

**APPROVED MINUTES¹
OPEN SESSION
400TH MEETING
NATIONAL SCIENCE BOARD**

National Science Foundation
Arlington, Virginia
October 2-3, 2007

Members Present:

Steven C. Beering, Chairman
Kathryn D. Sullivan, Vice Chairman
Mark R. Abbott
Barry C. Barish
Camilla P. Benbow
Ray M. Bowen*
G. Wayne Clough*
Kelvin K. Droegemeier
Kenneth M. Ford*
Patricia D. Galloway
José-Marie Griffiths
Elizabeth Hoffman
Louis J. Lanzerotti
Douglas D. Randall
Arthur K. Reilly
Jon C. Strauss*
Thomas N. Taylor
Richard F. Thompson
Jo Anne Vasquez**

Arden L. Bement, Jr., *ex officio*

Members Absent:

Dan E. Arvizu
John T. Bruer
Daniel E. Hastings
Karl Hess
Alan I. Leshner

¹ The minutes of the 400th meeting were approved by the Board at the December 2007 meeting.

* Board Members present on Wednesday, October 3, 2007 only.

** Board Member present on Tuesday, October 2, 2007 only.

The National Science Board (Board) convened in Open Session at 4:30 p.m. on Tuesday, October 2, 2007 with Dr. Steven Beering, Chairman, presiding (Agenda NSB-07-105, Board Book Tab 12). In accordance with the Government in the Sunshine Act, this portion of the meeting was open to the public.

AGENDA ITEM 1: Draft Action Plan for STEM Education

Dr. Beering opened this portion of the Open Session to address the Board's action plan for science, technology, engineering, and mathematics (STEM) education, more formally known as *A National Action Plan for Addressing the Critical Needs of the U.S. Science, Technology, Engineering, and Mathematics Education System* (NSB/EHR-07-9, revised September 28, 2007) (Board Book Supplemental Material Tab 8).

Dr. Beering reported that at the August 2007 Board meeting, a draft action plan was approved by the Board for release for public review and comment. The revised action plan, which included supplemental materials, public comments, and additional comments from Board Members, was provided to the full Board for review and consideration.

Dr. Elizabeth Hoffman, chairman of the Education and Human Resources (EHR) Committee, reported that the development of the Board's action plan for STEM education had been a long and systematic process for the Board. This process began in December 2005, when the Board held the first of three hearings on Capitol Hill to determine actions that could be taken to improve K-12 STEM education in the Nation. The board held two more hearings in February and March 2006 in Boulder, Colorado and Los Angeles, California.

In March 2006, the Board established a Federal Advisory Committee to the Board, the Commission on 21st Century Education in Science, Technology, Engineering, and Mathematics (Commission). The Commission presented a draft report to the Board in March 2007. More than 90 experts provided input to the draft action plan either by serving on the Commission or one of its working groups, or by testifying before the Board or the Commission. The Board Office staff held more than two dozen meetings with a range of stakeholders to gather their input. At the August 2007 meeting, the Board approved a draft action plan for release for public review and comment.

During August 2007, the Board received nearly 100 comments from a broad range of stakeholders, states, K-12 teachers, disciplinary societies, university faculty and administrators, mathematicians, scientists and engineers, various organizations, and parents. These were valuable and generally supportive comments, which were incorporated into the action plan. The EHR Committee recommended that the Board approve the action plan as final, subject to minor edits.

The Board unanimously APPROVED the *National Action Plan for Addressing the Critical Needs of the U.S. Science, Technology, Engineering, and Mathematics Education System* (NSB/EHR-07-9), subject to minor edits by the EHR chairman and the Board Chairman.

Dr. Michael Crosby, Executive Officer and Board Office Director, reported on the next steps related to this action. He announced that on Wednesday, October 3, 2007 at 11 a.m., Drs. Beering, Hoffman, and Jo Anne Vasquez would present the STEM education action plan at a briefing open to the public and media in the U.S. Capitol. Members of Congress would be present and would make remarks. Several members of the Board's Commission and representatives of a range of stakeholder groups would also be present.

A pre-publication version of the action plan (NSB-07-114) would be posted on the Board's Web site Thursday, October 4, 2007, and the final printed action plan was expected to be delivered and widely distributed in early December 2007. Additionally, several Board Members had plans to present the action plan at events where they would be speaking in the next few months. He offered Board Members the support of the Board Office to incorporate action plan comments, as well as PowerPoint slides, in presentations underway.

Dr. Beering adjourned this portion of the Open Session at 4:36 p.m. Other items for the Open Session would be addressed the following day, Wednesday, October 3, 2007.

The National Science Board (Board) reconvened in Open Session at 2:00 p.m. on Wednesday, October 3, 2007 with Dr. Steven Beering, Chairman, presiding (Agenda NSB-07-105, Board Book Tab 12). In accordance with the Government in the Sunshine Act, this portion of the meeting was open to the public.

AGENDA ITEM 7: Approval of Open Session Minutes, August 2007

The Board unanimously APPROVED the Open Session minutes of the August 2007 Board meeting (NSB-07-93, Board Book Tab 12D).

AGENDA ITEM 8: Closed Session Items for December 2007

The Board unanimously APPROVED the Closed Session items for the December 5-6, 2007 meeting (NSB-07-103, Board Book Tab 12E).

AGENDA ITEM 9: Chairman's Report

Dr. Beering reported on several issues:

a. 400th Meeting of the National Science Board

Dr. Beering noted that October 2007 marked the 400th meeting of the Board. For nearly 60 years, the Board has served as both the policy-setting and oversight body for the National Science Foundation (NSF). In addition, as an independent body of advisors to the President and Congress on national policy issues related to science and engineering research and education, the Board has made significant accomplishments through the decades - a sampling of which is reflected in the actions of the past year, during which the Board: approved the NSF *Strategic Plan* and accepted NSF's *Facility Plan*; approved 13 funding actions; and issued policy reports on hurricane science and engineering, transformative research, and most recently a national action plan for STEM education.

b. National Action Plan for STEM Education

Dr. Beering, along with Drs. Elizabeth Hoffman and Jo Anne Vasquez, unveiled the national action plan for STEM education on Capitol Hill on the morning of October 3, 2007, and pre-publication copies were distributed. The Board was honored to have Congressmen Brian Baird, Vernon Ehlers, Rush Holt, Michael Honda, and Daniel Lipinski attend this event and provide encouraging and insightful comments. The Board was also joined by several members of the Board Commission on STEM Education and by representatives from five STEM education stakeholder groups. Dr. Beering thanked all those involved in this project and event and especially Dr. Elizabeth Strickland of the Board Office.

Dr. Ray Bowen commented that the Board had expressed on many occasions appreciation to Drs. Hoffman and Vasquez, which bears repeating. He complimented them on the “magnificent way you took over this project and brought it to completion.” Dr. Kathryn Sullivan echoed Dr. Bowen’s sentiments and also thanked Dr. Strickland for all her efforts.

Dr. Sullivan reported that the National Academy of Sciences’ Board on Science Education (BOSE), National Research Council, represented by Dr. Heidi Schweingruber, Acting Director, BOSE, and Dr. Carl Wieman, BOSE chairman and Director of the Carl Wieman Science Education Initiative, University of British Columbia, invited the Board and the Board’s STEM representatives to speak at their upcoming meeting on December 3-4, 2007 at Irvine, California, on the strategy for education reflected in that Board report, and to understand better how that strategy fits within the Board's and NSF’s larger STEM strategy. She added that BOSE membership includes educators as well as outstanding scientists, Dr. Wieman among them, who think broadly about how education and STEM education fit into the national agenda for science and innovation and the Nation’s future.

c. America COMPETES Act, H.R. 2272

On August 9, 2007, the President signed into law the America COMPETES Act, H.R. 2272, which provided for the authorization of NSF. (COMPETES: Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science.)

Highlights of this Act, as related to the Board, were provided to Board Members (Board Book Tab 12F). Dr. Crosby summarized key points of this legislation that directly affect the Board.

The legislation provides a clarification to the manner in which the Board communicates with Congress such that: “The Board shall now render to the President *and* to the Congress no later than January 15 of each even-numbered year a report on indicators of the state of science and engineering in the U.S. The Board shall render to the President *and* to the Congress reports on specific individual policy matters related to science and engineering and education in science and engineering as the Board, the President, or the Congress determines the need for such reports.”

Other key points of the COMPETES legislation that directly affect the Board indicate that:

- No later than a 1 year following enactment of the act, the Board must submit to Congress a report of its evaluation of the role of NSF in supporting interdisciplinary research, including a recommendation for the appropriate proportion of NSF's research and related activities funding that should be allocated for interdisciplinary research.
- No later than 6 months following the enactment of the act, the Board shall evaluate and report to Congress on the impacts of its policy to eliminate cost sharing for existing programs that were developed around industry partnerships and that historically required industry cost sharing, such as the Engineering Research Centers and the Industry/University Cooperative Research Centers.
- No later than 6 months following the enactment of the act, the Board must submit to Congress a report of its evaluation of current NSF policy regarding preconstruction funding and maintenance and operation costs, including any recommendations for modifying the current policies related to allocation of funding for major research equipment and facilities. Specifically, the Board will evaluate the appropriateness of the requirement that funding for detailed design work and other preconstruction activities for major research equipment and facilities come exclusively from research and related activities (R&RA) rather than major research equipment and facilities construction (MREFC) accounts.
- No later than 3 years following the enactment of the act, the Board must submit to Congress a summary report of its findings including any recommendations regarding changes to, the termination of, or the continuation of the NSF pilot program of grants for new investigators as will be established per the America COMPETES Act.
- No later than 1 year following the enactment of the act, the Board must submit to Congress a summary report of its findings, including any recommendations regarding changes to the current NSF policies on institutions of higher education regarding the limitations on the number of proposal submissions by a single institution.

Dr. Beering assigned the Board's standing committees to work on the above reports to Congress. The Committee on Programs and Plans (CPP) will work on: an evaluation of the role of NSF in supporting interdisciplinary research; an evaluation of current NSF policy regarding preconstruction funding and maintenance and operation costs; and a summary of findings to include any recommendations regarding changes to, the termination of, or the continuation of the NSF pilot programs of grants for new investigators. The Committee on Strategy and Budget (CSB) will be responsible for: an evaluation on the impact of its policy to eliminate cost sharing; and a summary of findings to include any recommendations regarding changes to the current NSF policies on institutions of higher education regarding the limitations on the number of proposal submissions by a single institution.

d. Committee Announcements

Dr. Beering established the *ad hoc* Committee for the Vannevar Bush Award. This committee will recommend the recipient of the 2008 Vannevar Bush Award for "outstanding contributions toward the welfare of mankind and the Nation" for full Board approval. He re-appointed last year's committee with Dr. Sullivan, chairman, and the members Drs. Kelvin Droegemeier, Patricia Galloway, José-Marie Griffiths, and Thomas Taylor. The NSB Public Service Award Committee, which is a Federal Advisory Committee to the Board and not a Board committee, was established and new members were appointed. Both the Bush Award and the Public Service Award are presented at the Board's annual May dinner.

Dr. Beering discharged the *ad hoc* Committee on Nominations for the Class of 2008 - 2014, which completed its work, and thanked Dr. Wayne Clough, chairman, and Drs. Daniel Hastings, Elizabeth Hoffman, Alan Leshner, and Douglas Randall.

e. Board Meeting Schedule

Dr. Sullivan reported on informal discussions with several Board Members working on options for Board meeting structure and scheduling. She stated that the Board raised some concerns about the current meeting schedule and the degree to which the schedule allows the Board to consider and address both the NSF oversight issues and science as well as engineering policy issues of national importance.

Dr. Sullivan provided a summary to Board Members on a proposed Board annual meeting schedule and reviewed considerations for meeting structure, which revolve around legislative mandates, Federal budget development cycle, major award timelines, and Board Member availability.

Dr. Sullivan noted that the Board must:

- Meet annually on the third Monday in May unless it publicly announces an earlier May meeting date.
- Operate under the provisions of the Sunshine Act.
- Have a quorum of Board members to make decisions.
- Submit to the President and Congress a report on key indicators of the state of science and engineering in the U.S. no later than January 15 of each even-numbered year.
- Approve the NSF annual budget request before it goes to the Office of Management and Budget (OMB) in September of each year.
- Meet following the President's release of the new annual budget request in February of each year on the provisions made in that budget.

Additional factors include:

- Board guidelines mandate that a major award be brought to the Board no less than 6 months prior to the need to renew or award that project and that no action item be brought to the Board unless an information update has been provided within the previous 6 months. Board members have expressed a desire to have more time for review and deliberation on these sorts of major award matters.

- The Board should be fully briefed and have the opportunity to discuss the development of priority order and operations within the major research equipment and facilities construction (MREFC) Horizon projects and other NSF large facilities prior to these matters coming before the Board.
- Every effort is made to have no single Board Member miss more than two meetings each year.
- NSF has requested that the Board's annual retreat, which coincides with the President's budget submission to Congress in February, be held at a different time to facilitate attendance by the NSF Director and Deputy Director.
- The Board would benefit from having an additional day-long retreat that would be devoted entirely to informative discussions.

Based on all the above considerations, a revised Board meeting calendar for 2008 was recommended:

- The annual Board retreat moved from February to October 2008. At the August 2007 meeting, the Board recommended that the retreat be held at the University of Alaska, Fairbanks.
- Add an additional full-day retreat each year, which would be held outside of the NSF location at a mid-continent locale to facilitate travel and participation for the optimum number of Board Members.
- Add a stand-alone full-day Closed Session of CSB to be held at NSF in late June of each year. This meeting would be an opportunity for budget discussions with the NSF Director and Deputy Director, as well as the Assistant Directors. All Board Members would be invited to this meeting, and CSB members would be required to attend.
- Add a stand-alone full-day Closed Session of CPP to be held at NSF in late June of each year. This meeting would provide an opportunity for CPP to review and discuss priorities within the MREFC Horizon projects and other developing large facility projects. All Board Members would be invited to this meeting, and CPP members would be required to attend.

Several key points shape the recommended 2008 meeting schedule:

- Based on gaps in the existing Board calendar, the added retreat and committee meetings should be scheduled in late April or June.
- The CSB meeting must be scheduled in late June in order for the committee to be fully briefed on internal NSF budget development deliberations and to engage in substantive discussion with NSF during the budget development process.
- The retreat should be held outside NSF and the committee meetings should be held at NSF to facilitate the movement of the fewest number of people possible to achieve the purposes of the events.
- The added CSB and CPP meetings could be linked to ease logistical considerations.
- The new calendar of meetings would also include five Board meetings scheduled during the year.

Dr. Crosby commented that the revised calendar would create additional expenses for the added 2-3 full days of meetings. The new calendar will work financially within a tight budget, although the Board Office may need to curtail some Board Member travel for outreach

meetings and activities. From the Board Office's perspective, the logistical challenge will be scheduling the three new upcoming meetings for 2008, as Board Members are routinely polled a year in advance of scheduled meeting dates.

After lengthy discussion, Dr. Beering requested that Dr. Crosby reschedule the annual retreat from February to October 2008 and notify the University of Alaska, Fairbanks, and poll Board Members on their possible availability for proposed additional meeting times for CSB and CPP. Dr. Beering suggested that the Board table further discussion on this issue until the December 2007 meeting.

f. Board Member Recognition

Dr. Beering recognized the following Board Members:

Dr. Patricia Galloway recently published a book entitled *The 21st Century Engineer*, which addresses the skill sets that an engineer of the 21st century needs to survive and includes a suggested curriculum for a master's degree in professional engineering management.

Dr. Karl Hess was recently named to the Hawaii Innovation Council by the Governor of Hawaii. He is one of 18 distinguished citizens who will advise Governor Linda Lingle on ways to improve the economic impact of Hawaii's innovation resources, including technology research, development, and product creation.

Dr. Louis Lanzerotti was recently named the new chairman of the Governing Board of the American Institute of Physics (AIP). The AIP promotes the advancement and diffusion of the knowledge of physics and its application to human welfare.

AGENDA ITEM 10: Director's Report

Dr. Arden Bement, Jr., NSF Director, reported on the following items:

a. NSF Staff Announcements and Awards

Dr. Marc Rothenberg began serving as the NSF Historian in December 2006 with the Office of Legislative and Public Affairs (OLPA). Prior to his arrival, he was the editor of the Joseph Henry Papers Project at the Smithsonian Institution. He received his Ph.D. from Bryn Mawr College in History and Philosophy of Science. Dr. Rothenberg is actively engaged in conducting oral history interviews of former and current NSF staff; contracting a series of scholarly monograph histories of NSF, which will review the administrative history of NSF and the impact of NSF policies on American science; and planning for the NSF's 60th anniversary.

On Friday, September 28, 2007, the Office of Personnel Management (OPM) announced the selection of two NSF employees as recipients of the Presidential Distinguished Rank Awards for 2007. Individuals for this award are selected annually by the President for their exceptional leadership as well as accomplishments and service over an extended period of time. The 2007 NSF recipients are Dr. John "Jack" Lightbody and Ms. Mary Santonastasso.

Dr. Lightbody joined NSF in 1987 as a Program Director for Nuclear Physics in the Division of Physics. He went on to become Executive Officer in the Physics Division and very recently was asked to take the responsibilities of Deputy Assistant Director for the Directorate for Mathematical and Physical Sciences (MPS). Dr. Lightbody's contributions to NSF have been numerous and diverse, ranging from responsibility for premier discovery tools, like the Large Hadron Collider and the IceCube Neutrino Facility being installed at the South Pole, to stewarding embryonic research activities with transformative potential, like the Santa Fe Institute and the ePrint Archives, to acting to promote diversity at NSF and in the physics community, and serving as a leader in innovative and rigorous ethical management of Federal programs.

Ms. Santonastasso, Division Director of the Division of Institution and Award Support, Office of Budget, Finance, and Award Management (BFA) joined NSF in 2001 as the Director, Division of Grants and Agreements. She co-led the NSF successful designation as a Grants Management Line of Business "Center of Excellence," partnering with other agencies to launch "research.gov," which builds on Fastlane successes.

b. Congressional Update

The Director's legislative update, which included information on issues relating to NSF, was provided to Board Members (Board Book Tab 12G).

Dr. Beering reported on the following proposed hearings: The House Science and Technology Subcommittee on Research and Science Education held a hearing on October 2, 2007 regarding nanotechnology education. Testimony was provided by Dr. David Ucko, Deputy Division Director, Division on Research and Learning, Directorate for Education and Human Resources (NSF EHR). The House Science and Technology Committee was considering a hearing on October 17, 2007 on Women in Science and Engineering, especially aimed at looking at the National Academies of Science report, *Beyond Bias and Barriers*. Dr. Kathie Olsen, NSF Deputy Director, would testify.

AGENDA ITEM 11: Open Committee Reports

a. Audit and Oversight (A&O) Committee

Dr. Galloway reported for Dr. Dan Arvizu, A&O chairman. She stated that Dr. Arvizu met with NSF and Office of Inspector General (OIG) staff regarding the status of the Raytheon audit corrective action plan, and expressed confidence that progress was being made with this complex situation. Actions that are within the control of NSF should be finalized by the end of the year, most before the December 2007 Board meeting. The Program Fraud Civil Remedies Act was amended in August 2007 to include NSF. OIG worked to obtain authority for the agency, and the Board sent a letter to Congress in March 2006 formally requesting this action. This amendment provides NSF with an administrative vehicle to pursue recovery of losses resulting from fraud cases under \$150,000 when the Department of Justice declines civil or criminal False Claims Act prosecution. As a result, agency recoveries in small dollar fraud cases should be significantly enhanced.

Dr. Crosby proposed a process by which the Board can approve the transmittal of an OIG Semiannual Report package to Congress without holding a meeting. Due to timing issues, it would not be possible for the Board to conduct this business at the December 5-6, 2007 meeting. Therefore, the A&O Committee recommended that the full Board approve the process outlined by Dr. Crosby, which involves polling Board Members by e-mail during November 2007 to obtain approval of the Chairman's cover memorandum and the transmittal of the Semiannual Report package to Congress. Upon this recommendation:

The Board unanimously APPROVED the use of an e-mail polling process for Board approval of the NSF management response to the OIG Semiannual Report, the Board Chairman's transmittal letter, and the transmittal of the Semiannual Report package, due to Congress by December 1, 2007.

The committee approved a draft statement (Board Book Tab 7B) that affirms the roles and responsibilities of the Board Chairman, as prepared by Dr. Hoffman with input from Board Members, and recommended the following statement to the full Board for approval.

The Board unanimously APPROVED the statement:
The Board affirms the role of its Chairman to represent the Board by presenting or otherwise communicating established Board policies, positions, or programs. When taking such actions, the Chairman should, to the extent possible, seek input from other Board members, Board staff, and appropriate NSF staff; and promptly inform the Board of any such actions. These duties are in addition to those specifically provided or contemplated for the Board Chairman by statute.

Drs. Bowen and Galloway, as requested by the committee chairman at the August 2007 meeting, consulted other Board Members and developed a position for the committee to consider on the issue of the Board obtaining legal services. Dr. Bowen recommended and the committee approved the following language, which was submitted for full Board approval.

The Board unanimously APPROVED the statement:
The Board reaffirms the previous Board decision not to establish a separate General Counsel for the Board and further reaffirms that the Board has and retains the ability to seek legal and statutory interpretations and support for research on such issues by individuals and/or organizations outside the NSF Office of General Counsel, outside NSF, and outside the Federal agencies.

Mr. Thomas Cooley, NSF Chief Financial Officer, discussed the progress that had been made on addressing the reportable conditions from the FY 2006 audit and the status of the FY 2007 financial statements and performance reporting. Mr. Salvatore Ercolano, the Partner-in-Charge with Clifton-Gunderson LLP, confirmed that the audit was on track and that communication is good.

Dr. Emily Woodruff, NSF OIG, introduced the *NSF Annual Audit Plan, FY 2008* (Board Book Supplemental Material Tab 7). Twenty of the audits, or 41 percent of the audit work, in this year's plan was either requested by NSF or required by law. The balance of the audits was OIG- initiated. Some examples of the OIG-initiated audits include: reviews of time and effort reporting practices, large facility cooperative agreements, and NSF's contingency efforts.

b. Education and Human Resources (EHR) Committee

Dr. Hoffman, EHR chairman, reported that the committee approved the *National Action Plan for Addressing the Critical Needs of the U.S. Science, Technology, Engineering, and Mathematics Education System* (NSB/EHR-07-9), subject to minor edits approved by the Board Chairman and the EHR chairman, on October 2, 2007. A formal "rollout" for the publication took place the next day, October 3, 2007, on Capitol Hill. [A pre-publication version of the action plan (NSB-07-114) was released on October 4, 2007.]

Dr. Crosby noted that he will contact Congressman Rush Holt's staff and will report to the committee at the December 2007 meeting to follow up on the request for a report on the Board's review of NSF EHR programs with respect to evaluation procedures. Congressman Holt was interested in hearing from the Board with regard to future ideas for NSF EHR; the Academic Competitiveness Council's review of the evaluation of Federally-funded programs and projects in STEM education; as well as the Board's ongoing evaluation of the NSF EHR programs in the context of the national need to reform STEM education and to assure U.S. leadership in science and technology for the 21st century. The committee will further discuss this subject at the December 2007 meeting.

Dr. Marrett spoke on the impact of the America COMPETES Act. Dr. Marrett noted that implementing the act will require cooperation and collaboration across all of NSF. She reviewed the range of impact covered by the COMPETES Act, noting proposed increases for several programs. Further information will be shared with the EHR Committee as the act is understood, and if it is implemented and appropriated.

Dr. Hoffman reported on the status of the *ad hoc* Task Group for Engineering Education and additional STEM education issues.

ad hoc Task Group on Engineering Education

Dr. Wayne Clough reported to the EHR Committee on final comments received from Board Members since the August 2007 meeting on the draft report, *Moving Forward to Improve Engineering Education* (NSB/EHR-07-8, Board Book Tab 8B). The report recommends that NSF should expand and reinvigorate its efforts to stimulate and disseminate innovation on engineering education. Dr. Clough noted that retention of qualified students and maintaining flexibility in curricula are essential critical goals for engineering. He also stated that conversations are taking place with the National Academy of Engineering president and the co-chairmen of the President's Council of Advisors for Science and Technology for follow-on activities. Based on the recommendation of the EHR committee, the Board acted as follows:

The Board unanimously APPROVED the draft report, *Moving Forward to Improve Engineering Education* (NSB/EHR 07-8), for final publication and dissemination, subject to final edits approved by the Board Chairman and the *ad hoc* Task Group on Engineering Education.

Additional STEM Education Issues

The committee heard two reports from committee members on follow-on activities to the STEM education action plan. The committee heard first from Dr. Camilla Benbow, who spoke on “Fostering STEM Innovators” and the importance of nurturing human capital to the national economy. The STEM Commission did not address how to foster the next generation of innovators and, as workforce issues are of national interest, the committee discussed how it might go forward to develop and stimulate STEM innovators. Dr. Hoffman asked Dr. Benbow to follow up on this topic by preparing a proposed charge for EHR to be presented at December 2007 meeting that would establish a group to make recommendations to NSF on ways to improve the education of the next generation of STEM innovators. Drs. Griffiths, Lanzerotti, and Vasquez and Mr. Arthur Reilly volunteered to work with Dr. Benbow.

Dr. Vasquez spoke to the committee on the involvement of higher education STEM faculty in preparing K-12 teachers and how the higher education faculty reward system affects their involvement in K-12 STEM education. Faculty balances numerous issues that include responsibilities in research and teaching with other responsibilities. Concerns remain on how faculty involvement is rewarded by higher education institutions. Several committee members recognized the need for roles to change over time, and it was suggested that EHR review information from teaching associations and disciplinary groups for data to progress forward with this topic. The committee will return to this item at the December 2007 meeting.

c. EHR Subcommittee on Science and Engineering Indicators (SEI)

Dr. Griffiths reported for Dr. Lanzerotti, SEI chairman, on *Science and Engineering Indicators 2008 (Indicators)*. The subcommittee discussed several aspects relating to *Indicators 2008*. SEI agreed on the final version of the *Indicators 2008* cover design with the addition of a photo of an aurora and a picture of the NSF U.S. Air Force plane. The subcommittee also discussed and agreed upon the Statistical Appendix.

Mr. Rolf Lehming, Science Resources Statistics Director for the Science and Engineering Indicators Program, Directorate for Social, Behavioral, and Economic Sciences (SBE), provided a summary of SEI member and agency comments on the Overview Chapter (Board Book Supplemental Material Tab 4) and the resulting changes made in response to those comments. Upon the recommendation of the subcommittee, EHR approved the action and forwarded it to the full Board for approval.

The Board unanimously APPROVED the Overview Chapter of *Indicators 2008*, subject to final edits approved by the Board Chairman and SEI chairman.

The subcommittee also discussed the new “Digest” to *Indicators 2008* (Board Book Supplemental Material Tab 5). The purpose of the new Digest is to reach an expanded audience and serve as a portal to *Science and Engineering Indicators 2008*. Several improvements to the “Digest” were implemented since the August 2007 meeting, which included more clarity on research and development (R&D) support at the field level; emphasizing the difference in types of R&D supported by industry versus academe, versus Federal Government; review to ensure no opinions or policy positions are implied in the text; elimination of a confusing contents page from the August 2007 meeting version; and removal of a number of redundancies. Upon the recommendation of SEI to approve the “Digest,” EHR approved the action and forwarded it to the full Board for approval.

The Board unanimously APPROVED the “Digest of Key S&E Indicators” for *Indicators 2008*, ([NSB/SEI-07-11](#)), subject to final edits approved by the Board Chairman and the SEI chairman.

For the Companion Piece to *Indicators 2008*, several Board Members explored and considered a range of data and ideas on the general topic of research and development and U.S. competitiveness in a global economy. Dr. Lanzerotti proposed a schedule for producing the Companion Piece over the next month in order to produce the report for release with *Indicators 2008* about January 15, 2008. The schedule involved using the existing draft and producing a new document by October 22, 2007 for review and comment by the full Board on October 31, 2007. The objective would be to have a final report approved by the Board by the December 2007 meeting to meet publication deadlines. Upon the recommendation of the subcommittee for the Companion Piece topic, EHR approved the action and forwarded it to the full Board for approval.

The Board unanimously APPROVED the development of a Companion Piece for *Indicators 2008* on the general topic of “research and development and U.S. competitiveness in the global economy.”

With regard to *Indicators 2010*, the subcommittee considered the scheduling of several roundtable discussions with external groups representing state and industry customers for science and engineering indicators. A list of potential groups to contact to initiate such discussions was distributed to SEI and additional suggestions were requested. The potential meetings could occur during major conference events, other meetings that assemble potential users of *Indicators* data, or around Board meetings to involve appropriate individuals in discussions. Discussions should be completed by the May 2008 meeting in order for the findings to impact the planning for *Indicators 2010*. Upon recommendation of the subcommittee to hold workshops and roundtable discussions related to planning for *Indicators 2010*, EHR approved the action and forwarded it to the full Board for approval.

The Board unanimously APPROVED the subcommittee’s proposal to plan workshops and roundtable discussions in connection with *Indicators 2010*.

d. Committee on Programs and Plans (CPP)

Dr. Kenneth Ford, CPP chairman, addressed key points of the COMPETES legislation that directly affect the Board, three of which fall to CPP. He reported that the full committee will take two of the items under consideration: evaluating and reporting on the role of NSF in supporting interdisciplinary research, and reviewing and assessing the NSF pilot program of grants for new investigators. The committee discussed the third item, evaluating current NSF policy regarding preconstruction planning and maintenance and operations costs of facilities, during the discussion of facilities operations and management costs that included recommendations for modifying the current policies related to allocation of funding for major research equipment and facilities. The committee agreed that Dr. Mark Abbott will form an *ad hoc* group to combine these two activities and work quickly to develop a draft Board response to Congress.

The committee also discussed an action item, Revision to NSB Thresholds Policy (Board Book Tab 10D). NSF presented a proposal to change the threshold policy for bringing funding actions to the Board. This revision sets the threshold at 1 percent or more of the awarding directorate or office's prior year current plan or \$3 million, whichever is greater, but allows flexibility for both the Board and NSF staff to bring sensitive items forward whenever necessary. CPP approved the revision of the policy and recommended approval by the full Board.

The Board unanimously APPROVED the change to Board policy such that NSF directorates and offices would be required to bring forward for Board approval proposed awards where the average annual award amount is 1 percent or more of the awarding directorate or office's prior year current plan, or \$3 million, whichever is greater.

Dr. Ford reported on a discussion item, NSB Policy on Recompetition of NSF Awards. Dr. Lanzerotti provided the committee with an update on the NSB Policy on Recompetition of NSF Awards, beginning with a very brief overview of the history of this discussion item. NSF staff delivered a significant amount of data during the spring and summer, and Board Office staff and Dr. Lanzerotti worked closely with NSF to conduct an analysis of the data and additional background research related to NSF's four large Federally Funded Research and Development Centers (FFRDCs), large projects, and completed MREFC projects. The data provided the Board with a mechanism for evaluating how the Board's 1997 recompetition policy has been implemented. Dr. Lanzerotti informed the committee that he is working with the Board Office to develop policy options for the committee to consider and discuss at the December 2007 meeting.

The committee addressed two information items. The first information item was on the topic of Deep Underground Science and Engineering Laboratory (DUSEL) (Board Book Tab 10F). Dr. Tony Chan, Assistant Director for MPS, and Dr. Jonathan Kotcher, Program Officer in the Division of Physics, presented this information to the committee. DUSEL is an underground laboratory space that will provide infrastructure for science and engineering research. At this stage, it is an NSF MREFC Horizon project. NSF has conducted a rigorous selection process

consisting of three completed solicitations beginning with a site-independent competition and culminating with a fourth solicitation to develop technical designs for an initial suite of experiments.

The second information item was Baseline Reviews of the Advanced Laser Interferometer Gravitational-Wave Observatory, (Advanced LIGO) (Board Book Tab 10G). Dr. Chan and Dr. Tom Carruthers, Program Officer in the Division of Physics, presented this information item to the committee. Dr. Ford noted that LIGO has already collected a year of coincident data at better than the designed sensitivity. Advanced LIGO should tremendously enhance the capability of LIGO, providing both greater range and sampling a much greater volume of space. It will also use the infrastructure already in place and gain sensitivity with technical improvements such as replacing the seismic isolation system, among other improvements.

Dr. Ford stated that Dr. Barry Barish reported on his recent investigation of the integration of education and outreach activities with the MREFC process. He outlined an analysis from Dr. Mark Coles, the Deputy Director for Large Facility Projects in BFA. The committee agreed to address and discuss this complex issue further at the December 2007 meeting.

Dr. Ford reported on the status of the following subcommittee and task forces:

Subcommittee on Polar Issues (SOPI)

Dr. Barish, SOPI chairman, reported that Dr. Karl Erb, Director of the Office of Polar Programs (OPP), reported on a recent opening ceremony for the start of the Antarctic operating season and had an encouraging comparison of the early season as the edge of the ice did not extend as far into the open waters as in the previous 2 years. Dr. Lightbody, also Program Manager of the IceCube Neutrino Observatory, provided an overview of progress-to-date and the current status of the construction project.

Task Force on International Science (INT)

The committee voted to release the draft report for public review and comment, *International Science and Engineering Partnerships: A Priority for U.S. Foreign Policy and Our Nation's Innovation Enterprise* (NSB-07-10) (Board Book Supplemental Material Tab 3), and recommended approval by the full Board.

The Board unanimously approved the draft report, *International Science and Engineering Partnerships: A Priority for U.S. Foreign Policy and Our Nation's Innovation Enterprise* (NSB-07-10), to be released for public review and comment, subject to minor edits approved by the Board Chairman and the INT chairman.

Task Force on Transformative Research (TR)

Dr. Randall, TR chairman, informed the committee that Dr. Bement presented additional developments of NSF's transformative research initiative strategy in response to the Board's TR report, *Enhancing Support of Transformative Research at the National Science Foundation*

(NSB-07-32). Since the August 2007 meeting, NSF issued Important Notice 130 on the subject of Transformative Research, established a Working Group on Transformative and Inter-disciplinary Research, Solicited for Cyber-Enabled Discovery and Innovation, and developed enhanced Merit Review training. Dr. Randall also outlined NSF's next steps which include: implementation of a change to the Intellectual Merit Review Criterion that will need to provide guidance to reviewers and panels, development of new funding mechanisms, implementation of a merit review course, and continued activities promoting transformative research throughout the NSF.

Task Force on Sustainable Energy (SE)

Drs. Jon Strauss and Arvizu briefed the committee on the activities of the *ad hoc* Task Group on Sustainable Energy including a recent summit on sustainable energy held at the White House. After discussion, the committee approved the charge to create a formal Task Force on Sustainable Energy (Board Book Tab 10C), and recommended approval by the full Board.

The Board unanimously APPROVED the charge to the Task Force on Sustainable Energy (Appendix A).

e. Committee on Strategy and Budget (CSB)

Dr. Bowen, CSB chairman, reported that the committee would be tasked to draft Board responses to two sections of the America COMPETES Act: cost sharing, and the impact of limiting the number of proposals from an institution. The committee and NSF would provide the Board Office with information relative to the second section, which will be brought forward at the December 2007 meeting for discussion. CSB plans to develop a report prepared by the full committee instead of a CSB subgroup.

As a follow up to a presentation at the August 2007 meeting, Dr. Joanne Tornow, Chairman of the NSF Impact of Proposal and Award Management Mechanisms (IPAMM) Working Group, and Dr. Olsen made a presentation that included a summary of findings within the IPAMM report. Information on responses to questions raised related to the IPAMM report was provided to Board Members (Board Book Supplemental Material Tab 10). The committee also heard recommendations that IPAMM made to NSF, one of which was to "Focus on developing strategies that are appropriate within the context of each unit that balance long-term planning with the ability to respond to changing needs and that help break the decline-revise-submit cycle for highly fundable proposals." This recommendation will be factored into future actions by CSB.

Dr. Bowen summarized the Board's long-standing interest and efforts on the information provided by IPAMM to develop recommendations on NSF average award size, duration, and success rate. In addition to the IPAMM report, the context for the committee's discussion was a November 2005 CSB draft recommendation (Board Book Tab 11B). The committee discussed support for the IPAMM recommendation to NSF and a desire to support general principles and guidelines that can be adopted within individual directorates. An effort will be made to revise the draft guidance on this subject and address this guidance at the CSB meeting in December 2007.

Finally, Dr. Bowen reported that Dr. Bement provided a status report on the development of the 2008 NSF budget request and indicated the process that would be followed as the budget comes to completion. Dr. Bement also explained budget impacts under various continuing resolution scenarios, which might run through mid-November 2007.

Task Force on Cost Sharing (CS)

Dr. Droegemeier led a discussion on the creation of the *ad hoc* Task Group on Cost Sharing. He structured his discussions around a draft charge, which included a calendar for the Board's response to Congress, as requested in the authorization. The committee approved a draft charge for a Task Force on Cost Sharing (Board Book Tab 11C), and recommended approval by the full Board.

The Board unanimously APPROVED the charge to the Task Force on Cost Sharing (Appendix B).

Dr. Beerling adjourned the Open Session at 3:15 p.m.



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Attachments

Appendix A: NSB-07-121, Charge to the Task Force on Sustainable Energy
Appendix B: NSB-07-110, Charge to the Task Force on Cost Sharing

Charge to the Task Force on Sustainable Energy

Statutory Basis

"The Board shall render to the President and to the Congress reports on specific, individual policy matters related to science and engineering and education in science engineering, as the Board, the President, or the Congress determines the need for such reports." (42 U.S.C. Section 1863) SEC. 4. (j) (2)

Action Recommended

The National Science Board (Board) will examine the role of the U.S. Government in addressing the science and engineering (S&E) challenges related to development of sustainable energy, and provide recommendations to the President and Congress regarding a nationally coordinated S&E research and education initiative on sustainable energy with specific guidance on the role of the National Science Foundation (NSF) in such an initiative.

Background

The interest of the National Science Board in sustainable energy was encouraged by President George W. Bush's national call to action on energy with the announcement of the Advanced Energy Initiative in his January 31, 2006 State of the Union Address. The rapidly expanding literature warns of a number of threats from our Nation's and the World's reliance on fossil energy sources. These include:

- the economic and societal impacts of a rapidly growing global demand for energy and the increasing costs, both economic and environmental, of fossil fuel as the more easily accessible sources are depleted,
- the threat to national security and balance of trade as the U.S. and other countries, especially emerging economies, become increasingly dependent on a relatively few, often politically unstable, oil exporting nations, and
- the often cited threat of anthropogenic carbon loading in the atmosphere and its effects on the global climate and on human life.

These threats have given rise to a global call to move rapidly to a sustainable energy economy. However, most projections of trends for the next quarter to half century suggest little change in the future global energy mix without more concerted action. It is of concern that the scale and speed of the adoption of sustainable and clean energy technologies will be far short of that necessary to address the threats that will only become more acute with the passage of time. Of particular concern is the heavy dependence on fossil fuels for the transport sector and the carbon footprint that current and projected energy use represents.

Given the Board's responsibility to advise the President and Congress on national policy matters relating to science and engineering, the Board arranged for three expert presentations on the scientific challenges related to the development of sustainable energy:

- *Energy from Biomass*, Chris Somerville, Professor of Biological Sciences, Stanford University, September, 2006;
- *Scientific Challenges in the Development of Sustainable Energy*, Nathan S. Lewis, Professor of Chemistry at Caltech, November, 2006; and
- *Transformational Science for Energy and the Environment*, Raymond L. Orbach, Under Secretary for Science, U.S. Department of Energy, March, 2007.

The Board is also mindful of President Bush's challenge to the nation in his 2007 State of the Union Address: *"America is on the verge of technological breakthroughs that will enable us to live our lives less dependent on oil. And, these technologies will help us be better stewards of the environment, and they will help us to confront the serious challenge of global climate change."*

These presentations and the President's challenge energized the Board regarding the immediacy of the need to develop sustainable energy sources that would lessen the dependence on increasingly difficult to access fossil fuels and decrease the rate of atmospheric carbon loading. Given the vital strategic importance of energy use in carrying out the missions of most government agencies, the Board believes it to be an imperative for the long-term prosperity of this Nation for the government to develop a long-term, coordinated, inter-agency strategy to achieve a stable sustainable U.S. energy future. Such an approach will require that the attributes of a sustainable energy economy be defined and that all technology options be weighed and evaluated against their ability to meet these attributes. Further, this would need to be done in a global context. The Board is uniquely suited to make recommendations regarding the S&E research and education challenges in developing such a nationally coordinated strategy, with specific guidance to NSF on its role in this effort. The Board's Committee on Programs and Plans (CPP) should establish a formal Task Force on Sustainable Energy to lead this Board effort.

Policy Objectives

The following issues will be analyzed and discussed by the Task Force before constructive policy recommendations and a proposed strategy is recommended to CPP and the full Board consistent with the Board's statutory charge.

- Examine existing S&E sustainable energy research and education policies and efforts at the NSF, the Federal Government and U.S. corporations, and around the world in scope, scale, time frame, and in the context of national and global challenges.
- Develop recommendations for the Board to consider with respect to a nationally coordinated S&E research and education initiative on sustainable energy.
- Provide explicit guidance on NSF's role with respect to basic research and education in the overall national effort.

Based upon the work of this Task Force, the Board will then provide policy guidance to NSF, and broader recommendations to the Administration and Congress relative to a long-term coordinated inter-agency strategy for the development of sustainable U.S. energy production in light of President Bush's challenge to be better stewards of the environment.

Logistics

Once the Task Force has completed its initial analysis of existing policies and efforts, the Task Force will bring together representatives of NSF, academe, private sector industry and investors, NGOs, and other pertinent U.S. Federal agencies involved in energy, as well as members of the broader scientific community, through a series of workshops to examine, discuss and address the issues identified above. The Task Force will have the ability to convene such working groups as it deems necessary to obtain additional relevant information as well as to frame recommended strategies. It is anticipated that the Task Force will produce a final report that summarizes its findings and presents recommendations regarding the role of the U.S. Government in addressing S&E challenges related to development of sustainable energy, with specific recommendations for the NSF role in a national S&E research and education initiative on sustainable energy. Printed copies of a final Board report will be widely distributed and available on the Board Web site for the general public, universities, Congress, various special interest groups, and the broad scientific community. In addition, a regular and pro-active outreach effort to communicate task force activities will be implemented throughout the duration of the Task Force life. The Task Force expects to present a draft report to the Board in 12 months, and conclude its activities within 18 months, from the date that formation of the Task Force is approved. The Board Office will serve as the focal point for coordination and implementation of all Task Force activities.

Charge to the Task Force on Cost Sharing

Statutory Basis

“The Board shall render to the President and the Congress reports on specific, individual policy matters related to science and engineering and education in science and engineering, as the Board, the President, or the Congress determines the need for such reports.” (42 U.S.C. 1863(j)(2); and HR 2272)

Action Recommended

The National Science Board (Board) will examine National Science Foundation (NSF) cost sharing and institutional commitment policy, specifically focusing on the consequences of the Board’s 2004 revision to cost sharing policy that eliminated NSF program-specific cost sharing requirements and required only the statutory one percent of sharing.

Background

The Board has been involved with the issue of “cost sharing” since the Bureau of the Budget (predecessor of the Office of Management and Budget [OMB]) requested on September 15, 1954 assistance in setting uniform policies for indirect costs for research grants from Federal agencies. As defined in OMB Circular A-110, cost sharing refers to the contribution of quantifiable and auditable assistance from non-NSF (and non-Federal) sources to NSF-supported activities. Congressional statutory requirements dictate that the recipient of an NSF award resulting from an unsolicited proposal cost share a minimum of one percent on the project or a minimum of one percent of the aggregate costs of all NSF-supported projects subject to the statutory requirements. Prior to October 2004, specific programs could set cost sharing requirements for solicited proposals in addition to the statutory one percent requirement. Revisions to the Board’s cost sharing policy in 1999 and 2002 made it clear that cost sharing is an eligibility criterion rather than a review criterion.

On October 14, 2004, the Board approved its most recent cost sharing policy revision, eliminating NSF program-specific cost sharing requirements and requiring only the statutory one percent of sharing. This revision eliminated cost sharing as an eligibility requirement for grant proposals. This decision may have produced some unintended consequences. The America COMPETES Act (H.R. 2272), signed into law on August 9, 2007, directed the Board to evaluate and report to Congress on the impact of its policy to eliminate cost sharing for existing programs that were developed around industry partnerships and that historically required industry cost sharing. It further directed the Board to consider the impact that this cost sharing policy has on the initiation of new programs for which industry interest and participation are sought.

Policy Objectives

The *ad hoc* Task Group on Cost Sharing recommends that the Board approve the creation of a formal Task Force on Cost Sharing under the Committee on Strategy and Budget (CSB). The following issues will be analyzed and discussed before constructive policy recommendations are brought to CSB and the full Board:

- Requirement of cost sharing in NSF programs, with specific emphasis on programs developed around industry partnerships and programs that historically required cost sharing.
- Role and impact of institutional commitment in NSF programs, defined as voluntary cost sharing (cash or in-kind) provided by an institution for NSF proposals.
- Impact of cost sharing and/or institutional commitment in the review process of proposals for NSF awards.
- Mechanisms and workload, by both NSF and grantee institutions, involved with verifying expenditure of committed non-NSF funds.
- Impact of cost sharing and/or institutional commitment on broadening participation in NSF-funded research.

The task force will seek to contextualize its discussions and recommendations, and the analysis used in developing those recommendations, in broader terms of indirect costs and the overall costs borne by institutions in conducting research. The task force will make use of objective, quantitative data available from NSF and previous studies on cost sharing, and will seek to assemble new objective, quantitative information from various constituency groups. The task force will analyze this information in the context of differing philosophies and objectives by involving constituencies that have different views on cost sharing.

Based upon the work of this task force, the Board will then provide guidance to NSF and make recommendations to the Administration and Congress on future policy and actions with respect to cost sharing and institutional commitment policy for application at NSF.

Logistics

A series of workshops and roundtable discussions will be used by the task force to gather relevant information from academic and other NSF-funded institutions (to include faculty, vice presidents/chancellors for research, and presidents), representatives from U.S. Federal agencies, legislators, and NSF staff, as well as members of the broader scientific and industry communities. Members of the task force may also attend previously scheduled meetings/conferences of academic/scientific societies to discuss cost sharing with various stakeholder groups. A survey on cost sharing may be developed by the task force, within appropriate federal regulations, and distributed to key stakeholders. The purpose of these activities will be to better inform the task force as it develops draft cost sharing policy for full Board review. It is anticipated that the task force will produce a final report that synthesizes the contributions from its own deliberations, previous studies, and survey results, and that it will present recommendations regarding cost sharing and institutional commitment for application at NSF. Printed copies of a final Board report will be widely distributed and made available on the Board Web site for all interested parties. The following is a tentative general timeline for task force activities:

October 3	Discussion of Task Force charge and approval by full Board
October-November	Finalize plans for surveying stakeholders; execute stakeholder survey including quantitative analysis
November-January	Workshops and roundtable discussions and/or Board member/staff attendance at scheduled academic/scientific society conferences to discuss cost sharing with stakeholders
December 5	Task Force meeting as part of Board meeting to discuss survey data and possible recommendations; provide initial thoughts to Board
Early January	Draft preliminary report of initial recommendations shared via email and conference call to further discuss recommendations
Mid-January	Initial review and comment of preliminary report by Board via e-mail
Late January	Revise draft preliminary report and submit to Board
February 6, 2008	Board votes on preliminary report for Congress
Early/mid-February	Preliminary report delivered to Congress
February-May	Develop and approve final report for Congress
Mid-May	Final report delivered to Congress

A regular and proactive outreach effort to communicate task force activities will be implemented throughout the duration of the task force life. The task force expects to conclude its activities within 12 months from the date that formation of the task force is approved. The Board Office will serve as the focal point for coordination and implementation of all task force activities.