Directorate for Engineering Advisory Committee Meeting

National Science Foundation
Alexandria, Virginia
October 25-26, 2022
Virtual

ENG AdCom Members Present:
Dr. Leah Jamieson (Chair)
Dr. Robin Coger (Co-Chair)
Dr. Gretchen Baier
Dr. Charles Bott
Dr. Karina Edmonds
Dr. Cynthia Furse
Dr. Kimberly Jones
Dr. Ann Kelleher
Dr. Gregory Keoleian
Dr. Tsu-Jae King Liu
Dr. James R. Martin II
Dr. Danielle Merfeld
Dr. Ismael Pagán-Trinidad
Dr. Lance Pérez
Dr. Bruce Tromberg

ENG Senior Staff Present:
Dr. Susan Margulies (Assistant Director)
Dr. Don Millard (Deputy Assistant Director)
Dr. Usha Varshney (sitting in for Carmiña)
Dr. Sohi Rastegar
Dr. Mihail Roco
Dr. Robert Stone
Dr. Jeanne VanBriesen
Dr. José Zayas-Castro (Day 2 only)

Not present:
Dr. Bika Carter
Dr. Franklin (Lynn) Orr
Dr. James Thompson

Tuesday, October 25, 2022

CALL TO ORDER

Dr. Leah Jamieson, committee chair, called the meeting to order. Advisory Committee Members and ENG leadership introduced themselves. The committee unanimously approved the minutes of the Spring 2022 meeting. **Dr. Susan Margulies**, NSF Assistant Director for Engineering, reviewed the agenda with the committee members.

DIRECTORATE FOR ENGINEERING REPORT

Dr. Margulies described the organization of the directorate and introduced new staff and open positions. She described ENG activities and investments in terms of the directorate's strategic goals and priorities. These include research and research infrastructure to address climate change, clean energy,

and emerging technologies; opportunities for people, such as investments in engineering education and diversity, equity, and inclusion; and partnerships through ENG center awards, programs in the Directorate for Technology, Innovation, and Partnerships (TIP), and collaborations with federal agencies and other entities.

Discussion
Committee members noted that NSF has an opportunity for budget growth and will need to grow the agency workforce at the same time in order to manage outreach, proposal inquiries, award oversight, and other responsibilities. Also, award size should increase with the growing cost of research. NSF can ensure that the community can access necessary research infrastructure. They discussed alignment between the Engineering and TIP directorates.

NSF BUDGET UPDATE

Mr. Antony Giovanni, Deputy Division Director of NSF's Budget Division, described NSF's budget activities in the context of the U.S. federal budget process. NSF is working on three budget years at once. Currently, NSF is funded for FY 2023 under a continuing resolution through December 16 and is preparing its FY 2024 request. The CHIP and Science Act provided an authorization for NSF and a smaller appropriation.

Discussion
The group discussed how NSF navigates the timeframe between planning and funding. NSF's R&RA account has the flexibility to respond to new needs or directions.

CHIPS AND SCIENCE ACT & INFLATION REDUCTION ACT

Mr. Robert Moller, Branch Chief, Government Affairs, NSF Office of Legislative and Public Affairs, described the legislative origins of the CHIPS and Science Act. The Senate's Endless Frontier Act, which became the United States Innovation and Competition Act (USICA), and the House's NSF for the Future Act both proposed a new NSF directorate, but with a different focus. USICA also had competitiveness provisions and bipartisan support, and negotiations in the House added competitiveness language and moved them closer to USICA. Following more negotiation, the CHIPS and Science Act passed with strong bipartisan support in August 2022. It included provisions for semiconductor capacity-building, science for the future in multiple agencies, and the creation of TIP at NSF. It authorized steep growth for NSF to serve the U.S. economy and security. Moller shared highlights of the Inflation Reduction Act, the Infrastructure Investment and Jobs Act, and the National Defense Authorization Act legislation.

Discussion
The committee discussed how NSF can learn from the rapid doubling of the National Institutes of Health, which had unintended consequences for students and postdocs. NSF growth would likely be slower. Committee members expressed interest in sharing NSF outcomes and levering partnerships. NSF impacts on society and the economy are broad and holistic, yet it is important to highlight outcomes at the state or community level. NSF and the Department of Energy collaborate closely at both leadership

and program levels on workforce development and research translation, especially in the areas of climate change and energy.

Break

STRATEGY FOR ADVANCED MANUFACTURING: NEW ENGINEERING OPPORTUNITIES

Dr. Robert Stone, Division Director, NSF Division of Civil, Mechanical and Manufacturing Innovation (CMMI), introduced the National Science and Technology Council (NSTC)'s Subcommittee on Advanced Manufacturing, which developed the 2022 National Strategy for Advanced Manufacturing. The strategy's 11 objectives are designed to advance the 3 strategy's interrelated goals on technologies, workforce, and supply chains. **Dr. Alexis Lewis**, Deputy Division Director, CMMI, described each objective, examples of NSF programs that serve them, and examples of relevant projects. **Dr. Stone** emphasized the key role NSF has in both developing and implementing the strategic plan.

Discussion
Committee members discussed the importance of coordination with other agencies on advanced manufacturing and the connections between manufacturing and other national priorities, such as climate change, semiconductors, and pandemic preparedness and response. NSF welcomed input directly or through organizations such as the Engineering Research Visioning Alliance (ERVA). Underrepresented communities and diverse institutions need to be engaged in developing needs, priorities, activities, outcomes, and measures of success. NSF can provide structural frameworks for industry-academia collaborations at center-scale and smaller scales.

SUPPORTING ENGINEERING DISCOVERY RESEARCH AT PRIMARILY UNDERGRADUATE SETTINGS

Dr. Robin Coger, committee co-chair, introduced the speakers and moderated the discussion.

Dr. Sandra Richardson, EPSCoR Section Head, NSF Office of Integrative Activities, explained relevant institution types related to primarily undergraduate institutions (PUIs). The more than 2000 PUI institutions in the U.S. have different missions and cultures. NSF's Growing Research Access for National Transformative Equity and Diversity (GRANTED) is a new program designed to close access and inclusion gaps among institutions to create an equitable research enterprise. NSF seeks to engage PUIs in EPSCoR research infrastructure improvement and NSF programs in general to impact STEM.

The committee noted the relevance of CEOSE's 2022 report, "Envisioning the Future of NSF EPSCoR."

Dr. Lara Thompson, Associate Professor of Mechanical Engineering and Director of the Biomedical Engineering Program, University of the District of Columbia (UDC), described UDC, which is the only urban land-grant institution and the only public institution of higher education in Washington, DC. At UDC, she started the biomedical engineering program and used federal grants to equip her lab, engage undergraduate students in research and professional development, and build research infrastructure at UDC. For her to achieve these successes required years of work and wearing many hats (without help found at other institutions), and the work often is not visible. Short and long-term vision are needed to

navigate the path, answer practical questions, and balance work, while fulfilling expectation around teaching, mentoring, and advising students.

The committee asked about any shifts in institutional culture with the growth in research at UDC, and **Dr. Thompson** described the support from UDC leadership to set up her own research space and the shift to build research overall and create pathways to graduate education, with new graduate programs.

Dr. Sheryl H. Ehrman, the Don Beall Dean, School of Engineering, at San José State University (SJSU), described her school and the California State University system, which includes more than 20 campuses that vary in terms of students served and the level of programs offered. SJSU has a strong access mission, and undergraduates are 41% first-generation college students and 17% aged 25 or older. Most graduate students have full time jobs, which can mean they are not in the lab at the same time as faculty. Obtaining or accessing research instrumentation is challenging. Dr. Ehrman noted the lack of diversity in faculty training institutions. Institutions with an access mission have contributions to make in addressing regional programs and making regional impacts.

Committee members asked how SJSU adjusts when faculty and students get involved in research. **Dr. Ehrman** explained that students expect to be paid and may do research for academic credit, and that faculty gain flexibility through additional funding/buying faculty down. However, buy-downs are not widespread at undergraduate institutions, and providing administrative support and attracting postdocs are challenges to growth in research. Faculty get preliminary results to include in proposals using the resources they have, which come from startup packages, philanthropic seed funding, and NSF programs that support faculty at early career and later stages. Locating facilities at PUIs provides more opportunities for undergraduates. Partnerships with other universities can be more valuable at later stages, and partnerships with local industry are attractive for workforce development.

Discussion

The committee discussed educational pathways for PUI students. Many begin at community colleges. Engineering programs provide hands-on experience and a variety of potential career paths, such as biomedical engineering to medicine. Providing diverse PUI students with research experiences could increase their interest in doing research in both graduate programs and industry.

The committee also discussed industry partnerships. Industry may come with a focus on the workforce, but PUIs want them to think about other dimensions that the school can offer. Research collaborations take time and trust to establish. Companies may prefer more prestigious institutions until they see how PUI students perform. PUIs need to have ideas and solutions in addition to talent. Students bring their lived experience to problems and can help industry reach more consumers.

Break

OFFICE OF EMERGING FRONTIERS AND MULTIDISCIPLINARY ACTIVITIES (EFMA) OVERVIEW

Dr. Sohi Rastegar, Office Head of NSF EFMA, introduced the EFMA mission, the staff inside and outside of EFMA who run its programs, and EFMA programs. The Emerging Frontiers in Research and Innovation

(EFRI) program invests in potentially transformative research that may lead to new areas for fundamental or applied research, new industries or capabilities that result in U.S. leadership, and/or significant progress on a recognized national need or grand challenge. The Research Experience and Mentoring program supports mentoring and research participation for cohorts of diverse students. The Germination program supports learning frameworks, platforms, and/or environments that enable participants to conceive research ideas and questions with potentially transformative outcomes. EFMA also supports the Engineering Research Visioning Alliance (ERVA) and other ENG crosscutting programs and activities.

EFMA COMMITTEE OF VISITORS (COV) REPORT AND DISCUSSION

Dr. JoAnn S. Lighty, Dean of the College of Engineering at Boise State University and COV chair, provided the COV report on EFMA. The COV found the quality and effectiveness of the merit review process to be good overall and recommended ways to increase the substance of reviewer feedback on the broader impacts criterion. EFMA's selection of reviewers was good at resolving conflicts of interest and addressing intellectual merit, and the COV recommended increasing reviewers from diverse institutions and with strength in broader impacts. Program management was responsive to emerging opportunities and effective at mitigating risk, and EFMA was encouraged to increase partnerships. Portfolio balance was appropriate, though larger EFRI award size, greater geographic distribution, and more institutional diversity are wanted; additional planning grants could help with the latter two.

Discussion
The group discussed how funding decisions are made for the Emerging Frontiers in Research and Innovation (EFRI) program.

Vote on Acceptance of EFMA COV Report: The committee voted and approved the report unanimously.

STRATEGIC RECOMMENDATIONS FOR ENG

Dr. Jamieson, ENG Advisory Committee Chair, asked committee members to put forward strategic recommendations for the Engineering Directorate.

The committee discussed having a mechanism for NSF to get input from industry on NSF goals or priority topics, which is hard for industry to provide today. Engaging professional bodies could be helpful. In general, more engineers are needed in policymaking and government, but there is not a clear path for it.

Committee members advised NSF that CHIPS and Science presents an unusual opportunity to allocate funds differently and pursue new collaborations. NSF could invest more extensively in different institution types or undergraduate/masters students. Research and education should be integrated, as should fundamental and translational research. NSF can also think strategically about the skills needed by the nation and industry. Additional NSF staff resources will be needed.

NSF partnerships should have targets and be examined within the larger system to avoid redundancy. For example, partnering with NIST and others can help manufacturing reach rural and urban areas that

feel left out. A matrix showing goals and agencies could be applied to many crosscutting topics and help identify opportunities. Both innovation and scaling are needed in the U.S. for manufacturing itself and for emerging technologies.

On broader impacts, metrics for assessing impacts would be helpful. Principle Investigators can provide student data when writing proposals, but more robust data, such as longitudinal and intersectional data, and understanding of the science of belonging and inclusion are needed. Stories about research, education, and STEM impacts are important for attracting STEM students and garnering support.

WRAP UP

The committee reviewed the next day's agenda. The meeting adjourned for the day at 6:00 p.m.

Wednesday, October 26, 2022

The meeting reconvened at 9:00 a.m.

RAPIDLY EXPANDING THE ENGINEERING WORKFORCE: ON-RAMPS, PARALLEL PATHWAYS, AND ALTERNATIVE ROUTES TO CAREERS IN THE ENGINEERING WORKFORCE

Dr. Jamieson introduced the speakers and moderated the discussion.

Dr. Samuel Graham, Dean and Nariman Farvardin Professor, A. James Clark School of Engineering at the University of Maryland, spoke on engineering pathways at the University of Maryland (UMD), which has a diverse student body and undergraduate and graduate programs in engineering. The school's commitment to access and diversity is set at the start. The Clark School of Engineering at UMD is a limited enrollment program. High achieving students enter the Clark School directly, and students can transfer from other colleges at UMD or certain community college programs if they meet the requirements. By senior year, 40% of students are transfers (internal and external). To support transfer students, they provide additional programs that include the (ENTRY) Program for pre-transfer advising, Summer Pathways Scholarships for courses not available at community colleges, Maryland Engineering Transfer Alliance Conference for professional development, and remote programs to attract students across the state. Remote programs also provide technical options in locations with workforce needs, such as the naval base in southern Maryland, where the program has a 90% retention rate.

The Clark School also supports programs for under-represented minority undergraduates, such as the LSAMP summer bridge program and the Clark Scholars financial support. The school also has relationships with companies, such as Amazon, to support under-represented minority doctoral students with financial assistance, mentoring, and corporate engagement in capstone projects. The Clark School also offers living learning communities and courses on inclusion in engineering and engineering for social change, which increase retention and graduation. The school's programs and pathways show its commitment to diversity and access, which are further enabled by partnerships.

Clarifying Questions
How do external transfer students perform in comparison? **Dr. Graham** said that by senior year, all students do about the same. They see dispersion based on other factors (such as socioeconomics) rather than their pathway. Graduation rates are similar, and women students have the highest graduation rate.

Dr. Lance Pérez, Dean, College of Engineering, and Omar H. Heins Professor of Electrical and Computer Engineering at the University of Nebraska–Lincoln, spoke about how to meet the growing engineering workforce needs in the context of changing high school demographics and differing levels of academic preparedness.

In the classic "pipeline" model, students go from K-12 to 4-year undergraduate programs to graduate programs; some students at Nebraska can get support from private sources for tuition or internships. Between high school and college, "bridge" programs meet students where they are in many dimensions, and in Nebraska these programs often need to be bilingual, happen where students live, and involve families. Similarly, 2+2 programs accommodate a range of students at community colleges before transferring them to university programs, and Nebraska has hired faculty to teach at community college locations to ensure that students are prepared. In contrast to the pipeline model, "stacked credentials" may be earned in different sequences or settings, such as the workplace. Nebraska is working with software companies on stacked credentials, and the model could work for some engineering subdisciplines too, as long as industry is invested and committed to students. The last model is for students without a bachelor's degree in engineering (such as physics majors) to enter graduate programs in engineering that provide them with additional preparation.

Clarifying Questions
With a modular approach, what is replicable across states with various levels of support and different demographic changes? **Dr. Pérez** replied that commonalities among engineering programs across institutions currently offer students some mobility, which may change with a modular approach. An industry commitment to the full development of students is needed.

Committee members discussed the bridge to graduate school model. Dr. Pérez said the courses are a combination of existing and new courses that are based on the individual students and their institutions.

The committee discussed financial support for access programs and their staff, which rely on philanthropic sources.

Discussion
The committee discussed the role of industry in supporting engineering education and workforce development. Companies of any size can support interns or provide mentoring. Larger companies, such as Dow, support flexible and non-traditional career paths, including paths within the company. Fields such as civil and structural engineering may have more difficulty in providing nonlinear, credentialized approaches because of the current need for foundational knowledge and experience. Opportunities may be more targeted to community needs, for example, full-sized drones are available at the naval base but not at the main campus. Connecting with the right leaders is important.

Courses are not always sufficient. For example, for better coupling between the engineering and health professions, it is important to talk with practitioners so that engineers understand problems and how to create solutions. To encourage interest in sanitation, graduate students get to perform research at the Hampton Roads Sanitation District, take courses at school, and have paid internships; faculty at several universities are also engaged. Student participants have done well in industry thanks to their relevant research experience, and the sanitation district has benefited from innovations for the facility.

Committee members discussed transfers and retention of students between disciplines, which can compete with each other and experience changing demand. Interdisciplinary topics, such as smart transportation for electrical engineering and civil engineering majors, can attract students and demonstrate how they can pursue their interests within their disciplines. Industry partnerships that provide workforce experience could help here too, by showing the importance of what you can do, not just your academic discipline.

The committee discussed the need to make opportunities like those in Maryland and Nebraska more widely available, especially when they rely on fundraising or industry connections and must address a variety of student preparedness. Institutions must be in touch with student needs. Some options could be multi-institution cohorts, student networks, lower-cost opportunities, partnerships, and grant funding that includes support for extension faculty.

Recruitment is also important. Students with wide interests and their families should know about the need for engineers in the job market, and about the opportunities and career paths available through engineering.

PREPARATION FOR DISCUSSION WITH THE DIRECTOR'S OFFICE

Dr. Jamieson asked the committee to share high-priority topics to share with the director. The group decided to highlight the need for industry engagement with NSF, for foundational engineering research in advanced manufacturing, for expanded communication and awareness about engineering, and for support of discovery research by faculty in undergraduate settings to address the missing millions.

Break

PERSPECTIVE FROM THE DIRECTOR'S OFFICE

Dr. Jamieson and **Dr. Margulies** welcomed NSF Director Sethuraman Panchanathan, Chief Operating Officer Karen Marrongelle, and NSF Chief of Staff Brian Stone.

Dr. Charles Bott and **Dr. Danielle Merfeld** said that the CHIPS and Science Act could be a template for industry sectors beyond semiconductors. Industry relationships are critical for generating ideas and building collaborations. Industry needs to be a strong partner in a reimagined ecosystem with connections to government at multiple levels, which can survive political winds.

Dr. Sethuraman Panchanathan: NSF plans to rapidly scale TIP for ecosystems, catalyzed partnerships, and direct partnerships. NSF wants more people from industry to join TIP's staff, leadership, and advisory committee. NSF is collaborating with other agencies, such as the Commerce Department, to bring discussions on workforce and advancing R&D needs to their discussions with industry. New NSF programs on advanced wireless, for example, are developed with industry members as partners. NSF wants industry advice on what activities deliver the best results

Dr. Bruce Tromberg and **Dr. Pérez** described how innovation in manufacturing is necessary to achieve impacts at scale and advance U.S. competitiveness and national security. Manufacturing innovation has a unique potential to engage and revitalize the workforce in rural and urban areas, in different regions of the country, if there is a purposeful strategy.

Dr. Panchanathan agreed on the importance of manufacturing research in biotechnology and other sectors across the nation. The Engineering Directorate is thinking about it, and NSF will need to partner with other agencies and industry to expand its investments in biomanufacturing and biofoundries research. The White House is interested. We are firefighting with semiconductors, and we do not want to be in this situation with all industries of the future. This committee's advice and partnership are critical.

Dr. Jones and **Dr. King Liu** described the urgent need to expand the engineering workface and grow missing millions. The committee has heard about successful interventions, but PUIs and minority-serving institutions require resources from outside. They encouraged NSF to support sustainable and scalable partnerships with institutions and industry, so that more students can access engineering careers. If NSF published more detailed, intersectional data on students and the workforce, that would enable the community to better assess the effectiveness of interventions and identify best practices to quickly scale up impacts in regions across the nation.

Dr. Panchanathan said that the mission millions are an NSF priority. The agency works closely with a variety of institutions and listens to them about what is working or not and about how NSF can help. Many schools have sophisticated research offices to help the success of research and education proposals. To reach people who are in under-represented minority groups everywhere, NSF needs to reach non-R1 institutions. The NSF GRANTED program will be a virtual research office for any institution that does not have sufficient infrastructure. NSF is deeply committed to changing the game in a transformational way. Data is important to keep us accountable. It is hard to mandate the submission of demographic data and to make it easy to do -- NSF can encourage it. We are concerned that the people who do not submit such data are the people that we need data from, so we are working to gather the data. Many institutions can share aggregate data, and there may be other sources and lenses that NSF can use to understand the data and big picture.

Dr. Jamieson thanked Dr. Panchanathan, Dr. Marrongelle, and Dr. Stone. **Dr. Panchanathan** thanked the committee for their service and advice.

REPORTS FROM ADVISORY COMMITTEE LIAISONS

Dr. Kimberly Jones, liaison to the **Advisory Committee for Environmental Research and Education** (AC-ERE), introduced the committee objectives, members, and four current initiatives. One is with NSF's Directorate for Mathematical and Physical Sciences on improving interdisciplinary collaborations. Second, a forthcoming report on Engaged Research for Environmental Grand Challenges will advise on benefits and pitfalls, principles, and new frontiers. Third, the committee is exploring how to center environmental equity in research at the front end and will likely hold a workshop with diverse institutions and community leaders to provide NSF with advice. Finally, the committee is also looking at ways to minimize the environmental impacts of research. They discussed the types of impacts to consider (such as travel, facilities, or lab waste), recommendations, and potential implementation, and they will seek input from all directorates as they develop a white paper.

Discussion
Committee members noted that equity relates to broader impacts and could also include energy justice (e.g., the portion of household income used for energy, energy security). **Dr. Jones** responded that the committee is thinking broadly about energy and climate, along with the environment.

Dr. James Martin, liaison to the **Committee on Equal Opportunities in Science and Engineering** (CEOSE), introduced the history and purpose of CEOSE. At the committee's June meeting, they focused on preparing the next CEOSE biennial report, which is about broadening participation through institutional transformation and leadership. The report, which is informed by the National Science Board's *Vision 2030*, has overarching sentiments about urgency, critical time for the nation, and losing the nation's innovation edge and a focus on demographic and geographic strategies. Datasets and analyses must change to address intersectionality, for example, by growing data on faculty and workforce or through integrating for longitudinal study. The committee published "Envisioning the Future of NSF EPSCoR" in August 2022, which examples the impacts of EPSCoR and new strategies for geographic diversity.

Discussion
Committee members asked about the main factors impeding progress. **Dr. Martin** responded that the lack of data to understand program impacts is challenging. Different institutions and states have very different experiences, and without data it is hard to understand where we are and how we can leverage lessons learned.

ENGINEERING RESEARCH CENTERS: RECENT GRADUATES AND NEW CENTERS

Dr. José Zayas-Castro, the Division Director of the NSF Division of Engineering Education and Centers, briefly described the NSF Engineering Research Center (ERC) program and its history. The program, which began in 1985, is now in its fourth generation, which supports convergent research and innovation through inclusive partnerships and workforce development. Seven ERCs recently graduated from the program. Together they trained thousands of diverse students, published thousands of research papers, were awarded dozens of patents, and created dozens of companies. They also made significant advances in health, clean energy, semiconductors, and infrastructure resilience. Four ERCs began in summer 2022 after a competitive merit review process. They will explore sustainability, manufacturing, biotechnology, and urban streetscapes. NSF is preparing for its next cycle and how to meet the nation's future needs.

Discussion
The group discussed what happens with ERC ideas that are not funded. Some re-think their proposal and re-submit, some shift to other programs at NSF or elsewhere, some seek support for the equity, inclusion, and education elements in other programs. There are benefits from the application process.

Committee members were interested in ERC data, such as the performance of startups and participation of women and under-represented minority faculty. Aspects of this will be in the next ERC report, which is updated every 4-5 years. Currently, the program has more data about students than about faculty.

The fourth generation of ERCs was developed with ideas from the National Academies report on ERCs and ideas from elsewhere. The Engineering Directorate is working with EPSCoR to bring more participants to the table and help them succeed.

ROUNDTABLE ON STRATEGIC RECOMMENDATIONS FOR ENG

Dr. Jamieson invited the committee members to share recommendations that will be useful to the Engineering Directorate.

Committee members encouraged the Engineering Directorate to lead in reaching the missing millions, which would benefit from collaborations and partnerships to attract and retain people. Including themes around equity or engaging disadvantaged, EPSCoR, or rural communities could increase societal impacts and the diversity of the engineering workforce. There are strategic opportunities to focus on schools with talented human resources but not research infrastructure, which NSF could pilot and then broaden to more institutions and geographies. NSF can enable proposals from institutions and investigators who are new to NSF by increasing their awareness of NSF programs and providing resources to prepare strong proposals. Also, NSF can change academic culture, through center programs and review panels, for example, and needs to emphasize that equity is part of research.

The Engineering Directorate needs a strategy for different budget scenarios and can apply lessons from the CHIPS and Science Act. Solving hard problems and collectively communicating about it will attract support. Visibility can impact funding.

The EFMA COV noted unevenness to consideration given to broader impacts in proposals. Broader impacts need to be part of proposals, reviews, annual reports, and they should be a fit for engineering with use-inspired research.

CLOSING REMARKS

Dr. Jamieson and **Dr. Coger** thanked the committee members and the NSF team. **Dr. Margulies** agreed and recognized Dr. Robert Stone, whose NSF term is ending.

The meeting ended at 1:58 p.m.