December 15, 2003

TO: Division of Engineering Education and Centers (EEC)
Committee of Visitors (COV)

FROM: Assistant Director for Engineering

SUBJECT: Charge to the Committee of Visitors

Thank you for agreeing to serve on the Committee of Visitors (COV) for the Division of Engineering Education and Centers of the Engineering Directorate of the National Science Foundation (NSF). By NSF policy, programs that award grants or cooperative agreements are reviewed at three-year intervals by a COV. The COV is an ad hoc subcommittee of the Advisory Committee for the Directorate for Engineering. The purpose of the COV is to assess program-level technical and managerial matters pertaining to program decisions.

The COV is charged to address:

- The integrity, efficacy, and quality of the processes used to solicit, review, recommend and document proposal actions and monitor active projects;
- The quality and significance of the results of the Division's programmatic investments;
- The degree to which the award process supports the long-range goals and core strategies of the NSF as described in ***NSF FY 2001-2006 Strategic Plan (September 30,2000)*** that addresses the ***Government Performance and Results Act of 1993 (GRPA).*** The documents and other background on GRPA may be found at http://www.nsf.gov/od/gpra/start.htm. A framework for addressing this issue will be provided at the time of the COV meeting;
- The Division's balance, priorities, and future directions; and,
- Any other issues you think are relevant to the review.

The EEC COV shall use the enclosed Core Questions and Report Template in preparing its report.

Decisions to award or decline grant proposals are based on the informed judgment of program officers and division directors following merit review. Systematic examination of proposal files by qualified external parties provides and independent mechanism of monitoring and evaluating the quality and pertinence of proposal decisions. This examination is part of the task of the COV.

The review will assess the operations of the programs of the Engineering Education and Centers Division for years 2001, 2002, and 2003. The COV will examine a sample of files for both awarded and declined proposals in each program. The division is organized

into four program areas: (1) Centers; (2) Partnerships for Innovation; (3) Education; and (4) Human Resources.

The meeting of the Division of Engineering Education and Centers (COV) will take place on Tuesday and Wednesday, March 16-17, at the National Science Foundation located at 4201 Wilson Boulevard, Arlington, Virginia, 22230. The COV will convene at 8:00 am on Tuesday, in Room 515 - Stafford 2, and will adjourn about 3:00 pm on Wednesday.

The COV should transmit its report to Dr. Kristina Johnson, Chair of the Engineering Advisory Committee, within two weeks of the COV meeting. Dr. Johnson will forward the report to me with any comments that the Engineering Advisory committee may have. In accordance with NSF policy, I will provide a response setting forth any actions to be taken on each suggestion or recommendation. Both the COV report and my response will be forward to the Director of the NSF.

John A. Brighton

Enclosures
(1) Core Questions
(2) Report Template

Cc: Dr. Kristina Johnson

January 19, 2005

Dr. John Brighton
Assistant Director
Engineering Directorate
National Science Foundation
Room 505N
4201 Wilson Blvd.
Arlington, Va. 22230

Dear John:

It is my pleasure to report to you that the National Science Foundation (NSF) Advisory Committee on Engineering (Adcom) officially accepted the Committee of Visitors (COV) report for the Division of Engineering Education and Centers at the Adcom semi-annual meeting held May 19-20, 2004 at the NSF. This report assesses the Divisions' performance related to the process of proposal review, and the quality of the results of NSF's investments in the Division.

The committee was divided into three subcommittees to review:

- Engineering Research Centers
- Industry/University Cooperative Research Centers
- Engineering Education/Human Resources.

The COV found that the Center programs were excellent performers in all categories of assessment. To sustain the excellence, the COV recommends that the ERC program develop a vision for the next generation of programs, diversify the ERC portfolio in terms of innovative technologies supported, Center organization and structure, types of institutions and size of groups funded and the demographics of researchers and students supported by the ERC. In terms of the IUCRCs, the COV felt that the program is possibly under funded, and could use critical mass resources to sustain this important link to industry and exposure to real world problems.

The COV believes that the engineering education and human resource development program goals have been successfully achieved. The COV recommends the Division develop a high level strategic vision for EE and HR. Programs should be put in place to implement the vision and criteria established for assessing progress towards meeting program goals. It is further recommended that the Division "make a visible effort" to demonstrate how these awards have been successful in promoting diversity, multiculturalism, multidisciplinary and multi-institutional teams. The COV also recommends the Division review their efforts to utilize awards to integrate research and

teaching within the funded institutions. Finally, the COV highlighted the need to insure that adequate staff is in place to manage the Partnerships for Innovation, a young program too early to assess at this time.

General remarks in the report worth highlighting include the observation that in some programs, 25% of the reviewers do not provide reviews of sufficient depth to be useful to the Division program officers. Suggestions for improvement include having the Division hold training sessions for reviewers, and to insure that no fewer than three reviewers be assigned to a particular jacket.

As always, your efforts to promote this important Division is warranted by the quality of the programs and the impact they are making in carrying out the mission of the NSF.

Sincerely yours,

Kristina M. Johnson
Professor and Dean
Past-Chair, NSF Adcom

REPORT TO THE NATIONAL SCIENCE FOUNDATION

Review of the Division of Engineering Education and Centers

Committee of Visitors

March 16-17, 2004

Centers

Gilda Barabino
Andreas Cangellaris
Arlene Garrison
Linda Katehi (Chair)
Howard Phillips
Karl Reid
Kamal Sarabandi

Education and Human Resource and Development

Adnan Akay
Patricia B. Campbell
Martha Cyr
Isadore T. Davis
Norman L. Fortenberry
Donna C. Llewellyn
Andreas Spanias
Robert E. Spitzer

Partnerships for Innovation

Chris W. Busch
Joann Jacullo-Noto
John Villarreal

Review of the Division of Engineering Education and Centers

Executive Summary

The Committee of Visitors (COV) for the Division of Engineering Education and Centers (EEC) met at the National Science Foundation (NSF) on March 16-17, 2004. This report provides an assessment of the division'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. Furthermore, this report includes a feedback section that addresses program areas needing improvement, the various program's performance vis-à-vis their specific goals and objectives (beyond those NSF has specified for the agency under the Government Performance and Results Act [GPRA]), and recommendations that will strengthen the division and allow it to successfully meet its objectives and goals for the future.

Processes and Management

In most cases, merit review procedures are highly efficient, well organized, and effective, although a wide variance in the overall quality and level of detail of the reviews was observed. Some of this variance can be reduced by providing templates that specify the subjects, issues, and accomplishments to be reviewed. Templates, such as those used for ERC proposal and site visit reviews, can not only provide a higher level of review uniformity but also serve to identify and highlight issues and subjects (for example, review frequency, number of reviewers) that are important to the review process. It is important to point out that most EEC programs now use program-specific review templates in their panels.

The geographic distribution of reviewers and their professional affiliation, appear to be satisfactory, although in many cases the COV could not provide a meaningful evaluation due to a number of factors, including missing or incomplete data and inferences based solely on a person's first name or place of employment. The COV understands that NSF can not require reviewers to provide demographic information and for this reason, the COV cannot accurately assess the diversity of the pool. However, the COV would like to continue encouraging NSF, and the EEC division more specifically, to use a broader range of recruitment strategies in order to enlarge and diversify the pool of potential reviewers.

With respect to the portfolio of awards, the COV concluded that awards are consistent with program guidelines and reviewer recommendations. Particularly noteworthy are the number and nature of the Engineering Research Centers (ERC), awards in new and emerging areas, the integration of research with education, and the discretion given to ERC directors to support new investigators. Specific to ERCs, the COV found the size and duration of the awards to be very appropriate. Funding smaller multidisciplinary teams instead of increasing the size of the awards is recommended. The Industry/University Cooperative Research Centers (I/UCRC) program has been highly successful in promoting collaborations with industry for relatively small NSF investments. The Department Level Reform program

represents a unique opportunity to advance the state of practice within the most fundamental academic unit. In the future, the NSF should consider larger budgets for fewer high-priority projects, such as the Nanoscale Interdisciplinary Research Teams (NIRTs) whose engineering awards are managed in the ERC program metrics for proposal review and post-award progress monitoring. An ongoing challenge continues to be the question of how to maximize results, productivity, and dissemination during the final phases of program funding.

Outcomes

Programs administered by the Division of Engineering Education and Centers (EEC) have been highly successful in meeting the PEOPLE strategic outcome goal. A wide variety of programs, including many multi-institutional programs and programs with an international component, are having a significant and, in some cases, a dramatic impact on diversity, curricula, and pre-college outreach. Similar successes have been achieved with respect to the IDEAS and the TOOLS strategic outcome goals. Recent and ongoing programs are providing libraries of educational tools, have provided the impetus for the creation of entirely new degree programs, have produced breakthrough results that are redefining performance limits in a number of critical technology areas, and are making significant contributions to economic development.

The overwhelming majority of awards reviewed were at Research Extensive Institutions. Given where engineering students are, this may not be unreasonable. However there is little breadth and diversity in the small population of other than Research Extensive Institutions that are supported. There is a need to build more capacity across the set of other institutions.

Improvements, Performance, and the COV Review Process

Much of what is included in the report with respect to these issues has to do with planning the program goals and identifying assessment metrics for proposal review and post-award progress monitoring. The entire process of requesting and evaluating proposals, and reviewing ongoing projects through the use of panels and site visits, should have objective measures that emphasize the importance and the extent to which grantees address diversity; multidisciplinary, multicultural, and multi-institutional teams; and industry participation, such as the standard data in these and other categories that ERC and Nanoscale Science and Engineering Centers (NSECs), have been providing in annual reports, renewal proposals, and the program's database since the early years of these programs. A similar system of activity and performance indicators is being developed for the Partnerships for Innovation (PFI) program in 2004. The performance of the programs in these areas is noteworthy. However, all programs need to continually address the future goals and objectives, assess progress towards goals and develop new out-of-the-box ideas. Because of the maturity of the large-scale efforts funded by EEC, the COV recommends comprehensive studies that attempt to answer the following questions: What will ERCs look like in five to ten years? What are the overarching goals of the EEC Educational and HR development programs?

Finally, the COV recommends that steps be taken to make the COV review more efficient. These steps include: 1) providing clear guidelines about expected meeting outcomes and responsibilities to all members of the COV ahead of the meeting, 2) providing easy electronic access to the jackets, 3) streamlining the Core Questions document to clarify expectations with respect to process and deliverables, and 4) performing a successful sampling of the jackets that allows for minimal errors in conclusions. A method should be developed that allows one to select a sufficiently high proportion of proposal and award jackets at random per program to provide adequate coverage of the breadth of proposals and awards,

Summary

Although some improvements are recommended, the COV concludes that the EEC has been very successful in meeting its process and management responsibilities. Programs funded by the EEC have been highly successful with respect to the most important measures: results and outcomes that are redefining performance limits and the methods that are being used to address fundamental engineering and societal problems; the integration of research and education; outreach to pre-college students and to society as a whole; and the creation of new and highly relevant engineering education curricula and degree programs. The ERC and I/UCRC programs are examples of excellence for the whole agency.

I. INTRODUCTION

The Committee of Visitors (COV) for the Division of Engineering Education and Centers (EEC) met at the National Science Foundation (NSF) on March 16-17, 2004. Members of the committee were selected by the Office of the Assistant Director of Engineering *to form an independent group of credible, external experts, selected to ensure an independent review that reflects a diversity of perspectives and balanced programmatic coverage*. This committee was asked to address:

- The integrity, efficacy, and quality of processes used to solicit, review, recommend, and document proposal actions and to monitor active projects;
- The quality and significance of the results of the Division's programmatic investments;
- The degree to which the award process supports the long-range goals and core strategies of the NSF as described in the NSF FY 2001-2006 Strategic Plan (September 2000) that addresses the Government Performance and Results Act of 1993 (GRPA);
- The Division's balance, priorities, and future directions; and
- Any other issues the COV thinks are relevant to the review.

Furthermore, the committee was asked to submit a report that provides an assessment of the division'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. In addition, the report includes a third section (C) that discusses the division's performance in terms of balance, focus, priorities and future directions.

The COV Chair selected the jackets that each COV member was to review from a list of all active awards and all proposals submitted to EEC programs during FY 2001-2003. In order to conduct the COV meeting at NSF in just one and a half days, the committee members were given specially arranged remote access to the electronic jackets for all proposals and awards covered in the COV review almost a month before the meeting. This was the first time that NSF COV members had accessed jackets electronically and the first time that jackets were reviewed ahead of the meeting. This effort was met with variable success. Some members were able to access the jackets easily, while others faced a number of problems. Since the use of electronic jackets was phased in during FY 2001-2003, there were few complete electronic jackets for most 2001 proposals and awards but more partial or full 2002 electronic jackets. Some programs started using e-jacket earlier than others did. In all cases, full paper jackets were available to the committee. However, the committee strongly commends the NSF staff's efforts to provide this capability and strongly supports the idea of providing electronic access to the jackets ahead of the COV meeting for all future reviews. The committee met as a group in the morning of the first day to address questions related to process (group A) while it was divided into three groups that comprise the portfolio of the

Engineering Education and Centers Division in order to provide response to the other questions (groups B and C). The committee was divided into three program subcommittees as listed below:

- Engineering Research Centers
- Industry/University Cooperative Research Centers
- Engineering Education/Human Resources

The members of the COV had electronic and paper access to a variety of program materials: proposals, ad hoc and panel reviews, site visit reports, program officer evaluations, and so forth. Because of the huge volume of materials that accumulated during a three-year period, examination and evaluation of materials by committee members proceeded in two steps. First, the chair of the COV selected a subset of materials and made specific assignments to the members of the committee. This took place four weeks before the meeting. A number of members were able to access the jackets electronically before the meeting, while the rest looked at the jackets during the meeting.

This sampling process was met with mixed reviews from the COV. It seems that a similar reaction occurred with the COV committee of the 2001 review, despite the fact that the two sampling processes were totally different. The reason for this dissatisfaction may be partially due to the diverse portfolio of the division and the difficulty in creating a representative sample that is also manageable in volume. Specifically, members of the COV expressed difficulty in generalizing to the program level or program cluster level what was learned from review of a very small proportion of the division's proposals and awards (7% of the 1327) for that program/cluster over three years. Additionally, some program clusters, e.g. education program, a single revenue stream funded proposals submitted to a substantial number of short-lived program announcements, some of which resulted in awards that were active in FY 2001-03 but stopped soliciting new proposals before FY 2001; others that were launched and ended in that period; and yet others that were started and continued during that period. In many cases there were no codes that allowed identification of proposals and awards that stemmed from a particular program/program announcement. It is recognized that the sampling frame for this situation would be complex to design, especially given the limited time available in which each COV member can review jackets. Despite the challenges cited above, the COV would like to recommend addressing the sampling issue in a more systematic way and possibly ask for professional help in creating the appropriate samples, which will help the COV review the division in a holistic manner. This COV reviewed 171 jackets (90 awards 7% and 81 declines) selected randomly from each category of awards and declines.

In order to comply with the charge to the committee and in order to provide structure to the review process, committee members were provided with a set of core questions that are grouped as follows:

- ***Group A. Integrity and Efficiency of the Program's Processes and Management.*** These questions (core questions A.1- A.5) were addressed in terms of the

performance of the whole division; reference to specific programs was given only when comments refer to individual performance attributes.

- ***Group B. Results: Outputs and Outcomes of NSF Investments***. These questions (Core Questions B.1-B.4) are meant to address: (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.

- ***Group C. Other Topics***. These questions (questions C.1-C.5) were answered in terms of the whole division, although observations and recommendations that apply to individual programs are presented.

Group A questions (A.1-A.5) were addressed by the whole committee during the morning of Day One. Group B questions (B.1-B.4) were addressed during the afternoon of Day One. Day Two was devoted to Group C questions (C.1-C.5) and to an exit briefing provided to the Director of the Division.

The remainder of this report is organized as follows:

II. ***GROUP-A QUESTIONS: Integrity and Efficiency of the Program's Processes and Management***

1. Quality and effectiveness of the program's use of merit review procedures
2. Implementation of the NSF Merit Review Criteria (intellectual merit and broader impacts) by reviewers and program officers
3. Reviewer selection
4. Resulting portfolio of awards
5. Management of the program under review

III. ***GROUP-B QUESTIONS: Outputs and Outcomes of NSF's Investment***

1. Outcome Goal for PEOPLE: Development of a diverse, internationally competitive and globally engaged workforce of scientists, engineers, and well-prepared citizens
2. Outcome Goal for IDEAS: Enabling discovery across the frontier of science and engineering, connected to learning, innovation and service to society
3. Outcome Goal for TOOLS: Providing broadly accessible, state-of-the-art information bases and shared research and education tools
4. Outcome Goal for Organizational Experience: Providing an agile, innovative organization that fulfills its mission through leadership in state-of-the-art business practices

IV. ***GROUP-C QUESTIONS: Other Topics***

1. Comments on program areas in need of improvement or gaps within program areas

2. Comments on the program’s performance in meeting program-specific goals and objectives that are not covered by the above questions
3. Identify agency-wide issues that should be addressed by NSF to help improve the program's performance
4. Comments on any other issues the COV feels are relevant
5. Comments on how to improve the COV review process, format, and report template

II. GROUP A QUESTIONS

Group A questions (Questions A.1- A.5) address the integrity and efficiency of the program's processes and management. In this section of the report, questions were addressed in terms of the division, individual programs, or sets of related programs as appropriate. Comments and observations are followed by recommendations, where appropriate.

1. Quality and effectiveness of the program's use of merit review procedures

Examination of the materials led to the conclusion that merit review procedures are effective and that the review environment is very appropriate. The protocols for competitions, renewals, and annual reviews show open dissemination of the information to program officers, management, and reviewers and site visitors whenever applicable.

- *ERCs and Other Engineering Centers:* The review process is open and provides useful information to the PIs, while documentation collected from site visits, annual reviews, and renewals is excellent.
- *Other Programs:* The reviews are performed by panels of engineers, faculty members and other professionals selected from a variety of institutions and backgrounds relevant to the topic of the area. There is an effective timeline for review, and it is followed very carefully. Decisions are made on time and without delays. Some panels did not have detailed written summaries.

The review process is effective and efficient. As of 2004, 75% of the proposals are reviewed within less than 6 months and 99% or greater of the proposals are reviewed in less than nine months. The reviews are consistent with priorities and criteria and most of the time provide a direct explanation of how the proposal stands in relation to them. Most of the individual reviews are very detailed. It was observed that for proposals submitted in the 2001-2002 period, about 25% of the individual reviews were not very comprehensive. There has been considerable improvement in the past two years. Still, a small number of reviewers do not provide a comprehensive review. The committee concluded that some reviewers come to the review meeting unprepared, and their limited familiarity with the proposals they review is evident in their individual summaries by the lack of specificity in their comments. The majority of panel summaries provide detailed information to the principal investigators. Almost 80-90% of the summaries are fairly detailed and complete in their descriptions. However, the COV encourages NSF to seek further improvement in this area. While examining the history of proposals, it was not uncommon to find the program director's recommendation more valuable than the review panel summary in summarizing the response to the proposal. Program officers are consistent in using the criteria and priorities in program announcements and solicitations and demonstrate good judgment and professionalism. The COV notes positively that the provision of templates for reviewers is a good practice that reminds reviewers of the priorities of the EEC division and NSF's two main merit criteria.

Based on the review of a diverse set of proposals and proposal actions, the COV makes the following recommendations in order to promote process uniformity and the effectiveness of site visits:

Recommendations

II.1 The EEC Division should appoint a chair in every review panel, responsible for keeping detailed minutes of the discussions.

II.2 The EEC Division should provide the reviewers with a template indicating the need to review proposals ahead of time. At present, this practice happens in some programs, but it needs to be extended to the rest of the programs. Also it is recommended that the reviewers be asked to electronically submit their scores ahead of the meeting and be encouraged to act responsibly.

2. Implementation of the NSF Merit Review Criteria (intellectual merit and broader impacts) by reviewers and program officers

The COV concluded that about 75% of the reviewers adequately addressed the *intellectual merit* criterion and the *broader impact* criterion. This indicates that the NSF performance standard, better than 70%,(see PDF page 23, document page 16 of the GPRA performance plan) has been exceeded. In contrast to reviewers, program officers did a better good job of balancing *broader impact* and *intellectual merit* considerations in their decisions. The COV notes positively that the individual reviewer's comments have shown notable improvement in the last three years in terms of addressing both criteria. The committee, however, would like to strongly encourage NSF to reduce the percentage of incomplete/inappropriate reviews to substantially less than 25%.

Recommendations

II.3 The COV strongly recommends that the reviewers be provided with a template showing best practices in terms of how to address criteria 1 and 2 in a complete and informative way.

II.4 The EEC Division should create a short on-line training course for reviewers, to provide them with information, guidelines and best practices about the review.

3. Reviewer selection

After examining materials to determine whether reviewer selection has been appropriate for a balanced review, the COV concluded that:

- The most careful and extended review was done in the Engineering Research Centers. In the other categories, it was observed that about 30% of proposals had three reviewers or fewer, with a few proposals having only two reviewers. Two is an unacceptably small number, as it places the proposal at risk when there is

disagreement between the two reviewers. While NSF's standard has been three reviews per proposal for many years, with the possibility of including additional reviewers, approved exceptions to the standard three reviews have allowed, in some cases, two reviews per proposal. The COV strongly recommends that NSF consider eliminating exceptions for reduced numbers.

- Reviewers appear to be qualified (although the only data made available to the COV were the departments or job titles and organizational affiliation of the reviewers).
- Geography and type of institution are balanced (although addresses were the only information provided to reviewers).
- There is a good balance between industry and academe.

There are some concerns, however. Materials available to the COV provided no identification of members of underrepresented groups. COV members repeatedly asked why they were asked to comment on reviewer diversity when NSF staff is not permitted to designate the racial or ethnic group of a reviewer. While the diversity of reviewers exhibited by the EEC division is good, it could be better. In particular, the COV noted a low number of women reviewers, based on common female given names. As mentioned previously, the Privacy Act makes it illegal for EEC or most other portions of the Federal government to require reviewers, faculty, students, or any other participants in NSF awards to provide to NSF demographic data. A possible action that does not violate the Privacy Act, while allowing the agency to create diverse pools and assess performance, is to have the NSF managers or panel chairs summarize the demographic character of their panel's reviewer pools, to the best of their knowledge and without associating names to the data. The following recommendations are derived from these observations.

Recommendations

II.5 NSF managers need to make sure that all proposals have enough reviewers for a complete and fair review, without violating NSF policies.

II.6 Better care should be placed in selecting panels that are more diverse. There is a need to increase the number of female reviewers in the ERC reviews.

4. *Resulting portfolio of awards*

ERC Centers: The COV feels that the ERC program is, without a doubt, very strong. The emphasis of the ERC program in balancing research, education, and outreach has been very positive and has created an impact in engineering education and the integration of research and education. The size and duration of awards is appropriate. The program is highly interdisciplinary and encourages high-risk field-redefining research. The COV commends NSF for the following significant achievements:

- Identifying and seeking proposals in emerging opportunity areas.
- Giving ERC Directors discretion to use ERC funds to support new investigators who are initiating their careers.
- Strongly integrating research with education, as exemplified by the REU program and the recent Bioengineering Education ERC.

I/UCRC: The program portfolio is very broad but highly successful. The quality of science and applied research is high and focused appropriately. Centers supported by this program are responsive to their industrial sponsors, they move rapidly toward emerging technologies, and they provide a prime source of support for young investigators who use this support to establish industrial contacts and research collaborations. Projects funded by the I/UCRC program are highly multidisciplinary and innovative in creating collaborative research partnerships among multiple industry and academic institutions and providing opportunities to prepare students to work in selective industries. In spite of a high level of success, the COV concluded that the centers under this program struggle to acquire even the most fundamental infrastructure needed to sustain a viable center.

Engineering Education and Human Resources Development: This program covers a broad spectrum of awards. However, there was a strong sense among the members of the COV that there was no overarching plan to specify the goals and directions. The various awards came across as collections of generally very good to excellent but individual contributions were without coherence in terms of activities or goals. There is a distinct need to create an overarching plan that specifies the expected outcomes in the context of a strategic goal.

Recommendations

II.7 ***I/UCRC:*** NSF should ensure the successful progress of this program by providing the appropriate means to keep it healthy and allow it to achieve its goals. NSF should develop a strategic plan that identifies goals and outcomes which ought to be assessed by appropriate metrics.

II.8 ***EE and HR Development***: NSF should develop a strategic plan that identifies goals and outcomes which ought to be accessed by appropriate metrics.

5. Management of the program under review

Programs are very well managed and have made a tremendous difference in higher engineering education. All programs have leveraged industry's investment extremely successfully and have kept re-inventing themselves. Programs are not only responsive but very forward-looking. They are setting the national agenda. The Center programs have been going through a very extensive planning and review effort; this is why these programs have been able to re-invent themselves over the past 20 years. However, the EE and HRD

programs have not followed the same evolution. While these two programs have created a major impact in engineering education, better planning and assessment is recommended.

It has been observed that programs with a small number of small awards, that are discontinued after a few years, do not mature sufficiently or represent a critical mass of investment to make formal, systematic evaluation of the programs' achievements worth doing. Conducting an initial, short-term results study, that doubles as a summative evaluation of a program, provides little useful information. Within the first two or three years of initiating a new engineering education or human resources activity, a system of annual collection of activity and results data from awardees provides valuable program management information for improvement of the program while information sought by stakeholders about what the program is accomplishing in the short term. Planning for this type of annual data reporting began for PFI in its third award year. Depending on the complexity and nature of the program, a short-term outcomes study may be conducted, e.g. the study initiated in FY 2003 of RET.

Recommendations:

II.9 The ERC and I/UCRC programs should actively pursue disciplinary and multidisciplinary breadth in the technical management of the centers.

II.10 All EEC Division programs should have diversity goals which are carefully developed in coordination with the grantee community. These goals have to be aggressive but realistic.

II.11 EE and HR programs should focus on planning and assessment including cross project evaluation.

III. GROUP B QUESTIONS

Group B questions (Questions B.1-B.4) address results, that is, the outputs and outcomes of NSF investments. In this section, each question will be addressed separately.

1. PEOPLE Strategic Outcome Goal: Development of a diverse, internationally competitive and globally engaged workforce of scientists, engineers, and well-prepared citizens

Programs administered by EEC have been highly successful in meeting this goal. There are numerous examples of programs that have contributed to this success. A few such programs are presented below:

NSF Award: 0117518, PI Name: Jay Lee, Name of Institution: University of Wisconsin-Milwaukee

The Industry/University Cooperative Research Center for Intelligent Maintenance Systems involving the University of Wisconsin-Milwaukee and the University of Michigan is studying system for internet-based intelligent monitoring of equipment. The Center has sent five students to China with support from the National Science Foundation International East-Asia and Pacific Program. The students are doing a collaborative project with students of the Shanghai Jiao Tong University. The project will also be in partnership with U.S. companies with Chinese subsidiaries. This will allow the U.S. students to become internationally astute and competitive and be exposed to a foreign culture. This work is notable because: Research at this center has lead to the professional development of students who will be industrially relevant and competitive in an international marketplace

NSF Award: 9731748, PI Name: Russell Taylor, Name of Institution: Johns Hopkins University

If suddenly becoming a hospital patient tends to improve a doctor's bedside manner, then putting engineers in the shoes of the medical staff they design products for should help them produce better instruments. This was what the Johns Hopkins University Engineering Research Center for Computer-Integrated Surgical Systems and Technology (CISST) and its clinical collaborators had in mind when they developed an innovative course to teach biomedical, mechanical, electrical, and computer science and engineering students the fundamental skills and operative procedures for general surgery. "Surgery for Engineers" engages students in new and exciting learning experiences, fosters relationships between engineers and clinicians, identifies and solves relevant problems with engineering principles, and enhances the undergraduate curriculum for career preparation. The course is hands-on and conducted in an Operating Room (O.R.) setting that is designed for engineers tasked with the development of computer-integrated surgical systems and associated technologies. Surgery for Engineers challenges the students to develop useful surgery tools that will improve upon technologies currently used in the O.R. The undergraduates get a hands-on laboratory experience, unlike any other in their courses, that challenges them to continue this experience into their research at the graduate level. For graduate students, Surgery for Engineers provides a complementary experience that is often parallel to their current research projects, exposing them to further innovative ideas. This scope expands to the medical field where the research continues as engineers work with the medical staff to develop cutting-

edge instruments used in the O.R. This work is notable because: Giving engineering students a chance to obtain surgical training provides a cross-disciplinary experience that few bio-engineers have the opportunity to obtain.

NSF Award: 9529161, PI Name: Buddy Ratner, Name of Institution: University of Washington

A special focus of the University of Washington Engineered Biomaterials (UWEB) ERC's Education and Outreach program is to attract diverse students to engineering. The Center reaches out to inner city schools and rural schools with high populations of students of color through various programs. UWEB's Third Millennium Outreach, Science, and Training (UTMOST) program coalesces under one organizational umbrella all of the Center's efforts in K-12, undergraduate, graduate, and general public education and outreach, with special emphasis on reaching underrepresented minorities. It also provides opportunities for graduate students to enrich their educational experience by assisting middle schools, helping the industry program, or mentoring undergraduates. One way in which UWEB is taking an active role in increasing diversity in science is through the Scholarship in Engineering Training in the UWEB Program (SET-UP). In Spring 2002, UWEB inaugurated SET-UP for students at the African American Academy Middle School. Eighteen SET-UP students each year (six in the Fall, six in the Winter, and six in the Spring) work closely with UWEB scientists to learn about the excitement of research and also be tutored in basic science subjects. Students spend time with UWEB faculty and students conducting lab experiments, where they learn about plastics, polymers, cells, crystallization, and lab safety. UWEB's opportunities for high school students are drawing growing numbers of motivated and ethnically diverse young scholars. One such program is Science for Success (SFS). The SFS program caters to underrepresented minority and economically disadvantaged high school students and introduces them to exciting innovations in science and technology through hands-on experiences. Another program is Lab Experience for High School Students (LEHSS). The goal of the LEHSS program is to encourage students to pursue a career in science and engineering. This work is notable because: As an indication of its success in these efforts, in 2002 UWEB had a higher percentage of minority graduate and undergraduate students (11%) than did the University of Washington (7.1%) and its College of Engineering (4.7%).

2. IDEAS Strategic Outcome Goal: Enabling discovery across the frontier of science and engineering, connected to learning, innovation and service to society

As a result of demonstrating significant achievement in several key indicators, programs administered by the division were successful in meeting this goal.

NSF Award: 0214478, PI Name: John English, Institution Name: University of Arkansas

The Industry/University Cooperative Research Center for Engineering Logistics and Distribution involving the University of Arkansas, the University of Oklahoma, the University of Louisville and Oklahoma State University has been researching operational analysis and production line performance in processing industries. The results of these studies are broadly applicable and generally produce significant cost savings. For example, a food processing company utilized the research results and realized a productivity

improvement of greater than 2% resulting in an increase of 75,000 cases per year on two production lines and generating a savings of over $1M per year. In addition, the operational analysis studies identified a significant improvement in sanitation procedures in this company helping them improve their environmental impact. This work is notable because: The research results of this center have generated new technology which, after further refinement, will significantly increase productivity for the company.

NSF Award: 9843342, PI Name: Douglas Lauffenburger, Name of Institution: Massachusetts Institute of Technology

Gene therapy holds the promise to treat a myriad of inherited and acquired genetic disorders. Unfortunately, safe and effective therapeutics have yet to be fully realized, and many enabling technologies remain undeveloped. Research being conducted at MIT's Biotechnology Process Engineering Center (BPEC), an Engineering Research Center, has focused on the development, analysis, and improvement of synthetic gene delivery therapeutics. These therapeutics, also known as non-viral gene delivery vectors, have safety, production, and design potentials above and beyond those of viral-based vectors. This work seeks to help improve non-viral efficacy by combining quantitative experimentation and mathematical modeling to create novel tools for gene delivery vector development. Through investigation of what happens to different gene delivery vectors inside cells, we can begin to determine why some vectors work better than others and find out what the rate-limiting steps are for any particular one. Central to this work is the kinetic mathematical model developed at BPEC. Instead of vector design progress though analysis of single processes within the intracellular gene delivery pathway; multiple potentially rate-limiting steps can be simultaneously quantitatively compared. This work is notable because: This information will be used to design better gene delivery mechanisms, with the end goal of creating more effective treatments.

NSF Award: 9986866, PI Name: Kensall Wise, Name of Institution: University of Michigan Ann Arbor

One of neuroscience's most intriguing promises is the ability to create implanted micro-devices to help people cope with conditions like Parkinson's disease, deafness, paralysis, blindness, and epilepsy. Building a viable electronic interface to the central nervous system is key in understanding the fundamental operation of neural networks and in developing prosthetic devices that can affect them. During the past year, the Center for Wireless Integrated MicroSystems (WIMS), an ERC at the University of Michigan, contributed to moving this field forward significantly with the first chronic in-vivo use of high-density recording arrays containing embedded circuitry for signal amplification and site selection. In collaboration with the Center for Neuroscience at Rutgers University, 64- and 96-site probes containing CMOS electronics are being used to explore the hippocampus, leading to new understanding of long-term and short-term memory formation. This work was featured on the January 2003 cover of Neuron. WIMS is now moving forward with work on 3D electrode arrays, chips for in-vivo spike recognition, and wireless interfaces that will make implantable neural microsystems a reality for research and for prosthetic applications.

3. TOOLS Strategic Outcome Goal: Providing broadly accessible, state-of-the-art information-based and shared research and education tools

All programs in this area have performed extremely well. A few examples are given below:

NSF Award: 9908548, PI Name: Daniel Abrams , Institution Name: University of Illinois at Urbana-Champaign

Proper assessment of seismic hazards in the central and eastern United States requires development of tools that can be used to broadcast earthquake information to a variety of users at a variety of speeds. Researchers, emergency management workers, and various workers in the public and private sectors require access to seismic data. Investigators at the Mid-America Earthquake Center (MAE), an ERC, have developed a web-based seismic data resource capability that satisfies the needs of a broad spectrum of users. From one to several hours of data are archived for large, distant earthquakes of interest (300 events from 1999 to present). Routine and automated event locations are shared with other networks via "Quick Data Distribution." Reviewed earthquake parameters such as location and origin time are similarly shared and are emailed to the list server. This list server contains well over 1,000 recipients as of February 2003. By far the most popular tool has been the "Recent Earthquakes" Web page (http://folkworm.ceri.memphis.edu/recenteqs), accounting for more than three quarters of the 5.8 million hits over the past 12 months. Additionally, a weekly summary of regional and worldwide earthquakes is faxed to approximately 100 recipients in the government and the private sector. Data are also available via a "finger utility," a popular tool within the seismological research community. Various catalog searches are also supported and available online. Steps have been taken to enable automated archiving (and availability) of ground-motion histories from the IRIS Data Management Center. This work is notable because: This Web-based seismic data resource provides easy access for earthquake researchers to critical earthquake data.

NSF Award: 9986821, PI Name: Michael Silevitch, Institution Name: Northeastern University

A multi-disciplinary team of researchers at the Center for Subsurface Sensing and Imaging Systems (CenSSIS), an ERC headquartered at Northeastern University (NU), has developed a new imaging method with the potential to assess the health of early stage embryos. Infertility is a major problem in the United States. About one in six couples has trouble conceiving a child. Many of these couples turn to Assisted Reproductive Technologies (ART), the most common of which is In-Vitro Fertilization (IVF). Worldwide, more than one million IVF babies have been born, with about 70,000 born each year in the United States. There are two major problems with IVF. The first is that it has a success rate of only about 25%. The second is that due to transfer of two or three embryos, there are many instances of multiple births leading to a large increase in birth defects, such as cerebral palsy. A major reason for the low success rate of IVF and for the need to transfer more than one embryo is the inability to distinguish healthy from unhealthy embryos. A team of CenSSIS biologists and engineers from NU and its partner institutions-- Boston University, Rensselaer Polytechnic Institute, and the University of Puerto Rico at Mayaguez, along with the Memorial Sloan-Kettering Cancer Center--are working together to develop new imaging modalities to distinguish healthy from unhealthy embryos. The first of these modalities was

the completion of the Quadrature Tomographic Microscope (QTM) that allows non-toxic imaging of completely unstained embryos. The QTM was designed, developed, and built at NU. The second of these modalities will be the Keck Three-Dimensional Fusion Microscope (Keck 3DFM), which will combine in a single platform the QTM with four other imaging modalities: differential interference contrast (DIC) microscopy, laser scanning confocal microscopy (LSCM), reflectance confocal microscopy (RCM), and two-photon laser scanning microscopy (TPLSM). The Keck 3DFM, currently under construction at Northeastern University, will be used to generate quantitative images of embryos that are generated at the same time and place. This work is notable because: This unique imaging information will be combined with data on gene expression patterns in the embryos to develop an entirely novel way to assess the health of early-stage embryos. Researchers hope to transfer the information gained from their work on the mouse as a model system to the IVF clinic in the next 5-10 years.

NSF Award: 9529161, PI Name: Buddy Ratner, Institution Name: University of Washington

The main focus of the University of Washington Engineered Biomaterials ERC (UWEB) is to solve the problem of poor compatibility of biomaterials that are used in implanted medical devices--including the foreign body reaction. When a device is surgically implanted in the body, in almost all cases its longevity in the tissue suffers due to the failure of the surgical wound to heal properly in the tissue surrounding the device. The implant ultimately becomes separated from the tissue due to fibrous encapsulation and a lack of blood vessels--a process akin to scar formation. UWEB's approach to this problem has been to integrate fully the disciplines of biomaterial science and the biology of tissue healing. A comprehensive biological approach has been applied to the cellular physiology at the interface of the tissue and the biomaterial. Across all fronts, the underlying set of tools that were developed at UWEB to bear on the problem was based on modern molecular and cellular biology. Although biomaterials research has focused widely over the past five years on the interactions of proteins and cells with biomaterials, UWEB's unique contribution to the biomaterials field has been to extend this research through genetic engineering. As a case in point, UWEB has created a group of gene-specific deficient mice to study the role of influential signaling proteins. Furthermore, UWEB has created unique materials that control these signals from biomaterial implants in normal animals. These critical systems have been used successfully to dissect the complex biology of implant healing. More importantly, UWEB has demonstrated, as proof of principal, that many contributory factors to the foreign body reaction and other pathological responses can be controlled favorably by the presentation of the correct biological signal. These fundamental genetic methods have not been applied to the biomaterials problem outside of UWEB. Examples of knockout mice and the signaling discoveries made with them include the following proteins: osteopontin, which controls ectopic calcification, thrombospondin-2, which controls angiogenesis, SPARC, which controls the behavior of collagen fibers, and MCP-1, which controls the migration of macrophages and possibly the formation of foreign body giant cells. This work is notable because:
The development of knockout-mice for use in studying and controlling biomaterial-tissue interfaces provides critical tools for understanding the interaction of implants with bodily systems. Such tools are needed to develop improved implants.

4. ORGANIZATIONAL EXCELLENCE Strategic Outcome Goal: Providing an agile, innovative organization that fulfills its mission through leadership in state-of-the-art business practices

All programs have performed well in this category. Following is an example program:

NSF Award Numbers: 0090616, PI name: Richard Murray, Institution name: California Institute of Technology

Goal Indicators: Development or implementation of other notable approaches or new paradigms that promote progress toward the PEOPLE outcome goal. (For example, broad-based, program-wide results that demonstrate success related to improved math and science performance for preK-12 students, or professional development of the STEM instructional workforce, or enhancement of undergraduate curricular/laboratory/instructional infrastructure, or highly synergistic education and research activities, or international collaborations, or communication with the public regarding science and engineering.) **Areas of Emphasis**: Other PEOPLE nuggets and examples not covered by the preceding Indicators or Areas of Emphasis, i.e., PreK-12 Education (e.g. Systemic Reform), Undergraduate Education (e.g. REU), Graduate and Professional Development (e.g. IGERT, GK-12, CAREER), Centers for Learning and Teaching, Broadening Participation (e.g. Partnerships for Innovation, Programs that serve underrepresented groups), etc. (For example, broad-based, program-wide results that demonstrate success related to improved math and science performance for preK-12 students, or professional development of the STEM instructional workforce, or enhancement of undergraduate curricular/laboratory/instructional infrastructure, or highly synergistic education and research activities, or international collaborations, or communication with the public regarding science and engineering.) **Entrepreneurial Fellows Program:** This partnership has created post-degree entrepreneurial fellowships that will prepare students previously trained in science or design to adapt their skills to the development of commercial products in the start-up environment. These students also receive entrepreneurial training on topics such as business plans, the development of engineering prototypes, and financial resources and will participate in an industrial partner mentor program. The Entrepreneurial Fellowship Program (EFP) is geared toward graduates who want to make the transition from the academic environment to the world of business. It provides those non-MBA entrepreneurs the time, money, connections and skills they need to succeed. A successful and mature EFP can serve as a template for other academic institutions seeking to parlay their intellectual capital in viable business ventures. The goal is to cultivate entrepreneurial behavior in students with diverse technical and design backgrounds. More than 40 individuals (from Pasadena, Los Angeles and Silicon Valley) participated in instruction and mentoring of the Fellows. Four out of nine Fellows are now engaged in entrepreneurial endeavor. At least one of the four original ideas looks likely to form the basis of a new company. Five teams, totaling 14 students, have already been chosen for the second round of the Fellowship. This next round is for six months, beginning September 2002. This work is notable because: The diversity of the participants has been increased compared to the first round to include eight students representing minorities. It is planned to substantially increase efforts to make the program and its results much more accessible to the wider community.

IV. GROUP C QUESTIONS: Observations and recommendations on program areas needing improvement

Suggestions for improvements fall into various areas. Some of the suggestions have been addressed earlier in this report and are repeated here for completeness. More broadly, it is an open question as to how the division effectively leads the engineering community through the programmatic confusion (e.g., program starts and stops as well as disconnects between stated goal and implementation reality) that results from internal staff changes as well as conflicts between Congressional guidance and Administration policy. Comments for each of the program areas within the division are given below:

1. Comments/Suggestions for the ERC and I/UCRC Programs

The COV has found that the Center programs demonstrate excellent performance in all categories. We cannot say enough about the progress in these programs. The committee also strongly commends the programs for the excellent process followed in the review of the centers and management oversight. To further improve these excellent programs and ensure their future success, the COV recommends that the ERC program develop a vision for the next generation of centers and diversify the portfolio, implying broadening the technology areas, encouraging novel organizational structure of centers and considering funding smaller groups that have the potential to lead to science and technology breakthroughs

The COV raised questions about the appropriateness of funding and the duration of the awards. For ERCs, ten years of funding may be too long in some cases, especially when the rapid change of technology is considered. Evaluations should be done at a rate that maintains direction with respect to the original goals and objectives, yet allows for mid-course corrections prompted by new knowledge and new technology while not being unnecessarily burdensome. The COV recognizes the effort by the ERC and I/UCRC programs to address this issue. Site visits with external reviewers go to each ERC annually up through the center's sixth year. Depending on the strength of the sixth year renewal proposal and accomplishments in the first six years, there may or may not be a need for a site visit in the seventh year. Annual reporting requirements remain the same throughout the length of ERC support. All Engineering Research Centers have site visit reviews at some point following their sixth-year renewal site visit, usually multiple times. Results from site visits after the sixth-year renewal and annual reports continue to affect the level of funding awarded in each subsequent year and specific performance requirements are updated annually in each Engineering Research Center cooperative agreement. Poor annual performance according to annual reports in non-visited years prompts a site visit the following year. ERC programs have been discontinued early prior to the end of the full award period due to poor performance or erroneous reporting of performance data. In addition, late-year funding is cut back further than the standard phase-out schedule when expenditure trends over time justify doing so. The centers which are passing the sixth year review are not automatically funded through the full time final five years. One ERC was closed down in the eighth year because of false reporting. The COV suggests that similar thinking and efforts are exercised by the other Centers programs as well.

Recommendations:

IV.10 The ERC management should work with a "blue ribbon" panel to assess the appropriateness of the current ERC model for the next 20 years.

IV.11 The ERC program needs to provide a mechanism for funding interdisciplinary groups (smaller efforts) in addition to the current funding for centers, instead of simply expanding the funding for the centers. The COV expressed concern about the impact of too much funding in academic environments that lack the appropriate infrastructure and about the development of the "must continue" syndrome and its impact on the grantee institutions.

IV.12 The COV finds that the emerging trend toward multi-university centers has a strong positive impact on the quality of the engineering research. The positive and negative impact of this trend on universities and the foundation should be analyzed.

IV.13 The I/UCRC program needs to be provided with the appropriate resources to ensure its future viability and vitality.

IV.14 The COV encourages the establishment of diversity goals and targets.

2. Comments and Suggestions for Educational Programs

After an extensive discussion that considered the materials reviewed by the individual sub-groups, the COV concluded unanimously that the Engineering Education and Human Resource Development programs have been successful in meeting their program-specific goals and objectives. Specifically:

- *The COV found the quality of portfolio to be high. The review process involves a sufficient group of reviewers, and the results of the process are satisfactory. However, there is still room for improvement, as will be discussed later.*
- *EEC and the education programs constitute the single nexus in engineering for representing engineering education. It is a resource to be leveraged across the directorate.*
- *There are many activities that assert to integrate research and education, many involving REUs and RETs. However, this area needs to be more substantively addressed. For example, in an REU one should not simply provide a research experience, but also provide a tie back to the formal curriculum.*

In the spirit of continuous quality improvement, various aspects of the evaluation process led to the following recommendations.

Recommendations:

IV.15 There is a need for a vision at a high level and a need to develop programs that can support this vision. When these programs are developed, it is very critical to have goals and assessment criteria. Assessment criteria have not been established during the design of the programs.

IV.16 The EEC Division should make a visible effort to measure the extent to which awards promote multidisciplinary, multicultural, and multi-institutional teams.

IV.17 The COV observed that the increase in stipends that NSF has undertaken is placing a tremendous stress on individual grants and institutions. It is strongly recommended that NSF in general, and the Division of Engineering Education and Centers more specifically, carefully address this issue and consider its impact on the performance of the individual programs.

IV.18 The COV recommends that the Division of Engineering Education and Centers undertake a serious effort to engage underrepresented populations in their programs.

IV.19 The EE and HR Development programs need to review their efforts to integrate research and education. At present this is accomplished through REUs and RETs only. The COV would like to caution against using only these two programs to achieve integration. All program awards need to plan and execute integration of research and education via their own efforts and emphases.

3. Comments and Suggestions for the Partnerships for Innovation Program

The COV found this program to have very important strengths, including high quality in the proposed efforts, an appropriate number of new awards, support for nontraditional institutions that is very appropriate, and an effort to addresses national priorities. The review process has been handled well and has demonstrated the ability to attract underrepresented populations (PIs and Co-PIs).

The COV recognizes that the Partnerships for Innovations Program commissioned a study about the options for systematic post-award monitoring and formal program evaluation, given the great variety of PFI awards. That report is the basis for an annual data collection application for PFI awardees to provide annual support, performance, and activity data for PFI's program director to use in post-award monitoring of project and overall program monitoring, as well as program planning and management. The ERC program's annual data collection application will be the technical starting point for the new PFI data collection system. Longer term, an initial study of PFI outcomes and impacts is still a number of years out.

In order to extend the impact of this program and ensure its continued success, the COV makes the following recommendations:

Recommendations:

IV. 20 The COV has found this program to lack sufficient staffing. NSF is strongly encouraged to provide better help for management, meaning that more support staff are necessary and that there needs to be a stable cadre of program officers with experience managing these kinds of government programs running the various EEC-specific and ENG component of NSF-wide education and human resources programs.

IV.21 New PFI activities begun during FY 2001-03 are too young to assess impact, but program needs have to be assessed and addressed appropriately. It is acknowledged that such studies have been initiated and the COV would like to strongly recommend sustained activity in this area.

IV.22 The program needs growth opportunities.

IV.23 NSF needs to identify the impact of phasing out ATP on this program.

4. COV Meeting and Process: Recommendations

To ensure the future success of the COV meeting and review outcomes, this COV would like to make the following comments/recommendations as preparatory actions for future meetings:

1. The COV future chair and committee members should be given a fairly detailed description of their effort and anticipated outcomes.
2. Electronic access given to the chair and members of this committee, prior to the convening of the COV is very helpful and critical to the timely performance of the review. This year the members of the COV truly appreciated the efforts of the NSF staff to accomplish this, but expressed frustration at the complexity of the process. For future meetings, advanced remote access to the jackets through the Web is preferred.
3. Special care should be given to sampling the jackets in a way that minimizes error. EEC has a fairly broad portfolio of programs, and for this reason the sampling has to be done very carefully. Professional help in this regard is recommended. One possibility is a stratified random sample rather than a simple random sample like every 10^{th} jacket where division staff could select the strata to be used.

4. The COV core question on diversity (A3.c) collides with statutory limitations in collection of the data. All NSF reviewers are asked to provide demographic information every time they review a proposal, but the Privacy Act stipulates that NSF is not allowed to require submission of these data from anyone. There are many reasons for deciding not to profile the reviewers, so it is not possible to assume that most people whose data are missing are minority or are not. Similarly, a reviewer's place of employment is not a proxy for racial or ethnic group membership, since white faculty teach at minority serving institutions and vice versa. Thus, generalizing about the diversity of EEC's reviewer pool collectively from the available data has been a challenge for the COV.

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January 28, 2005

TO: Kristina Johnson
Chair ENG Advisory Committee

FROM: John Brighton
Assistant Director, ENG

S**UBJECT:** Report on Diversity, Independence, Balance and the Resolution of Conflicts for the EEC COV

This is my report to you, as the Chair of the Advisory Committee for the Engineering Directorate, on the diversity, independence and balance of the Committee of Visitors (COV) for the Division of Engineering Education and Centers (EEC) held on March 16 and 17, 2004.

The Committee of Visitors, chaired by Dr. Linda P. B. Katehi, was assembled to review the EEC Division, and whose report was presented to the Engineering Advisory Committee on May 20, 2004, consisted of 18 persons, of whom 11 are male and 7 are female. Two of the members of the committee are African-American, one is Hispanic, and one is Native American.

13 members of the COV are from academia, with affiliations at Arizona State University, Carnegie-Mellon University, Columbia University (Teachers College), Georgia Tech, Oklahoma State University, Purdue University, the University of Illinois at Urbana-Champaign, the University of Michigan, the University of North Carolina at Charlotte, the University of Tennessee, the University of Texas – Pan American, and Worcester Polytechnic Institute. Mr. Busch is an independent consultant and Dr. Campbell manages a consulting firm. Dr. Davis is Manager of Engineering University Relations for Raytheon Missile Systems and Dr. Spitzer is VP Technical Affiliations for the Boeing Company. Dr. Fortenberry is the Director of the Center for the Advancement of Scholarship on Engineering Education of the National Academy of Engineering. All invited COV members attended the meeting.

4 members (Davis, Jacullo-Noto, Phillips, and Spitzer) have not been applicants to NSF in the past five years and 6 members (Barabino, Cangellaris, Llewellyn, Sarabandi,

Spanias, and Villarreal) have been applicants to NSF, but not to EEC, in the past 5 years. Mr. Busch and Dr. Katehi are current members of the ENG AdCom. Most COV members are familiar with EEC, having served on the ENG Advisory Committee, on a previous COV, or on review panels, as former grantees, through involvement in EEC activities or initiatives, or through involvement with EEC personnel in meetings, conference sessions, etc. Assignments were made to the CoV members before the meeting so as to avoid any institutional conflicts of interest. A conflict of interest briefing was held on the first day of the COV visit. The absence of any conflict of interest was confirmed by asking all to complete the NSF Conflict of Interest form, none of which disclosed any conflicts. The COV members were then instructed to bring any potential conflicts that might arise in the course of their further investigations to the attention of NSF staff. No real or apparent conflicts arose during the course of the meeting that had to be resolved.

National Science Foundation

March 8, 2004

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