

Report of the National Science Board on the National Science Foundation's Merit Review System



September 30, 2005

MEMORANDUM FROM THE CHAIRMAN OF THE NATIONAL SCIENCE BOARD

SUBJECT: *Report of the National Science Board on the National Science Foundation's Merit Review System*

Merit review is the cornerstone of the National Science Foundation's (NSF's) work. The National Science Board (NSB, the Board) and NSF have diligently worked together to ensure that the NSF merit review system remains an international 'gold-standard' for review of science and engineering. In September 2004, Congress requested that NSB, in its role as policy making and oversight body for NSF, conduct a structured review of NSF's merit review process and report its findings to the House Committee on Appropriations.

Among the most fundamental and important characteristics of the NSF partnership with the extramural science community is that Federal financial support flows through a core system of merit-based peer review administered by NSF staff with expertise in scientific disciplines.

The review included, but was not limited to, the quantitative methodologies used to distinguish relative quality among projects; the discretion permitted and exercised by NSF staff in choosing peer review panels and in selecting specific projects for funding; the scientific, geographic, and institutional composition of peer review panels; and the ability of the existing process to identify the most innovative proposals.

NSB fully supports the current NSF system of merit review, which uses the peer review process as the principle driver in funding decisions. The Board also endorses the role of NSF's program officers' professional judgment, in concurrence with division directors, for addressing both Merit Review Criteria and achieving a balanced portfolio of research and education awards, within directorates and across the suite of NSF programs.

To improve the transparency and effectiveness of the NSF merit review system, NSB provides several recommendations that include: establish supplemental guidelines and procedures by all directorates and divisions to implement a set of readily accessible, NSF guidelines; increase outreach designed to inform the research community; encourage expanding collaboration across NSF to discuss funding decisions; and continue to improve outreach to traditionally underrepresented groups in the reviewer data base. The Board believes these changes will help to facilitate the training of incoming program officers while providing the research community with a better understanding of NSF's merit review system.



Warren M. Washington
Chairman, National Science Board

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**Michael P. Crosby**, Executive Officer, National Science Board, and National Science Board Office Director

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# National Science Foundation's Merit Review System

## Introduction

Merit review is the cornerstone of the National Science Foundation's (NSF's, the Foundation's) work. Each year NSF receives over 40,000 new proposals and subjects virtually all of them to an external merit review. In FY 2004, some 58,000 outside experts provided over 250,000 separate reviews to assist NSF in the evaluation of proposals, submitted to the Foundation's nine directorates and offices, covering a wide variety of topics. Through the use of merit review, NSF seeks to maintain the high standards of excellence and accountability for which it is known around the world.

The National Science Board (NSB, the Board) and NSF have diligently worked together to ensure that the Foundation's merit review system remains an international 'gold-standard' for review of science and engineering research proposals. In 1996, the NSB-NSF Task Force on Merit Review was formed to evaluate the merit review criteria in use at the time. After completing their year-long evaluation, the Task Force proposed the two merit review criteria that the Board approved for the current merit review system. In addition, NSF prepares an annual comprehensive report with summary information about the levels of proposal and award activity for the fiscal year and the process by which proposals are reviewed and awarded. This annual report on the merit review system is required by Board policy, and has been provided annually to NSB since 1977.

Competition for NSF funding is tough – over 72 percent of the proposals reviewed in FY 2004 received at least an average score of good/very good. Unfortunately, budget limitations allowed for the funding of less than 25 percent of the proposals NSF received. In FY 2004, nearly \$2.1 billion of declined proposals received a high average rating through the NSF merit review system. These highly rated, but declined, proposals comprise a rich portfolio of unfunded research and education opportunities. Because the Foundation receives so many highly competitive proposals, NSF program officers have discretion to use their expert judgment in order to select, support, and manage a well-balanced portfolio of research and educational activities in their area of responsibility. Program officers use: 1) the results of the peer review process; 2) the Board-approved policies and merit review criteria; and 3) their own expert judgment. A well-balanced research and education portfolio, as approved by the NSB, strives to include considerations for a variety of approaches to research and education problems, a consideration of geographic distribution, as well as gender, ethnicity, and institutional diversity. Factors such as portfolio balance and diversity are not readily accommodated either by a comparison of numerical proposal scores or by outside reviewers unfamiliar with the Foundation's portfolio as a whole. The merit review process also gives program officers flexibility in distinguishing the exceptionally high-risk, multidisciplinary, and innovative projects from other well-ranked proposals. Program officers combine external peer reviews with their professional judgment in recommending proposals for funding within budget constraints to produce a diverse portfolio that meets the Foundation's programmatic emphasis.

In September 2004, Congress requested the Board conduct a structured review of the NSF's merit review process and report its findings to the House Committee on Appropriations.<sup>2</sup> Congress expressed support for the NSF merit review system, but the Committee believes evaluations at regular intervals may ensure that the Foundation's system of award allocation continues to fund the highest quality science. NSF staff draw upon their scientific expertise to administer the merit-based peer review system that awards federal funds to the extramural scientific community. The merit review process consists of external reviewers, selected by NSF program officers, who quantitatively rate proposals on a five-point scale and provide

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<sup>2</sup> H.R. Report 108-674, 2004, p. 144.

written critique under each of the Board-approved criteria. The program officers then use the ratings and text (as well as panel deliberations, if any) to create a portfolio of recommended awards that is then reviewed by senior officials (typically division directors) for funding. This process, characterized as consensus decision-making according to NSF respondents,<sup>3</sup> is designed to ensure that each award has at least two co-signatures within NSF. NSF's merit review process is designed to foster research in the larger science community that is consistent with the national goals of the Foundation and is to be carried out in a fair and unbiased fashion.

The central focus of the Congressionally requested Board review of this system is to examine the following issues:

- the discretion permitted and exercised by NSF staff in choosing peer review panels;
- the scientific, geographic and institutional composition of peer review panels;
- the quantitative methodologies used to assess relative quality among projects;
- the discretion permitted and exercised by NSF staff in selecting specific projects for funding and;
- the ability of the existing process to identify the most innovative proposals.

This report presents a summary of a review of NSF documents relevant to each of these issues, along with information collected by the Board during interviews with current and former NSF staff. In addition to addressing each topic in turn, the report also provides an analysis of recommendations from the NSF Office of the Inspector General (OIG), recent Committees of Visitors (COVs), and the Foundation-wide Advisory Committee for GPRA Performance Assessment (AC/GPA).

## **Role of Program Officers in the Merit Review System**

Current and former NSF staff were selected by the NSF Director's Office for NSB interviews for this study. These staff commented that the heart of the merit review process depends upon the experience and integrity of the NSF program officers. NSF program officers (also referred to as program directors) are hired, the interview respondents said, either as permanent staff, temporary scientists, or IPA-type (Intergovernmental Personnel Act) 'rotators' because they are experts in their field and in touch with the larger community of scholars. NSF rotators generally spend approximately 2-3 years working at NSF and usually return to their home institution at the end of their term at the Foundation. The science community is an integral part of the merit review process through the participation of external reviewers. The agency's *Proposal and Award Manual (PAM)* encourages program officers to select external reviewers who are substantively and methodologically strong and represent diversity in perspective, disciplinary focus, experience, and demographic characteristics.<sup>4</sup> It is the program officer's responsibility to select appropriate external reviewers and panelists.

To help familiarize new program officers with NSF programs and policies, NSF offers a weeklong, off-site Program Management Seminar. New program officers are strongly encouraged to participate in the Seminar, which includes analysis of numerous case studies; one-third of which address the merit review process. Divisions may or may not provide additional guidance by way of informal mentoring with experienced staff or Directorate-specific formal instruction manuals.<sup>5</sup> In addition, NSF offers various voluntary on-line half-day and two-hour courses related to merit review. The PAM is also available to

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<sup>3</sup> Comments provided by selected NSF officers in interviews conducted by NSB in August 2005 are incorporated in the document review report.

<sup>4</sup> *Proposal and Award Manual #10*, August 19, 2005, p. V6.

<sup>5</sup> Interviews with NSB, August 2005.



assist both new and experienced program officers.<sup>6</sup> Various sections of the PAM are updated periodically, most recently in August 2005, and contains explicit guidance about the proposal package, including such topics as sample letters, guidance on selecting reviewers, conflict of interest language to read in panel meetings, timelines to follow, sample award documents, grant management, and instructions on closing out funded projects.

In the PAM (Chapter V), program officers are encouraged to consult with the NSF Office of General Counsel (OGC) and more experienced colleagues if they have any doubt about how to handle a possible reviewer conflict of interest. Similarly, the PAM and agency regulations require program officers to refer allegations of misconduct to OIG for investigation. The OIG referral process ensures assessments of proposals without consideration for unsubstantiated allegations and facilitates OIG's role in preventing abuse and ensuring the integrity of the peer review system. The PAM provides explicit instructions on the handling of allegations of misconduct during the review process. Procedures call for extensive documentation on a number of aspects of the merit review process, including individual reviews, panel summary, panel concurrence with panel summary, and any conversations with potential principal investigators (PIs).

Although improvements can be made in the process (and have been recommended by the Foundation-wide AC/GPA),<sup>7</sup> most suggestions call for marginal changes. NSF's budget has doubled in the past decade, resulting in a 50 percent increase in proposals and more than a doubling of proposals rated 'excellent.' NSF staff, on the other hand, has increased less than 5 percent,<sup>8</sup> and the program officers' increased workload needs to be considered with any proposed changes

## Selection of Review Panels

Program officers have discretion in the selection of reviewers and panel members for the programs they manage with oversight by the Division leadership throughout the various review stages. The program officer (or team in some divisions) selects reviewers and panel members based upon the program officer's knowledge, references listed in the proposal, recent publications in science and engineering journals, presentations at professional meetings, reviewer recommendations, bibliographic and citation databases, and proposal author suggestions.<sup>9</sup> They also rely on input from mail reviewers, panelists, and visiting scientists. In addition, NSF gathers potential reviewer data from associations and institutions serving groups that are underrepresented in science and engineering.<sup>10</sup> The NSF Library maintains this data and NSF periodically updates its library resources, including databases, web pages, and directories. In FY 2000, for example, the NSF electronic database contained information on about 250,000 reviewers;<sup>11</sup> by FY 2004, the database had grown to 300,000 reviewers.<sup>12</sup>

NSF has increased the participation of the science and engineering communities in the external review process. During FY 2004, 51,000 reviewers were sent one or more proposals for mail review and 12,000 reviewers served as panelists. In all, 58,000 individuals served on panels, were sent a proposal for mail review, or served in both functions. About 13,000 of these reviewers had never reviewed an NSF

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<sup>6</sup> Available at <http://www.inside.nsf.gov/pubs/pam/pam805/pam805.pdf> (visited on August 26, 2005)

<sup>7</sup> E.g., *Report of the Advisory Committee for Government Performance and Results Act (GPRA) Performance Assessment, 2005*, pp. 50-54

<sup>8</sup> *FY 2004 Report on the NSF Merit Review System (NSB-05-12)*

<sup>9</sup> *FY 2004 Report on the NSF Merit Review System (NSB-05-12)*

<sup>10</sup> *Ibid.*, pp. 16-17.

<sup>11</sup> *NSF Report to the National Science Board on the National Science Foundation's Merit Review System, FY 2001 (NSB-01-36)*

<sup>12</sup> *Ibid.*, p. 16.

proposal before.<sup>13</sup> In contrast, in FY 2001, about 45,000 external reviewers were sent one or more proposals for mail review and 10,000 reviewers served as panelists. About 9,000 of these reviewers had not reviewed an NSF proposal before.<sup>14</sup> The increase in reviewers is a result of the 49 percent increase in the number of proposals received for review since FY 2001.

## **The Scientific, Geographic, and Institutional Composition of Review Panels**

In FY 2004 reviewers came from 50 states in addition to the District of Columbia, Guam, and Puerto Rico. More than 5,000 reviewers, 10 percent of all reviewers in FY 2004, came from outside the United States.<sup>15</sup> Moreover, reviewers came from a variety of institutions, including minority-serving institutions, two-year and four-year colleges and universities, Master's level and Ph.D.-granting institutions, industry, and government.<sup>16</sup>

Data on traditionally underrepresented groups serving as reviewers, on the other hand, are incomplete. In FY 2001, NSF developed systems and policies to request demographic data electronically on gender and race/ethnicity of external reviewers on a voluntary basis. In FY 2004, however, only about 17 percent of reviewers provided that information. Of those, one-third indicated that they were members of underrepresented groups.<sup>17</sup> NSF subsequently altered the FastLane reviewer module, to make it more convenient for reviewers to provide this optional information. FastLane is the NSF website used to conduct Foundation business and to disseminate information to the public. No data were available on the extent to which data collection has improved. In 2004, the AC/GPA voiced its concern about the apparent lack of data on the demographics of reviewers:

We urge NSF to redouble its efforts to engage a diverse pool of reviewers in the [Merit Review Process]. In addition, the Committee understands that the [principal investigator] and the reviewer databases are currently separate[;] easy and comprehensive retrieval of systematic and holistic demographic information about reviewers and PIs remains desirable and necessary.<sup>18</sup>

## **Quantitative Methods Used to Distinguish Relative Quality Among Projects**

Reviewers are instructed to rate each proposal according to a five-point scale, defined as:

- 5 - Excellent –outstanding proposal in all respects; deserves highest priority for support
- 4 - Very good – high quality proposal in nearly all respects; should be supported if at all possible
- 3 - Good – a quality proposal, worthy of support
- 2 - Fair – proposal lacking in one or more critical aspects; key issues need to be addressed
- 1 - Poor – proposal has serious deficiencies

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<sup>13</sup> Ibid., p. 16.

<sup>14</sup> Ibid., p. 3.

<sup>15</sup> Ibid., p. 16.

<sup>16</sup> Ibid., p. 16.

<sup>17</sup> *FY 2004 Report on the NSF Merit Review System (NSB-05-12)*

<sup>18</sup> *Report of the Advisory Committee for Government Performance and Results Act (GPRA) Performance Assessment, 2004*, p. 48.

Reviewers are to use and provide written comments on the following two Board-approved NSF merit review criteria in their rating:

1. **What is the intellectual merit of the proposed activity?** How important is the proposed activity to advancing knowledge and understanding within its own field or across different fields? How well qualified is the proposer (individual or team) to conduct the project? To what extent does the proposed activity suggest and explore creative and original concepts? How well conceived and organized is the proposed activity? Is there sufficient access to resources?
2. **What are the broader impacts of the proposed activity?** How well does the activity advance discovery and understanding while promoting teaching, training, and learning? How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc)? To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships? Will the results be disseminated broadly to enhance scientific and technological understanding? What may be the benefits of the proposed activity to society?

The first criterion addresses intellectual merit and research quality and asks the reviewer to consider the interdisciplinary attributes, innovation, design, and organization of the project, along with investigator experience and access to resources. The second criterion examines the broader impacts of the research in regards to education, infrastructure, diversity, scientific literacy, and societal needs.

In addition, the two criteria need not be weighted equally. As noted by the NSB-NSF Merit Review Task Force that recommended the two revised criteria which were subsequently approved by the full Board in 1997: “Emphasis should depend upon either 1) additional guidance you have received from NSF or 2) your own judgment of the relative importance of the criteria to the proposed work.”<sup>19</sup> Reviewers must, however, comment on each criterion and also provide a summary statement. The external reviewers’ comments and summary quantitative ratings then become essential inputs to inform the judgment of the program officers as they formulate recommendations to NSF’s senior management about whether to grant or decline an award. The more complete and relevant the reviewer comments, the better able program officers are to recommend a high quality portfolio for funding.

According to the last Congressionally mandated study of the NSF’s merit review process conducted by the National Academy of Public Administration (NAPA) in 2001, the second ‘broader impacts’ criterion was problematic.<sup>20</sup> Using samples of project ‘jackets’ and reports from COVs, NAPA found that reviewers had difficulty interpreting what NSF meant by ‘broader range of projects.’ In some cases, *broader* was associated with methods used in research rather than scientific content. In other cases, *broader* was discussed in terms of novelty or uniqueness of research.

Reviewer and applicant attention to the ‘broader impact’ criterion has improved over time. In 2004, 92 percent of reviewers used both categories,<sup>21</sup> up from 90 percent of reviewers in 2003, 84 percent in 2002,

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<sup>19</sup> *Final Recommendations of the National Science Board and National Science Foundation Staff Task Force on Merit Review (NSB/MR-97-05)*

<sup>20</sup> *A Study of the National Science Foundation’s Criteria for Project Selection*, National Academy of Public Administration, 2001.

<sup>21</sup> *FY 2004 Report on the NSF Merit Review System (NSB-05-12)*

and 69 percent in 2001. Increased attention may be due to NSF efforts to provide examples, to specify that both criteria must be addressed, and to update reviewer forms to require separate comments by criterion.

When the AC/GPA issued its report of concern in July 2004, it noted that the quality of response to the ‘broader impacts’ criterion was still an issue. Based primarily upon their review of COV reports, they found that discussions of this criterion in proposals frequently lacked substance and appeared to be cursory at best, even though NSF now required a one-page discussion of both criteria in the project summary of the proposal. The AC/GPA found that the review of the broader impacts criterion remains a challenge for most reviewers as well. They reported: “We noted some inconsistency in the completeness and quality of this part of the review and we recommend that NSF continue to focus on this issue.”<sup>22</sup>

In its July 2005 report, AC/GPA found that NSF is making progress in implementing both principal merit review criteria and that over 90 percent of all reviewers are addressing both criteria.<sup>23</sup> However, from their analysis of COV reports, AC/GPA still found “the broader impact criterion needs better definition, since its meaning can vary substantially depending on the background and perspective of both proposers and reviewers.”<sup>24</sup> While acknowledging progress, AC/GPA determined that “an imbalance in the quality and thoroughness of the responses to Criterion 2 . . . persists.”<sup>25</sup> The Committee recommended continued work in this area, and specifically suggested NSF conduct workshops at national meetings to train and certify reviewers.

In light of the publicity about NSF’s concern over the small number of awards made to underrepresented minorities and the increase in overall applications for independent investigator grants, it is notable that the proportion of awards to traditionally underrepresented groups has not changed in the past 8 years, despite NSF’s considerable efforts to increase diversity in the review pool, on its advisory committees, and with COV membership. According to information voluntarily supplied by proposers, the proportion of women and minorities to apply for and receive NSF grants has remained unchanged over the past 8 years despite significant increases in the number of applications and overall number of awards. Because NSF lacks the legal authority to require proposers or reviewers to declare their ethnicity or gender, uncertainties remain in the associated demographic distribution. Other data do show NSF’s direct funding to minority serving institutions in 2004 increased 176 percent above 1994 levels, but those statistics are conservative and could, in fact, understate the ethnicity or gender of the funding recipients.

Division directors and program officers select the review methods that will be employed.<sup>27</sup> In FY 2004, the three principal methods were:<sup>28</sup>

- ‘**panel only**’ reviews, typically where panelists have submitted written reviews in advance and then meet as a group to discuss reviews and provide advice directly to the project officer. This method was used for 56 percent of proposals reviewed in 2004.

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<sup>22</sup> *Report of the Advisory Committee for Government Performance and Results Act (GPRA) Performance Assessment, 2004*, pp. 46-47.

<sup>23</sup> *Report of the Advisory Committee for Government Performance and Results Act (GPRA) Performance Assessment, 2005*, pp. 15, 52

<sup>24</sup> *Report of the Advisory Committee for Government Performance and Results Act (GPRA) Performance Assessment, 2005*, pp. 52

<sup>25</sup> *Report of the Advisory Committee for Government Performance and Results Act (GPRA) Performance Assessment, 2005*, p. 54

<sup>26</sup> *FY 2004 Report on the NSF Merit Review System (NSB-05-12)*

<sup>27</sup> *FY 2004 Report on the NSF Merit Review System (NSB-05-12)*

<sup>28</sup> *Ibid.*, pp. 12-13.

- ‘**mail plus panel**’ review, where either the reviewer is asked to submit a written review and also serve as a panelist or is asked to serve as a panelist discussing reviews written by others. This method was used in reviewing 31 percent of proposals in 2004.
- ‘**mail only**’ reviews, where reviewers are sent proposals for written comments. Overall, 10 percent of proposals were reviewed using this method in 2004. The Office of International Science and Engineering (OISE) used this method with 63 percent of its proposals; in this case, this method seems cost efficient, given that its median award is \$10,000.

Over the past 10 years, reviewer input has become more extensive by the increased use of panels over mail-only review. Since 1995, the percentage of proposals reviewed by panel-only has increased from 39 to 56 percent of all proposals, while there has been a steady decline in the use of mail-only review from 28 to 10 percent.<sup>29</sup> The trend toward panel review allows reviewers to discuss and compare proposals, an important process in evaluating multidisciplinary and interdisciplinary proposals in new or developing research areas because, unlike mail-only review, viewpoints representing several fields of specialization can be openly discussed and integrated. Similarly the panel review process can facilitate discussion of both merit review criteria.<sup>30</sup> For new program officers, the PAM (p. V-12) recommended soliciting suggestions from other program staff in the division who have experience running successful panels.

Program officers can exercise significant discretion in determining whether completed reviews are usable. Ensuring that there is no conflict of interest between the reviewer and proposer is a primary focus. Reviewers are alerted to conflict of interest guidance in the FastLane Proposal Evaluation Criteria and are to discuss any potential conflict as part of their written review. At the beginning of panel meetings, program officers are to read verbatim the conflict of interest language in the PAM. The conflict of interest provisions are contained in NSF Manual 15, Conflict of Interest and Standards of Ethical Conduct, Part II 20-21 and referenced in the PAM (p. V-7) used by program officers. All program officers also receive conflict-of-interest training annually and understand that any allegation of misconduct, fraud, waste, or abuse must be referred to OIG. By referring allegations to OIG for investigation, NSF can conduct peer review assessments in the absence of bias based on unsubstantiated allegations.<sup>31</sup>

In addition to conflicts of interest, reviews may not be usable for other reasons. In these areas, program officer discretion is also used. Bias in the review may have been introduced – for example if reviewers (regardless of their current institutional affiliation) were all former students or junior colleagues of the proposed PI, if the reviewer and proposer are known to be close friends or open antagonists, or if the reviewer has a proposal currently under review within the same area of research.<sup>32</sup> How to handle potential reviewer bias is outlined in the PAM (Chapter V) and also in multiple case studies included in the weeklong Program Management Seminar for new program officers. Program officers are encouraged to contact the NSF OGC as well as their more experienced colleagues in resolving these issues.<sup>33</sup>

The average number of reviews per proposal is double the required number to ensure that at least the minimum number of usable reviews is obtained. In FY 2004, the average number of reviews across all

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<sup>29</sup> Ibid., pp. 13-14.

<sup>30</sup> Ibid., p. 14.

<sup>31</sup> Ibid., p. 21.

<sup>32</sup> *Proposal and Award Manual #10, V-7, August 19, 2005.*

<sup>33</sup> *Proposal and Award Manual #10, V-7, August 19, 2005.*

review methods was 6.0, well above the mandated 3.0 reviews per proposal.<sup>34</sup> More specifically, mail-only reviews averaged 4.2 readers, panel-only reviews averaged 5.4 readers, while mail-plus-panel reviews averaged 7.7 readers. In addition to providing greater input from the scientific community, the additional reviews operate as a mechanism to ensure that the minimum number of usable reviews is obtained.

## **Selection of Specific Projects for Funding**

Once proposal evaluations and narratives from reviewers and panelists are submitted, the NSF program officer (or team of program officers in some divisions) analyzes the ratings, the narrative text for each of the two merit review criteria, summary comments on each proposal, and if a panel was used, the panel summary. Program officers do not propose awards solely on the average numerical rating of reviewers. NSB's interviews for this report with selected NSF staff (and reinforced in the documents reviewed) generally indicated that assessing the potential value of the proposal requires a very thorough analysis of the strengths and weaknesses of the proposal across all reviewers. For example, reviewers may have concentrated on select sections of a proposal such as the research methods or may have brought different disciplinary perspectives to bear. Reviewers may also have been inconsistent, giving high praise with a low numerical rating (or vice versa).

Program officers must also take into account multiple criteria in addition to reviewers' quantitative ratings, including balance of different approaches to significant research questions, support for high risk proposals with potential for significant impact in the field, and focus on such NSF core strategies as the integration of research and education. The NSB interview of NSF staff and NSF-provided data on trends in funding ratios revealed the challenging task facing program officers to stretch available funds to support a diversity of high quality proposals. In FY 2000, awards were made to 90 percent of the 2,420 proposals that received the highest rating, 'excellent,' by reviewers.<sup>35</sup> In contrast, in FY 2004, awards were made to 79 percent of the 4,021 proposals rated 'excellent.'<sup>36</sup> Unfortunately, NSF cannot afford to support all highly rated proposals due to a lack of sufficient funds. Farther down the ratings scale, 19 percent of the 12,011 proposals rated 'good to very good' received awards in FY 2000.<sup>37</sup> Conversely, among the 18,381 proposals rated 'good to very good' in FY 2004, only 11 percent received funding.<sup>38</sup>

Each program officer's portfolio of recommended awards is reviewed at a higher level (typically the division director) and subject to an administrative review by a grants officer. One division director noted in an NSB interview conducted for this report that program officers have to provide a convincing case and discuss their funding decision with the division director in instances where there is a divergence of opinions. When program officers recommend lower rated proposals over those with higher ratings; however, those recommendations need to include a written explanation and the program officer must persuade others of the recommended proposal's value. In NSB interviews with select NSF staff at the division director level, the portfolio balance discussions were described as collegial, with decisions based on consensus decision-making. No program officer operates in a vacuum; each award needs the co-signature of two NSF staff. In virtually all cases, external reviewers rated the funded awards worthy of

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<sup>34</sup> *FY 2004 Report on the NSF Merit Review System* (NSB-05-12)

<sup>35</sup> *NSF Report to the National Science Board on the National Science Foundation's Merit Review System, FY 2000* (NSB-01-36)

<sup>36</sup> *FY 2004 Report on the NSF Merit Review System* (NSB-05-12)

<sup>37</sup> *NSF Report to the National Science Board on the National Science Foundation's Merit Review System, FY 2000* (NSB-01-36)

<sup>38</sup> *FY 2004 Report on the NSF Merit Review System* (NSB-05-12)

support (that is, receiving a rating of at least 3.0, corresponding to a ‘good’ rating). In FY 2004, for example, reviewers rated 77 percent of the awards at 4.0 (‘very good’) or higher, and they rated an additional 22 percent between 3.0 and 3.9 on the five-point scale.<sup>39</sup>

Additional review beyond the division director level within NSF is required for proposals above certain budgetary amounts. The Director’s Review Board reviews all award recommendations with an average annual award amount of 2.5 percent or more of a Division’s annual budget. The NSB reviews and approves all recommended awards where the average annual amount is 1 percent or more of the awarding Directorate’s or Office’s annual budget.<sup>40</sup>

## **Reconsideration Process Available for Declinations**

Every applicant whose proposal undergoes merit review receives a letter stating the results, a panel summary explaining the rationale for the decision (if panel review was used), along with an anonymous verbatim copy of each review that was considered in the review process.<sup>41</sup> An unsuccessful applicant may ask the program officer for additional clarification of the decision. If after considering this additional information the applicant is not satisfied that the proposal was fairly handled and reasonably reviewed, he or she may request formal reconsideration from the Assistant Director. This request can be based on the applicant’s perception of procedural errors or on disagreements over the substantive issues dealt with by reviewers. If the Assistant Director upholds the original action, the applicant’s institution may request a second reconsideration from the Foundation’s Deputy Director.

NSF receives 30-50 requests for formal reconsideration of the approximately 30,000 proposals it declines each year. Of the 188 requests for formal reconsideration of declined proposals during the past 5 years, 12 decisions have been reversed.

## **Identification of the Most Innovative Proposals**

When program officers present their portfolio of proposed awards for review, they must explain what makes the projects exciting, high risk and/or multidisciplinary.<sup>42</sup> Identifying the most innovative proposals is an explicit part of program officers’ responsibilities. Several mechanisms are built into the oversight process to reinforce that high risk and multidisciplinary proposals are funded, including each program’s COV and NSF’s AC/GPA. In its 2004 review, the Advisory Committee urged a broader discussion of the issue, given the absence of clear definitions. In response to concerns about the uncertainty of what constitutes ‘high-risk’ and ‘multidisciplinary,’ NSF reported that it is now collecting explanations of projects that program officers identify as either high-risk or multidisciplinary. Program officers will be asked to explain why the projects fit into those categories. The next meeting of this Advisory Committee is scheduled to discuss this topic in more detail. In addition, NSB has constituted a task force to examine how NSF identifies, reviews, and funds potentially transformative research.

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<sup>39</sup> Ibid.

<sup>40</sup> Ibid., p. 22. NSB approval is also required if the award is part of a new Foundation Program that: 1) represent a substantial investment of Program resources (threshold defined as the total annualized awards to be made by the proposed Program exceed 3 percent of the awarding Directorate’s or Office’s prior year current plan); or 2) involve sensitive political or policy issues; or 3) are to be funded as an ongoing Foundation-wide activity. PAM H2.

<sup>41</sup> *FY 2004 Report on the NSF Merit Review System (NSB-05-12)*

<sup>42</sup> Ibid., p. 20.

<sup>43</sup> Comment submitted to the NSBO website.

Multidisciplinary proposals pose a challenge to NSF whose organizational structure consists of relatively autonomous directorates with disciplinary divisions. As the Advisory Committee pointed out in 2004, whether the organizational structure of NSF promotes effective reviews is an issue “ripe for additional discussion.”<sup>44</sup>

The Foundation has a growing investment in multidisciplinary and cross-directorate work. Since 1998, for example, NSF has funded the cross-directorate initiative, Integrative Graduate Education and Research Traineeship Program (IGERT). More than 75 universities have participated, joining together such fields as biology, mathematics, physics, chemistry, computer science, and engineering. Typically, students begin by rotating through the labs of several professors, take seminars in interdisciplinary topics, engage faculty from different departments on their dissertation committees, and work together in teams with students and faculty from disciplines other than their primary focus. At the Foundation, a cross-directorate coordinating committee managed the program and the lessons learned from IGERT have been disseminated broadly within the Foundation.

Since FY 1990, program officers have been permitted to use the Small Grants for Exploratory Research (SGER) option to make small-scale grants without formal external review. Program officers may obligate up to five percent of their program budget per fiscal year for SGER awards, which are specifically designed for exploratory and time-sensitive research. Such research is characterized as preliminary work on untested and novel ideas; ventures into emerging research ideas; the application of new expertise or new approaches to ‘established’ research topics; having extreme urgency with regard to availability of or access to data, facilities, or specialized equipment, including quick-response research on natural disasters, and efforts of similar character to catalyze rapid and innovative advances. The SGER program allows program officers the flexibility and freedom to quickly identify innovative research and fund it without external review. While program officers may obligate up to five percent of their program budget per fiscal year for SGER awards, only 0.5 percent of the total funds awarded by the Foundation in FY 2004 were in the form of SGER awards.<sup>45</sup> While this could be an indication that program officers are very careful with the use of their flexibility and expert judgment, there also seems to be an opportunity to have greater use of this program. The average award in FY 2004 was around \$77,000, up from \$68,000 in FY 2003. Since September 2003, the maximum SGER award is \$200,000.<sup>46</sup>

## **NSF Office of the Inspector General (OIG) Assessment of the Merit Review Process**

The OIG provided the Board with a summary of merit review issues that it investigated or referred to management for improvement in the past.<sup>47</sup> Those cases typically involved allegations regarding conflicts of interest between program officers and reviewers, confidentiality of material described in proposals, and panel diversity.

As in any federal agency, conflict of interest issues at the NSF are the primary responsibility of the Designated Agency Ethics Official. Those conflict of interest allegations that arise during a

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<sup>44</sup> *Report of the Advisory Committee for Government Performance and Results Act (GPRA) Performance Assessment, 2004*, p. 48.

<sup>45</sup> *FY 2004 Report on the NSF Merit Review System (NSB-05-12)*

<sup>46</sup> *Ibid*

<sup>47</sup> NSB Office meeting with NSF OIG, April 14, 2005.



reconsideration procedure are handled during that procedure. However, the OIG did document concern about the inconsistency across Directorates regarding the reconsideration process for PIs.<sup>48</sup>

There have also been situations where reviewers believe they have identified instances of fabricated or falsified data, plagiarized text in proposals, and undeclared duplicate proposal submissions. These are the kinds of research misconduct allegations that are OIG's responsibly to investigate. The reporting rate for misconduct allegations is relatively low. When an OIG investigation confirms an allegation of misconduct, the Director's office is responsible for determining and then taking appropriate action. In addition, the OIG serves as a readily available information resource to program officers to ensure the integrity and the effective and efficient operation of merit review.

## **External Assessment of the Merit Review Process**

The Foundation uses two formal mechanisms to periodically assess the merit review process on a regular basis: Committees of Visitors for individual NSF programs, and the AC/GPA for the Foundation as a whole.

### **Committees of Visitors (COVs)**

For individual NSF programs, an external COV (scientists, engineers, and educators) assesses each program every three to 5 years, examining the integrity and efficiency of the merit review processes and the quality of results from the Foundation's programmatic investments.<sup>50</sup> Multiple documents are reviewed, including project jackets, proposal review files, and other materials from project officers. The FY 2004 Report Template for NSF COVs included more than 15 items about the merit review process.<sup>51</sup> Questions asked of each program reviewed included:

- Did the program make use of reviewers having appropriate expertise and/or qualifications?
- Is the review mechanism appropriate?
- Have the individual reviews (either mail or panel) addressed whether the proposal contributes to both merit review criteria?
- Do the panel summaries provide sufficient information for the principal investigator(s) to understand the basis for the panel recommendation?
- Is the documentation for recommendations complete, and does the program officer provide sufficient information and justification for his/her recommendation?

In addition, the COV Report Template stresses the need for the portfolio of awards to not only be of high quality and matching national priorities but also reflect an appropriate balance regarding such areas as high risk proposals, multidisciplinary proposals, and innovative proposals; an appropriate balance of

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<sup>48</sup> NSF OIG, *Limited Review of NSF's Reconsideration Process*, October 1, 2001

<sup>49</sup> NSB Office meeting with NSF OIG, April 14, 2005

<sup>50</sup> *Ibid.*, p. 2.

<sup>51</sup> *FY 2004 Report on the NSF Merit Review System (NSB-05-12)*

funding to centers and to individuals; to experienced as well as new investigators; and to the full range of disciplines and subdisciplines.

The U.S. General Accounting Office (GAO) examined NSF's COV process in early 2003 and found that it demonstrated a high capacity for evaluation, the elements of which included an evaluation culture, data quality, analytic expertise, and collaborative partnerships.<sup>52</sup> Later in the year, the NSF OIG also reported that NSF makes good use of the COV reports in determining its performance to meet strategic goals under the Government Performance and Results Act (GPRA).<sup>53</sup> As a result of OIG recommendations to improve the COV process, NSF required Directorates and Offices to document the action taken on those accepted COV recommendations.<sup>54</sup>

### **Advisory Committee (AC)**

In July 2002, the Foundation created a single Advisory Committee to review all Foundation accomplishments using COV reports, investigator project reports, and collections of outstanding accomplishments from awards as reported by NSF program officers.<sup>55</sup> The Advisory Committee prepares annual reports. In its most recent July 2004 report, the Advisory Committee for GPRA Performance Assessment (AC/GPA) made specific recommendations concerning the proposal review process. They found that COV reports indicated that more specific feedback to the PIs is desirable, including strengths, weaknesses, and suggestions for improvement. Several reports recommended tutorials on review preparation with examples of helpful reviews (for prospective reviewers and panel members).<sup>56</sup> They noted that COVs believed that documentation should detail the decision making process for 1) awards made outside the external review process, 2) funded proposals that received low reviewer ratings, and 3) highly rated proposals that were declined. They also suggested that explanations for all decisions be included in the proposal jacket and recommended the examination of the success of resubmissions as a function of the comments of the previous review, panel constitution, and program officer.<sup>57</sup> The AC/GPA also noted that COVs often either did not respond at all or responded solely in monosyllables (i.e., yes or no) regarding the review process for the multidisciplinary proposals, and recommended NSF ensure that all COVs address effectiveness of the merit review process for multidisciplinary proposals.

In their overall conclusions, the AC/GPA in its 2004 report noted: "We did conclude that a reasonable level of flexibility in the review process must be maintained to allow program officers, division directors, and directorates to support proposals addressing strategic and emerging needs, issues, and directions."<sup>58</sup> They went on to note that the merit review process was "effective in the processing and review of a large volume of proposals, in the engagement of a broad and diverse segment of talent in the NSF's science and engineering enterprises, and in supporting the advancement of the frontiers of science and engineering."<sup>59</sup>

Although the recommendations of the AC/GPA are reasonable and would strengthen the merit review process, the Committee also acknowledged that the recommendations require additional time and

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<sup>52</sup> U.S. General Accounting Office, *Program Evaluation: An Evaluation Culture and Collaborative Partnerships Help Build Agency Capacity*, GAO-03-454. Washington, DC: May 2003, pp. 8, 10-11, 17, 21.

<sup>53</sup> *Audit of NSF's Committees of Visitors*, NSF Office of Inspector General, OIG-03-2-013, September 25, 2003, pp. 7-8.

<sup>54</sup> *FY 2004 Report on the NSF Merit Review System (NSB-05-12)*

<sup>55</sup> *Ibid.*, p. 25.

<sup>56</sup> *Report of the Advisory Committee for Government Performance and Results Act (GPRA) Performance Assessment, 2004*, p. 47.

<sup>57</sup> *Report of the Advisory Committee for Government Performance and Results Act (GPRA) Performance Assessment, 2004*, p. 47.

<sup>58</sup> *Ibid.*, p. 47.

<sup>59</sup> *Ibid.*, p. 48.

attention by program officers, even as they face serious workload issues. NSF has seen a 25 percent increase in number of proposals since FY 2002.<sup>60</sup> In 2004, almost 14,000 more proposals were submitted than in 1997, corresponding to an increase of almost 50 percent.<sup>61</sup> In the last decade, on the other hand, the agency's staffing level has increased less than five percent.<sup>62</sup> The AC/GPA strongly recommended that NSF examine the effects of increased proposal submissions and the level of staff support on the program officer workload. Regardless of the infrastructure, a review process may be compromised if staff do not have adequate time to consider each award carefully.

## Conclusions

The Board fully supports the current NSF system of merit review, which utilizes the peer review process as the principle driver in funding decisions. The Board also strongly endorses the role of NSF program officers' discretionary authority, in concurrence with division directors, for ensuring the implementation and goals of both Merit Review Criteria, along with achieving a balanced portfolio of research and education awards, both within directorates and across the suite of NSF programs. Unlike a system based solely on peer reviews' scores, NSF's merit review process incorporates peer review in a system that also considers those attributes of a proposal (risk, multidisciplinary nature, novelty) that are not readily accommodated by a numerical score, but essential to identifying the most innovative proposals. The following sets of conclusions and recommendations from this study may further enhance the integrity of the current NSF merit review system.

- On average, program officers spend 55 percent of their time on the merit review process, including the review of panel ratings and text, preparation of the portfolio of awards, and discussion with senior NSF management for approval of the portfolio.<sup>63</sup> NSF staff interviewed for this study indicated program officers must convince division directors on their funding decision, particularly where lower ranked proposals are recommended for funding. For all cross-disciplinary programs, NSF benefits greatly in its use of 'cluster-like' groups of program officers to increase the discussion of proposals and encourage a consensus decision-making process.
- Increased outreach to better inform the research community about the NSF's merit review process will increase transparency of the decision making process and may help to minimize misunderstandings associated with declinations. This outreach should describe the merit review process generally, and 'criteria 2,' the reconsideration process, and the role of program officer judgment specifically.
- Interview responses revealed that valuable instruction of new program officers often comes from informal mentoring by more experienced or permanent staff. Incoming program officers would benefit from the guidance provided by the outgoing program official in that position.

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<sup>60</sup> Ibid., p.6.

<sup>61</sup> Ibid., p. 30.

<sup>62</sup> Ibid., p. 21.

<sup>63</sup> *FY 2004 Report on the NSF Merit Review System (NSB-05-12)*

- Interview responses indicated that the format for the different divisions' guidelines for their merit review procedures range from unwritten and informal to detailed written instructions. The divisions do need some flexibility to accommodate the particular types of projects they fund and their specialized constituencies within the Foundation's review process. However, detailed documentation about the nuances of a division's review procedures contributes to the transparency of the process and the training of incoming program officers.
- A system of temporary scientists, engineers, educators and IPA-like rotators greatly enhances the ability of the Foundation to fund the best science, as interim program officers fresh from active research remain in touch with current issues in the research community and interface directly with scientists. However, at the higher management levels, including the division director, experienced individuals need to oversee the complete system of the merit review process and be able to recruit the best program officers.
- Program officers have significant discretion in selecting external reviewers. NSF maintains an extensive database of reviewers that receives periodic updates and currently lists 300,000 reviewers from a wide variety of scientific disciplines and subdisciplines, all 50 states, and a variety of higher education institutions. Data on traditionally underrepresented groups, on the other hand, are incomplete because the agency lacks the legal authority to require proposers or reviewers to declare their ethnicity or gender.
- Outreach to the scientific community enhances public understanding of how to address the second merit review criterion regarding the broader impacts of the proposed activity. External reviewers are instructed to use a five-point scale to rate each proposal. In 2004, 92 percent of the reviewers used both merit review criteria ('intellectual merit' and 'broader impacts') in their ratings – an increase from the 69 percent reported in 2001. The AC/GPA analysis of COV reports, however, indicate inconsistency in the completeness and quality of the broader impacts criterion. Several COV reports suggested tutorials on review preparation and examples of helpful reviews.
- Over the past 10 years, outside reviewers have played an increasing role in the proposal evaluation process, as evidenced by the growing use of review panels over mail-only review. Ninety percent of proposals reviewed in FY 2004 use either 'panel only' or 'mail plus panel' reviews compared to 28 percent in 1995.
- Identifying the most innovative, high risk, and multidisciplinary proposals is an explicit program officer responsibility, but these concepts are difficult to define for the proposal review context.<sup>64</sup> While program officers may obligate up to five percent of their budgets for SGER awards without a formal external review, SGER awards accounted for only 0.5 percent of the total obligations for NSF in FY 2004, indicating a potential for greater use of this option by program officers.

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<sup>64</sup> E.g. *Report of the Advisory Committee for Government Performance and Results Act (GPRA) Performance Assessment, 2005*, pp. 54-56

A major question for this report was an analysis of the discretion used by program officers in the selection of review panel members and projects for funding. Available documents provided extensive detail on the infrastructure but not readily apparent detailed descriptions or statistics on how this discretion is exercised. Regarding review panel selection, documents focused on ideal characteristics of reviewers, available reviewer databases, and reviewer statistics. Data on what program officers actually do in practice to identify reviewers were not available. Similarly, available documents of the selection of projects for awards discussed general procedures, which criteria to use, and required documentation, but did not provide concrete examples of what program officers and division directors do in practice.

## **Recommendations**

The Board finds the NSF merit review process to be a fair and effective way to review the more than 40,000 proposals the Foundation receives each year in a wide variety of subject areas. The Foundation accomplishes this, in great part, by having a professional staff that are familiar with the latest development in these subject areas. The Board believes it is important to continue to support an appropriate balance of temporary and permanent scientific staff by including approximately half of the program officer staff as rotators, with a majority of higher management (division director and deputy division director) as permanent staff. Training of the temporary scientists on the NSF merit review process should include of a short-term overlap, when possible, for incoming and outgoing program officers to facilitate mentoring and training. The Board also provides several recommendations for NSF to improve the transparency and effectiveness of the NSF merit review process, while preserving the ability of the program officer to identify the most innovative proposals and effectively diversify and balance NSF's research and education portfolio.

- Establish supplemental guidelines and procedures for all Directorates and Divisions to implement a set of readily accessible, standardized NSF guidelines regarding the merit review process, factors to consider in evaluating 'Criterion 2,' and the documentation of the decision-making process for a proposal's review. These guidelines should be readily available to proposers to insure transparency of the process and to increase the awareness of the established reconsideration procedures.
- Increase outreach designed to inform the research community about the merit review process. This will help to minimize misunderstandings associated with declinations and will better inform proposers about what factors are considered during the merit review process. This outreach should help distinguish the NSF's merit review system from other sponsors' peer review systems that do not provide program officers with the discretion that allows them to balance the diversity and content of the research portfolio or to select the exceptional proposals that may be high risk, multidisciplinary, or innovative.
- Encourage increased collaboration to discuss funding decisions and reach an informed consensus, particularly by establishing clusters of program officers.
- Seek to improve the information on traditionally underrepresented groups in the reviewer database within the agency's legal authority to poll proposers, reviewers, and COV members.
- Implement the AC/GPA recommendations that all COVs adequately address merit review effectiveness, particularly for multidisciplinary proposals, to improve transparency and accountability of the NSF merit review process.



## Appendix A

### A Summary of Major Changes to the NSF Merit Review System (1981-2005)

#### 1981

❖ NSB established four generic peer review criteria for research programs

1. **Research performance competence** – *This criterion relates to the capability of the investigator(s), the technical soundness of the proposed research, and the adequacy of the institutional resources available.*
2. **Intrinsic merit of the research** – *This criterion is used to assess the likelihood that the research will lead to new discoveries or fundamental advances within its field of science or engineering, or have substantial impact on progress in that field or in other scientific and engineering fields.*
3. **Utility or relevance of the research** – *This criterion is used to assess the likelihood that the research can contribute to the achievement of a goal that is extrinsic or in addition to that of the research field itself, and thereby serve as the basis for new or improved technology or assist in the solution of societal problems.*
4. **Effect of the research on the infrastructure of science and engineering** – *This criterion relates to the potential of the proposed research to contribute to better understanding or improvement of the quality, distribution, or effectiveness of the Nation's scientific and engineering research, education, and manpower base.*

#### 1990

❖ **February 8-9, 1990 291<sup>st</sup> Board Meeting (NSB-90-18)**

An NSF review panel recommended four major revisions to the merit review process. These suggestions would enhance information sharing and provide an opportunity for Primary Investigators (PIs) to easily request a reassessment of declined proposals. Board Members were in favor of these changes but expressed concern over a potential increase in NSF staff workload.

❖ **August, 1990 Report of the Merit Review Task Force (NSF-90-113)**

This NSF task force analyzed the Foundation's merit review process and assessed its workload impact on both NSF staff and the research community. Both short- and long-term recommendations were made that focused on streamlining the merit review process.

#### 1992

❖ **October.** NSF requested that National Academies' Committee on Science, Engineering and Public Policy (COSEPUP) examine NSF's merit review of large projects.

## 1994

❖ ***Major Award Decisionmaking at the National Science Foundation*** by the COSEPUP Panel on NSF Decisionmaking for Major Awards was released. The report concluded that the merit review system at NSF served fairly well but required improvements in accountability and general procedural effectiveness.<sup>65</sup>

❖ ***Peer Review: Reforms Needed to Ensure Fairness in Federal Agency Grant Selection***

(GAO/PEMD-94-1) This Government Accountability Office (GAO) study on the merit review process used in three federal agencies [NSF, National Institutes of Health (NIH) and National Endowment for the Humanities (NEH)] found that peer review is an effective system but requires improvements. In particular, the report identified issues with reviewer selection, the application of review criteria, and variation among agencies on the extent to which peer review scoring was used to make funding decisions.<sup>66</sup> Partly in response to this study, NSF established a senior-level Peer Review Study Group (PRSG) to examine relevant issues associated with merit review.

## 1995

❖ **May 11-12, 1995 328<sup>th</sup> Board Meeting (NSB 95-89)**

NSB decided to evaluate the four current merit review criteria.

## 1996

❖ **May 9-10, 1996 336<sup>th</sup> Board Meeting (NSB 96-87)**

The NSB/NSF Task Force on Merit Review was established to evaluate the generic review criteria adopted by the Board in 1981.

## 1997

❖ **March 26-28, 1997 342<sup>cd</sup> Board Meeting (NSB 97-96)**

The NSB approved the final report, *Recommendations of the Merit Review Task Force* (NSB/MR-97-05). The NSB also approved the resolution on revised merit review criteria (NSB-97-72) set forth by the task force that would replace the original four merit review criteria with only two criteria. The merit review changes would go into effect October 1, 1997.

### 1. What is the intellectual merit of the proposed activity?

The following are suggested questions to consider in assessing how well the proposal meets this criterion: *How important is the proposed activity to advancing knowledge and understanding within its own field and across different fields? How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, please comment on the quality of prior work.) To what extent does the proposed activity suggest and explore creative and original concepts? How well conceived and organized is the proposed activity? Is there sufficient access to resources?*

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<sup>65</sup> *Major Award Decisionmaking at the National Science Foundation*. (1994) NRC Panel on NSF Decisionmaking for Major Awards. National Academy Press, Washington, D.C. <http://www.nap.edu/catalog/2268.html>

<sup>66</sup> *Peer Review Reforms Needed to Ensure Fairness in Federal Agency Grant Selection*. (1994) U.S. General Accounting Office. Washington, D.C. June 2004. (GAO/PEMD-94-1)



## **2. What are the broader impacts of the proposed activity?**

The following are suggested questions to consider in assessing how well the proposal meets this criterion: *How well does the activity advance discovery and understanding while promoting teaching, training, and learning? How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, geographic, etc.)? To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships? Will the results be disseminated broadly to enhance scientific and technological understanding? What may be the benefits of the proposed activity to society?*

### **1998**

❖ **Senate Appropriations Committee report (S. Rept. 105-53)** accompanied the FY 1998 VA, HUD, and Independent Agencies Appropriations Act, and directed NSF to request a review of the effect of changes in the merit review criteria from The National Academy of Public Administration (NAPA).

### **1999**

❖ **March 25-16, 1999 348<sup>th</sup> Board Meeting (NSB-99-81)**

NSF recommended that program officers receive greater authorization regarding award offers. Some Board Members agreed that program officers might be better suited to choose applicants pursuing transformative research. The Board concluded that merit review issues of panel and program officer discretion require further consideration.

### **2000**

❖ **May 3-4, 2000 258<sup>th</sup> Board Meeting (NSB-00-123)**

The Board discussed the close relationship between merit review, Government Performance and Results Act (GPRA) goals, and elements of the second criterion including promotion of diversity in S&E programs, incorporation of educational goals with research objectives, and how to calculate the effects of the new criterion.

### **2001**

❖ **March 14-15, 2001 362<sup>nd</sup> Board Meeting (NSB-01-41)**

A year and half after the merit review revisions, Board members were concerned that the second criterion was still overlooked by researchers and reviewers.

❖ **May 24, 2001 363<sup>rd</sup> Board Meeting (NSB-01-98)**

The Board reviewed Criterion 2 in terms of diversity issues and agreed that it was important to increase the awareness of researchers and reviewers regarding this often-neglected element of the merit review evaluation criteria.

❖ **October 11, 2001 365<sup>th</sup> Board Meeting (NSB-01-189)**

The Board approved a resolution to increase proposer and reviewer understanding regarding the importance of considering both merit review criteria. (NSB-01-167)

❖ *A Study of the National Science Foundation's Criteria for Project Selection* (NAPA, 2001) This report grew out of the Senate committee's concern to ensure accountability and responsibility in public funding.<sup>67</sup>

The **major findings** of the NAPA report are summarized below:

1. It was too early to judge the impact and effectiveness of the new merit review criteria; not enough time had elapsed to make a valid assessment on their impact and further study is recommended.
2. It is difficult to gauge the impact of the new criteria because of a lack of quantitative measures and performance indicators. NSF should develop databases to track improvements such as broader representation of institutions and greater participation by underrepresented minorities. A long-term tracking system that measured the impacts of research projects at least 10 years out would also be highly useful.
3. The conceptual clarity of the new criteria and the language used in stating them needs to be improved. For example, 80 percent of the reviewers interviewed felt that the new merit review criteria "made little to no contribution to achieving NSF's stated objectives in instituting them." Furthermore, over 50 percent of those interviewed felt that the language used in Criterion 2 was vague, which made the criterion difficult to apply to the review process.
4. Nearly all reviewers and stakeholders within and outside NSF preferred using targeted (set-aside) programs for achieving broader impact (e.g., improving participation of underrepresented minorities) as opposed to applying these objectives to every project.
5. Changes to the merit review system need to go beyond surface level changes made to the language of the review criteria; these changes need to be incorporated into the entire merit review system process.

NAPA's **primary recommendations** to improve the merit review process are listed below:

1. Better train program officers and reviewers on the value of NSF's long-term strategies for improving research and the objectives of the new review criteria;
2. Better train program officers and reviewers on how to successfully use both new criteria together;
3. Address intellectual and philosophical issues raised by the new criteria in public forums to gain consensus on their use and to clarify their meaning;
4. Develop a *process evaluation* strategy for the merit review process system that incorporates both statistical and qualitative data collection methods.

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<sup>67</sup> *A Study of the National Science Foundation's Criteria for Project Selection* (2001) National Academy of Public Administration, Washington D.C.

## 2003

### ❖ **November 19-20, 2003 377<sup>th</sup> Board Meeting (NSB-03-164)**

Dr. Warren Washington, NSB Chairman, announced that he had participated in the National Academies' workshop on OMB's proposed "Guidelines on Peer Review and Information Quality." In his remarks at the workshop, he had stressed the importance of a transparent review process that would give the public confidence in the integrity and credibility of regulatory decisions. He also noted that the scientific community had to be cautious and respect the reviewers' time commitment to the review process.

## 2004

### ❖ **September 9, 2004**

Congress requested that the Board conduct an evaluation of the NSF system of merit review with particular attention to "the quantitative methodologies used to distinguish relative quality among projects, the discretion permitted and exercised by Foundation staff in choosing peer review panels and in selecting specific projects for funding, the scientific, geographic and institutional composition of peer review panels, and the ability of the existing process to identify the most innovative proposals."<sup>68</sup>

### ❖ **October 13-14, 2004 382<sup>nd</sup> Board Meeting (NSB-04-168)**

The Advisory Committee on GPRA Performance (AC/GPA) encouraged the Board to consider how NSF could best support "bold" or "high-risk" research.

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<sup>68</sup> H.R. Report 108-674, 2004, p. 144.



## Appendix B

### **A Summary of the Current NSF Merit Review Process From the Report to the National Science Board on the National Science Foundation's Merit Review Process Fiscal Year 2004 (NSB-05-12)**

The merit review process includes the steps listed below:

- The proposal arrives electronically, and NSF staff see that it is placed with the appropriate program(s) for review.
- The program officer (or team of program officers) reviews the proposal and assigns it to at least three experts from outside the Foundation (review generally takes place by mail, advisory panel, or combination of mail and advisory panel). Reviewers and panelists use two general criteria: intellectual merit and broader impacts. The Division leadership (Division Directors, Deputy Division Directors, and/or Section Heads) oversees the review process throughout its various stages. The program officer or team:
  - selects reviewers and panel members, based on program officer's knowledge, references listed in proposal, recent publications in science and engineering journals, presentations at professional meetings, reviewer recommendations, bibliographic and citation databases, and proposal author's suggestions.
  - receives the recommendation of the reviewers/panel, based on merit review criteria and other factors such as risk, balance of priorities, and budget constraints.
- The program officer makes a recommendation to award or decline the proposal, taking into account external reviews, panel discussion, and other factors such as portfolio balance and amount of funding available.
- A higher-level official (usually a Division Director, Deputy Division Director, or Section Head) conducts a programmatic review of all program officer recommendations. For award recommendations, a grants officer in the Office of Budget, Finance, and Award Management performs an administrative review. Recommendations for large awards receive additional review by higher-level organizations such as the Director's Review Board and the National Science Board.
- The Division leadership performs an annual qualitative assessment of the program portfolio.
- An external Committee of Visitors (scientists, engineers, and educators) assesses each program every 3-5 years, examining the integrity and efficiency of merit review processes and the quality of results from the Foundation's programmatic investments.
- Advisory Committees (scientists, engineers, educators) review Committee of Visitor reports and directorate/office responses and provide guidance to the Foundation's directorates and offices regarding the reports and other matters pertaining to past investments and future research and education activities.

- The Advisory Committee for Government Performance and Results Act (GPRA) Performance Assessment, a single committee of external experts convened yearly to assess results, evaluates the Foundation's portfolios and their linkages to strategic outcome goals. The Advisory Committee for GPRA Performance Assessment uses Committee of Visitor reports, internal and external directorate assessments of particular programs, investigator project reports, and directorate/division collections of outstanding accomplishments from awards in order to perform the evaluation.
- An external contractor performs an independent verification and validation of Foundation performance measurement.
- The National Science Board's Audit and Oversight Committee reviews the findings presented by the Advisory Committee for GPRA Performance Assessment.

Appendix C  
2004 Merit Review Process Assessment

**2004 Merit Review Process Assessment**

In general, the MRP continues to be impressive and effective. Some statistics and issues taken from the NSB merit review report and COVs on merit review (Table 1), include:

- **Proposal and Success Rate.** In 2004, over 96% of NSF's awards were selected through the competitive MRP. NSF took action on 43,851 competitively reviewed proposals (40,075 in 2003, 35,165 in 2002, and 31,942 in 2001) and provided funding to 10,380 of them. While the number of awards funded has not changed much in the past few years, the number of proposals acted upon has risen by 38% since 2001. This resulted in an overall NSF-wide average funding rate of 24 percent (27% in 2003, 30% in 2002, and 31% in 2001). The 2004 funding rate is the lowest rate in 15 years and largely due to the substantial increase in the number of submitted proposals and budget constraints. The funding rate ranges between 16-45% depending on the NSF program. Funding rates for female PIs is one percent above the overall average and one percent below this average for minorities. The funding rate for new PIs is 17% (down from 19% in 2003). Some COVs cited this declining rate as also contributing to larger numbers of proposals being resubmitted and re-reviewed with little gain in quality and further burdening the review process. However, in response to questions raised by the AC/GPA in 2004, NSF analyzed resubmitted proposals and the data show that these proposals are not disadvantaged in the review process – thus, the issue for NSF is one of proposal volume.
- **Sector Distribution.** The distribution of NSF awards among institutions of varying size remains relatively unchanged over the past four years. The top 100 universities still receive the overwhelming majority of all NSF awards (74 percent). The TOOLS subgroup also commented on this issue.
- **Grant Size and Duration.** The average annualized award amount for individual investigator research grants in 2004 was \$139,522 (3 percent more than in 2003 and 22 percent more than in 2002). The average award duration for 2004 was 2.96 years. NSF's goal has been 3.0 years.
- **Proposal Reviews.** Proposals are reviewed primarily by three mechanisms: *ad hoc* mail reviews only, panel reviews, and mail-panel combination. The use of the panel and mail-panel combination is increasing while the use of mail reviews only continues to decrease (down to 7% in 2004.) Including all mechanisms of review, the average number of reviews per proposal for 2004 was 6.0, slightly lower than the 2003 level of 6.3.
- **Reviewer Pool.** Selected from the electronic database of about 300,000 reviewers, 58,000 reviewers participated in the MRP, and of those, 13,000 were first time reviewers (up from 8,000 in 2003). In 2004, 7092 or 17% of the distinct 41,263 reviewers returned demographic information. Out of these, 2,449 or 35% indicated they were members of an underrepresented group (i.e., minority or women). Provision of demographic data is voluntary and, given the low response rate, there is not enough information to establish a baseline. Thus, there is no apparent way to judge balance between racial, ethnic, and gender representation among the reviewer population. The AC/GPA is concerned about this situation both for reviewers and for PIs and urge NSF to redouble its efforts to collect this data and engage a diverse pool of reviewers in the MRP. We understand that the PI database and the reviewer database are currently separate, but easy and

comprehensive retrieval of systematic and holistic demographic information about reviewers and PIs remains desirable and necessary. There were also concerns in many of the COVs about the potential for overuse of reviewers (i.e., burnout, low response rate, etc) and the impact on the reviewer pool from the substantial increase in the number of proposals. COVs made a number of suggestions on improving the reviewer pool:

- Include private sector reviewers especially when tool development is a major objective of a proposal to ensure that proposals benefit from private sector expertise and are not duplicating projects already underway in the private sector.
  - Create an on-line system to allow potential new reviewers to register, describe their interests, and be certified that they are prepared to be reviewers.
  - Promote the benefits of reviewing to prospective reviewers (e.g., there is no better way to learn how to write a good proposal) and develop ways to publicly recognize reviewers (e.g., distinguished service award). This could help change the social norm of reviewing from a burden to something that is valued by one's peers (the same way teaching awards have changed the norm in many universities). A panel provides the opportunity to bring developing scientists into contact with established researchers and help these developing researchers obtain insights about proposal preparation and review standards.
  - Seek more flexibility and mechanisms for appointing review panels, such as having six standing members on three-year rotations and two short-term members appointed on the basis of proposals received for each round of solicitations.
  - Increase the number of young qualified reviewers and ask panel members to provide lists of review candidates.
  - Encourage Program Officers to write journal articles to help increase reviewer return rates.
- **Reviewer Response Rates.** In 2004, 59% of requests for mail review elicited positive responses, up slightly from 58% in 2003. Many COVs mentioned the decline in review return rates and thought that this was attributed to the great number of proposals and fewer available reviewers. Many COVs mentioned the impact of this low reviewer return rate and that it could limit the number of outside reviewers, particularly if those who do respond are only somewhat familiar with the research area. Several COVs postulated that some of the lower return rate might be related to a "Fast Lane learning curve" and that Fast Lane has shifted the burden on reviewers to download and print proposals. Some COVs suggested that further testing be done on Fast Lane to help non-technical people use it -- although the AC/GPA has not seen the Fast Lane interface as an impediment. NSF might consider modifications to Fast Lane that would provide a convenient way to automatically monitor responses by prospective reviewers and remind reviewers as deadlines approach.
  - **Dwell Time.** The NSF goal of processing 70 percent of all proposals within six months of submission was once again exceeded in 2004 (77 percent, about the same as 2003 and



up from 63% in 2001). This achievement is particularly significant given that the number of proposals has increased 38% since 2001.

- **Review Feedback.** COV reports also indicate that more specific feedback to the PIs is desirable, including strengths, weaknesses, and suggestions for improvement. Several of those reports recommended tutorials on review preparation with examples of helpful reviews (for prospective reviewers and panel members). In 2003, the AC/GPA mentioned the need to ensure the panel summaries in the proposal jackets fully capture the rationale for funding decisions and the make up of panel experts (e.g., short bio). This lack of concise summaries was mentioned again repeatedly in the 2004 COV reports. While this may be a PO workload issue, the AC/GPA believes that it is very important that these rationales be included or the COVs process will be negatively impacted. There were some COV comments that the "Summary" section of the review forms varies considerably. In some reviews, the summary synthesizes all comments, while in others the summary simply reiterates reviewers' comments. The former is more desirable and NSF should make this clear to reviewers. One COV suggested that reviewers should take the perspective -- "if I were the PI on this proposal, what feedback would help me turn this into a successful proposal". Some reviewers organize their reviews according to NSF criteria and others do not. NSF should insist on a consistent format that easily relates to the MR criteria.
- **Merit Review Criteria.** One of NSF's original GPRA goals was to increase reviewer and PO attention to both review criteria (scientific merit and broader impacts). It has been noted in the past three AC/GPA reports that consideration of the broader impact of the proposed research (i.e., Criterion 2) continued to be somewhat inadequate. In 2004, 92 percent of all external reviews addressed aspects of both MR criteria (90% in 2003, 84% in 2002, and 69% in 2001). In 2004, 236 proposals were returned without review due to failure to address both criteria (276 in 2003). There is clear improvement in the statistics on this issue.

While most COVs mention this improvement, they also all continue to cite the uneven attention of reviewers to Criterion 2 because reviewers, proposers, and POs still don't fully understand and apply these criteria consistently. It was widely held by the COVs that the *broader impact* criterion needs better definition, since its meaning can vary substantially depending on the background and perspective of both proposers and reviewers. For example, how does one judge a proposal impacting 20 students at a small liberal arts college and another proposal impacting 1,700 students at a large university?

Suggestions offered by COVs to improve the quality of Criterion 2 include: (1) redesign Fast Lane so reviewers must fully address both criteria; (2) provide clear and repeated guidance to review panels to comment on both criteria; (3) better define the criteria; (4) make available models of good and bad reviews; and, (5) insist that program announcements specify what sorts of broader impacts are relevant to a particular program. Ideas for providing examples of broader impacts are presented throughout the COVs reports and the COVs suggested that NSF should consider conducting Panel Review Workshops at national meetings to help train and certify reviewers. The AC/GPA finds that the review of the *broader impacts* criterion remains a challenge for most reviewers and we recommend that NSF intensify its efforts on this issue.

- **Program Officers.** Many of the COVs found the thoughtfulness and thoroughness of the POs' review of proposals and reviews extraordinary. They balance competing priorities, manage the review process, and many other things. The AC/GPA recognizes that POs are a key element in the success of the MRP in that they select the reviewers, compose the panels, and manage the process of review. The typical PO processes 105 proposals each year and spends 55 percent of his/her time on the review process (source: Booz, Allen, Hamilton workload survey of NSF staff).

Since this survey was the first of its kind ever performed, we have no basis on which to assess whether more than half of an average PO work year on proposal review is too much or too little, but it does seem to us an inordinate amount of time, especially given the other important duties that a PO should be attending to (e.g., program development, award management and oversight, outreach and communication, performance assessment). In the past ten years the budget of NSF has nearly doubled and the number of proposals has increased significantly, yet the number of NSF staff has only increased by four percent.

The AC/GPA recommends that NSF continue to track the amount of the PO's workload that is devoted to the MRP and consider providing the POs with additional resources (e.g., portfolio assistants). Throughout the COVs there are references to outstanding POs. NSF should analyze why these particular POs are so effective, reward them, and develop training for other POs based on these findings. Some of the attributes of a good PO include: long-term experience in the MRP, well respected in the field, close ties to leading scholars, no perceived personal biases, and ability to run a very effective review process. COVs also mentioned the importance of non-rotator POs that bring "long-term memory" into the process and this should be balanced with the "fresh ideas" that rotators bring to NSF.

- **Efficiency and Effectiveness.** Some COVs mentioned that for very small awards, the peer review process might be excessive and add delay and cost to the process. NSF might want to consider a level under which some proposals can be handled with a less cumbersome procedure. It was also suggested that the number of required reviewers should vary with the amount of requested funding.
- **Lost Capacity.** In 2004, over \$2 billion of declined proposals were rated as high as the average rating for an NSF award (4.2 on a 5-point scale). These declined proposals represent a rich portfolio of high quality, yet unfunded research and education opportunities that we hope will not be lost to the nation.

Based on our analysis of NSF's merit review process, we offer these comments and recommendations that we hope will be helpful and that we suggest NSF consider for additional action:

- **Crosscutting Programs.** As crosscutting programs and initiatives increase, NSF must focus on the associated infrastructure and management to assure continued OE (i.e., the structure is balky and should be overhauled or streamlined).
- **COVs.** The COV reports have proved to be extremely valuable in the AC/GPA analysis. However, COVs too often either did not respond at all or responded solely in monosyllables (i.e., yes or no) regarding the review process for the multidisciplinary proposals and OE. As

the number of the proposals increases, the importance of effective program review by the COVs grows. Thus, NSF should ensure that all COVs address MRP effectiveness for multidisciplinary proposals and OE topics.

- **Program Officers.** The positive effects of outstanding POs are critical to the success of the MRP. NSF should develop and recognize these POs and use their best practices in the training and mentoring of new POs. Although the numbers of proposals have increased significantly, the staffing managing the MRP has not increased proportionately, causing heavy workloads for POs. NSF is encouraged to continue to track the PO workload and to assign resources based on these results.
- **Budget Constraints.** The AC/GPA noted the COVs' contention that the funding of multidisciplinary proposals is budget constrained or negatively impacted by the MRP itself. The ACGPA encourages NSF to not let the budget and/or review process limit the funding of these proposals.
- **Proposal and Success Rate.** The 2004 funding rate is the lowest rate in 15 years and largely due to the substantial increase in proposals. Many of the declined proposals are rated well above average (~\$2 billion) and are costly to develop. Thus, NSF will need to develop strategies on how to take advantage of this important national intellectual capacity and avoid discouraging the pursuit of important research and education efforts.
- **Reviewer Pools.** Demographic data allowing the determination of the balance of racial, ethnic, and gender representation among NSF reviewers remain scarce. The NSF is urged to redouble its efforts to broaden the numbers and diversity of the review pools. Reviewer response rates are roughly flat and there are signs of reviewer overuse and burnout. NSF should consider developing an on-line system to register and certify reviewers and develop a mechanism for Fast Lane to automatically monitor reviewer responses and deadlines. NSF should also promote the benefits of being a reviewer.
- **Review Criterion 2.** An imbalance in the quality and thoroughness of the responses to Criterion 2, the *broader impacts* criterion, persists. We recommend that NSF continue to focus on this issue, including considering conducting Panel Review Workshops at national meetings to help train and certify reviewers.



## Appendix D

### **CORE QUESTIONS and REPORT TEMPLATE for FY 2004 NSF COMMITTEE OF VISITOR (COV) REVIEWS**

**Guidance to NSF Staff:** This document includes the FY 2004 set of Core Questions and the COV Report Template for use by NSF staff when preparing and conducting COVs during FY 2004. Specific guidance for NSF staff describing the COV review process is described in Subchapter 300-Committee of Visitors Reviews (NSF Manual 1, Section VIII) that can be obtained at <http://www.nsf.gov/about/performance/index.jsp>.

NSF relies on the judgment of external experts to maintain high standards of program management, to provide advice for continuous improvement of NSF performance, and to ensure openness to the research and education community served by the Foundation. Committee of Visitor (COV) reviews provide NSF with external expert judgments in two areas: (1) assessments of the quality and integrity of program operations and program-level technical and managerial matters pertaining to proposal decisions; and (2) comments on how the outputs and outcomes generated by awardees have contributed to the attainment of NSF's mission and strategic outcome goals.

Many of the Core Questions are derived from NSF performance goals and apply to the portfolio of activities represented in the program(s) under review. The program(s) under review may include several subactivities as well as NSF-wide activities. The directorate or division may instruct the COV to provide answers addressing a cluster or group of programs – a portfolio of activities integrated as a whole – or to provide answers specific to the subactivities of the program, with the latter requiring more time but providing more detailed information.

The Division or Directorate may choose to add questions relevant to the activities under review. NSF staff should work with the COV members in advance of the meeting to provide them with the report template, organized background materials, and to identify questions/goals that apply to the program(s) under review.

**Guidance to the COV:** The COV report should provide a balanced assessment of NSF's performance in two primary areas: (A) the integrity and efficiency of the *processes* related to proposal review; and (B) the quality of the *results* of NSF's investments in the form of outputs and outcomes that appear over time. The COV also explores the relationships between award decisions and program/NSF-wide goals in order to determine the likelihood that the portfolio will lead to the desired results in the future. Discussions leading to answers for Part A 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.* Discussions leading to answers for Part B of the Core Questions will involve study of non-confidential material such as results of NSF-funded projects. It is important to recognize that the reports generated by COVs are used in assessing agency progress in order to meet government-wide performance reporting requirements, and are made available to the public. Since material from COV reports is used in NSF performance reports, the COV report may be subject to an audit.

*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.*

Excerpt from "Excerpt from FY 2004 Report on the NSF Merit Review System— 03/05"

**FY 2004 REPORT TEMPLATE FOR  
NSF COMMITTEES OF VISITORS (COVs)**

|                                                                                                                                                             |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Date of COV</b>                                                                                                                                          |
| <b>Program/Cluster:</b>                                                                                                                                     |
| <b>Division:</b>                                                                                                                                            |
| <b>Directorate:</b>                                                                                                                                         |
| <b>Number of actions reviewed by COV<sup>23</sup>: Awards:      Declinations:      Other:</b>                                                               |
| <b>Total number of actions within Program/Cluster/Division during period being reviewed by COV<sup>24</sup>:<br/>Awards:      Declinations:      Other:</b> |
| <b>Manner in which reviewed actions were selected:</b>                                                                                                      |

**PART A. 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, and withdrawals) 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 under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged.

**A.1 Questions about the quality and effectiveness of the program’s use of merit review procedures.** Provide comments in the space below the question. Discuss areas of concern in the space provided.

| <b>QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCEDURES</b>                             | <b>YES, NO,<br/>DATA NOT<br/>AVAILABLE,<br/>or NOT<br/>APPLICABLE<sup>25</sup></b> |
|-----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Is the review mechanism appropriate? (panels, ad hoc reviews, site visits)<br>Comments: |                                                                                    |
| Is the review process efficient and effective?<br>Comments:                             |                                                                                    |

<sup>23</sup> To be provided by NSF staff.

<sup>24</sup> To be provided by NSF staff.

<sup>25</sup> If “Not Applicable” please explain why in the “Comments” section.

|                                                                                                                                                                                           |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Are reviews consistent with priorities and criteria stated in the program’s solicitations, announcements, and guidelines?<br>Comments:                                                    |  |
| Do the individual reviews (either mail or panel) provide sufficient information for the principal investigator(s) to understand the basis for the reviewer’s recommendation?<br>Comments: |  |
| Do the panel summaries provide sufficient information for the principal investigator(s) to understand the basis for the panel recommendation?<br>Comments:                                |  |
| Is the documentation for recommendations complete, and does the program officer provide sufficient information and justification for her/his recommendation?<br>Comments:                 |  |
| Is the time to decision appropriate?<br>Comments:                                                                                                                                         |  |
| Discuss issues identified by the COV concerning the quality and effectiveness of the program’s use of merit review procedures:                                                            |  |

**A.2 Questions concerning the implementation of the NSF Merit Review Criteria (intellectual merit and broader impacts) by reviewers and program officers.** Provide comments in the space below the question. Discuss issues or concerns in the space provided.

| <b>IMPLEMENTATION OF NSF MERIT REVIEW CRITERIA</b>                                                                                        | <b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE<sup>26</sup></b> |
|-------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|
| Have the individual reviews (either mail or panel) addressed whether the proposal contributes to both merit review criteria?<br>Comments: |                                                                    |

<sup>26</sup> In “Not Applicable” please explain why in the “Comments” section.

|                                                                                                                                  |  |
|----------------------------------------------------------------------------------------------------------------------------------|--|
| Have the panel summary reviews addressed whether the proposal contributes to both merit review criteria?<br>Comments:            |  |
| Have the <i>review analyses</i> (Form 7s) addressed whether the proposal contributes to both merit review criteria?<br>Comments: |  |
| Discuss any issues or concerns the COV has identified with respect to NSF's merit review system.                                 |  |

**A.3 Questions concerning the selection of reviewers.** Provide comments in the space below the question. Discuss areas of concern in the space provided.

| <b>SELECTION OF REVIEWERS</b>                                                                                                                                                | <b>YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE<sup>27</sup></b> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| Did the program make use of an adequate number of reviewers for a balanced review?<br>Comments:                                                                              |                                                                     |
| Did the program make use of reviewers having appropriate expertise and/or qualifications?<br>Comments:                                                                       |                                                                     |
| Did the program make appropriate use of reviewers to reflect balance among characteristics such as geography, type of institution, and underrepresented groups?<br>Comments: |                                                                     |
| Did the program recognize and resolve conflicts of interest when appropriate?<br>Comments:                                                                                   |                                                                     |
| Discuss any concerns identified that are relevant to selection of reviewers.                                                                                                 |                                                                     |

**A.4 Questions concerning the resulting portfolio of awards under review.** Provide comments in the space below the question. Discuss areas of concern in the space provided.

<sup>27</sup> If "Not Applicable" please explain why in the "Comments" section.



| <p style="text-align: center;"><b>RESULTING PORTFOLIO OF AWARDS</b></p>                                                                                                                       | <p style="text-align: center;"><b>APPROPRIATE,<br/>NOT APPROPRIATE<sup>28</sup>,<br/>OR DATA NOT<br/>AVAILABLE</b></p> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| <p>Overall quality of the research and/or education projects supported by the program.<br/>Comments:</p>                                                                                      |                                                                                                                        |
| <p>Are awards appropriate in size and duration for the scope of the projects?<br/>Comments:</p>                                                                                               |                                                                                                                        |
| <p>Does the program portfolio have an appropriate balance of:</p> <ul style="list-style-type: none"> <li>• High Risk Proposals?</li> </ul> <p>Comments:</p>                                   |                                                                                                                        |
| <p>Does the program portfolio have an appropriate balance of:</p> <ul style="list-style-type: none"> <li>• Multidisciplinary Proposals?</li> </ul> <p>Comments:</p>                           |                                                                                                                        |
| <p>Does the program portfolio have an appropriate balance of:</p> <ul style="list-style-type: none"> <li>• Innovative Proposals?</li> </ul> <p>Comments:</p>                                  |                                                                                                                        |
| <p>Does the program portfolio have an appropriate balance of:</p> <ul style="list-style-type: none"> <li>• Funding for centers, groups and awards to individuals?</li> </ul> <p>Comments:</p> |                                                                                                                        |
| <p>Does the program portfolio have an appropriate balance of:</p> <ul style="list-style-type: none"> <li>• Awards to new investigators?</li> </ul> <p>Comments:</p>                           |                                                                                                                        |
| <p>Does the program portfolio have an appropriate balance of:</p> <ul style="list-style-type: none"> <li>• Geographical distribution of Principal Investigators?</li> </ul> <p>Comments:</p>  |                                                                                                                        |
| <p>Does the program portfolio have an appropriate balance of:</p> <ul style="list-style-type: none"> <li>• Institutional types?</li> </ul> <p>Comments:</p>                                   |                                                                                                                        |

<sup>28</sup> If “Not Appropriate” please explain why in the “Comments” section.

|                                                                                                                                                                                                            |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Does the program portfolio have an appropriate balance of: <ul style="list-style-type: none"> <li>• Projects that integrate research and education?</li> </ul> Comments:                                   |  |
| Does the program portfolio have an appropriate balance: <ul style="list-style-type: none"> <li>• Across disciplines and subdisciplines of the activity and of emerging opportunities?</li> </ul> Comments: |  |
| Does the program portfolio have appropriate participation of underrepresented groups? Comments:                                                                                                            |  |
| Is the program relevant to national priorities, agency mission, relevant fields and other customer needs? Include citations of relevant external reports. Comments:                                        |  |
| Discuss any concerns identified that are relevant to the quality of the projects or the balance of the portfolio.                                                                                          |  |

**A.5 Management of the program under review.** Please comment on:

|                                                                                                                                          |
|------------------------------------------------------------------------------------------------------------------------------------------|
| Management of the program. Comments:                                                                                                     |
| Responsiveness of the program to emerging research and education trends. Comments:                                                       |
| Program planning and prioritization process (internal and external) that guided the development of the portfolio under review. Comments: |
| Discuss any concerns identified that are relevant to the management of the program.                                                      |

## **PART B. RESULTS : OUTPUTS AND OUTCOMES OF NSF INVESTMENTS**

NSF investments produce results that appear over time. The answers to the first three (People, Ideas and Tools) questions in this section are to be based on the COV's study of award results, which are direct and indirect accomplishments of projects supported by the program. These projects may be currently active or closed out during the previous three fiscal years. The COV review may also include consideration of significant impacts and advances that have developed since the previous COV review and are demonstrably linked to NSF investments, regardless of when the investments were made. Incremental progress made on results reported in prior fiscal years may also be considered.

The following questions are developed using the NSF outcome goals in the NSF Strategic Plan. The COV should look carefully at and comment on (1) noteworthy achievements of the year based on NSF awards; (2) the ways in which funded projects have collectively affected progress toward NSF's mission and strategic outcomes; and (3) expectations for future performance based on the current set of awards. NSF asks the COV to provide comments on the degree to which past investments in research and education have contributed to NSF's progress towards its annual strategic outcome goals and to its mission:

- To promote the progress of science.
- To advance national health, prosperity, and welfare.
- To secure the national defense.
- And for other purposes.

Excellence in managing NSF underpins all of the agency's activities. For the response to the Outcome Goal for Organizational Excellence, the COV should comment, where appropriate, on NSF providing an agile, innovative organization. Critical indicators in this area include (1) operation of a credible, efficient merit review system; (2) utilizing and sustaining broad access to new and emerging technologies for business application; (3) developing a diverse, capable, motivated staff that operates with efficiency and integrity; and (4) developing and using performance assessment tools and measures to provide an environment of continuous improvement in NSF's intellectual investments as well as its management effectiveness.

**B. Please provide comments on the activity as it relates to NSF's Strategic Outcome Goals. Provide examples of outcomes (nuggets) as appropriate. Examples should reference the NSF award number, the Principal Investigator(s) names, and their institutions.**

**B.1 OUTCOME GOAL for PEOPLE: Developing "a diverse, competitive and globally engaged workforce of scientists, engineers, technologists and well-prepared citizens."**

Comments:

**B.2 OUTCOME GOAL for IDEAS: Enabling "discovery across the frontier of science and engineering, connected to learning, innovation, and service to society."**

Comments:

**B.3 OUTCOME GOAL for TOOLS: Providing “broadly accessible, state-of-the-art S&E facilities, tools and other infrastructure that enable discovery, learning and innovation.”**

Comments:

**B.4 OUTCOME GOAL for ORGANIZATIONAL EXCELLENCE: Providing “an agile, innovative organization that fulfills its mission through leadership in state-of-the-art business practices.”**

Comments:

## **PART C. OTHER TOPICS**

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

**C.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.**

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

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

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

### **SIGNATURE BLOCK:**

---

For the [Replace with Name of COV]  
[Name of Chair of COV]  
Chair

## Appendix E

### Terms and Acronyms Related to the NSF Merit Review System

| <b><u>Acronym</u></b> | <b><u>Definition</u></b>                                        |
|-----------------------|-----------------------------------------------------------------|
| AC                    | Advisory Committee                                              |
| AC/GPA                | Advisory Committee for GPRA Performance Assessment              |
| AD                    | Assistant Director                                              |
| COV                   | Committee of Visitors                                           |
| FY                    | Fiscal Year                                                     |
| GAO                   | U.S. General Accounting Office                                  |
| GPRA                  | Government Performance and Results Act                          |
| IGERT                 | Integrative Graduate Education and Research Traineeship Program |
| IPA                   | Intergovernmental Personnel Act                                 |
| NAPA                  | National Academy of Public Administration                       |
| NSB                   | National Science Board                                          |
| NSBO                  | National Science Board Office                                   |
| NSF                   | National Science Foundation                                     |
| OGC                   | Office of the General Counsel                                   |
| OIG                   | Office of Inspector General                                     |
| PAM                   | <i>Proposal and Award Manual</i>                                |
| PI                    | Principal Investigator                                          |
| SGER                  | Small Grant for Exploratory Research                            |