CORE QUESTIONS and REPORT TEMPLATE
for
FY 2014 NSF COMMITTEE OF VISITOR (COV) REVIEWS

Guidance to the COV: The COV report should provide a balanced assessment of NSF's performance in the integrity and efficiency of the ***processes*** related to proposal review. Discussions leading to answers of the Core Questions will require study of confidential material such as declined proposals and reviewer comments. ***COV reports should not contain confidential material or specific information about declined proposals.*** The reports generated by COVs are made available to the public.

We encourage COV members to provide comments to NSF on how to improve in all areas, as well as suggestions for the COV process, format, and questions. For past COV reports, please see http://www.nsf.gov/od/oia/activities/cov/.

FY 2014 REPORT TEMPLATE FOR NSF COMMITTEES OF VISITORS (COVs)

The table below should be completed by program staff.

Date of COV: September 22nd and 23rd, 2014

EFRI Topics:

- Multicellular and Inter-kingdom Signaling (MIKS)
- Mind, Machines, and Motor Control (M3C)
- Flexible Bioelectronics Systems (BioFlex)
- Origami Design for Integration of Self-assembling Systems for Engineering Innovation (ODISSEI)
- Photosynthetic Biorefineries (PSBR)

Division: Emerging Frontiers in Research and Innovation (EFRI)

Directorate: Engineering (ENG)

Number of actions reviewed:

Awards: 12 - (28% Sample)

Declinations: 16 - (12% Sample)

Other (Pre-proposals)**:** 50 – (12% Sample)

**Returned without review*

Total number of actions within Program/Division during period under review:

	All EFRI Actions	***EFRI Competitive* Proposal Actions***
Awards	55	43
Declinations	152	140
Pre-proposal (NIVT)	242	N/A
Pre-proposal (INVT)	187	N/A
Total	636	183

** Competitive proposal actions include all research and education proposals which have gone through the merit review process resulting in award or decline decisions; this excludes supplements, continuing grant increments, and any proposals that were withdrawn or returned without review.*
***Returned without review and withdrawn actions*

Manner in which reviewed actions were selected:
Random sample performed on EFRI new proposal actions during the period, FY-2011-2013. This included competitive, returned and withdrawn actions.

Proposal actions not included in the sampled population set:

- *Supplements*
- *Continuing grant increments*
- *Withdrawn proposals that did not enter any part of the EFRI merit review process*
- *Initiatives not led by EFRI or not subject to EFRI merit review process*

- *IPA Funds (Intergovernmental Mobility Assignment)*

The resulting population (N) came to *612* proposal actions (or jackets). The jackets were each assigned a random number from 0 to 1 using the Excel RAND function assuming a linear distribution.

All jackets were then binned to ensure an equal and representative sample based on:

1. *Year awarded*
2. *EFRI Topic*
3. *Awards/Declinations/Invited/Not-invited*

Based on a target quantity of samples (approximately 8 jackets to review per COV member), threshold levels of the random number assigned were set for awarded and declined jackets and their associated pre-proposals. Total jackets sampled for COV review amounted to 78 or 13% of the initial population (N = 612).

To facilitate the work of the COV, EFRI has also created a Self-Study Data Report to use in conjunction with the sampled jackets. Complementing the COV Report Template, this workbook presents data, definitions, and explanations that the COV may find useful in evaluating merit review and program management processes for the period under review (FY11-FY13). Each tab of the workbook directly relates to a question in the template. In keeping with the charge to the COV, the data provided in the Self-Study presents primarily retrospective information.

The information provided to you in the Self-Study references data from three main sources:

- *Enterprise Information System (EIS):* EIS is an NSF-wide system that generates summary reports in response to specific pre-defined queries and parameter selections. This system provides results by counts of proposal jackets and is used to generate the complete list of competitive proposal actions which provides the basis for many of the analyses in this report.
- *Report Server Data:* The NSF Report Server is a database of digital records which can be queried against the complete list of competitive actions for additional programmatic information using more complex criteria than EIS allows. Results of queries are usually reported by project, which means collaborative proposals are counted as a single unit.
- *Budget Internet Information System (BIIS):* BIIS connects to NSF's financial systems to provide summary data on funding and award trends by institutions and states.

In addition to the Self-Study Data Report, details regarding the previous COV Report, the associated ENG/EFRI response, and additional resources such as maps, viewgraphs, program solicitations, helpful acronyms, and the NSF Grant Proposal Guide (GPG) were provided in the "COV Documents" section of the NSF COV eJacket module.

Notes regarding useful data resources are also posted in each question of this Report Template to help facilitate the review process. Please take a moment to review each page.

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COV Membership

	Name	Affiliation
COV Chair	Gilda Barabino	The City College of New York
COV Members:	Dawn R. Applegate	RegeneMed, Inc
	Linda Blevins	Department of Energy (DOE)
	Christina L Bloebaum	Iowa State University
	Jane Davidson	University of Minnesota
	Abhi Deshmukh	Purdue University
	Rajinder Khosla	North Carolina State University
	Trung Van Nguyen	University of Kansas
	Babak Parviz	Amazon
	Alan Rudolph	Colorado State University
	Mario Rotea	University of Texas-Dallas
	Ann Savoca	Sealed Air Corporation, Advisory Committee liaison

INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

Briefly discuss and provide comments for *each* relevant aspect of the program's review process and management. Comments should be based on a review of proposal actions (awards, and declinations) that were *completed within the past three fiscal years*. Provide comments for *each* program being reviewed and for those questions that are relevant to the program(s) under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged.

I. Questions about the quality and effectiveness of the program's use of merit review process.

Please answer the following questions about the effectiveness of the merit review process and provide comments or concerns in the space below the question.

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
1. Are the review methods (for example, panel, ad hoc, site visits) appropriate? Comments: Overall the review methods are appropriate to achieve the goals of EFRI. The pre-proposal and proposal jackets reviewed by the COV showed a vibrant process of effective merit review. Preliminary and full proposals are reviewed against stated EFRI criteria that culminate in exciting investments that have paid off for NSF. Some inconsistencies in the quality of reviews were noted in the sample size reviewed by the COV including variation in specifics and the depth of information in the review process. In some instances there is poor correlation between the narrative and the ratings or insufficient details in the review analysis to support ratings and decision. The committee suggests the incorporation of additional details in the templates used for the review process. For example, the more thorough review with respect to the EFRI criteria would improve the review process. The panel also supports review methods that sustain high risk ideas from topic selection through the review process. The panel suggests criteria for pre-proposals should be weighted more toward evaluation of the transformative nature and impact of the idea while full proposals should also weigh feasibility and relevance/alignment with other priorities of the EFRI program. Videoconferencing might be considered as a mechanism to expand reviewer participation while reducing time and cost; albeit the reviewer engagement and group dynamic limitations of this mode of communication are understood. EFRI has an excellent track record of reviewing proposals in a shorter timeframe than the ENG Division or NSF general solicitations. This rapid review is responsive to EFRI's emerging innovation mission and is recommended to be	Yes

sustained as a programmatic process of EFRI. The pre-proposal to full proposal process has been effective in yielding high impact research programs. Single-round reviews with more reviewers to further shorten the review timeline could possibly be considered for future time-critical projects. **COV Data Resource:** ▪ **Assigned Jackets** ▪ **EFRI Self-Study Workbook**	
2. Are both merit review criteria addressed a) In individual reviews? The individual reviews sampled by the COV revealed that both technical merit and broader impacts criteria were represented in the review process. Some inconsistencies were noted in the depth, specifics and quality of constructive comments that support both merit criteria and included criteria outside the review elements. An improved template, integrated into FastLane, could enhance the collection of input from reviewers on EFRI specific criteria. A template might also be considered for use by PDs to standardize information collected in eJackets for programmatic review. More detailed forms for proposal submission would ensure equivalent information in submissions, enhancing uniformity in the review process. As suggested in Question 1 above, a pre-proposal format should emphasize the transformative nature and impact while a full proposal format should focus on feasibility, relevance, and EFRI priorities. The improved templates should standardize information collected while not limiting or prescribing how innovation and transformation is achieved. Reducing the budget detail required for the pre-proposal would simplify both the submission and review process. Detailed budgets are more appropriate for full proposals. The improved formats should ensure that elements of the pre-proposal that the reviewers feel are truly transformative and differentiating are communicated to the PI to ensure these elements are rigorously developed in the full proposal. b) In panel summaries? Sample summaries represented the review process well and communicated the major strengths and weaknesses of the idea and the application of review criteria. Some inconsistencies were noted in the depth of panel summaries from one summary to another. Summaries of funded proposals tended to be more detailed and constructive than reviews for weaker submissions, particularly for preliminary proposals that might benefit the most from a comprehensive critique. The critique	Yes Yes

should include opportunities for proposal improvement. c) In Program Officer review analyses? Program Officer review analysis generally addressed both merit review criteria. More specific comments in the review analysis are encouraged especially in the case of proposals with similar scores but different funding outcomes. Comments: **COV Data Resource:** ▪ **Assigned Jackets** ▪ **EFRI solicitations**	Yes
3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals? Comments: The written reviews were overall quite good. Some inconsistencies were noted in the depth and quality of reviews and in the alignment of the proposal rating with the written critique in the random sample size analyzed by the COV. Also, not all reviews addressed the EFRI criteria. As previously suggested, refined templates for the review process are recommended. Given the importance of broader impacts to the EFRI transformative vision, a template that encourages more substantive commentary for this topic would balance its weight with technical merit in the review process. To improve the quality of the peer reviews, reviews should be screened by the PD ahead of the panel to determine which don't address all the EFRI review requirements (e.g. specific, critical and constructive comments on Intellectual Merits, Broader Impacts, and specifics of the topic). The panelists of the reviews that don't meet the requirements should be alerted and given the opportunity to make the reviews more complete ahead of the start of the panel meeting. This is also a good time to catch inappropriate comments. Knowing that the PDs are already overloaded, EFRI should consider assigning a science assistant or some type of technical assistant for this role or to take on other tasks so the PD can focus on this activity. **COV Data Resource: Assigned Jackets**	Yes
4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?	Yes

Comments: The panel summaries generally articulate well the panel recommendation. In the limited sample provided, there were some inconsistencies between ratings and which proposals progressed in the review process that were difficult to understand based on the review comments. PDs should implement methods to ensure panel narratives are well aligned with their ratings. **COV Data Resource: Assigned Jackets**	
5. Does the documentation in the jacket provide the rationale for the award/decline decision? *[Note: Documentation in the jacket usually includes a context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.]* Comments: The COV found that the decisions rendered by the review process were justified and supported by documentation in the eJackets. Sufficient details on the review process were provided that support the decisions rendered. The COV noted that in some cases uploading the ranking of the panel into the eJacket was very helpful in providing transparency in the process and supporting recommendations. Justification for panel rankings and resulting decisions should be detailed in the review analysis. **COV Data Resource: Assigned Jackets**	Yes
6. Does the documentation to the PI provide the rationale for the award/decline decision? *[Note: Documentation to PI usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), and, if not otherwise provided in the panel summary, an explanation from the program officer (written in the PO Comments field or emailed with a copy in the jacket, or telephoned with a diary note in the jacket) of the basis for a declination.]* Comments: The documentation provided to reach the decisions made by the review process are generally good. Nonetheless, the COV emphasizes that more detailed and constructive feedback to the PI will improve \future submissions to EFRI. Hence, the COV suggests improved review methods be developed to provide more comprehensive feedback to PIs especially for preliminary proposals..	Yes, with improvement

Given the EFRI PDs come from diverse Divisions, improved methods to ensure consistency of a PD's direction of reviewers to achieve detailed reviews that are well aligned with scores are suggested. As previously highlighted, the key transformative concepts of the pre-proposal that differentiated and advanced the proposal in the review process should be clearly articulated to the PI so that these critical concepts are well developed in the full proposal submission. **COV Data Resource: Assigned Jackets**	
7. Additional comments on the quality and effectiveness of the program's use of merit review process: Methods to evaluate the effectiveness of the review process should include, among other things, the quality of reviews and whether or not the quality of reviews is influenced by the number of proposals assigned to a reviewer. **COV Data Resource:** ▪ **Assigned Jackets** ▪ **EFRI Self-Study Workbook** ▪ **NSF GPG Manual**	

II. Questions concerning the selection of reviewers. Please answer the following questions about the selection of reviewers and provide comments or concerns in the space below the question.

SELECTION OF REVIEWERS	YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE
1. Did the program make use of reviewers having appropriate expertise and/or qualifications? Comments: EFRI has done a good job identifying qualified experts from diverse disciplines and organizations for review panels. The selection process could be further enhanced by defining specific attributes of a qualified reviewer for a given EFRI solicitation then engaging field experts to assist in recruiting reviewers. For example, if the most transformative programs are to be selected, expertise of reviewers should include panelists that have a track record of transformative work. Delineating the criteria by which reviewers are selected for pre-proposals as well as those that continue onto full proposal panels may improve the selection process. Moreover, a post-review evaluation of whether the reviewer attributes were met would provide feedback on the effectiveness of the recruitment process. Participation by organization type was more difficult to evaluate given the broad grouping (business, state, local, foreign, other) versus PhD institutions in the statistical analysis provided. Hence, it was challenging to respond to the previous COV's recommendation for expanding industry participation on review panels. It is unclear what efforts were made to increase industry involvement and what the outcomes were. The COV did not have consensus on industry participation on review panels. Part of the COV felt increased industry involvement (including lawyers, venture capitalists, business development professionals, technology transfer experts, scientists and engineers) would provide critical commercial assessments of the technical feasibility, technology readiness level, engineered systems design, optimization/performance goal, market need, industry fit, application practicality and commercialization gaps thereby improving the success of post-EFRI translation of early technologies into applications. Other COV members felt industry's technology vision would be too short-term and innovation-adverse limiting the success of transformative projects in the review process. Mechanisms to identify appropriate industry experts for both the pre-proposal and full proposal review stages could add value to the review process. A diverse panel will aid in overcoming bias and broadening participation in funded programs. The reviewer's diversity, in all aspects thereof, should reflect the diversity of the desired awards. The COV encourages EFRI to continue to	Yes with improvement

broaden participation of all underrepresented groups. The former COV recommended, and this COV reiterates the need to describe the reviewer selection process for evaluation by the next COV. **COV Data Resource:** ▪ **Assigned Jackets**	
2. Did the program recognize and resolve conflicts of interest when appropriate? Comments: Methods and resources are in place to identify and resolve conflicts of interest. It is suggested to use the practice of diary notes to reflect the handling of conflicts of interest. **COV Data Resource:** ▪ **Assigned Jackets** ▪ **NSF GPG Manual**	Yes
Additional comments on reviewer selection: **COV Data Resource:** • **Assigned Jackets**	

III. Questions concerning the management of the program under review.

Please comment on the following:

MANAGEMENT OF THE PROGRAM UNDER REVIEW

1. Management of the program.

Comments:

EFRI is guided by a Director with a vision that helps ensure its unique role among the Divisions and programs in the ENG Directorate. The EFRI Director effectively utilizes Program Directors (PDs) across diverse ENG Divisions and NSF Directorates. The current PD championing approach depends on the sustained willingness and support of the PDs in ENG and other Directorates such as MPS and CISE. Moreover, synergy with PDs and their Divisions must exist for the success of EFRI. The EFRI Director is commended for his inclusive leadership style, applied in devising a collaborative program structure that is beneficial to all: EFRI, PDs and their Divisions. The Director and participating PDs are dedicated, passionate and committed to bringing high risk, transformative programs into the NSF portfolio.

The motivation of PDs to participate in EFRI is multifaceted: 1) ability to work across research areas/Divisions in NSF, 2) attract funding to the PD's program area, 3) obtain funding for cross-cutting research, and 4) opportunity to work on innovative research. A drawback of PD participation is the long and not always transparent topic selection process during which the PDs can at times feel excluded; such as in second round/year topic renewal/revision. These strengths and weaknesses should be considered as the EFRI program refines its effective structure to ensure continued success of participation of the PDs.

Increased resources could facilitate PDs' involvement and effectiveness, including additional staffing for EFRI panels, program marketing and an outreach/travel budget. Maintaining the value and prestige of EFRI 'brand' and expanding awareness through marketing and outreach are critical to attracting exceptional talent to continue to deliver high impact innovations. Communicating EFRI to larger community could also broaden participation, including underrepresented groups. Staffing needs should be commensurate with operational needs but should not detract from EFRI funding levels for awards.

EFRI is a strategic program at NSF with significant benefits to the scientific community. We commend the program for taking a leading role in guiding the existing programs to the next level. However, the COV encourages evaluation of the potential risk associated with this course of action. Budgetary issues of the transition should be worked out ahead of time so the core EFRI program is not adversely affected. EFRI should also consider developing a strategy for "life after EFRI" for its portfolio so that the resources available for its annual solicitation can remain robust. The prestige and resources of the EFRI program attract quality investigators and should not be compromised. It is important to maintain the EFRI "brand"/position in the community with clear communication of the resources available to the program.

The COV feels the 4-year award duration is appropriate. Funding levels could possibly increase with inflation or other costs but not decrease under the current $2M level.

As previously described, the COV recommends simplifying the preliminary proposal process to make it less burdensome on PIs, NSF staff, and reviewers. Concepts for simplification include eliminating the need for a detailed budget and developing evaluation criteria for pre-proposals that weigh more on the transformative nature and impacts of the idea than on the feasibility. Full proposal reviews can put more emphasis on feasibility.

Overall, the EFRI program operations are lean and the COV feels that resources are maximally utilized. The EFRI Director is commended for reaching outside the NSF to advance and expand the program in partnership with other government agencies.

[Note: We encourage the COV to refer to relevant documents available in eJacket such as Program Solicitations for general information as well as Diary Notes and Correspondence in the jackets that provide information about the management of the specific projects.]

COV Data Resource:

- **Assigned Jackets**
- **EFRI Self-Study Workbook - all tabs**
- **Additional Documents from NSF COV eJacket Module**
- **Discussions with EFRI Management & PDs**

2. Responsiveness of the program to emerging research and education opportunities.

Comments:

The COV commends the EFRI program director for working across disciplines both inside and outside the NSF to advance the educational opportunities for the program. The COV encourages EFRI to develop venues to allow EFRI investigators to exchange ideas among grantees and with other researchers to increase the impacts of the EFRI program. For example, specific EFRI groups could be encouraged to run workshops on an EFRI topic attached to a larger conference to facilitate exchange of ideas and exposure of EFRI activities to the wider community. Such an approach is especially important in light of budgetary constraints on EFRI hosted meetings.

Establishment of the REM program in response to recommendations of the previous COV is a prime example of EFRI-led innovation in the integration of transformative research with education that reaches across all learning stages (elementary grades through professional development) and roles (students and teachers).

COV Data Resource:

- **Assigned Jackets**
- **EFRI Self-Study Workbook**
- **Additional Documents from NSF COV eJacket Module**
- **Discussions with EFRI Management & PDs**

3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.

Comments:

The COV recommends EFRI more effectively reach out to a wider community for idea generation and more effectively inform the community once the topics are selected. EFRI could also ensure that the PDs have resources necessary and are appropriately incentivized throughout the idea generation, topic selection and review processes to maximize the transformative and community-building nature of EFRI funded programs. Emphasis should be placed on incentivizing PD involvement while making the process less burdensome.

EFRI should also design a process to ensure that the best ideas don't die in review and selected topics are transformative. Methods could include formalization of the selection of the Working Group and operation of the topic selection process to make it more transparent and thereby straightforward to critique. Commendably, the flexibility of the topic selection process affords rapid response, for example 1) to drop or change a topic in response to receipt of limited or low quality proposals, or 2) the implementation of the former COV's recommendation to change topics every 2 years.

A future challenge for EFRI may be how to best build and prepare for a next-generation topic when the research community must be built from a nascent pool of investigators, or novel technologies must be developed from the ground up.

[Note: During the three-year time period under review, the EFRI program used one or more of the following methods for prioritizing funding recommendations:

- *Portfolio analysis with respect to demographics and subject areas at the program level*
- *Annual reports*
- *Community workshop reports*
- *Directorate/Division retreat discussions]*

COV Data Resource:

- **Assigned Jackets**
- **EFRI Self-Study Workbook - all tabs**
- **Additional Documents from NSF COV eJacket Module**
- **Discussions with EFRI Management**

4. Responsiveness of program to previous COV comments and recommendations.

Comments: Mixed

The COV found the EFRI program officers have been responsive to many of the previous committee's suggestions and have taken appropriate actions to address the concerns (for example, by creating the REM program and reducing EFRI Office workload).

It appears that the involvement of industry experts in the review process remains limited. The COV had mixed opinions about the benefits and risks of using industry reviewers. Developing a mechanism to make it easier to identify appropriate industrial experts could add value to the EFRI process.

Outside of REM, the 2014 EFRI Workshop on interdisciplinarity and innovation, a demographic analysis of EFRI applicants, and the addition of the requirement to have a broadening participation plan in each EFRI proposal are new instruments aimed at increasing participation of underrepresented groups. Participation of women as PIs has increased. Participation of underrepresented ethnic groups as PIs remains a challenge and should be addressed for the next COV. Included in this assessment should be a comparison of the participation in the EFRI program versus NSF-wide programs versus the available talent pool, specifically for engineers, chemists and biologists, not simply the general PhD candidate pool. The latter was a limitation in interpretation of demographic data presented to this COV.

COV Data Resource:

- **Previous EFRI COV Report (FY07-FY10)**
- **Response to Previous EFRI COV Report**
- **EFRI Self-Study Workbook - all tabs**
- **Additional Documents from NSF COV eJacket Module**
- **Discussions with EFRI Management**

IV. Questions about Portfolio. Please answer the following about the portfolio of awards made by the program under review.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity? Comments: The COV feels the EFRI program has achieved an appropriate balance of awards across disciplines and sub-disciplines with representation from a wide range of disciplines. **COV Data Resource:** • **Assigned Jackets** • **EFRI Self-Study Workbook**	Yes
2. Are awards appropriate in size and duration for the scope of the projects? Comments: The COV feels the 4-year award duration is appropriate. Perhaps a re-evaluation for a slight increase in funding level to meet inflation or exceptional requirements for equipment, but not a decrease under the current $2M level. Many transformative endeavors require substantial equipment or facility expenditures. The current level of support in these cases may not be sufficient particularly for smaller institutions or younger PIs. In these cases, additional support could facilitate broader representation. Mechanisms to encourage such participants such as leveraging or partnering other funding mechanisms including the NIH Major Equipment/Facilities grants or Core Facilities programs could maximize benefits for both funding agencies while broadening participation of currently underrepresented groups, institutions or locales/states. This situation may also afford opportunities for collaboration with and leverage resources in government labs or industry that otherwise are not eligible or responsive to the EFRI program. **COV Data Resource:** • **Assigned Jackets**	Yes

• **EFRI Self-Study Workbook**	
3. Does the program portfolio include awards for projects that are innovative or potentially transformative? Comments: The overall portfolio has examples of innovative and transformative outcomes including tools, technologies and products that have been translated to and adopted by industry, arguably an ultimate measure of success in innovation and transformation. **COV Data Resource:** • **Assigned Jackets** • **EFRI Self-Study Workbook**	Yes
4. Does the program portfolio include inter- and multi-disciplinary projects? Comments: The program includes a good balance of inter- and multi-disciplinary projects with a large focus on multi-disciplinary projects. Even so, there are examples of transformative projects led by a single discipline. Communication of this approach to the community could broaden participation of young investigators and researchers at institutions with smaller infrastructure support. **COV Data Resource:** • **Assigned Jackets** • **EFRI Self-Study Workbook**	Yes
5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators? Comments: The geographic distribution of EFRI awards reflects to a large degree the concentration of major universities across the country. Certainly excellence of the investigators and the innovation and transformative nature of the science are primary drivers of funding decisions. Nonetheless, the recent addition to EFRI solicitations to address broadening participation could be clarified to include geographic distribution as a means to include a more diverse population.	Yes

COV Data Resource: • **Assigned Jackets** • **EFRI Self-Study Workbook** • **EFRI Geographical Slides**	
6. Does the program portfolio have an appropriate balance of awards to different types of institutions? Comments: EFRI awards are focused in PhD and research-intensive PhD institutions with some involvement of Masters institutions. EFRI should continue to strive to broaden participation. Outreach could improve the balance. **COV Data Resource:** • **Assigned Jackets** • **EFRI Self-Study Workbook**	Yes
7. Does the program portfolio have an appropriate balance of awards to new investigators? [*NOTE: A new investigator is an investigator who has not been a PI on a previously funded NSF grant.]* Comments: Nearly one-third of the awards are to new investigators. This is impressive for a highly competitive, innovation-driven program that often requires the contribution of significant resources from the PI such as capital-intensive equipment and specialized facilities. **COV Data Resource:** • **Assigned Jackets** • **EFRI Self-Study Workbook**	Yes
8. Does the program portfolio include projects that integrate research and education? Comments: Yes The REM program which effectively integrates education into transformative research is an exceptional addition to the EFRI program. Outside of REM,	Yes

portfolio programs tend to leverage existing education initiatives at their institute as opposed to innovating new programs. This is reasonable for the past EFRI solicitations. With the creation of the REM program, EFRI management should decide if they prefer new proposals to leverage REM and/or existing educational initiatives at NSF or available in the proposer's consortium, or to create new educational programs. **COV Data Resource:** • **Assigned Jackets** • **EFRI Self-Study Workbook**	
9. Does the program portfolio have appropriate participation of underrepresented groups[1]? Comments: Given the reach and impact of EFRI, through participating PDs, across multiple ENG Divisions of the NSF Directorates it is especially important for EFRI to take a leadership role in broadening participation, especially of underrepresented groups. It appears from the data presented that awards to women are on par or better in EFRI than NSF-wide. This is an improvement since the last COV. The demographic analysis presented reveal that the issue with women is getting them to apply. Once they apply, their funding rate is higher than for male applicants. For other underrepresented groups the issues are both in limited number of applications and transitioning from the full proposal to funding stage. The data presented show that other underrepresented groups are poorly represented in the awards due in part to a low success rate in funding of full proposals. This issue is apparent to NSF and the prior COV who recommended that a plan of action be formulated to address the challenge. EFRI has begun to address this through demographic analyses, a faculty innovation workshop, and the REM program, all of which were presented to this COV. An action plan to expand on these efforts should be developed in short order and progress against the efforts reported to the next COV. For example, consider a workshop for preparation of EFRI proposals similar to the ones developed for the CAREER program. . Interpretation of the demographic analysis was somewhat limited due to the normalization of a portion of the data to the total number of PhDs as a candidate pool versus engineering-only or engineering+math+science PhDs (the choice perhaps based on the backgrounds of EFRI PIs or applicants) which are far fewer than the total number of PhDs awarded to underrepresented groups. Use of these subgroups to define the available	Yes by gender, No by other minority

[1] NSF does not have the legal authority to require principal investigators or reviewers to provide demographic data. Since provision of such data is voluntary, the demographic data available are incomplete. This may make it difficult to answer this question for small programs. However, experience suggests that even with the limited data available, COVs are able to provide a meaningful response to this question for most programs.

PhD pool should be implemented in future analysis of EFRI demographics to more appropriately evaluate the participation of underrepresented groups of science and engineering disciplines in EFRI. **COV Data Resource:** ▪ **Assigned Jackets** ▪ **EFRI Self-Study Workbook**	
10. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports. Comments: EFRI is a good example of implementation of the mission of NSF, to promote innovation. The process followed by EFRI to select solicitation topics is linked to national needs as articulated by both the NAE's Engineering Grand Challenges and the PD's knowledge of new frontiers. EFRI is commended in this regard. Continued support of inter-agency communication and collaboration to promote relevance is encouraged. **COV Data Resource:** ▪ **Assigned Jackets** ▪ **EFRI Self-Study Workbook - all tabs** ▪ **Additional Documents from NSF COV eJacket Module** ▪ **Discussions with EFRI Management**	Yes
11. Additional comments on the quality of the projects or the balance of the portfolio: The COV has some concern that a large portion of EFRI funding has been allocated for continuing topics rather than new initiatives. This approach has limited the number of solicitations which may be detrimental to the program in the short and long run. Continuing topics (new topics every 2 years) was a suggestion of the previous COV. Retrospective analysis in years to come may reveal the best approach moving forward. The expanding EFRI mission, to include translation of projects out of the EFRI program could cannibalize the funding pool for EFRI programs. The COV strongly suggests that a strategy be developed for funding post-EFRI translational projects outside of the EFRI budget. As part of future program evaluation consider if success of EFRI research programs is partially due to the significant award amount and does this point to a critical minimum level of funding for major transformation? Does major transformation require collaborative innovation or can it be single-investigator	

driven? Post-award accountability might also be a metric by which the program is evaluated and rated. For example, how many of the research programs ended where they had envisioned in their proposals and what EFRI program/solicitation changes may be implied?	

OTHER TOPICS

1. Please comment on any program areas in need of improvement or gaps (if any) within program areas.

   No additional comments.

2. Please provide comments as appropriate on the program's performance in meeting program-specific goals and objectives that are not covered by the above questions.

a- Sustaining EFRI Topics (Champions for Topics, Post-EFRI support)

Champions for Topics:
As discussed under the Management of the Program Section III. 1. above, consideration should be given to provide incentives for PDs to become champions of topics; e.g. travel funds for outreach, marketing funds, staff assistants to reduce workload, etc. Marketing and outreach should increase topic generation from the community. Communicating EFRI to larger community could also broaden participation, including underrepresented groups. Moreover, mechanisms to ensure community solicited topics are championed should be formalized in the topic selection process.

Post-EFRI support
As discussed in Section III. I and IV. 11 above, EFRI should consider developing a strategy for "life after EFRI" for its portfolio so that the resources available for its annual solicitation can remain robust. Given the success of many EFRI research programs, including technology translation to commercialized products, maintaining a presence or involvement through industry adoption is important for EFRI recognition and branding and advancing the NSF mission. Hence, efforts should be undertaken to partner or otherwise grow funding mechanisms for post-EFRI project development. Perhaps EFRI in collaboration with follow-on funding and industrial partnerships can become the model for bridging the gap. NSF should assist EFRI in these endeavors, especially in creating relationships with other government agencies.

b- Topic Selection Process (Criteria, Repeat Topic, No Topic)

Criteria
Approximately 150 pre-submission topic ideas have been received to date. While a significant amount of time was spent reviewing the topic selection process with the COV some aspects remain unclear. Further formalizing and documenting the topic selection process is recommended to enable internal review and refinement. A critique of the process by the PDs and Program Management should be performed prior to the next COV. Appropriate data and information to enable an effective review of the topic selection process should be made available to the next COV.

In critiquing the topic selection process the following should be addressed.

1. The current policy is that the topic submitter's identity is kept confidential. Is this a prudent practice or could benefit be gained in revealing the identity?

2. Regarding funded PIs how many were involved in the topic selection/development process and how many were funded under the topic they helped select/develop?

3. Solicitation of topics from the community began in 2006. NSF recognizes the success of the EFRI program hinges on quality input from the community. EFRI would like to interact more with the community on idea generation including having investigators recommend transformative concepts outside their laboratory research or area of expertise. Methods to achieve these aims should be outlined and presented.

4. PDs stated that a PD champion is required for a topic to survive the selection process. Are high risk topics lost in the selection process, either because of a lack of a PD champion or because they are envisioned as too high risk? How can the topic selection process be improved to ensure transformative, unusual and exciting projects survive the selection process?

5. Once topics are selected, wide dissemination of the information through presentations, meetings, email list serves, etc. to the range of eligible institutions and investigators should ensure the best proposals are submitted as well as broader participation in the program. Methods to implement broad dissemination should be presented.

Repeat Topic

The COV is supportive of repeat topics as long as the topic remains relevant to the NSF mission. Unfunded recommended proposals from a previous round show interest/pool justifying continuation of selected topics. .

No Topic

Overall the COV was not supportive of no-topic solicitations. This approach would distract from the considerable effort expended to develop the topic generation and selection process. The COV felt the potential increase in number and variety of proposals submitted would over-burden the review process and make consistent review difficult to achieve. A minority of COV members were supportive of topic and no-topic calls in the same solicitation, a practice common among government funding agencies.

c- PD Workload and Overlapping EFRI Activities

As outlined in several of the above sections, it is recognized that PDs are overloaded. In response, EFRI has increased program staff and worked to streamline the topic selection and panel review processes. Continued refinement of the topic selection process and grant application templates should further reduce PD workload. Incentives for PDs to champion topics (e.g. travel funds and staff assistance) would enhance PDs commitment during the topic selection process. Commitment of funding to a selected topic is adequate motivation for PDs to enthusiastically continue their support of EFRI.

d- Any other issues or ideas?

PI Meetings

OMB and Congressional restrictions on conferences has limited PI meetings. As outlined in Section III. 2. above, the COV encourages EFRI to develop alternative venues to enable interaction between researchers and with the broader community to increase the visibility and impact of the EFRI program.

Broadening Participation

REM

Development of the REM program is a promising response to the last COV's recommendation to devise new methods to broaden participation. The open structure is aligned with the EFRI innovation mission, enabling PIs to customize a REM program specific to their research and community to achieve transformative outcomes. The COV is highly enthusiastic about efforts to expand REM beyond EFRI. It was noted that the NSF is considering transfer of REM to the Education Directorate. Leveraging the transformative talent pool of EFRI leadership and researchers to innovate and grow REM within and outside of EFRI to a mature program prior to transfer to the Education Directorate may provide the highest impact for all programs. REM funding is currently annual. Securing multi-year support over the EFRI 4-year award duration would be beneficial and is more likely to occur with partners external to EFRI. REM could enhance visibility of the EFRI program. A formal evaluation of the REM program (logic evaluation for REM is embedded in the logic model for EFRI) is planned and should be available for the next COV.

The REM program, which encompasses all education levels and student/teacher training, should be expanded with a focus on addressing EFRI-specific diversity issues.

Underrepresented Groups

Given the reach and impact of EFRI, through participating PDs, across multiple ENG Divisions and NSF Directorates both the past and current COV expressed the importance of EFRI taking a leadership role in broadening participation, especially of underrepresented groups. Detailed feedback is covered in Sections III. 4 and IV. 9. above.

In addition to REM, the 2014 EFRI Workshop, Interdisciplinarity and Innovation: Strategies for Effective Team Research, a demographic analysis of EFRI applicants, and the addition of the requirement to have a broadening participation plan in each EFRI proposal are new instruments aimed at increasing participation of underrepresented groups. The Workshop, targeted towards women and underrepresented minority engineering faculty, provided a mechanism for participants to enhance their professional development and to gain a better understanding of how to identify, conduct, fund and lead transformative research carried out by interdisciplinary teams. It highlighted the value of broad participation in research innovation, the influence of race and gender on interdisciplinarity and issues associated with implicit bias. Importantly, the Workshop is a step toward increasing the representation of women and underrepresented minorities among EFRI investigators. Additional workshops of this nature are encouraged. The demographic analysis is outlined in Section IV. 9. above. A formal workshop report, improved demographic data and implementation plan for increasing underrepresented groups in the applicant pool and funded research should be presented to the next COV.

International Reviewers
Presently there are no international reviewers for the EFRI program. Enlisting overseas reviewers may help address limited availability of reviewers due to conflicts of interest or as a result of a small pool of experts in a nascent field also being applicants. However, it may be expensive or otherwise prohibitive to engage international reviewers.

Industry Participation
Industry participation in review panels is covered in Section II. 1. above.

The buy-in of industry to a selected topic could ensure a champion for project translation to post-EFRI funding and commercialization. NSF's commitment to investments in foundational science and engineering translating to commercialized technologies forms the foundation of the Industrial Innovation and Partnerships (IIP) Division. Developing a hand-off relationship or funding mechanism between EFRI and IIP might be one approach to post-EFRI funding.

Industry representation on the COV is good, indicating EFRI believes industry involvement at some level will enhance the program. Efforts should be made to include people with significant responsibility and experience for research (long-term impact) within their companies.

3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.

EFRI is a highly successful program with an effective management and operating structure that efficiently utilizes and integrates PDs across a multitude of ENG Divisions and NSF Directorates. The NSF should enthusiastically embrace and expand this program towards maintaining NSF's leadership role in meeting government priorities and national challenges. The NSF should assist EFRI with establishing collaborations across NSF and with other government funding agencies that maximize the value of EFRI without compromising its mission or resources. Examples include:

- structuring of win-win relationships with divisions or agencies that provide collaborative funding so as not to decrease EFRI resources (e.g. CRISP experience),
- consideration for transfer of the REM program prior to its maturity to the Education Directorate should be weighed against the impact of EFRI innovators, both leadership and researchers, to refine and expand REM, and
- new funding mechanisms that bridge post-EFRI projects with translation and commercialization partners such as the IIP Division.

4. Please provide comments on any other issues the COV feels are relevant.

No additional comments.

5. NSF would appreciate your comments on how to improve the COV review process, format and report template.

The pre-meeting teleconference to review the objectives of the COV and EFRI program was very helpful to describe the COV review process. Instructions to the COV for reviewing proposals

should be to elicit information requested in the COV review process and report template as opposed to focusing on the details of the proposal and reviews.

The method by which EFRI portfolio documents are sampled might be reevaluated. There may be benefit in following all proposals under one call/topic/year/review panel from pre-proposal through funding to better evaluate the effectiveness of an entire review process; the limitation of this approach being focus on a single review/topic. Alternatively, selection of proposals to provide continuity of document review and/or better linkage and comparison of funded and non-funded awards could be considered.

The COV should be provided with a list and relevant information of all awards funded during the fiscal years evaluated ahead of the meeting so that portfolio-related questions can be addressed.

A prior-evening or few days in advance COV-member-only teleconference or meeting to discuss strategy might better prepare and focus the panel for the COV meeting days with EFRI and report completion. Receiving NSF presentations before the meeting could also improve the effectiveness of the panel during the COV meeting. Moreover, additional discussion time on the first day of the COV meeting would leave more writing time for the second day.

SIGNATURE BLOCK:

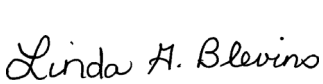
For the EFRI 2014 Committee of Visitors
Dr. Gilda Barabino
Chair

SIGNATURE BLOCK:

EFRI Committee of Visitors (Other than the Chair)

Dr. Dawn Applegate

Dr. Trung Van Nguyen



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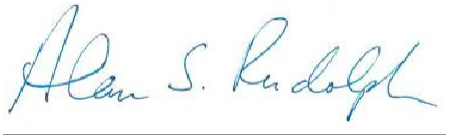
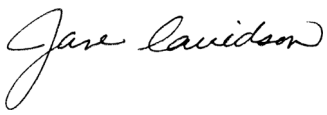


Dr. Alan Rudolph



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