NSB-13-15

APPROVED MINUTES[1]
OPEN SESSION
430TH MEETING
NATIONAL SCIENCE BOARD

National Science Foundation
Arlington, Virginia
February 20-21, 2013

Members Present
Dan E. Arvizu, Chairman
Kelvin K. Droegemeier, Vice Chairman
Bonnie Bassler
Arthur Bienenstock
Ray M. Bowen
Vinton G. Cerf
Inez Fung
Esin Gulari
G. Peter Lepage
Alan I. Leshner
W. Carl Lineberger#
G.P. "Bud" Peterson
Geraldine Richmond
Anneila I. Sargent
Diane L. Souvaine
Arnold F. Stancell
Maria T. Zuber

Subra Suresh, *ex officio*

Members Absent
Deborah L. Ball
France A. Córdova
Ruth David
Douglas D. Randall
Robert J. Zimmer

Consultant Present
Mark R. Abbott

[1] The minutes of the 430th meeting were approved by the Board at the May 2013 meeting.
Participated by telephone

The National Science Board (Board, NSB) convened in Open Session at 10:00 a.m. on Thursday, February 21, 2013 with Dr. Dan Arvizu, Chairman, presiding. (Agenda NSB-13-3, Board Book page 384). In accordance with the Government in the Sunshine Act, this portion of the meeting was open to the public.

Prior to the meeting, Dr. Arvizu announced that the President recently appointed the following Board Members for the Class of 2018:

- Dr. Vinton Cerf, Vice President and Chief Internet Evangelist, Google (replacing Mr. Arthur Reilly)
- Dr. Ruth David, President and Chief Executive Officer, Analytic Services, Inc. (replacing Dr. John Bruer)
- Dr. Maria Zuber, Professor of Geophysics and incoming Vice President for Research, Massachusetts Institute of Technology (replacing Dr. Richard Thompson)

Dr. Arvizu gave the Oath of Office to Drs. Cerf and Zuber, as well as Dr. Inez Fung (appointed in December 2012), who were present at the meeting.

AGENDA ITEM 5: Approval of Open Session Minutes, December 2012

The Board unanimously APPROVED the Open Session minutes of the December 2012 Board meeting (NSB-12-66, Board Book page 390).

AGENDA ITEM 6: Chairman's Report

In the Chairman's Introduction on Wednesday, February 20, 2013 and during the Chairman's Report in the Plenary Open Session on Thursday, February 21, 2013, Dr. Arvizu announced and reported on several items.

a. Recognition of Dr. Subra Suresh

On behalf the Board, Dr. Arvizu congratulated Dr. Subra Suresh on his appointment as Carnegie Mellon University's ninth President effective July 1, 2013. He will step down from his current role as NSF Director at the end of March 2013. Dr. Suresh was nominated by the President and confirmed by the Senate in 2010 – coming to NSF from the Massachusetts Institute of Technology (MIT) where he served as the Dean of the School of Engineering.

Dr. Arvizu thanked Dr. Suresh for his vision and leadership of NSF during the past 2 1/2 years. He expressed appreciation for Dr. Suresh's thoughtful contributions to all of the Board's work. He said that, personally, it had been a great opportunity to work with him directly and to have such a wonderful partner and collaborator. Dr. Arvizu stated that Dr. Suresh's accomplishments were many, but noteworthy was his unprecedented engagement and collaboration with the international community and his efforts to ensure that NSF-sponsored science results could find their way more quickly into the marketplace.

Although Dr. Suresh's leadership will be missed at NSF, the collective university community – as well as the scientific and engineering enterprise – will certainly benefit from his tenure at Carnegie Mellon University.

Dr. Arvizu presented Dr. Suresh with a plaque for "achievements in promoting the progress of science and engineering," and a letter of appreciation from him on behalf of the Board that stated in part, "the Board has enjoyed the close and collaborative relationship with the management of NSF that's been fostered by your leadership and your tenure. You've led NSF with great intellectual power, with calm and steady hand and voice, and inspired confidence that impacted everyone around you in the most positive manner." An addendum of the letter with personal comments from Board Members will follow.

b. Merit Review Implementation

In December 2011, the Board published a report entitled, *National Science Foundation's Merit Review Criteria, Review and Revisions* (NSB-11-86). The Board was interested in hearing about NSF's implementation of the Board's recommendations for a set of principles and revised merit review criteria, including the collection and analysis of data that contributed to the Board-approved enhancements. At the meeting in December 2012, Dr. Suresh agreed to present information about the Merit Review implementation.

Dr. Suresh reported on NSF staff work to implement the recommendations contained in the Board's report on merit review. The revisions recommended in the Board report were developed in the context of an extensive effort to gather and analyze data about the use of the criteria with input from stakeholders. In addition to providing information on the revisions, several issues were identified that NSF seriously considered. For example, NSF made a number of changes to the policy documents and business systems to ensure that both merit review criteria were given full consideration by Principal Investigators (PIs), reviewers, and NSF staff. The revised criteria and supporting information were published in the October 2012 version of the *Proposal and Award Policies and Procedures Guide* (NSF-13-1) and became effective in January 2013.

In particular, Dr. Suresh thanked Ms. Jean Feldman, Head, Policy Office, Division of Institution and Award Support (DIAS), Office of Budget, Finance, and Award Management (BFA), and her staff, who led the implementation working group. The implementation working group developed modifications to policy language, and also coordinated with the Division of Information Services (DIS) to ensure that all the connected electronic business systems were modified to reflect these changes.

He also thanked Dr. Joanne Tornow, Executive Secretary, Task Force on Merit Review, for her efforts in that capacity and for working closely with Ms. Feldman through the implementation phase. Ms. Feldman and Dr. Tornow held several internal Town Hall meetings to inform the NSF of the changes and conducted numerous outreach events at professional society meetings, NSF days, and the semi-annual NSF grants conferences. For internal staff and members of the external community who were not able to attend any of these events, NSF posted Webinars explaining the revision of the merit review criteria as well as the NSF's implementation.

NSF will continue to monitor the merit review implementation, and make adjustments to its outreach and resource materials as needed to assist the community in using these criteria most effectively.

c. Final Letter to OSTP on Science Communication and Travel Restrictions

The Chairman reported that a final letter was sent to the Office of Science and Technology Policy (OSTP) on February 15, 2013 on scientific communication and travel restrictions. Since the December 2012 meeting, BFA informed the Board that NSF was subject to an effective 12 percent, instead of 30 percent, reduction below the 2010 travel restrictions that were earlier described by the Office of Management and Budget (OMB). Accordingly, the letter was revised to include updated information on travel reductions and more specific examples of how travel budget restrictions create difficulties for the agency. It was sent to OSTP, with a copy to OMB, on February 15, 2013. (Appendix A)

d. Committee Announcement

Dr. Arvizu appointed the *ad hoc* Committee on Nominating for NSB Elections, otherwise known as the Elections Committee. Dr. Douglas Randall will be the chairman, and Drs. Esin Gulari and Arnold Stancell will serve with him. There will be two vacancies on the Executive Committee in May 2013 as the terms for Drs. Carl Lineberger and Diane Souvaine end. The Elections Committee will prepare a slate of candidates for consideration and election at the May 2013 meeting for two 2-year terms from 2013 to 2015.

e. Board Off-Site Research Visit, Retreat, and Possible Meeting for September 2013

Dr. Arvizu announced that in the Plenary Executive Closed Session, the Board reviewed and discussed proposed sites for the 2013 Board off-site research visit, Retreat, and possible meeting, which is slated for September 19-20, 2013. The Board agreed to hold the Retreat at an off-site location in Seattle, Washington. The Chairman asked Dr. Michael Van Woert, Executive Officer and Board Office Director, to begin making appropriate arrangements.

f. Board Office Staff

For the Board Office staff, Dr. Arvizu made the following announcements:

Ms. Betty Wong, Program Analyst with the Board Office, left the agency on December 28, 2012 to work as a Program and Management Analyst with the Federal Housing Finance Agency, Office of Inspector General. Betty served NSF for 26 years, and was a remarkable administrator who fulfilled many roles for the Board Office - mastering various IT programs and systems, Budget Officer, Coordinator for the Annual Awards Ceremony and Dinner – just to name a few. A tireless and dedicated staffer, Betty was the "go-to" person for quick, accurate, and outstanding results.

Also, as of December 28, 2012, Ms. Kim Silverman, a Science Policy Analyst with the Board Office, began a Brookings Institute Congressional Fellowship for 1 year. She is serving the Senate Special Committee on Aging.

g. Webcast of Board Meeting / Concurrent Sessions

The February 2013 Board meeting was Webcast and simultaneously available to viewers through the Internet. The Webcast included the Plenary Open Session of the full Board as well as Open Sessions of its committees. The Webcast is available from the NSB and NSF Web sites, http://www.tvworldwide.com/events/nsf/130220/#.

AGENDA ITEM 7: Director's Report

Dr. Subra Suresh, NSF Director, reported on the following items:

a. NSF Staff Introductions

Dr. Pramod Khargonekar will join NSF on March 11, 2013 as the Assistant Director, Directorate for Engineering (ENG). Dr. Khargonekar joins NSF from the University of Florida where he serves as Eckis Professor of Electrical and Computer Engineering. Currently, Dr. Khargonekar is on leave serving as the Deputy Director for Technology at the U.S. Department of Energy's Advanced Research Projects Agency-Energy (ARPA-E). Dr. Khargonekar has a distinguished record of accomplishments in research and education. He received his Ph.D. in Electrical Engineering from the University of Florida.

Dr. Roger M. Wakimoto, from the University of Colorado, will join NSF on February 25, 2013 Assistant Director (AD), Directorate for Geoscience (GEO). Previously, Dr. Wakimoto served as the Director, National Center for Atmospheric Research (NCAR). He received his Ph.D. in Geophysical Sciences from the University of Chicago in 1981.

Dr. Mary Galvin-Donoghue joined NSF as Division Director, Division of Materials Research (DMR), Directorate for Mathematical and Physical Sciences (MPS), on January 13, 2013. Previously, in 2010, Dr. Galvin-Donoghue came to NSF as a Program Director from the Department of Energy. She has held appointments as Director of External Research and Development (R&D) and Senior Scientist for Air Products and Chemicals, and was a Distinguished Member of the Technical Staff at Bell Laboratories. Dr. Galvin received her Ph.D. in Polymers/Materials Science from MIT in 1984.

Mr. John Gawalt became the Division Director, National Center for Science and Engineering Statistics (NCSES), Directorate for Social, Behavioral, and Economic Sciences (SBE) on December 16, 2012. Mr. Gawalt served as the Acting NCSES Division Director from February 2012 and Deputy Division Director from 2010. Since joining NSF from the Bureau of Labor Statistics in 1988, he has held a number of progressively more responsible positions in SBE. Mr. Gawalt received his M.S. in Resource Economics from the University of Rhode Island in 1982.

Dr. Susan Singer joined NSF as Division Director, Division of Undergraduate Education (DUE), Directorate for Education and Human Resources (EHR) on January 29, 2013. Dr. Singer came to NSF from Carleton College where she is the Laurence McKinley Gould Professor of the

Natural Sciences. Dr. Singer was Co-Director of the Carleton Interdisciplinary Science and Math Initiative and served as Department Chair from 1995 to 1998. Dr. Singer received her Ph.D. in Biology from Rensselaer Polytechnic Institute in 1985.

Dr. Wendy Harrison joined NSF as Division Director, GEO Division of Earth Sciences (EAR), on August 27, 2012. Dr. Harrison came to NSF from the Colorado School of Mines where she held a number of positions including Professor within the Department of Geology and Geological Engineering, Associate Provost, and Dean of Undergraduate Studies and Faculty. She received her Ph.D. in Geology from the University of Manchester, U.K.

b. Congressional Update

Dr. Suresh reported that NSF was up against two deadlines. If Congress did not act by March 1, 2013, the President would issue a sequestration order. Agencies would have 30 days to submit new operating plans to Congress. For NSF, it would mean across-the-board reductions in budgetary resources (both discretionary and mandatory accounts) of approximately 5 percent compared to FY 2012. During this 30 day period, Congress must also act on the FY 2013 Continuing Resolution, which was set to expire on March 27, 2013. Congress acted in January 2013 to temporarily raise the debt ceiling, but only through May 2013. The FY 2014 budget request to Congress was expected in mid- to late-March 2013, and testimony was being scheduled.

The House and Senate appropriations and authorization committees recently completed organizational structures with several changes to chairmen and ranking members. [Committees included: the House Appropriations Subcommittee on Commerce, Justice, Science, and Related Agencies; House Science, Space, and Technology Committee; Senate Appropriations Subcommittee on Commerce, Justice, Science, and Related Agencies; Senate Committee on Commerce, Science, and Transportation; and Senate Committee on Health, Education, Labor, and Pensions.]

AGENDA ITEM 8: Open Committee Reports
[Note: The Executive Committee (EC) did not meet in February 2013.]

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

Dr. Bud Peterson, A&O chairman, reported that Ms. Allison Lerner, NSF Inspector General (IG), gave the new Board Members a primer on the Office of Inspector General (OIG) roles and responsibilities, and updated to the committee about OIG recent activities (including a "Sunshine Act" audit of the NSB), and her upcoming testimony at congressional hearings. As a follow-up to the discussion at the December 2012 meeting, she announced plans for an April 16, 2013 national Webinar on the use of data analytics in OIG's audits to update the university community about the processes and changes underway.

The committee heard a report from Ms. Martha "Marty" Rubenstein, NSF Chief Financial Officer (CFO). Her office is actively "keeping the trains running" despite issues and uncertainties surrounding the Federal budget (Board Book page 265).

Additionally, A&O began a conversation about updating the committee charge (Board Book page 261).

Lastly, Dr. Peterson recognized Mr. Thomas "Tim" Cross, upon his retirement, who served as the Deputy Inspector General since 2000.

b. Committee on Education and Human Resources (CEH)

Dr. Bonnie Bassler reported on behalf of Dr. Claude Steele, CEH chairman. The committee was reminded that its order of business this spring was to identify one or two topic areas related to science, technology, engineering, and mathematics (STEM) education and workforce development that are of high priority for the committee during the next year or so. The goal was to narrow the list of potential topics by the end of the May 2013 meeting. To start that process, the agenda focused on two main topic areas: (1) issues related to graduate STEM education and (2) issues related to undergraduate STEM education.

The discussion on the topic of modernization of graduate STEM education was introduced by Dr. Richard Linton, Council of Graduate Schools/NSF Dean-in-Residence. Dr. Linton provided an overview on the state of graduate education in STEM, as well as NSF's role in funding graduate students, and identified some of the shifts in skills and training required for graduate students to meet the needs of today's workforce. NSF supports nearly 42,000 graduate students annually, with 80 percent of those funded with research assistantships. He summarized some of the key considerations regarding graduate education in STEM that are emerging from several recent reports and an NSF-initiated "Year of Dialogue on Graduate Education" with various stakeholders in the community and within NSF. Among those concerns was the desire to provide more professional development opportunities, which could have implications for NSF's model of supporting graduate education. In addition, there was a need for more data on the impact of NSF funding at the graduate level. Dr. Linton invited CEH to consider becoming a partner in the Year of Dialog effort to help foster the necessary transformations at the institutional level. (Board Book page 123, Board Book Addendum, Presentation Book)

The committee discussed the possible roles of NSB and NSF for innovations for undergraduate STEM education. Dr. Susan Singer, Division Director, EHR Division of Undergraduate Education (DUE), and Dr. Judith Verbeke, Acting Division Director, Division of Biological Infrastructure (DBI), Directorate for Biological Sciences (BIO), gave presentations to the Board (Presentation Book). Dr. Singer summarized findings in the National Research Council (NRC) report, *Discipline-Based Education Research: Understanding and Improving Learning in Undergraduate Science and Engineering*, which synthesizes some of the research base for effectively training students to acquire the special skills associated with specific scientific and engineering disciplines. The report also provides a baseline analysis of how broadly the known best practices have been adopted, which reveals that they are not widely used by STEM faculty (Board Book page 140).

Dr. Verbeke described efforts underway to implement the recommendations of the American Association for the Advancement of Science (AAAS) report, *Vision and Change in Undergraduate Biology Education – A Call to Action*, which focuses on modernization of the undergraduate Biological and Life Sciences curriculum and specific efforts to engage faculty

and department chairs as ambassadors to help promote cultural changes within institutions and departments (Board Book page 144). She suggested that the Board might help to foster transformation at the institutional level by creating the appropriate mechanisms for incentives and rewards.

The final segment of the CEH meeting identified additional topics, beyond those already raised, that might be candidates for committee consideration. Dr. Steele briefly described some of the opportunities and challenges associated with Massive Open Online Courses (MOOCs), as well as some of the drivers that are catalyzing this approach. Among the many complex issues and questions surrounding MOOCs are: its implications for the higher education business model, issues related to giving credit or certifications, intellectual property rights of the course creators, the opportunity to use these as a platform for doing "Big Data" STEM education research, and the need to gauge the impact of both traditional graduate education models and the new methods. He asked whether the committee should consider developing an appraisal of the disruptive effects that these types of transformations will have on higher education in STEM (Board Book page 244).

As time did not permit for all committee members to bring forward other topics of interest, the committee might convene a teleconference before the May 2013 meeting to continue that part of the conversation.

On behalf of the committee, Dr. Bassler recognized the departing Dr. Jill Karsten, who served as Executive Secretary to CEH during the past 3 years.

c. Committee on Science and Engineering Indicators (SEI)

Dr. Ray Bowen, SEI chairman, reported that SEI began the meeting with an overview of *Science and Engineering Indicators (Indicators)* 2014 production. A working group of the Board continued to discuss potential changes to the state chapter of *Indicators*, and started a process to implement improvements. The working group will report back to the committee in May 2013.

Dr. Bowen thanked those Board Members who have already agreed to be a chapter reviewer or lead reviewer, and hoped to receive responses from the other Board Members to a recent review survey. This oversight role is critical to ensuring that *Indicators* remains the standard bearer of Science and Engineering (S&E) data and trends. He expected that all Board Members will receive their review assignments within the next 2 weeks. At the May 2013 meeting, the committee will review the external expert responses to the initial chapter drafts and the authors' plans for revision (Board Book page 272).

SEI selected a cover for *Indicators* 2014, which was provided to the Board. A picture of a flower-like structure helps to illustrate the energy of electrons in a molecule called sym-triazine.

NCSES finalized all of the content for the *Indicators* 2012 mobile application. It selected an icon for the application, which will allow NCSES to submit the entire package to be published in the Apple App Store. The staff will work on making the NSB and NSF logos or names more prominent within the application itself. The application will deliver all of the SEI content, which

includes the main report, Digest, state data tool, and Companion reports. The initial publication will be for Apple mobile platforms, and Android access will follow. A report on the rollout of the application will be presented at the May 2013 meeting.

The mobile application is one step toward providing the user community with better access to the *Indicators* data. Mr. Jeffrey Alexander, SRI International, described the initial plans for the project to redesign Indicators as a "born digital" document that takes fuller advantage of digital media. The committee discussed various ways for implementation, including thinking about *Indicators* as perhaps a curated database, adding video or other interactive elements, and considering a "responsive design" platform. The *Indicators* report is mandated by law, so the views of Congress and the President must also be kept in mind. Some of the SEI members offered to consult on the project, and the committee expects to receive regular updates on progress at future meetings.

The committee continued the discussion it began in December 2012 on the topic for a Companion report for *Indicators* 2014 (Board Book page 280).

- Members expressed interest in topic (1) "Online Education," but cautioned that there are limited data on which to rely and the field is rapidly evolving. A Companion report on this topic may be premature at this stage.
- Members also expressed enthusiasm for topic (2) "The Opportunities Afforded by a Science and Engineering (S&E) Degree," particularly important for providing students with economic data on possible career options in light of the rising costs of higher education.
- A few members were interested in topic (3) "The Globalization of Higher Education," particularly the importance of creating a highly skilled workforce to maintain the national competitiveness in knowledge and technology intensive industries.

Given the support for certain aspects of topics (2) and (3), the committee asked staff to explore how these two topics might be combined into a single cohesive topic for the 2014 Companion report of *Indicators*. The staff will report back to the Board with a revised option, and the committee hopes to finalize this topic at the May 2013 meeting.

As part of the ongoing outreach strategy and support of *Indicators* and the 2012 Companion reports, the staff developed a tentative plan for a panel discussion on challenges facing public research universities. Staff will continue to refine this particular plan and will distribute the proposal to the committee members for their input.

Finally, continuing on the theme of outreach, Mr. John Chase, SRI International, gave a demonstration of the updated and redesigned STEM Education Data and Trends online tool. The purpose of this tool is to make *Indicators* data accessible to parents, students, and educational professionals. A summary of the key changes to the tool and a draft of the tool itself will be provided to the Board in advance of the May 2013 meeting with a goal of approving the tool for public release at the May 2013 meeting.

d. Joint Committee on Programs and Plans / Committee on Strategy and Budget (Joint CPP-CSB)

Dr. Diane Souvaine reported for the Joint CPP-CSB, which she co-chaired with Dr. France Córdova, CSB chairman. The Joint CPP-CSB considered the NSF Annual Facilities Plan, which is also helpful to the CSB Subcommittee on Facilities (SCF), as it prepares for the annual facilities portfolio review in May 2013. Dr. Scott Horner, Acting Director, NSF Large Facilities Office, presented the NSF Annual Facilities Review and responded to questions (Board Book page 12, Presentation Book).

e. Committee on Programs and Plans (CPP)

Dr. Diane Souvaine, CPP chairman, noted that according to the CY 2013 Schedule of Action and Information Items for NSB Review (Board Book page 55), the committee will have four action items for the May 2013 meeting. At the CPP meeting, Dr. Douglas Randall also noted the written information item on iPlant (NSB/CPP-13-2, Board book page 61), which provided advance guidance on the project's award for renewal, will also be on the May 2013 CPP agenda.

NSB Discussion Item: Review of CPP Charge

The committee discussed the structure and charge for CPP. At the December 2012 meeting, the Subcommittee on Polar Issues (SOPI) was folded into the full committee, prompting CPP to review the committee's charge, make revisions as needed, and reflect on the broad responsibilities of the committee.

Dr. Kelvin Droegemeier, former CPP chairman, began this review several years ago, and noted that the new draft charge clarifies and addresses the role of CPP. The committee received a copy of the proposed revision, and will receive a copy of the 2002 version for comparison. Committee members were asked to send their comments and feedback to Ms. Sonya Mallinoff, CPP Executive Secretary, to incorporate into a final draft for approval at the May 2013 meeting.

NSB Information Item: Arctic Support Contract – Annual Update
(Board Book page 62)

The first information item was a written information document on the Arctic Support Contract.

NSB Information Item: Seismological Facilities for the Advancement of Geoscience and EarthScope (SAGE) / Geodesy Advancing Geoscience and EarthScope (GAGE), Directorate for Geosciences (GEO) Facility Awards
(Board Book page 65, Presentation Book)

Dr. Gregory Anderson, GEO Division of Earth Sciences (EAR), informed the committee about two new cooperative agreements for 5 years that are planned for these facilities. The agreements were requested to encourage the integration of management and operations of core geodetic facilities managed by UNAVCO and the Plate Boundary Observatory component of the

EarthScope facility, and the core seismic facilities managed by Incorporated Research Institutions for Seismology (IRIS) with the USArray component of the EarthScope Facility. The committee plans to bring an action item on SAGE/GAGE to the Board in May 2013.

NSB Information Item: University Corporation for Atmospheric Research (UCAR) Award for Management of the National Center for Atmospheric Research (NCAR)
(Presentation Book)

Dr. Sarah Ruth, Program Coordinator, GEO Division of Atmospheric and Geospace Sciences (AGS) updated the committee on the comprehensive NCAR review in 2011 and noted that all reviews indicated that it was performing well and that the UCAR management was excellent. She informed the committee that NSF allowed UCAR to submit a renewal proposal for another 5 years. The proposal is under review and will come before the Board in May 2013. The facility will again come up for recompetition following that award.

NSB Information Item: Science of Learning Centers (SLCs) Update
(Presentation Book)

Dr. Mark Weiss, Division Director, SBE Division of Behavioral and Cognitive Sciences (BCS), provided an update on the SLCs. Dr. Weiss highlighted notable features of the centers, including collaborations involving more than 30 academic institutions and 60 nonacademic institutions, as well as countries around the world. He also informed the committee of two upcoming workshops that will evaluate the history of the centers and determine the direction forward.

NSB Information Item: Atacama Large Millimeter Array (ALMA) Operations Update – Planning Recompetition
(Presentation Book)

Dr. Philip Puxley, Program Director, MPS Division of Astronomical Sciences (AST), presented an information item on the plans for recompetition of ALMA. He noted that the Board previously urged the separation of ALMA from the National Radio Astronomy Observatory (NRAO), due to concern about schedule slippage. As that concern did not materialize, NSF plans for ALMA to remain part of NRAO in order to keep a strong technical base and maintain North America's position in the international partnership. He informed the committee that NSF met with a number of interested potential proposers who have shown interest in managing both ALMA and the Very Large Array (VLA).

Dr. Puxley also noted that the MPS Portfolio Review, addressed at the CPP December 2012 meeting, recommended separation of the Green Bank Telescope and the Very Long Baseline Array from the ALMA and VLA projects. NSF agreed with this assessment and plans to separate these in order to create a more competitive bidding environment for ALMA and VLA.

NSB Discussion Item: CPP Program Portfolio Planning
(Board Book page 79)

The committee then turned to the February 2013 CPP Program Portfolio Planning topic - Water. Dr. Wendy Harrison, GEO EAR Division Director, gave a presentation about the importance of

water - a critical, globally important resource. Most of the NSF ADs joined the committee at the table for the discussion.

Dr. Kelvin Droegemeier and Dr. Geraldine Richmond served as lead discussants. The committee engaged in a productive discussion with NSF senior management on this topic, noting that all directorates have an important role to play in water issues. Several committee members noted the important role of the social and behavioral sciences, because many questions related to water are fundamentally human driven. The resulting summary document, "From Disciplinary Science to Global Reach: Water Research at NSF" (NSB/CPP-13-9, Appendix B), was provided to Board Members and submitted for the record of the Plenary Open Session.

The committee also briefly discussed the future of these planning sessions, and will not address a new topic during the May 2013 meeting. This is an effort to take time to review and engage in more long-range planning before resuming the one- portfolio-planning- topic format at each of the NSB quarterly meetings.

f. Committee on Strategy and Budget (CSB)

Dr. Arnold Stancell reported on behalf of Dr. France Córdova, CSB chairman. He stated that the committee received an update on the FY 2013 budget related items from the NSF Director. Dr. Suresh shared that March 2013 would be an eventful month for both NSF and the Federal Government. He stated that the first concern was related to mandatory sequestration as a result of the 2011 Budget Control Act. Sequestration was delayed 2 months from the original January 2013 date until March 1, 2013. If sequestration goes into effect, NSF will be subject to an across-the-board cut of 5.1 percent from FY 2012 funding levels. Dr. Suresh also noted that polar logistics, which involved Department of Defense (DoD) funds, will be subject to a 7.7 percent reduction in line with the associated DoD reduction.

Dr. Suresh stated that OMB encouraged NSF to use any flexible plan available to minimize the impact of the budget cuts. NSF senior management developed a set of principles that would be followed should sequestration be implemented, and were communicated to the workforce. The principles are: (1) protect the NSF workforce – no layoffs or furloughs, (2) meet existing grant and contract commitments, and (3) protect STEM human capital development programs such as Fellowships and the Faculty Early Career Development Program (CAREER). He closed by telling the committee that there was no clear action in sight, but the NSF had plans and contingencies ready.

The committee also received an update on NSF Strategic Plan development. NSF began its Strategic Plan for 2014 - 2018 under the leadership of Dr. Joseph Dehmer, Senior Advisor for Strategic Planning. A few CSB members met with Dr. Dehmer by teleconference last month. Dr. Dehmer provided an overview of the process and a timeline for development and submission of the plan. The final plan will be published on Performance.gov concurrently with the release of the President's FY 2015 Budget Request to Congress in early February 2014. (Board Book page 112, Presentation Book)

g. Task Force on Administrative Burdens (AB)

Dr. Arthur Bienenstock, AB chairman, reported that Dr. Susan Sedwick, Chair of the Federal Demonstration Partnership (FDP), provided an overview of the current FDP projects, which are aimed at streamlining and improving administrative processes. Dr. Susan Schneider, FDP Vice Chair and the PI for the FDP Faculty Workload Survey (FWS), briefed the task force on the results of their latest survey. The data presented a detailed look at the administrative burdens associated with Federally-funded projects. Dr. Schneider's presentation also provided interesting results relating to administrative workload associated with the NSF proposal and award process. (Board Book pages 293 and 299, Board Book Addendum, Presentation Book)

The task force discussed which aspects of Federal and agency requirements are necessary responsibilities that come with Federal funding and what represents unnecessary administrative work. The task force will focus on identifying the core of information that is needed to satisfy requirements so that the administrative workload of PIs and program officers can be reduced.

Dr. Clifford Gabriel, Senior Advisor, Office of the Director and NSF Representative to the Research Business Models Working Group, and Ms. Jean Feldman, Head, DIAS Policy Office, briefed the task force on the development of the Research Performance Progress Report (RPPR) and implementation for reporting at NSF.

Questions focused on the usability of systems being developed for submission of reports to NSF including the browser testing and whether considerations have been given to the time required on the part of PIs to submit structured data versus the current practice of uploading a PDF document.

A teleconference will be scheduled to discuss the items that were not covered in the task force meeting. This will include discussion on a Request for Information that the task force is currently preparing for dissemination, the OMB's new Proposed Uniform Guidance, and proposed roundtable discussions with the community.

Dr. Arvizu adjourned the Open Session at 10:50 a.m.

[signed]
Ann A. Ferrante
Executive Secretary
National Science Board

Attachments:

Appendix A: Final Letter to OSTP from NSB Chairman regarding Scientific Communication and Travel Restrictions
Appendix B: CPP From Disciplinary Science to Global Reach: Water Research at NSF (NSB/CPP-13-9)

National Science Board

February 15, 2013

John Holdren, Ph.D.
Director, Office of Science and Technology Policy
Executive Office of the President
Eisenhower Executive Office Building
Washington, DC 20504

Dear Dr. Holdren,

I am writing on behalf of the National Science Board (NSB, Board), the independent governing body responsible for oversight and policy for the National Science Foundation (NSF). The Board has requested that I share some thoughts with you about the importance of travel funds for NSF's ability to accomplish its mission. Some of the Foundation's strategies for efficiency, effectiveness, and fairness of operations are tied to this budget item in ways that may not be fully understood outside the agency. The Board is concerned that continuing pressure on NSF's travel funds can impede the agency's capacity to lead the scientific community and perform as a wise steward of basic science and engineering research.

The Board entirely concurs with the need to avoid wasteful government spending. NSF has been highly responsible in this regard, holding its administrative expenses, including salaries and travel, to approximately 5% of its budget for over a decade. NSF has maintained this impressive efficiency in the face of substantial workload increases by devising creative and extensive strategies constraining administrative costs, including travel costs. In this context, sustained low levels of travel funding threaten NSF's ability to achieve its mission by:

- reducing participation in scientific meetings,
- impairing the agency's ability to recruit key scientific talent, and
- reducing travel for purposes of providing advice to and oversight of major scientific infrastructure and centers.

With regard to participation in scientific meetings: NSF program directors conduct large amounts of crucial work at scientific workshops and conferences. In these meetings, program directors:

- share information about grant opportunities, priorities, review and funding processes, and policy changes efficiently in group forums and in numbers of one-on-one interactions;
- meet in person with grantees to monitor their progress and problems, which allows great richness of interaction but is less costly than site visits;
- facilitate new interactions among scientists who they know to have common interests and complementary capabilities;
- learn about recent advances and fruitful new areas for investment. As OSTP knows well, the leading edge of findings and ideas in science is typically not found in journals but rather in discussions at conferences and workshops prior to publication. When NSF cannot attend or convene such meetings, the staff and the organization as a whole are in danger of becoming out of date.

In other words, NSF has developed strategies for conducting much of its business at widely accessible science meetings in order to be as fair and effective as possible while keeping costs down. As a result, pressure to cut travel to scientific meetings threatens many aspects of the NSF's work.

With regard to recruitment: NSF is unusual in that many of its scientific staff serve only temporarily, for 1-4 years. These visiting scientists bring up-to-date knowledge and fresh thinking to the agency and keep the Foundation in close touch with the relevant communities. Unlike many other agencies, NSF has no branch locations in the U.S.. In this context, NSF's temporary personnel serve as regional ambassadors when they return to their home institutions. These visiting scientists make significant personal and professional sacrifices in order to serve as stewards for science. They are away from home for extended periods and have less time for their own research programs. They are disadvantaged if they must dramatically reduce their travel to conferences or to their home institutions in order to serve the Foundation. To the extent that the agency cannot promise them the ability to do the travel necessary to reasonably sustain their personal lives and their careers, NSF's ability to recruit key talent is hampered.

With regard to oversight: the Foundation needs to maintain careful, effective oversight and guidance of its investments. NSF is committed to proactive oversight to ensure that awardees avoid problems, instead of just holding them accountable after a problem is found. The Foundation therefore conducts both oversight and capacity building and it does so both in terms of the science, which involves program directors, and also in terms of institutional grants management and financial adequacy, which involves the agency's business process and grants experts. Telecommunications are used regularly to do this work, but in complex situations remote communications can be inadequate. For example, staff from NSF's Office of Polar Programs were recently unable to travel to work with a prime contractor for Antarctic vehicles. As a result, only a portion of the planned procurement was able to be executed and several of the vehicles received have flaws that will take time and money to rectify. The staff is convinced they could have achieved proper coordination and collaboration among all parties with one or two focused, face-to-face meetings.

In sum, severe restrictions on travel funds can impede NSF's ability to achieve its mission to promote the progress of science for the public good by significantly constraining its communications with science and engineering communities, reducing its ability to employ excellent scientists as expert and efficient participants in the agency's work, and limiting its ability to guide and oversee its investments.

Thank you for taking time to consider the concerns of the National Science Board.

Respectfully,

[signed]
Dan E. Arvizu, Ph.D.
Chairman
National Science Board

CC: Mr. Danny Werfel, Controller of the Office of Management and Budget
Ms. Sally Ericsson, Principal Assistant Deputy, Office of Management and Budget

Committee on Programs and Plans
Program Portfolio Planning

From Disciplinary Science to Global Reach: Water Research at NSF

February 2013 NSB Meeting

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The National Science Board (NSB) has charged its Committee on Programs and Plans (CPP) with long-range policy oversight of the National Science Foundation's (NSF) Research and Related Activities (R&RA) portfolio. To inform this oversight and provide an interactive forum for informal recommendations and advice, CPP conducts program portfolio planning discussions at each meeting. These discussions seek to address issues that have the potential to impact the portfolio as a whole or which have strategic or national significance. This document summarizes CPP's February 2013 portfolio planning discussion, which addressed NSF's portfolio-wide investments in water research. While research on water has a global reach and great societal importance, CPP selected the topic because it also connects directly to core science and engineering challenges.

After a presentation by Dr. Wendy Harrison, Director of the Division of Earth Sciences (GEO), which included information provided by Dr. Thomas Torgersen (GEO) and program officers throughout the Foundation, CPP began a discussion that featured Drs. Myron Gutmann (SBE), Margaret Cavanaugh (GEO), John Wingfield (BIO), Kesh Narayanan (ENG), and Fleming Crim (MPS). The disciplinary breadth of these discussants was reflected in the presentation and is one indication of the interdisciplinary, interagency, and international scope of water research. The CPP discussion indicated clear support for NSF's water research activities, and observed that water-related challenges are "a crucial issue of our time." The Committee also expressly intends that this summary document aid NSF in planning and development rather than be prescriptive.

Background and Presentation

Water's importance to our planet has global reach. Population growth demands water for agriculture, energy production, industry, and the support of healthy human life; and climate, land-use, and population change all create stress on water resources. Food supply, economic growth, and political stability hinge on water security (ICA-08-2012). While freshwater is a renewable resource, it is not inexhaustible, and poor quality often limits availability.

Human actions related to agriculture and urbanization, among others, cause re-plumbing of how water moves on and within the Earth, as do variations in temperature and precipitation related to climate change. There are many fundamental questions related to how these changes will impact cities, countries, and continents, and therefore need to investigate hydrologic response to abrupt, short-term as well as long term decadal to millennial changes in climate and land-use.

Even basic world-wide goals, such as universal access to water and sanitation, remain distant and will require significant investments. The World Bank has estimated a cost of $5-21 billion to achieve this goal by 2015. In parts of northern Africa, western Asia, and indeed the United States, water resources are being

depleted at rates that are unsustainable. A review of water related research at NSF is timely to examine current initiatives and identify opportunities to further leverage partnerships and collaborations.

Water Research at NSF is Interdisciplinary, Interagency, and International. At NSF, GEO, ENG, BIO, SBE, MPS, EHR, and CISE Directorates, along with offices supporting the Office of the Director, all support water-related research in their core/focus areas. NSF has also developed strong and long-standing partnerships with the US Geological Survey (USGS), US Department of Agriculture (USDA), and the U.S. Army Corps of Engineers (USACE) in water research and technology innovation. International collaborations and partnerships are key to NSF's leadership in water related research, engineering, and education. As examples, NSF participates in the Inter-American Institute for Global Change research (IAI) water related projects; the Asia Pacific Network for Global Change Research (APN); with USAID through PEER projects; and was a founding partner of the Belmont-G8 Heads of Research International Opportunities. Proposals on Freshwater Security are under review during Spring 2013.

The National Academies recently articulated three key areas into which scientific challenges for water in the coming decade *(Challenges and Opportunities in Hydrologic Sciences, NAS 2012).* NSF's disciplinary and interdisciplinary research and partnerships fall into this tripartite structure: The Water Cycle: An Agent of Change; Water and Life; and Clean Water for People**.**

NSF supports basic scientific understanding of reaction and transport driven by hydrologic flows from a molecular scale to a continental scale; with time dimensions of milliseconds to millions of years. Conceptual frameworks for describing variability over such a wide range of dimensional scales and our next Earth system challenge are needed to connect atmosphere-ocean models with terrestrial processes.

NSF supports creativity and innovation in supplying clean water through engineering solutions at molecular to megacity scales and enables the development of technologies to understand water purification, and movement and remediation of contaminants in the natural and built environments.

NSF's research provides knowledge that informs and enables social, political and economic decision-making for the world's population; engages participation of under-represented groups, teacher and workforce development, public literacy and partnerships with industry nationally and internationally; and enables transferable knowledge from highly calibrated regions (North America) to locales that are minimally monitored and have a critical need (developing world).

In 2009, NSF addressed the importance of water sustainability and the impact of climate change with its SEES portfolio through Water Sustainability and Climate (WSC) program. SEES projects are co-funded by GEO, ENG, SBE, BIO and USDA/NIFA (National Institute of Food and Water) with participation from OISE. WSC enables the complexity of water sustainability to be investigated in light of climate, land-use and population change and it enables the feedbacks among disciplinary processes to be investigated in large complex systems. WSC projects identify specific high-order problems, resilience and thresholds, and allow prioritization of specific research needs which are the domain of the core programs among the Directorates. Fifteen WSC projects were awarded in 2010 for $25M and 14 projects were awarded in 2012 for $26M.

Within the core discovery programs, some examples of outstanding challenges include:

- Understanding the physical role of water in the past, present, and future of the Earth's terrestrial system, including the hydrologic response to changes on multiple time scales;
- Understanding the mobilization of nutrients and multiple redox reactions that shape the environment. A grand challenge is to understand the complex means by which flow regimes and the built environment impact ecological function of both natural and agricultural systems;

- Developing basic hydrologic principles and tools to further understand the movement and remediation of contaminants in clean-up, water purification, and waste-water treatment facilities; and
- Creating water knowledge in a form that reflects systems level complexity; integrates the needs of urban planners, water managers, forest managers, agriculturists, policy makers and the public; enables novel cross-agency partnerships that are non-duplicative; enables and advances social and policy decision-making; and enables transferable knowledge.
- Obtaining a deeper understanding of water's behavior at the molecular level, and its role in important chemical, physical, biological, and environmental processes.

Suggested Questions for Discussion

1. NSF has a comprehensive portfolio of water-related research and education. Should NSF further its national and global reach in water security?

2. NSF supports basic research that underpins many actions taken by partner agencies. How can we make our contributions more visible to water managers, policy makers, and the public?

3. How can NSF interact more productively with sister agencies and international partners to better predict and mitigate floods, droughts, fire, and climate impact?

Discussion and Recommendations

Board Members applauded NSF for both its willingness to spotlight a critical issue in a portfolio discussion and for the impressive richness and breadth of its $400 million annual water research portfolio. The ensuing discussion covered issues ranging from educating the general public to the cultural variation on technology adoption. Much of the discussion was driven by a consensus that water issues lie at the heart of the many pressing global challenges, including energy, health, food, climate change, and even political stability. Board Members concurred with the discussants that science – including the social, behavioral, and economic science --- and engineering research needs be part of the solution to these challenges.

An International Problem

CPP Members agreed wholeheartedly that water research is inextricably international in scope and practice, and appreciated the portions of the presentation devoted to international partnerships such as the Belmont Forum. Director Suresh also elaborated on the PEER program, run in partnership with the U.S. Agency for International Development (USAID), and noted that several of its first grants were focused specifically on water research. Dr. Richmond also pointed out that avoiding a parochial, U.S.-focused viewpoint can lead to more creative science and more useful solutions to problems. She added that she had directly seen the benefits of this program, including helping students think about problems from other perspectives.

Members observed that immediate water challenges seen elsewhere in the world today likely foreshadow problems the U.S. will have, and that efforts to both and promote sustainable practices and adapt to change will therefore have both national and international benefits. They supported the idea that advancing our understanding of water-based terrestrial systems could help inject the best science into policy and planning for this country and developing countries and to understand the future impacts of population, land use change and climate.

CPP Members' embrace of the societal importance of water research segued into two lines of discussion: strategic considerations for program development and the opportunity for Foundation and Board leadership.

Envisioning the Future

Multiple members raise the issue that, because most of NSF's water research programs have emerged out of decentralized efforts to fund the best science in diverse disciplines, overall the Foundation lacked an appropriate integrated "grand goal" and might be missing major opportunities to directly connect with societal problems such as resource projection and political instability[2].

Board members suggested a need to ensure that we were training a workforce with the skills needed to help meet global water challenges. Dr. Droegemeier emphasized that water is a human problem, and that social, behavioral, and economic science research is essential. Dr. Gutmann concurred, emphasizing the need to understand behavior, and pointing out that techno-centric research strategies may ignore cultural variations that have significant impacts on the adoption of technologies. He also suggested that the science of resource consumption could not be dissociated from behavioral science. WSC was cited by discussants as a program that creates the kind of bridges and integration that can address these issues, and CPP members observed that public education on water issues can be important for these and other reasons.

In response to a Board question about challenges in the draft National Climate Assessment, NSF discussants cited Critical Zone Observatories (CZO) as the right kind of "next generation" research infrastructure. Data from this network, when coupled to models, enhances synthesis of how the terrestrial system functions across multiple length-scales and disciplines. Not only does this high level integration of knowledge help us understand how terrestrial systems respond to changes, but it also helps define what still needs to be known better from the core disciplines

Discussants also stated that a more systematic review of NSF's portfolio might help identify gaps and opportunities.

An Opportunity for Leadership

CPP Members asked how NSF's $400 million portfolio may fit into broader picture of water research done by other agencies. They learned that although USGS, for instance, has an immense presence in water research, especially in data collection, and that they partner with NSF on fundamental science questions. This led to a discussion of what we can gain by enhanced partnerships with mission agencies, with the consensus being that improved coordination could lead to fundamental discoveries that directly help other agencies advance their missions.

Given the universal recognition of the importance of water research and the breadth of disciplines involved, the discussion of improved interagency coordination led to a general consensus that it is an opportunity for both NSF and NSB to provide leadership on the issue. Members felt that NSB could promote water research in a way that can benefit both science and society. Moreover, they felt that increasing the visibility of the programs discussed would reflect positively on both the Foundation and federal research investments generally.

Two principal recommendations emerged: First, CPP recommends that the Board engage with OSTP to convey this discussion and the conclusion that water research may be worthy of an interagency initiative on a larger scale. Board Members observed that they had seen this kind of interagency initiative succeed in other circumstances. Members suggested that this might not only benefit mission agencies, but that it could also help contextualize and focus NSF research programs.

[2] See, for example, the Global Water Security report referenced in the bibliography.

Second, Board members observed that water research should embody one of NSF's strategic goals: strengthening the linkage between our basic research programs and societal needs. Members recommended enhancing this connection by better aligning our research strategy with specific goals and by improving our ability to measure progress toward those goals.

Conclusion

CPP appreciated NSF's willingness to bring forth a complex, interdisciplinary portfolio that has international importance. The Committee recommends that the Board convey this discussion to OSTP, possibly proposing an interagency initiative on water research. CPP also recommends that NSF frame water research in the context of its strategic objectives, specifically the goal of linking research programs to societal needs. It hopes that the discussion captured in this summary will be useful to the Foundation as it continues and builds on existing water research programs and partnerships.

Suggested Technical Reports for Reference

Landscapes on the Edge: New Horizons for Research on Earth's Surface, National Research Council, National Academy Press, Washington, D.C., 2010.
http://www.nsf.gov/cgi-bin/good-bye?http://www.nap.edu/openbook.php?record_id=12700&page=R1

WATERS Network Science Plan http://www.nsf.gov/cgi-bin/good-bye?http://www.watersnet.org/docs/WATERS_Network_SciencePlan_2009May15.pdf

Climate Change and Water Resources Management: A Federal Perspective. Circular 1331, U.S. Geological Survey Circular 1331, 65p. 2009
http://pubs.usgs.gov/circ/1331/

GEO Vision Report (Water: Changing Perspectives)
http://www.nsf.gov/geo/acgeo/geovision/start.jsp

2001 Water and Watersheds Progress Review
http://www.epa.gov/ncer/publications/workshop/pdf/2001_water_watersheds.pdf

Transitions and Tipping Points in Complex Environmental Systems
http://www.nsf.gov/geo/ere/ereweb/ac-ere/nsf6895_ere_report_090809.pdf

Energy Demands On Water Resources: Report To Congress On The Interdependency Of Energy And Water
http://www.sandia.gov/energy-water/docs/121-RptToCongress-EWwEIAcomments-FINAL.pdf

NAE Grand Challenges (March 1, 2009 Summit on the National Academy of Engineering Grand Challenges at Duke University)
http://www.nsf.gov/cgi-bin/good-bye?http://www.engineeringchallenges.org/cms/challenges.aspx

WATERS Network Social/Behavioral/Economic Science Agenda Workshop Final Report
http://www.nsf.gov/cgi-bin/good-bye?http://www.watersnet.org/docs/WATERS-SBE-Workshop-Report-Final-20091123.pdf

Subcommittee on Water Availability and Quality Strategic Plan
http://www.ostp.gov/galleries/NSTC/Fed%20ST%20Strategy%20for%20Water%209-07%20FINAL.pdf

NOAA Hydrology program Strategic Science Plan http://www.weather.gov/oh/src/docs/Strategic_Sience_Plan_2007-Final.pdf

National Research Council, 2012, New Research Opportunities in the Earth Sciences, http://www.nap.edu/catalog.php?record_id=13236

National Research Council, 2012, Challenges and Opportunities in the Hydrologic Sciences, National Academy Press, Washington, D.C. 162 pp. http://www.nap.edu/catalog.php?record_id=13293

Global Water Security, ICA 2012-08 http://www.transboundarywaters.orst.edu/publications/publications/ICA_Global%20Water%20Security%5B1%5D%20(1).pdf

National Research Council, 2012. Ecosystems Services: charting a path to sustainability http://www.nap.edu/catalog.php?record_id=13331

National Research Council, 2012. Computing Research for Sustainability http://www.nap.edu/catalog.php?record_id=13415