

MEMORANDUM TO MEMBERS AND CONSULTANTS OF THE NATIONAL SCIENCE BOARD

SUBJECT: Summary Report of October 13-14, 2004 Meeting

The major actions of the National Science Board (NSB, the Board) at its 382nd meeting on October 13-14, 2004 and a preliminary summary of the proceedings are provided below. This memorandum will be made publicly available for any interested parties to review. A more comprehensive set of NSB meeting minutes will be posted on the Board's public Web site (<http://www.nsf.gov/nsb/>) following Board approval at its next meeting.

1. Major Actions of the Board (not in rank order of importance)

- a. The Board approved the minutes for the Open Plenary Session, Executive Closed Plenary, and Closed Plenary Session of the August 2004 meeting of the NSB (http://www.nsf.gov/nsb/meetings/2004/0804/minutes_0804.pdf)
- b. The Board concurred that planning for Advanced LIGO is sufficiently advanced and the intellectual value of the project sufficiently well demonstrated to justify consideration by the Acting Director and the National Science Board for funding in FY 2007 or a future NSF budget request. The Board approved the resolution with the understanding that the existing LIGO Program will collect at least a year's data of coincident operation at the science goal sensitivity before initiating facility upgrades to the new Advanced LIGO technology.
- c. The Board authorized the Acting Director, at his discretion, to make an award to the University of Illinois at Urbana-Champaign for the support of *Cyberinfrastructure in Support of Research: A New Imperative*. Further, the Board requested the Acting Director to present to NSB, in mid-2005, a plan for high performance computing at NSF that describes how the three NSF funded centers (SDSC, PSC, NCSA) will cooperate and how each of them will inter-operate and relate to the emerging investments in cyberinfrastructure.
- d. The Board authorized the Acting Director, at his discretion, to make an award to the San Diego Supercomputer Center (SDSC) for the support of *Delivering Cyberinfrastructure: From Vision to Reality*. Further, the Board requested the Acting Director to present to NSB, in mid-2005, a plan for high performance computing at NSF that describes how the three NSF funded centers (SDSC, PSC, NCSA) will cooperate and how each of them will inter-operate and relate to the emerging investments in cyberinfrastructure.

- e. The Board approved NSF management's request to begin implementation of the general principles of the jointly developed provisional report, *Setting Priorities for Large Research Facility Projects Supported by the National Science Foundation* (NSB/PPP-04-20) (Attachment 1). [Comments on the provisional report may be sent to the NSB Executive Officer (NSBExecOfficer@nsf.gov).]
- f. At the request of NSF, the NSB Audit and Oversight Committee recommended, and the full Board approved for implementation early in 2005, a revision to the current Board policy on cost sharing to eliminate NSF program specific cost sharing requirements and require only the statutory cost sharing of 1 percent.
- g. The Board approved for publication the report, *Broadening Participation in Science and Education Faculty* (NSB-04-41) subject to final edits by the NSB and the Committee on Education and Human Resources (EHR) chairs (Attachment 2).
- h. The Board approved a resolution to close portions of the December 15-16, 2004 NSB meeting dealing with staff appointments, future budgets, pending proposals/awards for specific grants, contracts, or other arrangements, and those portions dealing with specific Office of the Inspector General (OIG) investigations and enforcement actions, or agency audit guidelines (NSB-04-143) (Attachment 3).

2. NSB Chairman's Report

Dr. Warren Washington, NSB Chairman, introduced the President's nominees for the NSB Class of 2010 who attended the meeting:

- Dr. Dan Arvizu, Executive Director for Energy and Technology at the University of Chicago;
- Dr. Louis Lanzerotti, Distinguished Professor of Physics, Center for Solar and Terrestrial Research, Department of Physics, New Jersey Institute of Technology;
- Dr. Alan Leshner, Chief Executive Officer, American Association for the Advancement of Science;
- Dr. Jon Strauss, President, Harvey Mudd College; and
- Dr. Steven Beering, President Emeritus, Purdue University, who is a former member of the NSB.

The additional three nominees who were not able to attend the meeting are:

- Dr. Wayne Clough, President of the Georgia Institute of Technology;
- Dr. Kelvin Droegemeier, Regents' Professor of Meteorology, Roger and Sherry Teigen Presidential Professor and Director, Center for Analysis and Prediction of Storms, University of Oklahoma; and
- Dr. Kathryn Sullivan, President and Chief Executive Officer, Center for Science and Industry, Columbus, Ohio.

The Chairman informed the Board that the 2005 retreat, site-visit, and meeting will take place at the University of Texas at El Paso (UTEP) on February 7-8. Dr. Michael Crosby visited UTEP and is working closely with Dr. Diana Natalicio to develop the logistics and agenda for these activities. He will provide more specific information to the Board at the December meeting.

Dr. Washington thanked the Chancellors and Presidents of historically black colleges and universities (HBCUs) for attending a National Science Board reception and the meeting of the EHR committee to discuss important issues.

Lastly, the Chairman reported on Dr. Mark Wrighton's televised introduction to the October 8 Presidential debate that took place at Washington University, St. Louis. The Chairman thanked Dr. Wrighton for his opening remarks that included an emphasis on the importance of science and technology to the Nation and the need for more support for science and education research and education.

3. NSF Director's Report

Dr. Arden Bement, NSF Acting Director, congratulated Dr. Washington on receiving the prestigious Vollum Award for distinguished accomplishment in science and technology from Reed College. The award recognizes Dr. Washington's role as a pioneer in the development of computer models for studying climate change.

The Acting Director announced that the Office of International Science and Engineering (OISE) was transferred to the Office of the Director in response to recommendations from recent NSB reports, and in recognition of the increasing importance of engagement in international science and engineering. OISE will report directly to the Deputy Director, Dr. Bordogna.

Additionally, the Acting Director announced new NSF staff positions: Dr. Margaret Cavanaugh, Deputy Assistant Director for Geosciences; Dr. David Campbell, Staff Associate for Environment in the Office of the Director; Dr. Gary Gabriel, Director of the Division of Engineering Education and Centers; and Dr. Thomas Brady, Director of the Division of Integrative Organismal Biology.

He also noted that five of the ten scientists recently recognized for Nobel prizes had been supported by NSF. In addition, one Nobel Laureate was a 1982 recipient of the National Science Foundation's Alan T. Waterman award.

Finally, the Acting Director reported that since the last NSB meeting in August, no Congressional hearings have involved testimony from NSF. He stated that a continuing resolution, due to expire November 20, 2004, is funding the Foundation.

4. NSB Committee Reports

a. Committee on Audit and Oversight (A&O)

A&O Open Session

Dr. Mark Wrighton, A&O chairman, invited Dr. Norine Noonan, chair of the Advisory Committee on GPRA Performance Assessment (AC/GPA), to report on the advisory committee's recent findings. Dr. Noonan reported that it was the unanimous judgment of AC/GPA that NSF has demonstrated significant achievement for all indicators in the People, Ideas, and Tools outcome goals, and for the merit review indicator of the Organizational Excellence goal. AC/GPA also concluded that the quality and relevance of the NSF portfolio remained high, largely due to the rigorous competitive merit review process. The advisory committee encouraged the Board to pay special attention to how NSF can best support "bold" (high risk) research and encouraged NSF's experiments in new organizational models, such as the Directorate for Biological Science's Emerging Frontiers virtual division.

Dr. Wrighton led a discussion on draft Board responses to questions raised by the House Appropriations Committee staff on the use and compensation of NSF rotators via the Intergovernmental Personnel Act. The Board Office was requested to revise the draft responses based on this discussion and schedule a public A&O teleconference meeting in mid-November to further discuss.

The committee discussed strategies for developing a Board position regarding recommendations of a National Academy of Public Administration report, *National Science Foundation: Governance and Management for the Future*. The Board Office was asked to develop an NSB position paper to be discussed during a public A&O teleconference meeting in mid-November.

Dan Kovlak, KPMG, NSF's financial statement auditors, presented information on the Sarbanes Oxley Act and its implications for internal controls at Federal agencies. Mr. Kovlak reported that preparation of the 2004 NSF financial statement audit is on schedule.

Mr. Thomas Cooley, NSF Chief Financial Officer, elaborated on the status of the 2004 financial statement audit, and will provide more details at the December NSB meeting. Mr. Cooley summarized the history of the cost sharing policy at NSF. The committee recommended, and the Board approved for implementation early in 2005, a revision to the current Board policy on cost sharing to eliminate NSF program specific cost sharing requirements and require only statutory cost sharing of 1 percent.

Ms. Kathleen Graham, Office of the Inspector General, gave a presentation on the FY 2005 audit plan. The audits to be performed over the next year include: FFRDC employee benefits, management of research results information, and government purchase cards. The committee requested, and subsequently received authority from the Board, to approve management's response to the OIG Semiannual Report to Congress during a public teleconference in November.

A&O Closed Session

Two ongoing investigations were discussed in closed session.

b. Committee on Programs and Plans (CPP)

CPP Open Session

Dr. Daniel Simberloff, CPP Chair, led a discussion of a joint NSB-NSF draft report, *Setting Priorities for Large Research Facility Projects Supported by the National Science Foundation (NSB/CPP-04-20)* (Attachment1). With some specific modification to the draft report, CPP provisionally approved this report as the general description of the new process. [Comments on the report may be sent to the Board's Executive Officer (NSBExecOfficer@nsf.gov).] CPP recommended that the full Board approve NSF's beginning implementation of the general principals of the new process as soon as possible. The full Board subsequently approved this recommendation in Plenary Session.

The committee further requested that NSF proceed to detail very specific steps to implement the principles and general process given in the provisionally approved report, and present these to CPP by the end of 2004. Additionally, NSF was asked to consider how it could implement such specific steps as part of the proposed timeline CPP provided for integrating both the annual NSF budget development cycle and the new large facility project review and prioritization cycle. NSF will report to CPP at the December Board meeting on how it may be able to accommodate this proposed timeline.

The committee asked NSF to provide comments on the committee's working-draft report on long-lived data collections by November 1. A public teleconference will be scheduled in November to discuss NSF's comments and a revised draft report will be prepared for the December CPP meeting. Dr. Michael Rossmann volunteered to be the new lead on this project.

The committee also heard status reports from the *ad hoc* Task Group on High-Risk Research and the Subcommittee on Polar Issues.

CPP Closed Session

In closed session, the committee reviewed and approved three action items. These items were subsequently approved by the Board in Closed Plenary Session and are described in the Major Actions of the Board section of this Summary Report: the Advanced LIGO Project; *Cyberinfrastructure in Support of Research: A New Imperative*; and *Delivering Cyberinfrastructure: From Vision to Reality*.

The committee discussed the potential future budget implications of a growing backlog of NSB-approved but unfunded major research equipment and facilities construction (MREFC) projects. The committee then heard an update on the Atacama Large Millimeter Array (ALMA) project.

c. Subcommittee on Polar Issues (SOPI), Committee on Programs and Plans

Dr. John White, SOPI chair, introduced the Office of Polar Programs staff who briefed the committee on three information items. Dr. Polly Penhale, Program Director for Antarctic Biology and Medicine has taken responsibility as Environmental Officer. The U.S. Coast Guard

has revised its guidance, since the SOPI meeting in August, and suggests a second icebreaker be deployed to insure a successful opening of the channel to the McMurdo Station. Lastly, the plans for the International Polar Year, 2007-2008 are proceeding.

d. *ad hoc* Task Group on High Risk Research (HiRisk), Committee on Programs and Plans

Dr. Nina Fedoroff, Lead for the *ad hoc* Task Group on High Risk Research, reported on an NSB-sponsored Workshop: Identifying, Reviewing, and Funding Transformative Research, held in Santa Fe, New Mexico on September 22-23, 2004. Invited Members of the academic community, NSF staff, and the NSB attended the workshop. Ideas and issues expressed in the individual researcher position papers and presentations by workshop participants served to draw out their perspectives into topics that were further explored during breakout sessions. Board Members who attended the workshop felt that several major strategies relating to the specific challenges of pursuing transformative research emerged from the workshop. As a next step option for the NSB, the task group recommended the creation of a formal task force on transformative research to further examine potentials for enhancing NSF's ability to identify, evaluate, and fund transformative research. CPP approved this idea, in concept, and asked the task group to develop a draft charge for the task force for discussion in December.

e. Committee on Strategy and Budget (CSB)

CSB Open Session

Dr. Ray Bowen, CSB chair, invited Dr. Arden Bement to provide an update on the FY 2005 budget request to Congress. Dr. Bement noted that NSF is currently operating under a continuing resolution until November 20. He reviewed mark-ups from the House and Senate Appropriations Committees and compared them with the President's budget request. The CSB committee will monitor progress and the impact of the FY 2005 mark on the FY 2006 budget request.

Dr. Bement discussed strategic planning and outlined the environment under which priorities and budgets are set. The committee noted that a constrained budget provides opportunities to reevaluate the total portfolio and make difficult allocation decisions. Dr. Bement responded that this process is ongoing and adjustments have been made to increase flexibility in core programs. The committee discussed the impact of FY 2006 budget projections on the recommendations submitted to Congress by the Board in its report as mandated in Section 22 of the NSF Authorization Act of 2002.

CSB Closed Session

In closed session, the committee discussed strategic planning in the context of anticipated future budget constraints, as well as the specifics of the FY 2006 budget request. Dr. Bement provided information on the FY 2006 outlook and discussed NSF strategies and investment priorities under various budget scenarios.

f. Executive Committee (EC)

EC Open Session

Dr. Bement asked Dr. Washington if he had any items that he would like to have discussed. Dr. Washington stated that Dr. Crosby has been working closely with Dr. Natalicio developing logistics and agendas for the February 2005 retreat, site-visit and meeting at the University of Texas at El Paso. Dr. Crosby informed the committee that preparations are proceeding well and the Board can expect interesting sessions on applications of science and engineering to homeland security, international partnerships in research and education, and learning about the role of NSF in the evolution of a teaching college to a research university serving the Hispanic community.

Dr. Washington stated that the Board Office has been working closely with the new Class of 2010 Board Members, the White House Office of Personnel, the Office of Science and Technology Policy, and the Senate Confirmation Committee to facilitate final confirmation of new Members. Dr. Crosby informed the committee that, as a result of the changes to the Board Office since the 2002 NSF re-authorization Act, this is the first time that the Board Office has been so actively involved in the process. With very short notice, the Board Office was able to get nominee information to the Senate Committee on Health, Education, Labor and Pensions (HELP) in time for the Senate committee to discharge all eight Board nominees out of the HELP Committee by unanimous consent on October 11. He also stated that with the Senate now in recess and scheduled re-convening on November 16, there is potential that final Senate confirmation of Board nominees will take place during that session.

EC Closed Session

Dr. Bement informed members on the status of several executive staff searches and aspects of the developing FY 2006 and future budgets.

g. Committee on Education and Human Resources (EHR)

Dr. Elizabeth Hoffman, EHR chair, welcomed a panel of chancellors and presidents from Historically Black Colleges and Universities (HBCU's), representing the Science Technology Engineering and Mathematics Doctoral-Granting HBCU "Cluster". Dr. James Renick, Chancellor of the North Carolina Agricultural and Technical State University, and spokesman for the Cluster, provided background about the group and how their work links to two recent NSB reports on this subject: *The Science and Engineering Workforce – Realizing America's Potential* (NSB-03-69) and the draft *Broadening Participation in Science and Engineering Faculty* (NSB-04-41).

Dr. Judith Ramaley, Assistant Director for Education and Human Resources (NSF/EHR), reviewed NSF goals and strategies for broadening participation and introduced NSF staff who provided examples of how research and related programs involving human resource development are being linked to activities in the NSF/EHR directorate.

The committee expressed interest in the possibility of NSB sponsoring a panel discussion of science and technology industry leaders on the topic of the workforce for the 21st century. Dr. Mark Wrighton, Chairman of the Business-Higher Education Forum (BHEF), will bring the NSF industry panel concept to the BHEF at its winter/spring workshop. Dr. Hoffman will include discussion of the industry panel option in the December EHR meeting.

The committee discussed final revisions to the NSB report, *Broadening Participation in Science and Engineering Faculty*, (NSB-04-41) (Attachment 2), and recommended approval to the full Board for publication, which was subsequently approved by the Board in Plenary Session. The committee also reviewed and approved a plan for disseminating the report.

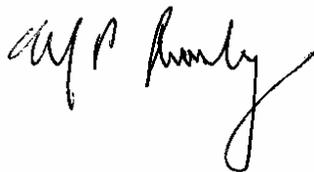
A status report from the Subcommittee on Science and Engineering Indicators was also heard by the committee.

h. Subcommittee on Science & Engineering Indicators (SEI), Committee on Education and Human Resources

Dr. Steven Beering, SEI chairman, reported on the status of the preparation of the 2006 Science and Engineering (S&E) Indicators report. The subcommittee and NSF staff discussed and resolved issues raised by Members about chapter outlines for the S&E Indicators report. The subcommittee approved the chapter outlines. The subcommittee reviewed and approved a revised schedule for production of the S&E Indicators report. NSF staff agreed to provide the subcommittee with the deadline for the companion piece so that it can be released with the S&E Indicators report.

i. *ad hoc* Committee on Nominations for NSB Class of 2006-2012

In closed session, the committee continued review of potential recommendations for the NSB Class of 2012.



Michael P. Crosby
Executive Officer

Attachment 1: NSB/PPP-04-20

Attachment 2: NSB-04-41

Attachment 3: NSB-04-143

Attachment 1 to NSB-04-158

NSB/CPP-04-20

CPP provisionally approved October 14, 2004



SETTING PRIORITIES FOR LARGE RESEARCH FACILITY PROJECTS SUPPORTED BY THE NATIONAL SCIENCE FOUNDATION



Introduction

The National Academies Report regarding NSF's process for identifying, approving, constructing, and managing large-research-facility projects states:

"A number of concerns have been expressed by policy-makers and researchers about the process used to rank large-research-facility projects for funding. First, the ability of new projects to be considered for approval at the National Science Board (NSB) level has stalled in the face of a backlog of approved but unfunded projects. Second, the rationale and criteria used to select projects and set priorities among projects for MREFC funding have not been clearly and publicly articulated. Third, there is a lack of funding for disciplines to conduct idea-generating and project-ranking activities and, once ideas have some level of approval, a lack of funding for conceptual development, planning, engineering, and design—information needed when judging whether a project is ready for funding in light of its ranking and for preparing a project for funding if it is selected. Those concerns have eroded confidence among policy-makers and the research community that large-research-facility projects are being ranked on the basis of their potential returns to science, technology, and society."

The Report includes a number of recommendations by the Study Committee for actions by NSF to address these concerns. NSF embraces the spirit of the Report's recommendations. In this response we address the principles of the primary recommendations, leaving the detailed mechanisms to be addressed in consultation with our communities, OMB and Congress.

Transparency or Clarity of the MREFC Process

The National Academies' Report calls for an open process with well-defined criteria and with a maximum of community input. The Report also recommends that the results of the final prioritization be "discussed, explained and documented." NSF concurs with these recommendations and is making the necessary changes to its processes to ensure that decisions are clearly documented and explained, and selection criteria clearly articulated. There is in fact substantial overlap between the "Criteria for Developing Large-Facilities Roadmaps and Budgets" in the National Academies Report and those already in use by NSF¹. NSF has begun

¹ The documents referenced here and elsewhere include the Facilities Management and Oversight Guide (NSF-03049) (<http://www.nsf.gov/pubs/2003/nsf03049/nsf03049.pdf>), and the Guidelines for Planning and Managing the

the process of evaluating and adapting the National Academies' criteria for application in making decisions about and setting priorities among large facility projects. The revised NSF criteria and the details of the revised MREFC process will be made public. The *Guidelines for Planning and Managing the Major Research Equipment and Facilities Construction Account*, which is available on the NSF Website, will be modified to include the revised selection criteria and process. The rationale for and results of the final prioritization of projects will be discussed, explained, documented and made public as well. Periodic updates of the NSF *Facility Plan* (discussed below) by the NSF Director will also contribute to transparency.

Community Involvement

NSF will continue to encourage and invite the involvement of research communities to provide scientific input for the planning, development, and implementation of the Large Facility Projects it funds. Presently NSF utilizes Academies studies, community workshop reports and professional society activities, and many other methods to ensure community input. NSF will also continue to use Directorate advisory committees for input to the process, and will continue to involve members of the community in the merit review of MREFC projects. The goal is to make sure that the voices of the communities are solicited and clearly heard, in a manner that is systematic and fair.

NSF will encourage disciplinary and interdisciplinary science planning by all of the research communities that NSF supports. In particular, NSF will encourage formal planning in fields in which scientists and engineers have traditionally not been organized to identify MREFC projects needed for breakthrough advances.

Roadmap: NSF Facility Plan

In response to the recommendation that there be a Major Research Equipment and Facilities (MREFC) "Roadmap", NSF will develop an NSF *Facility Plan*, including the process for selection of MREFC projects. The *Facility Plan*, illustrated graphically in Appendix 1, will combine in one document a report on major facilities under construction and in various stages of development, together with an extensive discussion of the science objectives and opportunities at the frontiers of science and engineering that provide the context and compelling need for major facilities. The Objectives and Opportunities section of the document will provide an overarching, cross-discipline context for assessing the value of a proposed facility in comparison to other investments.

On at least an annual basis, the Director will provide an update of the Facility Plan. The NSF will have an opportunity at that time to review the MREFC process and provide guidance to the Director if necessary. NSF believes that the Facility Plan, updated regularly and made public, will be a valuable planning tool within NSF and the Executive Branch, providing a comprehensive exposition of needs and plans to inform decisions in Congress, and serving as an important vehicle for communicating with our research communities.

Major Research Equipment and Facilities Construction Account (<http://www.nsf.gov/home/about/mre01.html>). Both of these documents will be revised as the MREFC process is refined.

Considerations in the Development and Revisions of the Facility Plan

As recognized in the National Academies' Report's discussion of the "Roadmap," in order to develop and maintain its *Facility Plan*, NSF will need to establish a process that respects NSF's distinctive culture and mission. NSF supports research and education in nearly every field of science and engineering. Over decadal time spans, the enormously diverse NSF research community is very likely to reconsider its views regarding what science is most important and also its facility requirements and prioritizations. NSF therefore appreciates the Report's recognition that NSF needs to be able to reconsider facilities at every stage in their development. Preserving NSF's flexibility to re-consider the Facilities Plan, and even the MREFC decisional processes is essential for many reasons:

- Technology needed for an instrument or facility may be uncertain, unproven or need to mature. To manage risk and ensure key technology readiness will often require substantial research and development over many years.
- Community judgments about what are the most important projects to build "next" may well change over decadal timescales. New technology and capability emerge and make possible facilities that might not have been considered earlier. New discoveries change the view of the community about what research questions should be answered most urgently, and therefore what facilities are needed.
- NSF facilities often involve industrial and interagency participation, as well as international consortia, agreements, and even co-funding. Such cooperation cannot be planned a decade in advance, and then shelved until funds are available. The Foundation needs to be appropriately responsive. NSF has been particularly effective at such collaborations.
- NSF does not have a single core mission but funds fundamental research in all nearly all science and engineering disciplines. There is often little relationship between facilities needed by one discipline and those needed by another. The balance and timing of investments in different areas need to be taken into account.

Process of Large Facility Project Development

The process of nurturing and maturation of a concept for a facility can take many years to fully develop, or it can come together as a detailed proposal more quickly. This depends largely on the nature of the opportunity, the immediacy of scientific need, and the potential payoffs scientifically and for society in general. Typically, potential projects first come to light at the "Horizon Stage" that includes ideas and opportunities identified by the research communities with perhaps a 10 to 20 year forward look. NSF program officers, divisional and directorate staff are always alert for such breakthrough concepts and actively encourage continued thinking and planning. The availability of such funding and guidance for requesting funds will be included in the MREFC Guidelines posted on the NSF Website.

The Concept Stage, which follows the Horizon Stage, is defined as starting when a candidate facility project is proposed for support of development. The MREFC Panel is fully apprized of the evolution of projects from Horizon to Concept stage.

On the basis of merit-reviewed proposals, NSF will fund these planning and project development efforts. These will include ad hoc workshop groups in one or more disciplines, National Academies' studies, and research projects related to the development of new

technologies. In many research disciplines, appropriate community evaluation groups exist that will critique and evaluate each project along the way. For several communities, such planning bodies have as a routine part of their deliberations discussions of facility needs, and even priority setting among possible facilities. Examples of such planning groups are the High Energy Physics Advisory Panel (HEPAP) and the Astronomy and Astrophysics Survey Committee of the National Academies Board on Physics and Astronomy.

Development Stage: Formation of Development Plans

Concept Projects mature into more formal Development Projects on varying timescales and with varying requirements for NSF support. This support is provided from accounts other than the MREFC account, on the basis of merit-reviewed proposals. Decisions at this stage are made at the appropriate level of NSF, according to well-established delegations of authority and corresponding processes. As this evolution occurs, the MREFC panel is informed on a regular basis of the status of the project. The *Facility Plan* will serve to provide periodic updates on the progress of each project to the Board.

At an appropriate time in the development, which may differ for each case, project and NSF program staff will define the project's Development Plan. The Development Plan, updated regularly, will lay out the necessary technical, logistical, and financial trajectory of the project, including decision points, needed to ready the project for construction consideration. The Development Plan will also identify long-lead items at the appropriate stage and should set out strategies to minimize possible gaps in support as planning matures. These Development Plans are presented within the *Facilities Plan*. Through regular briefings of the MREFC panel and, at appropriate intervals, the NSB, all stakeholders remain aware of the progress and the projected resources necessary to continue development. These projections will be taken into account in the development of the NSF budget, as well as planning for future MREFC investment.

It is important to note that some projects may arise from internal exigencies, such as the upgrade of the Polar Support Aircraft, or from studies conducted by external groups, such as the Academic Research Fleet Renewal Plan. These projects will often come to NSF very well developed, having required very little in the way of concept stage support. Such projects are subjected to rigorous scrutiny as they are developed by the responsible NSF Directorates.

It is in the Concept and Development Stages that the appropriate first and second rank evaluations suggested by the Report are performed². First level evaluation of the proposed project includes assessment by appropriate expert peers of the scientific and technical criteria for a project, and the second level evaluation extends to include assessment from the view of related fields. NSF will seek input from its directorate advisory committees in the performance of the second level assessment, and will include committee members in review panels.

However, these committees are not constituted appropriately to conduct thorough evaluations of facilities or to compare the merits of facilities in different disciplines.

As already noted, NSF will evaluate and adapt a set of first and second ranking criteria and publish the resulting criteria on the NSF Website in revised versions of the *Facilities*

² Appendix 2 identifies all three levels of criteria suggested by the National Academies.

Management and Oversight Guide and of the *Guidelines for Planning and Managing the Major Research Equipment and Facilities Construction Account*. The rationale for application of the criteria to specific projects will be included as part of the Facility Plan. NSF will revisit these criteria periodically to determine whether changes are needed.

Funding for Pre-approval Planning and Development

The National Academies' Report properly calls attention to the necessity for considerable pre-approval funding for planning and development when it questions whether there is sufficient NSF support for this "bottom up" process. NSF endorses the Report's recommendations to provide researchers access to funding sufficient to develop compelling research agendas, to refine and prioritize their facility requirements, and to complete research and development on facility designs and needed technologies. The level and form of funding for planning and development will be reviewed, and an evaluation will be made of how project funds are best invested to attain robust plans and schedules with better cost projections, so that only well-defined and thoroughly-costed projects are brought forward for consideration by the Board. The availability of such funding and guidance for requesting such will be included in the MREFC Guidelines posted on the NSF Website.

Readiness Stage

On at least an annual basis, the Facility Plan will identify a small group of projects in the advanced stages of development (Readiness) that the MREFC panel has agreed will be ready to go to the Board for approval within approximately the next year as Candidates for New Start. The rationale for these decisions will be clearly articulated in the Facility Plan. Readiness is defined in terms of a clearly defined science program, sufficiently mature engineering design and construction plans, plans for operation subsequent to construction, budget projections, and late stage evaluation of the proposed project both by the research community and within the NSF. In accepting the Facility Plan the NSB will concur that each of the Readiness List projects has attained that status by an appropriate process.

Individual Large Facility Projects may be removed fall from the Readiness List due to insufficient priority over the long-term, failure of the plans to reach construction readiness, eclipse by other projects, collapse of major international agreements, or any other reason that the Director deems appropriate. Specific decision criteria for removing Large Facility Projects from the Readiness List will be developed by NSF and, following Board approval, made available to the public.

Candidates for New Start

The MREFC panel and the Director will prioritize the Readiness List projects using an appropriately modified set of "third ranking" (National) criteria. When deemed appropriate the highest priority projects will go to the NSB for approval and inclusion in the "Candidate for New Start" pool of NSB approved projects. Any project that is recommended to the Board for approval will be expected to have achieved its specific goals, as laid out in its development plan. An additional important aspect of planning for future facilities is consideration of the costs of operation and maintenance, since these costs are not borne by the MREFC Account; NSF

must be able to operate and maintain the facilities it constructs. The rationale for the prioritization of projects will be clearly articulated in the Facility Plan. The Director and the Board will communicate the rationale for decisions to the community.

The Board may prefer to consider several projects at a time and may ask the Director to defer proposal of individual projects until additional projects are ready for consideration. The Board will reconsider its current guidelines for project approval in order to refine and adapt them using the third ranking (National) criteria proposed in the National Academies' Report, and then re-publish them as the necessary criteria for a project to move into the "Candidate for New Start" pool of Board approved projects. (Appendix 3 includes a draft of these criteria.)

The Director will prepare annually, as part of the Facility Plan, an analysis of projects included in the "New Start Pool" and propose a recommended prioritization among those projects, including the new additions. Priority among projects may be changed at that time, utilizing the third ranking (National) criteria. If a project's plans are no longer deemed to be clearly and fully construction ready, the Director may recommend that the project be remanded back to Readiness Stage for further consideration and development. The Director will present these recommended actions to the Board for approval. The Director and the Board will make public the rationale for the prioritization of projects.

Budgetary Approach

Large Facility projects that are under construction have the very highest priority and all have the same priority. Every effort will be made to move them all forward at a rate consistent with sound management and well-conceived engineering and construction plans, in accordance with the longstanding policy of the Administration, Congress, the Board, and the Foundation.

As part of the annual budget preparation, the Director will propose funding for some subset of the Board-approved New Start pool of projects in their priority order, as budget constraints permit, and then negotiate with the Office of Management and Budget (OMB) on budget inclusion. This approach is apparent in the NSF FY 2005 Request to Congress, which includes funding for three projects currently under construction and five projected new starts with budget estimates detailed through FY 2009. In the future, the observations and considerations used by the Director and the Board to rank one large-facility-project idea over another for inclusion in NSF's annual budget requests will be clearly and publicly described so that policy-makers and researchers understand the rationale for the decisions. Whenever possible and appropriate, OSTP and the Congress will be informed concerning the process and decisions about prioritization. NSF will seek OSTP assistance in the development of interagency collaborations.

Oversight of and Flexibility in Implementation of Large-Facility Projects

The Director and the Board recognize the need to strengthen oversight of the implementation of large facility projects, which will require increased investments of NSF staff time and travel funds. The Report emphasizes the importance of initial planning and definition of technical scope, budget, and schedule, followed by periodic post-award status reviews held on-site by external experts, with implementation of a transparent process for management of changes to a project's implementation plan. These principles are well appreciated, but they have not been

uniformly applied at NSF. Furthermore, they constitute a new rigor of oversight for some disciplines supported by the Foundation. While NSF construction projects are typically well-managed and there is a good record on meeting cost, schedule, and especially facility performance goals, we recognize the need to apply standards uniformly, in accordance with the recently developed Facilities Management and Oversight Guide.

NSF has established the Deputy for Large Facility Projects (DLFP) position to have broad administrative, coordinating and accountability roles that span the Foundation, with goals of: defining uniform and well-established processes for reviewing projects; analyzing and monitoring costs; and meeting scientific and technical goals. The DLFP monitors the business operations and project management aspects of large facility project design, construction/acquisition, and operation. In this capacity, the DLFP supports and assists NSF program staff while maintaining NSF divisional and program officer authority to directly oversee large facility projects.

However, enhanced uniformity of process and improved initial planning of facilities must also preserve the flexibility of NSF to pursue opportunities that arise during implementation. For example, while future operations and maintenance budgets must be defined as part of the overall planning for construction and utilization of each new large facility, it is crucial to recognize that the operations phase is the research component of any project and is consequently less predictable. For example, the advent of grid computing has presented new opportunities and new challenges to operating budgets for many NSF facilities. Flexibility must exist to support evolving needs for the most successful projects and to support new developments and opportunities that inevitably arise from research activities. It is important also that NSF sustain a system of checks and balances within its organizational framework. Such a system is integral to ensuring more effective communication, greater transparency, and the ability to elevate concerns to the attention of NSF Senior Management and the National Science Board.

Criteria for Developing Large-Facilities Roadmaps and Budgets

Excerpted from the National Academies' Report: Setting Priorities for Large Facility Projects Supported by the National Science Foundation.

First Ranking: Scientific and Technical Criteria Assessed by Researchers in a Field or Interdisciplinary Area

- Which projects have the most scientific merit, potential, and opportunities within a field or interdisciplinary area?
- Which projects are the most technologically ready?
- Are the scientific credentials of the proposers of the highest rank?
- Are the project-management capabilities of the proposal team of the highest quality?

Second Ranking: Agency Strategic Criteria Assessed Across Related Fields by Using the Advice of Directorate Advisory Committees

- Which projects will have the greatest impact on scientific advances in this set of related fields taking into account the importance of balance among fields for NSF's portfolio management in the nation's interest?
- Which projects include opportunities to serve the needs of researchers from multiple disciplines or the ability to facilitate interdisciplinary research?
- Which projects have major commitments from other agencies or countries that should be considered?
- Which projects have the greatest potential for education and workforce development?
- Which projects have the most readiness for further development and construction?

Third Ranking: National Criteria Assessed Across All Fields by the National Science Board

- Which projects are in new and emerging fields that have the most potential to be transformative? Which projects have the most potential to change how research is conducted or to expand fundamental science and engineering frontiers?
- Which projects have the greatest potential for maintaining US leadership in key science and engineering fields?
- Which projects produce the greatest benefits in numbers of researchers, educators, and students enabled?
- Which projects most need to be undertaken in the near term? Which ones have the most current windows of opportunity, pressing needs, and international or interagency commitments that must be met?
- Which projects have the greatest degree of community support?
- Which projects will have the greatest impact on scientific advances across fields taking into account the importance of balance among fields for NSF's portfolio management in the nation's interest?

**DRAFT NATIONAL SCIENCE BOARD CRITERIA FOR APPROVING AND
PRIORITIZING LARGE FACILITY PROJECTS (LFPs)³**

In presenting a Large Facility Project to the Board for final Board approval, NSF must document the following properties for that project:

- project plans are judged to be construction ready by the NSF BFA Deputy Director for Large Facility Projects,
- the budget for construction and for operations costs has been justified to the satisfaction of the Chief Financial Officer,
- the project has been evaluated by the community and the NSF MREFC Panel asserts that it is of high priority to meet specifically identified *NSF Science Objectives*,
- the science program to be supported by the facility is adequately planned, and
- the NSF Director proposes the project to move into the *Board approved* stage.

For the Board to approve a project to enter the BOARD APPROVED stage, the Board considers the following:

- research enabled by the proposed facility,
- construction plans together with their risk and readiness,
- budget justification for construction and operation of the facility,
- imminent funding⁴ is likely to be available in the next two or so years, and
- priority of the project for achieving one or several of the *NSF Science Objectives* is validated by the community and the relevant Directorate Advisory Committees.

The Board will utilize the following criteria as part of its consideration to provide BOARD APPROVAL to each LFP:

- Scientific & Technical Assessment w/in Field or Interdisciplinary Area
- Community & Advisory Committee Support; Address Reviews
- Potential to be Transformative
- Essential for US Leadership in S&E
- Greatest Leverage of Researchers, Educators & Students Enabled
- Time Sensitive Window of Opportunity and Commitments
- Impact National Priorities & Needs (include social)
- Impact Across Fields & NSF; Balanced Portfolio

³ These are draft criteria. Not all will be appropriate for every project under consideration, and additional criteria may be appropriate for some projects.

⁴ The certification of "imminent funding" is a clear statement from NSF of intent to include project funds as part of the next or following fiscal year budget request, along with some indication through informal discussions with OMB and the Hill that overall NSF next year funding levels will allow for new project funding requests to be made.

PRE-PUBLICATION COPY

Approved by the National Science Board on October 14, 2004, subject to final edits by the NSB and EHR Chair. Do not quote without permission.

Attachment 2 to NSB-04-158

NSB-04-41



National Science Board Report

Broadening Participation in Science and Engineering Faculty

Background

Education has always been vital to the success of individuals and the science and engineering enterprise. In the technology- and knowledge-based economy of the 21st century, science, technology, engineering, and mathematics (STEM) education is also an investment in the United States' collective future as a nation and as a society. For decades, the United States has excelled in building and sustaining institutions of higher education that attract science and engineering talent from all over the world. The Nation has done less well in encouraging and developing the mostly untapped potential of underrepresented minorities, women, and persons with disabilities to contribute to STEM research and education. Developing this potential will lead to expanded opportunities for individuals as well as improving national competitiveness and prosperity.

To address these concerns, the National Science Board (NSB, the Board) Committee on Education and Human Resources (EHR) hosted a group of distinguished panelists to participate in a workshop entitled, "Broadening Participation in Science and Engineering Research and Education" on August 12, 2003. The workshop was very well attended by people concerned with diversity in U.S. academic institutions and the workforce. The workshop had two objectives: first, to celebrate the progress that American universities have made in bringing diversity to science and engineering; and second, to identify strategies for further increasing the diversity of the nation's science and engineering workforce. The workshop was designed specifically to address U.S. underrepresented minorities. NSB's recent publication, *The Science and Engineering Workforce / Realizing America's Potential* (NSB-03-69), explores science, technology, engineering, and mathematics workforce issues more broadly.

National Science Board Selected Findings and Recommendations

Based on workshop presentations and subsequent discussions by the EHR Committee and the full Board, selected findings from the workshop proceedings and recommendations for action are presented below. While we recognize that there may be many more issues of concern to the public, we focus our recommendations on issues specifically addressed by the speakers at the workshop. Moreover, rather than dwell on the obvious national shortcomings, our objective was to identify “best practices” programs that have been shown to be effective in enhancing diversity.

National Science Board Selected Findings⁵

1. The percentage of tenure-track faculty from underrepresented minority groups at post-secondary institutions is significantly lower than the percentage of students from underrepresented minority groups at these institutions.
2. Low numbers of underrepresented minority science and engineering faculty impede the recruitment and retention of underrepresented minority students in science and engineering programs.
3. The number of underrepresented minority students who pursue graduate study in science and engineering fields lags significantly behind undergraduate minority participation.
4. Encouraging and facilitating the movement of students from undergraduate to graduate and post-doctorate levels will expand the pool of science and engineering faculty candidates from underrepresented groups.
5. Best practices have been identified for programs that successfully broaden participation at the undergraduate level. Hands-on research experience at the undergraduate level has a positive influence on decisions to pursue a graduate degree in science and engineering.
6. Faculty diversity at post-secondary institutions can be achieved with thoughtfully conceived and executed programs for recruiting and retaining science and engineering faculty from underrepresented minority groups. Target of opportunity faculty search programs are examples that involve the university president, provosts, deans, department heads, and senior faculty who clearly signal that faculty diversity is a high priority and that it must be pursued aggressively with clear expectations and meaningful incentives and rewards.

⁵ Specific examples and discussion supporting the findings can be found in the proceedings of the workshop, *National Science Board Workshop Proceedings: Broadening Participation in Science and Engineering Research and Education (NSB-04-72)*.

PRE-PUBLICATION COPY

Approved by the National Science Board on October 14, 2004, subject to final edits by the NSB and EHR Chair. Do not quote without permission.

National Science Board Recommendations

- A. Explore the feasibility of establishing a public database identifying recent science and engineering Ph.D. recipients to facilitate the recruiting of minority faculty at post-secondary institutions.
- B. Explore the feasibility of expanding NSF programs to facilitate the progression of bachelor-level science and engineering students to advanced degrees, post-doctorates, and the professoriate. Examples of NSF programs that address this goal include, but are not limited to, Research Experiences for Undergraduates (REU), Louis Stokes Alliances for Minority Participation (LSAMP), and Research Alliances for Graduate Education and the Professoriate (AGEP). While the workshop did not specifically address K-12 STEM education, the Board reaffirms our commitment that broadening participation in K-12 STEM education is an important part of our mission. Without broadening participation at the K-12 level, the pool from which future faculty will be drawn would be limited.
- C. Develop NSF programs that provide incentives and rewards to institutions that pursue or have implemented creative organizational strategies to advance underrepresented minorities into the professoriate, using legally permissible strategies.
- D. Encourage NSF staff to work closely with staff in other research-intensive agencies, such as the National Institutes of Health, to identify and disseminate best practices and effective incentive programs. An example of such cooperation is the Education and Workforce subcommittee of the Committee on Science of the National Science and Technology Council in the White House.
- E. Disseminate information on research results and experiences with diversity programs through periodic publications.

MEMORANDUM TO MEMBERS AND CONSULTANTS OF THE NATIONAL
SCIENCE BOARD

SUBJECT: Closed Session Agenda Items for December 15-16, 2004 Meeting

The Government in the Sunshine Act requires formal action on closing portions of each Board meeting. The following are the closed session agenda items anticipated for the December 15-16, 2004 meeting.

1. Staff appointments
2. Future budgets
3. Grants and contracts
4. Specific Office of Inspector General investigations and enforcement actions

A proposed resolution and the General Counsel's certification for closing these portions of the meetings are attached for your consideration.



Michael P. Crosby
Executive Officer

Attachments

PROPOSED
RESOLUTION
TO CLOSE PORTIONS OF
383rd MEETING
NATIONAL SCIENCE BOARD

RESOLVED: That the following portions of the meeting of the National Science Board (NSB) scheduled for December 15-16, 2004 shall be closed to the public.

1. Those portions having to do with discussions regarding nominees for appointments as National Science Board Members and National Science Foundation (NSF) staff appointments, or with specific staffing or personnel issues involving identifiable individuals. An open meeting on these subjects would be likely to constitute a clearly unwarranted invasion of personal privacy.
2. Those portions having to do with future budgets not yet submitted by the President to the Congress.
3. Those portions having to do with proposals and awards for specific grants, contracts, or other arrangements. An open meeting on those portions would be likely to disclose personal information and constitute a clearly unwarranted invasion of privacy. It would also be likely to disclose research plans and other related information that are trade secrets, and commercial or financial information obtained from a person that are privileged or confidential. An open meeting would also prematurely disclose the position of the NSF on the proposals in question before final negotiations and any determination by the Director to make the awards and so would be likely to frustrate significantly the implementation of the proposed Foundation action.
4. Those portions having to do with specific Office of the Inspector General investigations and enforcement actions, or agency audit guidelines.

The Board finds that any public interest in an open discussion of these items is outweighed by protection of the interests asserted for closing the items.

CERTIFICATE

It is my opinion that portions of the meeting of the National Science Board (NSB) or its subdivisions scheduled for December 15-16, 2004 having to do with nominees for appointments as NSB Members and National Science Foundation (NSF) staff, or with specific staffing or personnel issues or actions, may properly be closed to the public under 5 U.S.C. § 552b(c) (2) and (6); those portions having to do with future budgets may properly be closed to the public under 5 U.S.C. § 552b(c) (3) and 42 U.S.C. 1863(k); those portions having to do with proposals and awards for specific grants, contracts, or other arrangements may properly be closed to the public under 5 U.S.C. § 552b(c) (4), (6), and (9) (B); those portions disclosure of which would risk the circumvention of a statute or agency regulation under 5 U.S.C. § 552b(c) (2); and those portions having to do with specific Office of the Inspector General investigations and enforcement actions may properly be closed to the public under 5 U.S.C. § 552b(c) (5), (7) and (10).



Lawrence Rudolph
General Counsel
National Science Foundation