addition, these biweekly teleconferences have become more than an improvement in communications with the development of template. The template allows progress to be easily noted and the resulting teleconferences folder has become a repository for information (such as highlights, changes, and publications), making the process of JCESR's development more transparent and manageable. It now seems that the teleconferences folder are the "go to place" for the JCESR hub status.

In Year 3, JCESR instituted the SPRINT process, which is a focus group that, on the scale of a few months, decides if a certain approach is worth continuing. This process appears to be extremely helpful. Not only does it help JCESR management decide pursuit directions, but it also keeps BES management in the loop. This process also leaves a "paper trail" for difficult decisions and showcases successes in new research directions.

Overall the BES management is excellent. The COV recognizes the difficulty in finding non-conflicted reviewers for the annual site reviews. During our visit, the COV requested more information on the reviewers and it was quickly supplied. We think that such information would be useful for future COVs – for transparency and an understanding of how reviewers were chosen. The quality of the written reviews was high: they were very detailed and addressed all aspects of the hub (science, technology, and management). The process BES-DOE uses to prepare the review team is excellent. We also note that there was a good balance between returning and new reviewers.

As an example, the information provided to the reviewers during the 2013 management review was complete. The choice of reviewers provided a high-level and broad purview: a range of well-established experts from industry, academia, and national labs, and most with experience with large research operations. The depth and detail of the written reviews were outstanding and very helpful to BES and JCESR. Comments were overall positive, but a few concerns led BES to present JCESR with three action items to which a response within 30 days was required, and with five recommendations.

The COV was impressed by the positive comments made by the reviewers about the management skills of the director of JCESR. It is clear that together, the current JCESR leadership represents an outstanding example of management of a large-scale research organization.

The Oversight Plan appears to be dynamic and flexible, with the right level of interaction to achieve the 5-5-5 goal.

JCESR, following BES guidance, has adopted a template for the quarterly reports, which ensures that progress is tracked versus milestones.

After three years of operation, it was readily apparent to the COV that JCESR is making steady progress on their goals. Their most notable scientific accomplishments are impactful and clearly would only have been possible to achieve with the highly multidisciplinary team environment that a hub structure provides:

- Development of a battery electrolyte and electrode theory database that includes contributions from over 16,000 molecules that is readily available to the public through the Materials Project.
- Elucidated the mechanisms and kinetics of Li_2S precipitation on nanoscale conductors.
- Developed system level designs (including anode, cathode and electrolyte compatibility issues) for multivalent intercalation batteries based on magnesium ions.
- Scalable designs for non-aqueous flow batteries for the grid that take advantage of off-the-shelf components.
- Design of high-performance size-selective membranes that prevent a major degradation mechanism in lithium-sulfur battery designs.

ii. Comments - JCESR

The change control documents seem often to document personnel changes after the fact. We understand that there is communication by phone and email before the changes are effective, but it would be good to show the paper trail documenting that BES and JCESR are in agreement about the changes before they happen. These notations could be a footnote in the biweekly teleconference notes.

BES is to be commended for the choice of reviewers, for responding to their concerns, and for implementing recommendations. BES's responsiveness made it possible for JCESR to quickly and efficiently respond with corrective actions.

c. Recommendations – JCAP and JCESR

The COV recommends that at the end of a hub award period, irrespective of renewal, that a final 5-year summary of accomplishments be required. Since **t**he SEAB Hubs+ report stresses the importance of a "retroactive measure of transformational impact" at the end of a hub program, it is recommended that the final report focus on this topic. The core language in this report should be accessible by a wide variety of interested parties, e.g., congressional staffers.

Many of the report and review documents are very lengthy and it can be difficult to navigate and determine the accomplishments, changes in research direction, and personnel changes. The COV recommends that additional guidance be given to produce more concise and clear documents, including page limits, short summaries of top accomplishments, etc. It would also seem appropriate for the hub to receive a brief response from BES to the report.

It is recommended that the lessons learned in developing the effective management of JCAP be recorded and used to manage other hubs and large programs at DOE where basic science must be coupled with clear milestones and research goals.

As recommendations and action items are addressed, the quarterly reports should describe how the changes are affecting the research ability and outcomes of the hubs.

B. IMPACT AND STANDING OF THE HUBS

1. Breadth and Depth of the Hub Awards

a. Findings - JCAP

In general, the BES award and oversight processes resulted in the selection of a hub proposal and team that was composed of outstanding, world-leading scientists at top US institutions. The original JCAP proposal was very high risk, required very significant innovation, and made an interdisciplinary approach mandatory.

By year 3 of JCAP-I, however, peer reviewers and BES-DOE management generally agreed that the JCAP team was pursuing a lower-risk strategy with more conventional materials. A deliberate and effective effort was then taken to redirect the research into higher risk, more innovative areas. These new avenues open more opportunities for substantive breakthroughs, and continue into JCAP-II with some of the original JCAP-I team. In addition, JCAP-II has more strongly integrated experiment with theory. The COV also notes improvements in collaboration and outreach in JCAP-II's operation in the form of greater interaction with related EFRCs.

The award scope, size and duration appear appropriate and in line with DOE's overall mission.

b. Findings - JCESR

The central mission of JCESR is to deliver energy storage systems with five times the energy density at one-fifth the cost of current commercial batteries within five years (the so-called 5-5-5 goal). This goal is, of course, very risky and will be difficult to achieve even with a multimillion-dollar investment such as JCESR. However, having this "stretch goal" has been important in focusing the overall scope and direction of the hub and has led to defining the following three legacy areas that JCESR will establish:

- A library of the fundamental science of the materials and phenomena of energy storage at the atomic and molecular scales;
- Two prototypes, one for transportation and another for the grid, that, when scaled up

to manufacturing, have the potential to meet JCESR's 5-5-5 mission;

- A new paradigm for battery R&D that integrates discovery science, battery design, research prototyping, and manufacturing collaboration in a single, highly interactive organization.

In order to realize these goals, JCESR has had to work hard to find the right balance between innovation, risk, and interdisciplinary research. An example of their management was the decision early on to discontinue research on Li-air battery designs given the unacceptably high level of risk involved. On the other hand, the focus on concepts beyond Li-ion system such as multivalent intercalation strategies or the use of high-energy chemical reactions (Li-S, Li-O, Na-S, etc.) was viewed as having the right amount of risk with the potential for significant rather than incremental advances, which is clearly appropriate given the award size and duration.

We note that BES management has been effective in helping JCESR evolve in their research directions. The implementation of SPRINTs, which were created by JCESR in response to BES observations from the annual review process, was particularly helpful for JCESR. We note that this organizational method may not be the best style for all research, but has been enormously effective for JCESR. We commend BES for providing the observation and guidance to JCESR management that led them to this particular research organizational structure.

The COV was in agreement that JCESR is highly relevant to the missions of BES and DOE and is well integrated with other programs, both internal and external to BES. In particular, the inclusion of the relevant program managers from ARPA-E and EERE on monthly conference calls has been particularly helpful in identifying crosscutting areas of research and in avoiding unnecessary duplication of effort between the JCESR and other DOE funded efforts. JCESR has also worked to establish an extensive network of meaningful collaborations with the external battery research community (58 non-JCESR institutions).

The COV are in agreement that the size and duration of the JCESR award is appropriate.

c. Comment – JCAP and JCESR

We do note that there is a 10-year "sunset clause," that prevents hubs from being granted a second renewal. As the hub concept develops and as this transformative method of research continues to demonstrate its worth, we hope that BES find ways to continue the existence of these research institutions into the future.

d. Recommendation – JCESR

Now that JCESR has completed the down select to two prototype designs, the COV recommends that BES provide guidance and monitoring to ensure that JCESR has the appropriate distribution of resources to pursue optimally these two designs.

2. National and International Standing

a. JCAP

i. Findings - JCAP

Clearly, JCAP is led by two of the top research institutions in the world and many of the participants have strong international research reputations. Since the redirection of JCAP-I in 2013, the publication output has been strong and continues to grow. However, it should be noted that there are other groups who are also working on CO_2 reduction and are making significant progress.

ii. Comment - JCAP

It is important that JCAP investigators recognize other groups who are working on CO_2 reduction in order to take full advantage of the totality of the knowledge base. A full understanding of this related work could speed up their research and technology development.

b. JCESR

i. Findings - JCESR

Although the initial publication rate for JCESR had been slow, it has improved considerably and is on target to exceed their goal of publishing at least 100 papers a year, including 25 multi-institutional publications and 20 invention disclosures. It is still too early to judge the overall impact of these publications on the broader research community, but it is encouraging to see that a large fraction of the JCESR publications have appeared in relatively high impact journals, and that in 2015, JCESR authored papers received over 1000 citations.

The current JCESR team involves a broad range of researchers from five national labs, ten universities, and five private sectors, all of whom are highly regarded and well known for carrying out world-class battery research.

ii. Comments - JCESR

The COV noted that in searching the web for the term “battery research,” JCESR receives the top hits. It is unclear how research at JCESR compares with other battery research centers throughout the world, such as RS2E and Batteries2020 in Europe. It would be good to see some comparisons, as well as evidence for communication among battery research institutions and laboratories on an international scale. We suspect such comparisons and exchanges exist, but their documentation would be appropriate.

c. Recommendations – JCAP and JCESR

DOE should develop a process to gauge the international standing of the hubs.

JCAP and JCESR should continue to work to build a strong international reputation for their researchers in their two fields.

APPENDIX I – Charge to Committee

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September 1, 2016

Professor Sylvia T. Ceyer
Department of Chemistry
Massachusetts Institute of Technology

Dear Sylvia:

The Basic Energy Sciences Advisory Committee (BESAC) has been charged by the Department of Energy's Office of Science to assemble a Committee of Visitors (COV) to review the Basic Energy Sciences (BES) procurement and management processes for the Energy Frontier Research Centers (EFRCs) and the two BES-managed Energy Innovation Hubs – the Joint Center for Artificial Photosynthesis (JCAP) and the Joint Center for Energy Storage Research (JCESR).

Thank you for agreeing to chair this BESAC COV panel. Under your leadership, the panel should provide an assessment of the processes used to solicit, review, recommend, and document proposal actions and to monitor active projects. The panel should assess the procurement and management of the programs during the following time periods:

(1) EFRCs and JCAP: 2013 – 2016
(2) JCESR: 2012 – 2016

The panel may examine any files from this period. Following the 2013 COV, we expect to structure the review into the following groups:

(1) EFRC Procurement
(2) EFRC Management
(3) Hub (JCAP and JCESR) Procurement and Management

You will be provided with background material on these program elements prior to the meeting. The COV is scheduled to take place Tuesday, November 15, 2016 through Thursday, November 17, 2016 at the Hilton Washington DC North/Gaithersburg hotel at 620 Perry Parkway, Gaithersburg, Maryland 20877. A presentation to BESAC is requested at the BESAC Winter 2017 meeting (scheduled for February 23, 24, 2017).

Following acceptance of the report by the full BESAC committee, the COV report with findings and recommendations will be presented to the Director of the Office of Science.

The Basic Energy Sciences Advisory Committee has given the panel the following charge:

(1) Assess the efficacy and quality of the processes used to:
    (a) solicit, review, recommend, and document proposal actions; and
    (b) monitor active projects.

(2) Within the boundaries defined by DOE missions and available funding, comment on how the award process has affected:
    (a) the breadth and depth of portfolio elements; and
    (b) the national and international standing of the portfolio elements.

If you have any questions regarding BESAC or its legalities, please contact Katie Runkles, Office of Basic Energy Sciences at (301) 903-6529 or via e-mail at katie.runkles@science.doe.gov. Kerry Hochberger, the Program Support Specialist for the EFRCs, will provide logistical support for the COV meeting. She may be contacted by phone at (301) 903-7661 or via e-mail at kerry.hochberger@science.doe.gov. For questions related to the overall COV, please contact Harriet Kung at (301) 903-0497, or via e-mail at harriet.kung@science.doe.gov. Also, if I can be of any help with the process, please feel free to contact me at (949) 824-6020 or via email at jchemmin@uci.edu.

Sincerely,

John C Hemminger

Digitally signed by John C. Hemminger
DN: cn=John C. Hemminger, o=UC Irvine, ou=Department of Chemistry, email=jchemmin@uci.edu, c=US
Date: 2016.09.01 09:36:46 -07'00'

John C. Hemminger
UC Irvine Distinguished Professor of Chemistry
Chair, Basic Energy Sciences Advisory Committee

APPENDIX II - Agenda

Tuesday, November 15, 2016

Time	Activity	Presenters, Participants	Location
7:30am - 8:30am	Continental Breakfast		Grand Ballroom Reception
8:30am - 8:40am	Introductions	All	Salons A, B, C
8:40am - 8:50am	Welcome and Charge to the Committee	John Hemminger, BESAC Chair	Salons A, B, C
8:50 am - 9:10am	Welcome and SC-BES Overview, including EFRCs and Hubs	Harriet Kung, BES Associate Director	Salons A, B, C
9:10am - 9:40am	Overview of JCAP Hub: Award Renewal and Management	Gail McLean, Team Lead for Photo- and Bio-Chemistry Chemical Sciences, Geosciences and Biosciences Division	Salons A, B, C
9:40am - 10:10am	Overview of JCESR Hub: Award Selection and Management	Linda Horton, Division Director Materials Sciences and Engineering Division	Salons A, B, C
10:10am - 10:30am	Break		
10:30am - 11:15am	Overview of EFRCs: Award Selection and Management	Andy Schwartz, Team Lead for EFRCs	Salons A, B, C
11:15am - 11:45am	Instructions, procedures, and schedule	Sylvia Ceyer, COV Chair	Salons A, B, C
Panel Breakouts 11:45am - 12:15pm	EFRC Panel Introduction - Electronic file overview/orientation	**BES Lead:** Andy Schwartz **BES Staff:** Chris Fecko, Robin Hayes, Craig Henderson, Mick Pechan, Bob Stack, Thiyaga Thiyagarajan, Philip Wilk **Admin Support:** Katie Runkles	Salons A, B, C
	Hubs Panel Introduction - Electronic file overview/orientation	**BES Leads:** Linda Horton and Gail McLean **BES Staff:** Chris Fecko, Craig Henderson, John Vetrano **Admin Support:** Teresa Crockett	Salon D
12:15pm - 1:15pm	**Working Lunch in Panel Rooms:** **Discussion of initial questions from overviews and process**	**COV Members / BES Staff**	
Panel Breakouts 1:15pm - 4:45pm	EFRC Panel (first read) - Review EFRC files - Panel discussion	As above	Salons A, B, C
	Hubs Panel (first read) - Review Hub files - Panel discussion	As above	Salon D
4:45pm - 5:15pm	COV Executive Session - preliminary assessment	COV Members	Salons A, B, C
5:15pm - 5:45pm	COV and BES Discussion - respond to questions and provide additional information	COV Members / BES Management	Salons A, B, C
5:45pm	Adjourn for the day		
6:30pm - 8:30pm	**Working Dinner**	**COV Members / BES Staff**	**Salon E**

Wednesday, November 16, 2016

Time	Activity	Participants	Location
7:30am - 8:30am	Continental Breakfast		Grand Ballroom Reception
Panel Breakouts, cont'd 8:30am - 12:00pm	EFRC Panel (second read) - Continued review of files - Panel discussion	As above	Salons A, B, C
	Hubs Panel (second read) - Continued review of files - Panel discussion	As above	Salon D
12:00pm - 1:00pm	**Working Lunch**		
Panel Breakouts, cont'd 1:00pm - 4:00pm	EFRC Panel (final read) - Continued review of files - Panel discussion	As above	Salons A, B, C
	Hub Panel (final read) - Continued review of files - Panel discussion	As above	Salon D
4:00pm - 4:30pm	Break and opportunity for discussion with BES representatives in both panel rooms	As above	
4:30pm - 5:30pm	COV Executive Session	COV Members	Salons A, B, C
5:30pm - 6:00pm	COV and BES Discussion - respond to questions	COV Members / BES Management	Salons A, B, C
6:00pm	Adjourn for the day		
	Dinner on your own		

Thursday, November 17, 2016

Time	Activity	Participants/Lead	Location
7:30am - 8:30am	Continental Breakfast		Grand Ballroom Reception
8:30am - 10:30am	Panel Breakouts - Report Writing	COV Members	Salons A, B, C Salon D
10:30am - 11:15am	COV Executive Session	COV / BES Management	Salons A, B, C
11:15am - 12:00pm	Closeout Session	COV / BES Staff	Salons A, B, C
12:00pm	**Adjourn - Thank You!**		

APPENDIX III – EFRC Checklist

Checklist for COV Review -- EFRC Selection Process	Comments
I. Efficacy and Quality of Processes used for EFRC Selection **(a) Solicit, review, recommend, and document proposal actions**	
FOAs: Adequate information for potential proposers?	
2014 FOA (broad) 2016 FOA (targeted)	
Review process: Consider, for example:	
Review process (2-stage in 2014; single stage in 2016)? Sufficient number of reviews? Qualified reviewers? Quality of reviews (consistent with criteria)?	
Documentation: Consider, for example:	
Quality of selection statements? Revised budgets? Revised scope?	
II. Impact and Standing of the EFRCs **(a) Breadth and depth of awards:** Consider, for example:	
Overall quality of awarded EFRCs? Balance of innovation, risk, and interdisciplinary research? Technical diversity?	
Relationship to other BES portfolio? Relevant to mission?	
Length of awards? Award size?	

Checklist for COV Review -- General EFRC Management	Comments
I. Efficacy and Quality of Processes used for EFRC Management Oversight **(b) BES management of EFRCs**	
General Management approach: consider, for example:	
Communication to and among EFRCs:	
Mix of monthly phone calls, in person meetings Use of management reference documents?	
Web resources: Community website? Annual technical summaries?	
PI Meetings	
Annual Reports:	
Instructions? Quality of report?	
Peer reviews:	
2015 Management reviews: Consider, for example:	
Reviewers qualified? BES feedback-EFRC response?	
2016 Midterm reviews: Consider, for example:	
Reviewers qualified? BES guidance-EFRC response?	
II. Impact and Standing of the EFRCs **(b) National and international standing of EFRCs**	
Are the EFRC PIs leaders in their fields? Are the EFRCs having impact?	

APPENDIX IV – Hub Checklist

Checklist for COV Review -- JCAP Renewal Process	
	Comments
I. Efficacy and Quality of Processes used for Hub Renewal **(a) Solicit, review, recommend and document proposal actions**	
Decision process to request a renewal proposal from the existing Hub? Does the FOA contain adequate information for preparation of the renewal proposal?	
Review Process: Consider, for example:	
Approach for the merit review process? Sufficient number of reviews? Qualified reviewers? Quality of reviews (consistent with criteria)?	
Documentation: Consider, for example:	
Completeness of justification statement for renewal? Revised budget and other project documents?	
II. Impact and Standing of JCAP **(a) Award breadth and quality: Consider, for example:**	
Is the award decision justified by the quality of the proposal, including the balance of innovation, risk, and interdisciplinary research?	
Complement the BES research portfolio? Relevant to the DOE's mission?	
Size and duration of award?	

Checklist for COV Review -- JCAP Management	
	Comments
I. Efficacy and Quality of Processes used for JCAP Management Oversight **(b) Management Processes**	
Communication to and from JCAP:	
Are the frequency and content of teleconference calls appropriate?	
Annual and Quarterly Reports:	
Quality of reports?	
Peer reviews:	
Information provided to reviewers prior to on-site reviews adequate?	
2013 On-Site Review	
Qualified reviewers? BES guidance letter and JCAP response?	
2014 On-Site Review	
Qualified reviewers? BES guidance letter and JCAP response?	
2016 On-Site Review	
Qualified reviewers? BES guidance letter and JCAP response?	
II. Impact and Standing of JCAP **(b) National and International Standing.** Consider, for example:	
JCAP PIs national/international leaders in their fields? Potential and/or actual impact of JCAP evident?	

Checklist for COV Review -- JCESR Selection Process	
	Comments
I. Efficacy and Quality of Processes used for Hub Selection: **(a) Solicit, review, recommend and document proposal actions**	
FOA: Adequate information for potential proposers?	
External Peer Review Process: Consider, for example:	
Approach for the email and reverse-site panel merit review panels?	
Sufficient number of reviews? Qualified reviewers? Quality of reviews (consistent with criteria)?	
Recommendation and Documentation: Consider, for example:	
Selection analysis? Revised budget? Notifications of declination?	
II. Impact and Standing of JCESR: **(a) Award breadth and quality: Consider, for example:**	
Quality of the JCESR proposal? Balance of innovation, risk, and interdisciplinary research?	
Complement the BES research portfolio? Relevant to the DOE's mission?	
Size and duration of award?	

Checklist for COV Review -- JCESR Management	
	Comments
I. Efficacy and Quality of Processes used for JCESR Management Oversight: **(b) Management Processes**	
Communication to and from JCESR:	
Mix of periodic phone calls/electronic communications and in person meetings?	
Annual and Quarterly Reports:	
Quality of reports?	
Peer review process (general):	
Information/review documentation provided to reviewers prior to reviews adequate?	
2013 Reverse-Site Management Review	
Qualified reviewers? BES guidance letter and JCESR response?	
2014 On-Site Science and Management Review	
Qualified reviewers? BES guidance letter and JCESR response?	
2015 On-Site Science and Management Review	
Qualified reviewers? BES guidance letter and JCESR response?	
2016 On-Site Science and Management Review	
Qualified reviewers? BES guidance letter and JCESR response?	
II. Impact and Standing of JCESR (b) National and International Standing: Consider, for example:	
JCESR PIs national/international leaders in their fields? Potential and/or actual impact of JCESR evident?	

APPENDIX V – EFRC Report Template

COV PANEL REPORT TEMPLATE

Panel: ____EFRC_____

BES COMMITTEE OF VISITORS (COV)

Reviewing the EFRCs and JCAP and JCSER Hubs

Based on the Charge to the COV:

1) For the EFRCs, assess the efficacy and quality of the processes used to:

(a) solicit, review, recommend, and document proposal actions and

(b) monitor technical and administrative progress.

(2) Within the boundaries defined by DOE missions and available funding, comment on the impact and standing of the EFRC awards:

(a) the breadth and depth of EFRCs, and

(b) the national and international standing of EFRCs.

I. Efficacy and Quality of Processes used for EFRC Selection and BES Management Oversight

Based on the COV's study of the review and selection process that led to the EFRC awards and BES management of EFRCs, please provide brief findings, recommendations, and comments on the following:

(a) Solicit, review, recommend, and document proposal actions

Consider, for example:

- consistency with priorities and criteria stated in the program's solicitation, announcement, and guideline
- adequate number of reviewers for balanced review; use of reviewers having appropriate expertise/qualifications; use of a sufficiently broad pool of reviewers; avoidance of conflicts of interest
- efficiency/time to decision
- completeness of documentation making recommendations

Findings:

Comments:

Recommendations:

(b) BES Management processes for EFRCs

Consider, for example

- "color group" approach and management guidance documents
- written progress reports
- the management peer review in the first year of operation
- Summit and Forum principal investigator meeting
- mid-term science peer-reviews
- effective interactions between program managers and PIs

Findings:

Comments:

Recommendations:

II. Impact and Standing of the EFRCs

Taking into account the DOE, BES, and Division missions, the available funding, and information presented about EFRCs, comment on how the EFRC **award and oversight processes** have affected:

(a) The breadth and depth of EFRC Awards

Consider, for example:

- the overall quality of the science
- the balance with respect to innovation, risk, and interdisciplinary research
- the technical diversity of the awards
- the relationship of EFRCs to other parts of the BES (optional)
- the relevance of EFRCs with respect to the missions of BES and DOE
- the appropriateness of award scope, size, and duration

Findings:

Comments:

Recommendations:

(b) The national and international standing of EFRCs

Consider, for example:

- the evolution of individual EFRCs with respect to science directions
- the uniqueness, significance, and scientific progress and impact
- the stature of the principal investigators in their fields
- the leadership position in the nation and the world

Findings:

Comments:

Recommendations:

APPENDIX VI – Hub Report Template

COV PANEL REPORT TEMPLATE

Panel: JCAP and JCESR

BES COMMITTEE OF VISITORS (COV)

Reviewing the EFRCs and JCAP and JCESR Hubs

Based on the Charge to the COV:

1) For JCESR and JCAP, assess the efficacy and quality of the processes used to:

(a) solicit, review, recommend, and document proposal actions and

(b) monitor technical and administrative progress.

(2) Within the boundaries defined by DOE missions and available funding, comment on the impact and standing of the JCAP award:

(a) the breadth and depth of JCAP and JCESR, and

(b) the national and international standing of JCAP and JCESR.

I. Efficacy and Quality of Processes used for JCAP and JCESR Selection and BES Management Oversight

Based on the COV's study of the review and selection process that led to the JCAP and JCESR awards and BES management of JCAP and JCESR, please provide brief findings, recommendations, and comments on the following:

(a) Solicit, review, recommend, and document proposal actions

Consider, for example:

- consistency with priorities and criteria stated in the program's solicitation, announcement, and guideline
- adequate number of reviewers for balanced review; use of reviewers having appropriate expertise/qualifications; use of a sufficiently broad pool of reviewers; avoidance of conflicts of interest
- efficiency/time to decision
- completeness of documentation making recommendations
- cooperative agreement

Findings:

Comments:

Recommendations:

(b) BES Management processes for JCAP and JCESR

Consider, for example

- oversight plan
- written progress reports
- monthly teleconferences
- annual external peer reviews
- effective interactions between program managers and PIs

Findings:

Comments:

Recommendations:

II. Impact and Standing of the JCAP and JCESR Awards

Taking into account the DOE, BES, and Division missions, the available funding, and information presented about JCAP and JCESR, comment on how the JCAP and JCESR **awards and oversight processes** have affected:

(a) The breadth and depth of JCAP and JCESR

Consider, for example:

- the overall quality of the science
- the balance with respect to innovation, risk, and interdisciplinary research
- the evolution of the JCAP and JCESR with respect to science directions
- the relationship of JCAP and JCESR to other parts of the BES (optional)
- the relevance of JCAP and JCESR with respect to the missions of BES and DOE
- the appropriateness of award scope, size, and duration

Findings:

Comments:

Recommendations:

(b) The national and international standing of JCAP and JCESR

Consider, for example:

- the uniqueness, significance, and scientific progress and impact
- the stature of the principal investigators in their fields
- the leadership position in the nation and the world

Findings:

Comments:

Recommendations: