EHR Response to the Report of the Committee of Visitors (COV) for the IUSE: EHR, STEP, TUES, and WIDER Programs

February 2017

(Responses to recommendations begin on Page 7.)

FY 2017 REPORT TEMPLATE FOR NSF COMMITTEES OF VISITORS (COVs)

Date of COV: October 13-14, 2016

Program/Cluster/Section: Improving Undergraduate STEM Education (IUSE: EHR), STEM Talent Expansion Program (STEP), Transforming Undergraduate Education in STEM (TUES), and Widening Implementation & Demonstration of Evidence-Based Reforms (WIDER)

Division: Division of Undergraduate Education (DUE)

Directorate: Directorate for Education and Human Resources (EHR)

Number of actions reviewed:

Awards: 129 (71 projects)

Declinations: 290 (180 projects)

Other:

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

Awards: 856

Declinations: 3648

Other:

Manner in which reviewed actions were selected:

The COV chair was asked to select several digits between "0" and "9" that would be used in selecting proposals based on their occurrence as the last digit in the proposal number. If more jackets were needed after the first number was used, the second and then third number could be used. If any jacket that was part of a collaborative was selected, then the entire collaborative would be included. The chair selected "6," then "8," then "4." After selecting all jackets ending in "6," a more than sufficient number of projects were available. The set of projects was reduced by deleting jackets in regular intervals from the list until a total of ~250 awards and declines was reached, which was the target number suggested by the EHR COV Coordinator. In only a few cases, jackets ending in "8" were selected to increase the number for a particular program. In the case of TUES Central Resource Projects, no awards ended in "8" or "4," so in order to add another TUES CRP award to the sample, a jacket with "6" as the second-to-last digit was chosen.

COV Membership

	Name	Affiliation
COV Chair or Co-Chairs:	Elizabeth S. Boylan	Alfred P. Sloan Foundation
COV Members:	Edwin J. Barea-Rodriguez	University of Texas, San Antonio
	Alan Cheville	Bucknell University
	Christina Eubanks-Turner	Loyola Marymount University
	Regina (Gina) Frey	Washington University in St. Louis
	Bruce Mason	University of Oklahoma
	Renée A. McCauley	College of Charleston
	Kalyn S. Owens	North Seattle College
	X. Ben Wu	Texas A&M University

MERIT REVIEW CRITERIA

An understanding of NSF's merit review criteria is important in order to answer some of the questions on the template. Reproduced below is the information provided to proposers in the Grant Proposal Guide about the merit review criteria and the principles associated with them.   Also included is a description of some examples of broader impacts, provided by the National Science Board

1. Merit Review Principles
These principles are to be given due diligence by PIs and organizations when preparing proposals and managing projects, by reviewers when reading and evaluating proposals, and by NSF program staff when determining whether or not to recommend proposals for funding and while overseeing awards. Given that NSF is the primary federal agency charged with nurturing and supporting excellence in basic research and education, the following three principles apply:

- All NSF projects should be of the highest quality and have the potential to advance, if not transform, the frontiers of knowledge.

- NSF projects, in the aggregate, should contribute more broadly to achieving societal goals. These broader impacts may be accomplished through the research itself, through activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. The project activities may be based on previously established and/or innovative methods and approaches, but in either case must be well justified.

- Meaningful assessment and evaluation of NSF funded projects should be based on appropriate metrics, keeping in mind the likely correlation between the effect of broader impacts and the resources provided to implement projects. If the size of the activity is limited, evaluation of that activity in isolation is not likely to be meaningful. Thus, assessing the effectiveness of these activities may best be done at a higher, more aggregated, level than the individual project.

With respect to the third principle, even if assessment of Broader Impacts outcomes for particular projects is done at an aggregated level, PIs are expected to be accountable for carrying out the activities described in the funded project. Thus, individual projects should include clearly stated goals, specific descriptions of the activities that the PI intends to do, and a plan in place to document the outputs of those activities.   These three merit review principles provide the basis for the merit review criteria, as well as a context within which the users of the criteria can better understand their intent.

2. Merit Review Criteria
All NSF proposals are evaluated through use of two National Science Board approved merit review criteria. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

The two merit review criteria are listed below. Both criteria are to be given full consideration during the review and decision-making processes; each criterion is necessary but neither, by itself, is sufficient. Therefore, proposers must fully address both criteria. (GPG Chapter II.C.2.d.(i) contains additional information for use by proposers in development of the Project Description section of the proposal.) Reviewers are strongly encouraged to review the criteria, including GPG Chapter II.C.2.d.(i), prior to the review of a proposal.

When evaluating NSF proposals, reviewers will be asked to consider what the proposers want to do, why they want to do it, how they plan to do it, how they will know if they succeed, and what benefits

could accrue if the project is successful. These issues apply both to the technical aspects of the proposal and the way in which the project may make broader contributions. To that end, reviewers will be asked to evaluate all proposals against two criteria:

- **Intellectual Merit**: The Intellectual Merit criterion encompasses the potential to advance knowledge; and

- **Broader Impacts**: The Broader Impacts criterion encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes.

The following elements should be considered in the review for both criteria:

1. What is the potential for the proposed activity to:
a. Advance knowledge and understanding within its own field or across different fields (Intellectual Merit); and
b. Benefit society or advance desired societal outcomes (Broader Impacts)?
2. To what extent do the proposed activities suggest and explore creative, original, or potentially transformative concepts?
3. Is the plan for carrying out the proposed activities well-reasoned, well-organized, and based on a sound rationale? Does the plan incorporate a mechanism to assess success?
4. How well qualified is the individual, team, or organization to conduct the proposed activities?
5. Are there adequate resources available to the PI (either at the home organization or through collaborations) to carry out the proposed activities?

3. Examples of Broader Impacts
The National Science Board described some examples of broader impacts of research, beyond the intrinsic importance of advancing knowledge.[1] "These outcomes include (but are not limited to) increased participation of women, persons with disabilities, and underrepresented minorities in science, technology, engineering, and mathematics (STEM); improved STEM education at all levels; increased public scientific literacy and public engagement with science and technology; improved well-being of individuals in society; development of a globally competitive STEM workforce; increased partnerships between academia, industry, and others; increased national security; increased economic competitiveness of the United States; and enhanced infrastructure for research and education. These examples of societally relevant outcomes should not be considered either comprehensive or prescriptive. Investigators may include appropriate outcomes not covered by these examples."

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[1] NSB-MR-11-22

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, declinations, returns without review, and withdrawals) that were *completed within the past four 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: The vast majority of the proposals were reviewed using the panel review method. The use of the panel-review method is an excellent method to evaluate the proposals from these programs to ensure an in-depth review of the strengths and weaknesses of the Intellectual Merit and Broader Impacts. A few proposals were reviewed internally by individual Program Officers (POs) or by several POs, as NSF policy allows. These proposals were generally for purposes such as workshops under a certain threshold amount. The use of PO reviews or internal reviews for small awards is entirely appropriate and more efficient, allowing the time of external reviewers to be concentrated on larger, complex proposals. **Data Source: EIS/Type of Review Module**	YES
2. Are both merit review criteria addressed a) In individual reviews? b) In panel summaries? c) In Program Officer review analyses? Both merit review criteria were explicitly addressed in almost all of the reviews sampled. There appeared to be two categories of reviews where the COV found that the merit review criteria were not addressed, or addressed to a lesser extent than deemed advisable. The categories were in individual reviews of	YES

some proposals, and in either the individual reviews, the panel summary, or the PO's review analysis in some proposals that were declined.

It was the sense of the COV that the presence of specific comments on both merit review criteria in individual reviews seemed to improve over time. COV members attributed this improvement to efforts by POs to respond to previous COV reports and possibly to POs sharing with the panels specific frameworks or guiding questions. Reviewers seemed to find these practices useful in organizing their comments and the net result was more detailed reviews that systematically addressed both of the merit review criteria.

The reviews for declined proposals had the least amount of information regarding the merit review criteria. This was true for individual reviews and panel summaries and, in some cases, for the PO review analyses as well.

The COV observed that most of the reviewers (even those providing detailed reviews) wrote more specifics on the Intellectual Merit criterion than on the Broader Impacts criterion. The STEP reviews consistently addressed the Broader Impacts criterion well, while TUES reviews were more mixed in addressing Broader Impacts. There was some discussion as to whether one way to address the weakness in the Broader Impacts comments might be to reverse the order and ask the reviewers to write about the Broader Impacts criterion first and the Intellectual Merit second.

For panel summaries, both merit review criteria were addressed in most cases. Some panel summaries addressed strengths and weaknesses overall instead of addressing them separately according to each merit review criterion.

The review analyses and PO comments always addressed both merit review criteria. However, they varied in the amount of detail provided. For the awarded proposals, there were consistently well-written PO comments for the PI. For the declined proposals, the PO comments were more varied; many were found to have standard or generic comments that would not be helpful to the proposers who seek information about how to improve their proposal for resubmission.

COV Recommendation:

Continue to develop approaches for improving the quality of individual reviews, panel summaries, and PO comments, especially for declined proposals. Suggestions include:
1) More detailed feedback could help PIs who have been declined to write better proposals next time. The COV believes that helping PIs who have been declined is important for broadening the types of institutions and demographics of students and faculty being served by NSF funding. The COV also fully appreciates the additional time that would be needed to devote more attention to feedback on the declined proposals, but believes that an evaluation of the costs-benefits and creative problem-solving can make a difference, given the stakes involved in improving the various forms of diversity of the applicant and awardee populations.
2) DUE staff are encouraged to continue to investigate the effectiveness of the training of reviewers. The COV recognizes that efforts have been made to provide orientations and webinars for the reviewers and the progress seen in review organization and specificity may well be the result of these efforts. However, there are still opportunities to improve

the quality of reviews to provide truly effective feedback to the PIs on how to improve their proposals. Possibilities include: a) modify the reviewer guidelines to provide even more concrete questions to guide their reviews; and b) consider providing reviewers with four (or more) fictionalized examples of reviews to model length and content specificity, e.g. a good review of a funded proposal, a poor review of a funded proposal, a good review of a declined proposal, and a poor review of a declined proposal. *EHR Response:* *We agree that helping the PIs of proposals that have been declined is important for broadening the types of institutions and demographics of students and faculty being served by NSF funding. We will explore offering webinars on "best practices for proposal writing" to PIs of declined proposals, focusing first on those which were not discussed by a panel ("triaged" proposals). We will ask reviewers during panel debriefing sessions to identify "common areas that could be strengthened" and will include this information in our webinars and other presentations and, when appropriate, in the PO comments for proposals that are declined.* *Reviewer training is a concern across programs, and NSF has begun to address it as an agency. During recent years, with the encouragement of NSF's senior leadership, different NSF units have undertaken and studied a range of pilot programs to improve the merit review process. (These are summarized in NSF's annual reports to the National Science Board on NSF's merit review process; see https://www.nsf.gov/nsb/publications/pubmeritreview.jsp.) In particular, in January 2017, NSF launched a "Merit Review Pilot" to improve the quality of written reviews by focusing on a timely, consistent orientation for reviewers. This pilot includes a standard set of training modules. Several DUE program officers have already participated in this pilot, and the IUSE: EHR program will implement it more widely during the upcoming review cycle. We will also consider developing fictionalized examples of reviews, as suggested by the COV. The Advanced Technological Education (ATE) program has followed this approach for several years, and the model reviews have helped new reviewers, but it is not clear whether their use has resulted in an overall improvement in the quality of reviews.* **Data Source: Jackets**	
3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals? Comments: The comments in the individual reviews were mixed in the extent to which there was adequate justification of the proposal's assessment. Some comments were short, some detailed and extensive. In addition, some of the comments in the reviews did not appear to agree with the rating. For example, comments would be highly complementary and the rating would be "Good." The COV observed that at times there was more consistency in what reviewers actually wrote in their comments than the summary ratings they assigned. This observation	YES

would argue that some additional time be spent in training reviewers to distinguish among the ratings categories more consistently.

The COV also noted that the response to a previous COV report used the word "plead" when speaking about staff efforts to have all reviewers write substantive comments. The COV appreciates the difficulty experienced by POs when reviewers are faced with sizable numbers of proposals and limited time for review, and surmises that proposal overload may contribute to the finding that some individual reviews are lacking with respect to substantive comments that explain the reviewers' assessments. One suggestion is to determine whether using more virtual review panels that save on time and travel costs is a useful strategy: by increasing the number of reviewers per panel or the number of panels and decreasing the number of proposals assigned to each reviewer, an improvement in the quality of individual reviews may be realized. The COV understands that some experimentation is happening along these lines with the new IUSE: EHR program and supports such creative problem-solving.

COV Recommendations:

Consider ways to modify the training of reviewers to improve the consistency with which the justifications provided in reviewer comments are aligned with the summary ratings.
Possible approaches include:
1) providing specific training to Panel Chairs to make sure reviewers are consistent in the appropriate use of the ratings and in the alignment of the ratings and the comments;
2) providing a rubric (or list of questions) and examples of reviews of different levels of quality. (See Section I.2. above.)

Consider sharing with both proposers and reviewers some version of the logic models that are now developed by staff for each program, so that proposers and reviewers are more aware of the program's objectives and outcome goals. This might help give the reviewers some guidance as they are writing their reviews, and assist prospective PIs in more fully understanding the assumptions that are made when a program is announced.

EHR Response: We agree with the COV's comments and will undertake such training either with Panel Chairs (if used) or with POs who are managing a panel. As noted above in our response to the recommendation under Question I.2, we will explore the use of fictionalized examples of reviews. With regard to sharing the IUSE: EHR program's logic model, we will include the model in the next solicitation if it is technically feasible to do so.

Data Source: Jackets

4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)? Comments: The panel summaries were mixed in quality regarding a detailed rationale for panel consensus. Many of the panel summaries were described by the COV as well written, containing sufficient information to understand the rationale for	YES

consensus. However, a significant number of panel summaries were described by the committee as short and lacking in sufficient detail.

The COV also observed that the weakest proposals were more likely to receive minimal feedback in the panel summary. The management plan for the IUSE: EHR program noted that panels would be given flexibility about discussing, and preparing a panel summary for, low-rated proposals; however, the COV reiterates the comments and suggestions made, as well as the recommendation offered, in Section I.2: providing panel summaries that are consistently well-written and well-justified may be an effective means by which the NSF merit review system can educate and diversify its applicant and awardee pools.

COV Recommendation:

See Recommendation in Section I.2. above.

EHR Response: See our responses to the recommendations under Questions I.2 and I.3 above.

 Data Source: 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: Taken in its entirety, eJacket documentation does provide the rationale for the award/decline decision. The individual documents for each proposal are, however, more variable on this point. As indicated in other sections, the COV suggests particular targets for greater attention. *EHR Response: See our responses to the recommendations under Questions I.2 and I.3 above.* **Data Source: 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:	YES

The majority of the documents sent to PIs provide sufficient rationale for the decision and often highlight the strengths and weaknesses (as applicable). This is especially the case in the panel summaries and PO comments. Some of those for decline decisions, however, were generic and short, lacking what the COV deemed to be sufficient rationale for the decision or suggestions on possible ways to improve the proposal.

The COV understands the pressure of workload on POs, and that some triage of effort is warranted. The COV suggests continued conversation among POs and senior staff as to the best balance between efficiency (of PO time) and efficacy (of PI understanding and education) when setting standards about what to communicate to applicants when their proposals are declined.

COV Recommendation:

Provide more rationales for decline decisions and more suggestions for improvement to cultivate a broad PI base and encourage revisions of proposals that will prove successful in later cycles of review. As noted in recommendations in previous sections, the COV believes that such feedback and mentoring can have disproportionally large benefits to the PIs from underrepresented regions and from institutions and individuals with limited support and resources.

EHR Response: We appreciate the COV's sensitivity to the constraints on POs' time, and we agree with the need to provide feedback that will help PIs— especially those with less experience and less support—improve proposals that are declined. See our responses to the recommendations under Questions I.2 and I.3.

 Data Source: Jackets

7. Additional comments on the quality and effectiveness of the program's use of merit review process:

The COV notes its full support for the practice of ensuring continuity in the panel chairs as suggested in the TUES management plan. Doing so would allow the experience of leading a panel to be realized more fully in a subsequent review meeting.

The COV also discussed the extent to which there are approaches that can strengthen peer mentoring and quality control of the individual reviews by using panel chairs and experienced reviewers in new ways. One or more well-prepared reviewers, possibly with explicit roles of peer mentoring and quality control, may do much in enhancing the effectiveness of individual reviews and panel summaries.

The COV appreciates the challenges of orienting new PO staff, and commends the efforts to help them to develop understanding and proficiency in all aspects of the complex grant administration process. The COV encourages continued attention to and enhancement of these efforts.

The COV notes that NSF staff regularly offer proposal writing workshops on campuses and at professional society meetings. Less well known to the COV

was the offering of mock review panels, and the COV believes that the number of these could be increased and the organization of them adapted to reach even more scientists at a variety of institutional types. The COV suggests that running regional workshops/"academies" regarding the effective peer review of NSF proposals could help both prospective PIs and potential reviewers/panel chairs in developing relevant understanding and competencies. Bringing together faculty from multiple campuses in a region could increase opportunities for those employed by underserved institutions to collaborate with those at more-resourced ones, and diversify the pool from which POs and panel chairs can draw for the merit review process. More intentional scheduling of regional mock review panels by staff may prove fruitful.

EHR Response:

As we bring aboard new POs, we will continue to explore new ways of training and mentoring them, as the COV suggests. It is worth noting that in recent years, the NSF Academy (the internal unit that leads learning and professional development for NSF employees) has developed and refined a series of four "Merit Review Basics" courses, which cover all aspects of NSF's merit review process. Since July 2013, all new POs have been required to take the first two courses within 90 days of beginning work at NSF; and effective September 1, 2018, all new POs will be required to take the third and fourth courses within their first six months at NSF. Those courses are continuously improved, and several experienced DUE staff members serve as facilitators for them and have input into their improvement.

With regard to training and mentoring reviewers, we will be more explicit about asking experienced reviewers to take on a real-time mentoring role with new panelists with respect to the content of reviews.

With regard to workshops on effective peer review (including mock panels), we will explore opportunities to expand such offerings within the constraints of budget and personnel. (POs already often include mock panel reviews as part of proposal writing workshops at professional society meetings, although sometimes the limited length of sessions precludes this approach.) Potential approaches include using webinars and enlisting grantees who have appropriate expertise.

Our responses to the recommendations under Questions I.2 and I.3 are also germane to the COV's suggestions.

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: The COV found evidence that, overall, the expertise and qualifications of the reviewers were well-suited for the panels for which they were chosen. The few cases where reviewer comments seemed to indicate that the reviewer lacked the desired amount of knowledge and/or experience may be attributed to DUE's practice of deliberately inviting a few less-experienced reviewers, including early career individuals. For such individuals, the panel experience is likely to prove very useful for their professional development purposes. The COV believes that actual decisions about funding were not materially affected by having a small percentage of reviewers who fell into this "professional development" category. However, the COV cautions that the trend/pressure towards reducing the number of reviewers per proposal may become a complicating factor in maintaining rigorous review while still seeking to include a small fraction of reviewers who are chosen for such "professional development" experiences. Eliminating or substantially reducing these professional development opportunities to serve on review panels would be, in the COV's view, a net loss. From multiple sources (the eJackets, reviewer lists provided for the individual programs, and expectations about reviewer expertise and demographics from the program management plans), the COV found that the details provided on reviewer characteristics were surprisingly limited. While virtually all documentation contained the reviewer's name and institution, there was much less consistency about the reviewer's department, title, and possible concurrent position related to the panel subject. Without such additional information about the reviewers, it was hard for the COV to fully assess the appropriateness of the expertise and background of the panel as a whole. Going forward, the COV believes that data on special expertise in education research or program management and evaluation may be especially important for NSF staff, panel chairs, and future COV's. Programs such as the Level 2 IUSE: EHR program track on "Institutional and Community Transformation" will need to be able to identify a pool of reviewers who have STEM disciplinary expertise *and* program management and evaluation experience related to institutional and community transformation. From the sample of proposals examined, the COV found that the latter type of expertise was not routinely collected or easily extracted.	YES

COV Recommendations:

Continue to investigate the means by which quality in panel expertise *and* in diversity can be achieved.

Continue to enrich the data available in the reviewer database that are available for future COVs, POs, and panel chairs.
Doing so will assure that the choices about panel memberships are consistent with the objectives set by DUE and NSF regarding reviewer expertise, experience, and diversity -- individual, institutional, and geographic. One suggestion about how to accomplish this is to enhance the collection of demographics/expertise in the Panelist Functions section of FastLane, i.e. make even greater attempts to have reviewers and potential reviewers supply relevant demographic information and add checklists for other forms of relevant expertise that would not be easily discernable from an individual's primary title and home department.

EHR Response:

We will more systematically encourage reviewers to provide their demographic information in FastLane (although doing so is voluntary) and will focus on improving the quality of the reviewer data that FastLane currently accommodates.

Besides expertise in the appropriate areas of STEM or STEM education, NSF policy requires that "[o]ptimally, reviewers should have ... to the extent possible, diverse representation within the review group. The goal is to achieve a balance among various characteristics. Important factors to consider include: type of organization represented, reviewer diversity, age distribution, and geographic balance" (https://www.nsf.gov/pubs/policydocs/pappg17_1/pappg_3.jsp#IIIB). When POs are deciding on appropriate reviewers for proposals, they typically have information about many characteristics of the reviewers, not just the characteristics shown in the "Review Record" section of proposals in eJacket. We will look at all the available information and seek ways to better portray it to future COVs. For example, DUE already collects CVs and short narrative biosketches from all reviewers before they are assigned to panels, and this information usually reveals a reviewer's appropriateness for a particular panel. However, it is not easy to summarize that information across panels.

Enhancing FastLane to collect additional information about reviewers' expertise would require consensus across NSF and prioritization in the agency's information technology plans; but it would also simplify the several channels that POs currently use to obtain sufficient information about the backgrounds of prospective reviewers. The relevant NSF offices look seriously at the recommendations made by COVs, and we will call this one to their attention.

 Data Source: Jackets

2. Did the program recognize and resolve conflicts of interest when appropriate? Comments: Conflicts of interest were identified and flagged. Overall NSF staff did a great job. **Data Source: Jackets**	YES
3. Additional comments on reviewer selection: COV Recommendations: Continue the practice of choosing a fraction of each panel composed of reviewers for whom panel service will perform an important professional development experience. In using such reviewers, continue to account for their presence and assignments so that proposals have a balance of seasoned and new reviewers. Consider how best to share information about program logic models with prospective grantees and panelists. Consider how best to engage panelists in discussions about logic models, rubrics, and the dynamics of developing portfolios of grants. Panels should still concentrate on the quality of the proposals for Intellectual Merit and Broader Impacts but may also find the discussions on these meta-questions useful as they assess the contributions that particular grants could make to established national needs. Consider forming a committee of expert reviewers who are willing to mentor new or potential reviewers. From this committee of experts, consider including panel chairs that serve for two years to secure consistency in the review process. *EHR Response: We agree with the COV's comments. Our responses to the recommendations under Questions I.2 and I.3 speak to continuing to constitute panels with a mix of experienced and new reviewers, sharing logic models more widely, and explicitly employing seasoned reviewers as mentors for new reviewers. During panel meetings, time pressures often focus the discussions on the individual proposals, but POs will look for opportunities to discuss the "meta-questions" with reviewers. (The orientation sessions and debriefing sessions for panels might offer more temporal flexibility.) In practice, we believe that the COV's idea of utilizing expert reviewers as mentors for less experienced reviewers can be best realized by enlisting panel chairs who are former POs or very experienced reviewers.*	

III. Questions concerning the management of the program under review. Please comment on the following:

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MANAGEMENT OF THE PROGRAM UNDER REVIEW

1. Management of the program.

Comments:

The COV looked over the management plans of DUE programs submitted for NSF approval and found them to be well crafted and rich in detail. The plans provide necessary guidance for POs which the COV felt was important for programs like TUES and IUSE: EHR where awards are made across a variety of disciplines and panels, ensuring that there is sufficient consistency of reviews. Despite the challenges of managing complex programs that cover a range of disciplines, the COV found ample evidence of sound management plans and practices.

The COV noted positively how solicitations and program management documents have evolved over time to address changing expectations and developments in education. In particular, the updates that focus programs on research, the management plans, and inclusion of a logic model were seen as positive developments.

The information on dwell times provided to the COV showed that the review processes proceeded as planned, with the majority of review decisions completed within six month of proposal submission. This is an impressive feat considering the number and diversity of proposals received for these programs. The only exceptions to this finding were the STEP and TUES programs in 2014, during the transition to IUSE: EHR. The COV believed it understood why this might have been the case during such a major transition, and predicts that analysis of the dwell times will show reversion to a more normal state as the IUSE: EHR program matures.

The COV felt that the inclusion of the program logic models with the program management plans was quite useful, and suggests that distributing this information more widely (in solicitations and training) could benefit all involved. Such additional information could help prospective grantees see additional dimensions of the program to which their proposals might be submitted. Furthermore, the material could be productively used in the training of new NSF staff, panel chairs, and reviewers.

The COV discussed the challenges of bringing on new permanent and rotator staff who become responsible quickly for the merit review panels. The COV encourages NSF to continue to explore ever more effective ways for training and mentoring new POs so that they can become fully competent in training and facilitating panels and providing feedback to and mentoring PIs in as short a time as possible.

The COV appreciates that NSF places very high priority to allocating as much of its funding as possible to its external grants for research and education, and we concur with that general principle and direction. However members also believe that the merit review process should not bear a disproportionate brunt of any budget cuts that may be necessary. The COV asks NSF to consider at what point does cutting the review budget and/or streamlining the review process begin to negatively affect the quality of proposals received by the Foundation or the quality of the funding decisions made.

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COV Recommendations:

Consider ways to better link program data to the outcome indicators initially outlined in the logic models and management plans. Doing so may provide POs, future COVs, and Advisory Committees better guidance and information to determine how well programs are adhering to best practices in program management.

Consider the impact that well-crafted reviews have in encouraging PIs from less research-focused/resourced institutions and those from states who have yet to develop a robust research infrastructure to continue submitting proposals despite initial "no fund" decisions.

EHR Response: The logic model for the IUSE: EHR program is somewhat new and evolving, but we agree that the data collection for a program should align with the identified outcome measures. As the program matures, our data analysts and evaluation experts will look for more intentional ways to collect data that matches the logic model. Our responses to the recommendations under Questions I.2 and I.3 address the comment regarding the quality of reviews.

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

Comments:

Overall the COV finds that DUE has been actively modifying programs to respond to changing research and education opportunities. Changes to the STEP program that focused on increasing retention in engineering and computer science were noted as an example of DUE responding to calls from policy makers. We see as particularly meritorious the increased focus over time to base interventions on valid research and to support more research into effective practices. The COV notes, however, that the pace of change in higher education may be increasing so that more agile practices and program management innovations will continue to be critical to DUE's long term success.

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

Comments:

The COV was unable to make a substantive judgment of the process that DUE used to guide the development of its portfolio because of a lack of information available to the COV. We note that as the programs are evolving to focus more on research and research-based institutional transformation, there may be an even greater challenge than exists now in attracting and funding proposals that are representative of geographic or institution type variation. Strategies may need to be adjusted to guide future program investments across DUE's portfolio, at least in the short-term, to allow the development of institutional capacity for fundable research.

The COV noted that while the program management plans provided a snapshot of the desired review process, the alignment between and among the management plan, program solicitation, instructions to reviewers, desired impact, and relation to the program logic model was not always clear. The COV recognizes that, while the complexity of IUSE: EHR likely makes a full 360-degree view impossible to achieve, the inter-divisional discussions such an effort will encourage may themselves be of value.

The IUSE: EHR program represents an emphasis on research and evidence-based activities and measured outcomes. We caution that while the emphasis on research is overall a positive direction

for the program, in the short term it may make proposals from some institutions less competitive if they have not yet developed a culture of inquiry in teaching and learning. While more narrowly focused NSF programs in other divisions can drive scientific advances by funding the most capable researchers, the DUE goal of more systemic transformation (e.g., the WIDER and IUSE: EHR programs) seems to require full participation of the entire diversity of institutions in the STEM education ecosystem. We recognize the inherent tension between this need and NSF's merit review criteria and note positively some of the outreach activities being tested by DUE.

The COV understands that the 2014 IUSE: EHR call for proposals was an anomaly necessitated by directives at the time, and believes that the 2015 solicitation provides a better background and justification for the program, including reference to some of the literature used in planning and priorities. With this substantial progress to better align the various elements that have been integrated to make up the IUSE: EHR program, IUSE: EHR reviewers are now in a better position to have the needed context so that they can apply NSF's merit review criteria with even greater fidelity.

As noted in earlier sections, the COV suggests that DUE consider how best to communicate the research behind the program solicitations to make the logic models and theories of change even clearer to those writing and reviewing proposals. More wide-spread dissemination of the logic models developed for the grant programs could help in this process. Similarly, explicitly indicating the correlation between awarded grants and the logic models' desired outcomes could be useful for closing the evidence-based loop on program assessment.

COV Recommendation:

Continue to experiment with and evaluate which outreach practices are most effective. Where possible, draw from the research funded by NSF to look at effective methods of outreach, peer review, and mentoring of applicants and awardees.

The COV encourages substantive use of EPSCoR's resources and complementary strategies to develop more meritorious proposals from states and institution types that have historically submitted fewer proposals and have low proposal funding rates. While the COV recognizes the constraints that DUE is under in collecting data and the costs associated with such efforts, we urge the program to think holistically on how to capture data that show how the portfolio is addressing the desired outcomes (as identified in the logic model) while supporting the entirety of the complex ecosystem of institutional types, disciplines, student demographics, geographic distribution, etc.

EHR Response:

We will continue to try to improve and expand our engagement with potential applicants. This effort includes collaborating with the EPSCoR program and paying attention to institutions in EPSCoR jurisdictions. DUE has recently made an award to support a project that will explore such an opportunity in the context of the NSF Scholarships in STEM (S-STEM) program. As that project proceeds, we will look to leverage it for enhancing similar aims for the IUSE: EHR program. As we look for cost-effective ways to offer more proposal writing workshops and mock proposal-review panels (see the response to the recommendation under Question I.7), we will prioritize outreach to institutions that are less competitive or appear to be underrepresented in the IUSE: EHR program.

As part of the evaluation of the IUSE: EHR program, we will attempt to collect data which connects clearly with the program's logic model and which measures the program's effects on many dimensions of the higher education ecosystem.

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

Comments:

The current COV looked both at DUE's responses immediately following the prior COV visit as well as the October 2016 responses to determine how responsive DUE had been to previous external feedback. Overall, it is clear that the program staff have taken seriously these review processes. The COV finds that DUE has been responsive to the concerns raised by past COVs. Discussion with program staff, in particular, helped the COV understand the nuances of changes to the programs, barriers that have proven resistant to improvement efforts, and the continuing evolution of program aims and practices. The COV is pleased to find that the lessons learned from many years of experience with the CCLI, TUES, and STEP programs, including the COV reviews, are informing the development of IUSE: EHR programs in meaningful ways.

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: No additional comments. **Data Source: EIS/Committee of Visitors Module. From the Report View drop-down, select the Funding Rate module to see counts of proposals and awards for programs. The Proposal Count by Type Report View will also provide a summary of proposals by program.**	APPROPRIATE
2. Are awards appropriate in size and duration for the scope of the projects? Comments: No additional comments. **Data Source: EIS/Committee of Visitors Module. From the Report View drop-down, select Average Award Size and Duration.**	APPROPRIATE
3. Does the program portfolio include awards for projects that are innovative or potentially transformative? Comments: The program portfolio included awards for projects that are innovative and potentially transformative. In reviewing the proposals, we encourage POs to be more systematic about documenting in their review analyses their logic about which projects have these desired characteristics. **Data Source: Jackets**	APPROPRIATE
4. Does the program portfolio include inter- and multi-disciplinary projects? Comments: TUES and IUSE: EHR represent good examples of programs that have an explicit category for interdisciplinary and multidisciplinary proposals. The COV concurred that it made good sense to have a specialized set of POs	APPROPRIATE

manage these proposals, review process, and awards. Most STEP awards fulfilled objectives to fund across a range of STEM disciplines, e.g. by grants spanning an entire college of engineering or a college of science and mathematics. **Data Source: If co-funding is a desired proxy for measuring inter- and multi-disciplinary projects, the Co-Funding from Contributing Orgs and Co-Funding Contributed to Recipient Orgs reports can be obtained using the EIS/Committee of Visitors Module. They are available as selections on the Report View drop-down.**	
5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators? Comments: The COV appreciates the efforts that program staff have made to educate prospective grantees and encourages the staff to strengthen their efforts to innovate regarding outreach activities, particularly in states from which few proposals are received and in states where funding rates are relatively low. The COV noted that in the latest IUSE: EHR management plan, DUE had begun to make panel discussion/panel summaries of proposals that were not sufficiently highly rated optional, as is allowed by NSF policy. While we understand the need to reduce review costs, we also note that providing a panel summary could help improve declined proposals for resubmission, which could be especially useful in boosting the participation of PIs from states that currently show relatively few submissions and/or a relatively low success rate. *EHR Response:* *As our responses to the recommendations under Questions I.2 and III.3 indicate, we agree that we should take steps to improve participation and success in states with low numbers of proposal submissions and awards.* *With regard to the "triaging" of low-rated proposals, we also understand the COV's concerns. We have begun to query reviewers during IUSE: EHR panel debriefing sessions about characteristics that triaged proposals share. Feedback on this point will inform common text that can complement individualized remarks that POs provide to the PIs of declined proposals.* **Data Source: EIS/Committee of Visitors Module. Select Proposals by State from the Report View drop-down.**	APPROPRIATE
6. Does the program portfolio have an appropriate balance of awards to different types of institutions? Comments : The program portfolio has an appropriate balance of awards to different types of institutions in terms of the five categories recorded by NSF (Associate,	APPROPRIATE

Bachelor's, Master's, Doctorate, Other). However we suggest that NSF consider adopting the more nuanced Carnegie Classification of institutional types (e.g. http://carnegieclassifications.iu.edu/lookup/lookup.php) to differentiate even further between and among the missions and characteristics of the wide variety of higher education institutions in the U.S. **Data Source: EIS/Committee of Visitors Module. Select Proposals by Institution Type from the Report View drop-down. Also, the Obligations by Institution Type will provide information on the funding to institutions by type.** *EHR Response: We appreciate the COV's suggestion regarding the use of a finer-grained classification system for institution types. We will ask NSF's data experts whether linking NSF's institution database with the Carnegie classifications has been considered.*	
7. Does the program portfolio have an appropriate balance of awards to new and early-career investigators? NOTE: A new investigator is an individual who has not served as the PI or Co-PI on any award from NSF (with the exception of doctoral dissertation awards, graduate or post-doctoral fellowships, research planning grants, or conferences, symposia and workshop grants.) An early-career investigator is defined as someone within seven years of receiving his or her last degree at the time of the award. Comments: No additional comments. **Data Source: EIS/Committee of Visitors Module. Select Funding Rate from the Report View drop-down. After this report is run, use the Category Filter button to select New PI for the PI Status filter or New Involvement (PIs & coPIs) = Yes.**	APPROPRIATE
8. Does the program portfolio include projects that integrate research and education? Comments: The program portfolio included projects that integrated research and education. DUE should be commended for moving to include more education research into its programs. **Data Source: Jackets**	APPROPRIATE

9. Does the program portfolio have appropriate participation of underrepresented groups[2]? Comments: In IUSE: EHR there were improvements in increasing the participation and funding rates of underrepresented groups. We encourage DUE to continue to strengthen and broaden the improvements made in IUSE: EHR. **Data Source: EIS/Committee of Visitors Module. Select Funding Rate from the Report View drop-down. After this report is run, use the Category Filter button to select Women Involvement = Yes or Minority Involvement = Yes to apply the appropriate filters.**	APPROPRIATE
10. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports. Comments: The COV found that the program is relevant to national priorities, agency mission, relevant fields, and other constituent needs. The TUES and STEP programs have responded to changes in national priorities and opportunities for collaboration with other programs. The emphasis in the TUES and IUSE: EHR programs on evidence-based education transformation is clearly a response to research and recommendations from the National Research Council and other national groups. DUE is doing its part in working to meet identified national educational needs. In addition to the literature cited in the announcements for the programs under review, the COV notes additional recent citations that are relevant to DUE activities. In many cases, COV members are aware that DUE staff have been actively engaged in the development and refinement of these resources. They include: • The Coalition for Reform of Undergraduate STEM Education. (2014.) *Achieving Systemic Change: A Sourcebook for Advancing and Funding Undergraduate STEM Education*. Association of American Colleges & Universities. • Weaver, Gabriela C., Burgess, Wilella D., Childress, Amy L., and Slakey, Linda. (2015.) *Transforming Institutions: Undergraduate STEM Education for the 21st Century*. Purdue University Press. • Malcom, Shirley, and Feder, Michael. (2016.) *Barriers and Opportunities for 2-Year and 4-Year STEM Degrees: Systemic*	APPROPRIATE

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[2] 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.

Change to Support Students' Diverse Pathways. The National Academies Press.

- Selingo, Jeff. (2016.) *2026 - The Decade Ahead*. Chronicle of Higher Education.

Data Source: Jackets

EHR Response: We appreciate the COV's inclusion of this set of recent references, and we will explore ways to further disseminate them, including possibly citing them in the next version of the IUSE: EHR solicitation.

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11. Additional comments on the quality of the projects or the balance of the portfolio:

At an overarching, 40,000 foot level, the COV has observed that DUE programs are undergoing a fundamental transformation away from many small projects spread across regions, disciplines, and institutions towards more generalizable, research-based interventions and knowledge generation. Overall, the COV agrees with this direction based on its understanding of current objectives and opportunities. However, members encourage DUE to be sensitive to how this choice may have unintended systemic impacts on the STEM education ecosystem, and to how processes and practices within DUE may need to change. We note that there are DUE staff who were responsible for earlier programs that were widely judged to be successful. Setting aside time to permit them to reflect on lessons learned that could be adapted to current programs and future planning could have beneficial outcomes.

The COV was unable to find data on how the outcomes and goals of the logic models were used to help DUE manage "portfolio balance." We encourage DUE to be more transparent with the program logic models even to the extent of sharing these with the PI and reviewer community. The 2012 STEP COV made several comments on strategic planning that are apropos to continual improvement in this area.

EHR Response: We appreciate this caution to be alert to the potential for unintended consequences as DUE's programs change. While it is important that the programs support advances by highly experienced researchers, we want the programs to serve a diverse range of institutions and build capacity. We will monitor the characteristics of the applicants and awardees to ensure that the programs maintain an appropriate balance. Since all program officers in DUE are involved in the IUSE: EHR program, the process of revising the solicitation presents an ideal time to take account of the implications of changes for the larger undergraduate STEM education enterprise. Our responses to the recommendations under Questions I.3, III.1, and III.3 note our intent to share the IUSE: EHR logic model more broadly and to collect data that connects with it. We will follow this approach with other programs, as well.

OTHER TOPICS

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

While the COV recognizes that DUE operates within the larger culture, structure, and constraints of NSF, we note that its mission of systemic transformation distinguishes it from NSF's disciplinary programs. We commend DUE for further embracing this view in the IUSE: EHR program and recognize that it will be necessary to explore ways to stimulate innovation that might include giving more autonomy to individual program officers for sub-goals of IUSE: EHR (perhaps drawn from the logic model), experimenting with alternative panel structures, and reviving the use of experienced panel chairs drawn from the PI community as was practiced in the CCLI program.

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.

It is difficult to determine how well other aspects of the program management plans are carried out. The data do not seem to be available, at least not to the COV. One example that received significant consideration by the committee was the goal to have a diverse set of reviewers by institution type. The information provided was not sufficiently detailed for evaluation by the NSF or review by the COV.

The COV had some of the same concerns observed by previous COV's including the mixed quality of individual reviews, the distribution of awards across institutions in certain states and serving distinct populations of students, and the low proposal success rate by institutions in some states. While some positive steps have been taken, notably an increasing emphasis on replicating promising results, effectively addressing all these concerns remains a significant challenge. The COV appreciates the challenge and associated constraints, and recommends that DUE strengthen its efforts and innovations to effectively address these important concerns.

EHR Response: The COV's comments here echo those in several earlier sections, and we will take steps to address these issues, as described in the responses to the recommendations under Questions I.2, I.3, I.7, II.1, II.3, and III.3. We acknowledge that some of them are enduring challenges, even though we make progress over time.

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

The COV felt that the inclusion of the program logic models with the program management plans was quite useful to NSF internal decision-making. Logic models appeared to drive the aims of the programs in appropriate ways. However the COV did not have a clear idea about what body(ies) of knowledge, workshops, or reports on the "inputs/problems" were used in developing the TUES and IUSE: EHR logic models, and we suggest that DUE consider providing a "Review of Existing Research" to justify the problems driving the logic model as would be required in a competitive proposal. In particular the COV noted that the citation of the driving problem as "Fewer than 40% of students entering college intending to major in STEM complete degrees in STEM" is true in many non-STEM disciplines as well, and that several studies have shown an inability to transfer in, rather than low retention, drives loss in STEM fields.

Members of the COV had some concerns about statements regarding the high rate of students leaving STEM fields. The rate of students leaving STEM majors is not unusually high. Reports from the National Center for Education Statistics indicate that

"…At the bachelor's degree level, students in humanities, education, and health sciences had higher attrition rates (56−62 percent) than did those in STEM fields (48 percent), and students in business and social/behavioral sciences had comparable attrition rates (50 and 45 percent, respectively) as did students in STEM fields." http://nces.ed.gov/pubs2014/2014001rev.pdf.

Care should be taken not to perpetuate as true those conclusions that are not fully supported by recent evidence, especially comparative analysis.

Given the synergistic relationship that NSF must maintain with the PI community in order to succeed in its larger mission, DUE should consider what partnerships with this community might help drive further development and refinement of logic models or theories of change.

EHR Response: We appreciate the COV's comments regarding the assumptions, bodies of knowledge, and other inputs that inform the IUSE: EHR logic model. The process of revising the solicitation will provide an opportunity to reexamine the program's logic model using the lens that the COV has encouraged.

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

The COV commends the DUE staff involved with IUSE: EHR, STEP, TUES, and WIDER on:

Their clear and unwavering commitment to the mission of the National Science Foundation and the aspirations of the Division of Undergraduate Education.
> Through discussions with the staff and through the examination of eJackets and other documentation, the COV found ample evidence that staff acted with a thorough understanding of NSF regulations and in the spirit of integrity, fidelity, and transparency in decision-making that NSF has established as hallmarks of its merit review processes.

Their careful stewardship of NSF resources (grants, staffing, and support budgets) and their willingness to test new approaches to maintain or enhance the quality of the Division's work while conserving funds that could be used for additional research and program needs.

Their culture of mutual assistance in sharing successful approaches and lessons learned in the management of their varied tasks: convening panels, working with prospective grantees, and contributing to the vision and analysis of division-wide programs and goals.

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

The COV was interested in learning how the COV reports are being used during the periods between COV reviews. Are these reviews revisited periodically? Is there a process such that the review comments and recommendations are incorporated into the DUE planning and assessment activities on a regular basis?

While the COV commends the thought DUE puts in to management plans crafted at the initiation of a program, we initially were unable to easily access data that showed how effectively the plan was being followed or what mid-course corrections had been necessary. However, many questions were later addressed during Q&A with program staff. Examples included the estimated number of program staff and how the division adjusted to situations when there was a larger than expected number of proposals, how the expected numbers of proposals and the required staff were being

determined, contingency plans for an unexpected number of proposals (e.g. 190 proposals were expected and the actual number was nearer to 300 for one year in STEP), or information on dwell times during the review process.

The orientation webinar held in advance was helpful in gaining an overview of the structure of eJackets and how to navigate through documents for information.

The COV is grateful for the NSF staff responsible for coordinating our activities. They were very responsive to COV requests for information and were very attentive to making our working environment as supportive of our work as possible.

EHR Response:

In accordance with NSF policy, program staff revisit the COV report annually and assess their progress toward addressing the COV's recommendations. Immediately before the next COV review, they prepare a final "update" to the initial "response" document, summarizing the actions they ended up taking over the three- or four-year period to respond to the COV report. For example, this COV reviewed the final "updates" to the responses to the previous COV reports for the TUES and STEP programs, and the COV used that information to inform its answer to Question III.4. The program staff also revisit the COV report when they revise the program's solicitation; typically, solicitations for DUE programs are revised every two or three years. Observations from the most recent COV report are also taken into account when program evaluations are designed. In addition, at some point during the period between COVs, in EHR, each program gives a formal presentation at one or more of the semiannual meetings of the EHR Advisory Committee to update that committee (which reviewed, discussed, and approved the COV report) on the program's progress in responding to the COV's major recommendations.

Also in accordance with NSF policy, the program staff review the program's management plan on an annual basis and update it if necessary. However, the changes *that are made are often not documented in detail; hence we recognize that the COV, on the basis of the management plans provided, would not necessarily be able to judge "how effectively the plan was being followed or what mid-course corrections had been necessary." Q&A with program staff is usually necessary to uncover which aspects of the plan (if any) changed from year to year.*

Although our comments in this "response" document have focused on the COV's specific recommendations for action, we wish to express our gratitude to the COV members for their many positive comments about the management and nature of the programs in this review. The entire review (the written products, the interactions with NSF staff, the interactions among the committee members) was thoughtful and constructive, and the committee clearly appreciated the importance of the programs as well as the pressures that affect the management of the programs and the administration of the merit review process.

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SIGNATURE BLOCK:

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Elizabeth S. Boylan
Chair

For the COV on Improving Undergraduate STEM Education (IUSE: EHR), STEM Talent Expansion Program (STEP), Transforming Undergraduate Education in STEM (TUES), and Widening Implementation & Demonstration of Evidence-Based Reforms (WIDER)