Management Challenges for the National Science Foundation in Fiscal Year 2023

NATIONAL SCIENCE FOUNDATION
OFFICE OF INSPECTOR GENERAL

October 14, 2022

AT A GLANCE

Management Challenges for the National Science Foundation
in Fiscal Year 2023
October 14, 2022

WHY WE DID THIS REPORT

The *Reports Consolidation Act of 2000* (Pub. L. No. 106-531) requires us to annually update our assessment of the National Science Foundation's "most serious management and performance challenges facing the agency ... and the agency's progress in addressing those challenges."

WHAT WE FOUND

Each year, we identify NSF's most serious challenges based on our audit and investigative work, knowledge of NSF's operations, independent sources such as U.S. Government Accountability Office reports and NSF's advisory committees, and discussions with NSF senior staff and contractors. This year, we identified eight areas representing the most serious management and performance challenges facing NSF:

- Increasing Diversity in Science & Engineering Education and Employment
- Overseeing the United States Antarctic Program (USAP)
- Overseeing Grants in a Changing Environment
- Managing the Intergovernmental Personnel Act Program
- Overseeing NSF-Funded Research Infrastructure
- Mitigating Threats to Research Security
- Mitigating Threats Posed by the Risk of Cyberattacks
- Addressing Harassment in the Academic Community

We are encouraged by NSF's progress in its efforts to address critical management and performance challenges. Effective responses to these challenges will promote the integrity of NSF-funded projects, help ensure research funds are spent effectively and efficiently, and help maintain the highest level of accountability over taxpayer dollars.

AGENCY RESPONSE TO *MANAGEMENT CHALLENGES FOR FISCAL YEAR 2022*

Following the issuance of this report, NSF will include its Management Challenges Progress Report and its response to *Management Challenges for the National Science Foundation in Fiscal Year 2022* in its Agency Financial Report.

FOR FURTHER INFORMATION, CONTACT US AT OIGPUBLICAFFAIRS@NSF.GOV.

MEMORANDUM

DATE: October 14, 2022

TO: Dr. Dan Reed
                    Chair
                    National Science Board

                    Dr. Sethuraman Panchanathan
                    Director
                    National Science Foundation

FROM: Allison C. Lerner
                    Inspector General
                    National Science Foundation

SUBJECT: Management Challenges for the National Science Foundation in Fiscal Year 2022

Attached for your information is our report*, Management Challenges for the National Science Foundation in Fiscal Year 2023*. The *Reports Consolidation Act of 2000* (Pub. L. No. 106-531) requires us to annually update our assessment of the "most serious management and performance challenges facing the agency … and the agency's progress in addressing those challenges." A summary of the report will be included in the National Science Foundation Agency Financial Report.

We appreciate the courtesies and assistance NSF staff provided during the completion of this report.

If you have questions, please contact me at 703.292.7100.

Attachment

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Introduction

The National Science Foundation is an independent federal agency that supports fundamental research and education in all the non-medical fields of science and engineering. With a budget of approximately $8.8 billion (FY 2022), NSF funds about 25 percent of all federally supported basic research at the Nation's colleges and universities, and supports about 200,000 scientists, engineers, educators, and students each year. NSF's goals include advancing the frontiers of knowledge, cultivating a broadly inclusive science and engineering workforce, expanding the scientific literacy of all citizens, building the nation's research capability through investments in advanced instrumentation and facilities, and supporting excellence in science and engineering research and education.

The *Reports Consolidation Act of 2000* (Pub. L. No. 106-531) requires us to annually update our assessment of NSF's "most serious management and performance challenges … and the agency's progress in addressing those challenges." Each year, we identify these challenges based on our audit and investigative work, knowledge of the Foundation's operations, independent sources such as U.S. Government Accountability Office reports and NSF's advisory committees, and discussions with NSF senior staff and contractors. We identify management challenges as those that meet at least one of the following criteria:

- The issue involves an operation that is critical to an NSF core mission.[1]
- The issue presents a risk of fraud, waste, or abuse to NSF or other government assets.
- The issue involves strategic alliances with other agencies, the Office of Management and Budget, the Administration, Congress, or the public.
- The issue is related to key initiatives of the President.

It is important to note that identifying an issue as a "management challenge" does not necessarily mean NSF is having difficulty addressing it; instead, it means we identify the issue as one of the top challenges facing NSF and report on NSF's progress in addressing it, as required by the Act.

This year, we have identified eight areas representing the most serious management and performance challenges facing NSF:

- Increasing Diversity in Science & Engineering Education and Employment
- Overseeing the United States Antarctic Program (USAP)
- Overseeing Grants in a Changing Environment
- Managing the Intergovernmental Personnel Act Program
- Overseeing NSF-Funded Research Infrastructure
- Mitigating Threats to Research Security
- Mitigating Threats Posed by the Risk of Cyberattacks
- Addressing Harassment in the Academic Community

This year, we are introducing one new challenge area, Addressing Harassment in the Academic Community. We added this challenge because recent reports and legislation indicate harassment is pervasive in institutions of higher education and a deterrent to participation in science, technology, engineering, and mathematics (STEM) fields.

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[1] The *National Science Foundation Act of 1950* (Pub. L. No. 81-507) sets forth the mission: "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes."

In addition, we renamed two prior challenge areas to better reflect the challenges they describe: "Overseeing NSF-Funded Research Infrastructure" expands the prior challenge "Overseeing Major Multi-User Research Facilities" to include overseeing mid-scale research infrastructure. "Mitigating Threats to Research Security" expands upon the challenge titled "Mitigating Threats Posed by Foreign Government Talent Recruitment Programs" in prior years.

Finally, we did not include last year's challenge "Managing Transformational Change" in this year's report; instead, we have included information about NSF's progress in managing transformational change in the other challenge areas.

NSF has continued to demonstrate its ability to achieve its mission in an ever-changing environment. As the agency moves into FY 2023 and beyond, it is well positioned to address both familiar and new challenges it may face with acuity, agility, and adaptability.

This computer cluster provides the main hardware resource for the Apt, an NSF-funded precursor to CloudLab, located at University of Utah's Downtown Data Center. *Credit: Chris Coleman, School of Computing, University of Utah*

Increasing Diversity in Science & Engineering Education and Employment

Increasing diversity in science and engineering education and employment continues to be a high-priority goal of NSF, the National Science Board (NSB), the Executive Branch of the federal government, and Congress. In *Vision 2030*, the NSB emphasized the need to develop more diverse STEM talent to remain competitive globally. In the *FY 2022-2026 NSF Strategic Plan*, NSF listed as its top goal the empowerment of STEM talent to fully participate in science and engineering. In addition, Congress authorized initiatives in the *CHIPS and Science Act of 2022* (CHIPS Act, Pub. L. No. 117-167) to promote diversity, equity, inclusion, and accessibility (DEIA) in STEM, and the Administration has issued multiple Executive Orders[2] to enhance DEIA government wide.

NSF has taken steps to increase participation in STEM among populations that have been under-resourced and under-served. For example, NSF:

- Expanded its Broadening Participation in STEM portfolio, including the NSF Eddie Bernice Johnson INCLUDES program;
- Responded to the NSB's February 2021 resolutions to broaden participation[3] by offering training videos on unconscious bias and other topics to merit review panelists, and by piloting the inclusion of Broader Impacts experts in Committees of Visitors; and
- Requested $247 million in its FY 2023 Budget Request — a 23.5 percent increase over the actual funding in FY 2021 — for its Established Program to Stimulate Competitive Research (EPSCoR) program, which seeks to enhance research competitiveness in jurisdictions (U.S. states, territories, and the Commonwealth of Puerto Rico) that have historically received a small share of NSF grant dollars by strengthening STEM capability and capacity.

NSF convened a Racial Equity Task Force to examine the potential for racial barriers and recommend how NSF can address such barriers both internally, for the NSF workforce, and externally, for program delivery. In addition, NSF prepared a DEIA strategic plan in response to Executive Order 14035 to improve DEIA internally.

As NSF recognizes, "It is more important now than ever that we measure and evaluate our outcomes and analyze and distill this evidence to ... create a clear data-driven picture of what's working ...."[4] In evaluating outcomes, it will need to determine the baseline goals and metrics to assess progress[5] and obtain relevant, reliable data. In FY 2023, we will monitor NSF's progress in measuring and evaluating the

[2] Relevant Executive Orders include 13985, 13988, 14020, and 14035.
[3] NSB-2021-10, NSB-2021-11
[4] *Enhancing Mission Success through Evidence: Perspectives from NSF Leaders*, April 25, 2021
[5] NSB Meeting, May 19, 2021, Vision 2023, Implementation

A research project at the University of Nebraska-Lincoln, supported by an NSF EPSCoR award, focuses on ensuring global food security by improving crop resilience. *Credit: University Communication / University of Nebraska-Lincoln*

outcomes of its policies and programs to increase diversity in the NSF workforce, as well as for program delivery, in areas such as merit review.

Key Completed Actions

- Issued FY 2022-2026 Strategic Plan with Strategic Goal 1, "to promote inclusion in the research community and STEM workforce, access to STEM learning and training and widespread STEM literacy."
- Issued FY 2022-2026 Learning Agenda and FY 2023 Annual Evaluation Plan to measure progress in achieving the FY 2022-2026 Strategic Plan Goal 1.
- Staff-convened Racial Equity Task Force released report with recommendations to increase racial equity internally and externally.
- Issued NSF's Diversity, Equity, Inclusion and Accessibility Strategic Plan 2022-2024.
- Expanded NSF Eddie Bernice Johnson INCLUDES program and its other broadening participation portfolios.

Key Ongoing Actions

- Implementing NSF's Diversity, Equity, Inclusion and Accessibility Strategic Plan, 2022-2024.
- Addressing recommendations from staff-led Racial Equity Task Force's report.
- Addressing known barriers in growing research capacity for emerging research institutions.
- Fostering geographic diversity with the NSF Engines and expanded EPSCoR programs.
- Piloting and assessing initiatives to provide merit review panelists with a video on broader impacts and unconscious bias, and including broader impacts experts in Committees of Visitors.

Overseeing the United States Antarctic Program (USAP)

NSF, through the United States Antarctic Program (USAP), manages U.S. scientific research in Antarctica. Leidos Innovations Corporation holds the Antarctic Support Contract for USAP logistical support. It is NSF's largest and most visible contract, valued at $2.3 billion over 13 years. Through this and other contracting vehicles, NSF is also starting a long-range infrastructure investment program across the program, including the three U.S. Antarctic stations (McMurdo, Palmer, and South Pole). The Office of Polar Programs (OPP) monitors performance of the contract, with several other NSF offices collaborating to manage the USAP more broadly.

The COVID-19 global pandemic added unprecedented complexity and uncertainty to USAP operations and construction projects, which were already hampered by Antarctica's remote location, extreme environment, and the short period each year during which the continent is accessible. For example, deployments in the 2020–2021 and 2021–2022 seasons were limited to only those necessary for health and safety or to preserve long-term data sets. In addition, construction at McMurdo under the Antarctic Infrastructure Modernization for Science (AIMS) project and the Information Technology and Communications primary addition was put on hold. NSF plans to resume construction in October 2022, and it has worked to re-baseline the Information Technology and Communications primary addition and the first two components of AIMS, as well as to implement a new approach that will use NSF's Antarctic Infrastructure Recapitalization program to address needed long-term infrastructure improvements, including consideration of the unfunded components of AIMS.

KEY FACTS

- This challenge involves an operation that is critical to an NSF core mission. It also presents a risk of fraud, waste, or abuse of NSF or other government assets.
- The Antarctic Support Contract is NSF's largest and most visible contract, valued at $2.3 billion over 13 years.
- Due to COVID-19, construction at McMurdo under the AIMS project and the Information Technology and Communications primary addition was put on hold.
- Recent information security audit findings have identified challenges.
- NSF commissioned a sexual assault and sexual harassment risk assessment in the USAP environment.

Adelie penguin just out of the ocean.
Credit: Elaine Hood, NSF

Additionally, recent information security audit findings[6] have identified challenges in USAP's implementation of authentication and incident response requirements. These findings, first identified in FY 2019, demonstrate the extended time needed to fully enact security measures for the USAP network consistent with those of NSF. OPP is working with various NSF offices to identify and enact the right approach for personnel screening and to issue contract modifications and procure solutions as necessary. For example, OPP has modified its process to follow federal requirements for vetting and credentialing contractors that require elevated access to USAP systems and data.

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[6] FISMA *Audit of NSF's Information Security Program for FY 2020*, November 20, 2020

In addition, OPP is working to address audit recommendations related to incident detection and monitoring, as well as implementation of Personal Identity Verification (PIV) for USAP contractors. OPP has also added technical resources to support its monitoring program and worked with the contractor to develop a Cybersecurity Roadmap. However, due to the challenges of operating in this remote environment and the time necessary to implement changes to USAP contracts, USAP remains at an increased risk of negative impacts to personnel, systems, and data.

Finally, the recently issued assessment[7] of the risk for sexual assault and sexual harassment in the USAP environment further demonstrates the wide-ranging challenges facing NSF as it continues to manage the USAP.

Key Completed Actions
- Accepted new AIMS baseline; unfunded components to be evaluated along with other infrastructure priorities.
- Established a Project Execution Plan to implement PIV for non-privileged access to USAP applications.
- Cleared the backlog of NSF personnel security adjudications for contractors in elevated risk positions.
- Identified a critical need to 1) improve communication, 2) increase engagement, 3) enhance education and training, 4) strengthen reporting infrastructure and accountability, 5) provide support to victims, and 6) probe more deeply into policies and mechanisms aimed at prevention of sexual assault/harassment.

Key Ongoing Actions
- Monitoring AIMS via the NSF Office of the Director's Watch List.
- Implementing the risk-based Cybersecurity Road Map to address audit findings.
- Implementing a new process for NSF adjudication of all Antarctic support contractors.
- Distributing PIV cards to employees with privileged access to USAP systems and employees who do not require privileged access.
- Implementing enforcement of PIV credentials for USAP locations outside the U.S.
- Hosting a series of listening sessions to get community feedback on sexual assault/harassment prevention and reporting.
- Identifying ways to provide additional support to victims of sexual assault/harassment.
- Establishing a Sexual Assault/Harassment Prevention and Response Support Office to (i) provide necessary resources including on-the-ground personnel in Antarctica, (ii) support deployed personnel on matters relating to sexual assault and harassment, and (iii) remove barriers, as well as provide an independent line of reporting for victims of sexual assault/harassment matters in the USAP.

[7] Department of the Interior's Federal Consulting Group, NSF/OPP/USAP Sexual Assault/Harassment Prevention and Response (SAHPR) Final Report, June 22, 2022

Overseeing Grants in a Changing Environment

Making grants to support promising scientific research is a key element of NSF's mission. Among other things, the CHIPS Act officially authorized the Directorate for Technology, Innovation and Partnerships (TIP); requires significant expansion of programs aimed at increasing the diversity of participation in STEM; and authorizes NSF's budget to more than double within 5 years from $8.8 billion to nearly $19 billion.

TIP, the agency's first new directorate in more than three decades, will strive to accelerate the pace of innovation and translation in emerging technologies, address the societal and economic challenges facing the nation, and engage diverse talents nationwide. TIP also seeks to ensure the nation remains at the forefront of competitiveness by establishing partnerships across a broad array of stakeholders: other federal agencies; state, local, and tribal governments; academics; the private sector; nonprofits; civil society; and investors. By FY 2024, TIP's budget is authorized at $3.35 billion, which accounts for more than 21 percent of NSF's total authorization.

KEY FACTS

- This challenge involves an operation that is critical to an NSF core mission. It also presents a risk of fraud, waste, or abuse of NSF or other government assets.
- The CHIPS Act authorized the Technology, Innovation, and Partnerships Directorate, requires significant expansion of programs aimed at increasing diversity in STEM, and authorizes NSF's budget to more than double within 5 years, to nearly $19 billion.

TIP represents a transformational change to NSF's traditional mission by expanding its emphasis on applied and use-inspired research and includes the authority for NSF to use new funding methods. A dramatic increase in funding coupled with new award vehicles and a new mission will bring inherent challenges in ensuring proper stewardship and accountability of award funds.

The CHIPS Act also creates new requirements related to the long-time NSF priority of increasing diversity in the STEM workforce and expanding both the institutional and geographic diversity of federal award recipients. As previously discussed, NSF's EPSCoR is directed to grow — from about 12 percent in FY 2021 to 15.5 percent of NSF's budget in FY 2023 and to up to 20 percent by FY 2029. The Act also directs NSF to establish a program to build research capacity at institutions outside the top 100 recipients of federal research funding over the prior 3 years and for NSF to expand its investment in improving STEM instruction in rural schools. In addition, it requires NSF to further the overall goal of increasing diversity in the STEM workforce. Finally, the CHIPS Act also builds upon the research security requirements established by *National Security Presidential Memorandum 33* (NSPM-33) and creates additional obligations for NSF and its award recipients.

The Act established funding targets over the next 5 years that seek to eventually double NSF's budget. However, future appropriated funds might not match authorized amounts, creating fiscal uncertainty and challenges in meeting some of the Act's goals. NSF must continue to adapt to effectively manage this complex and changing environment over the next several years.
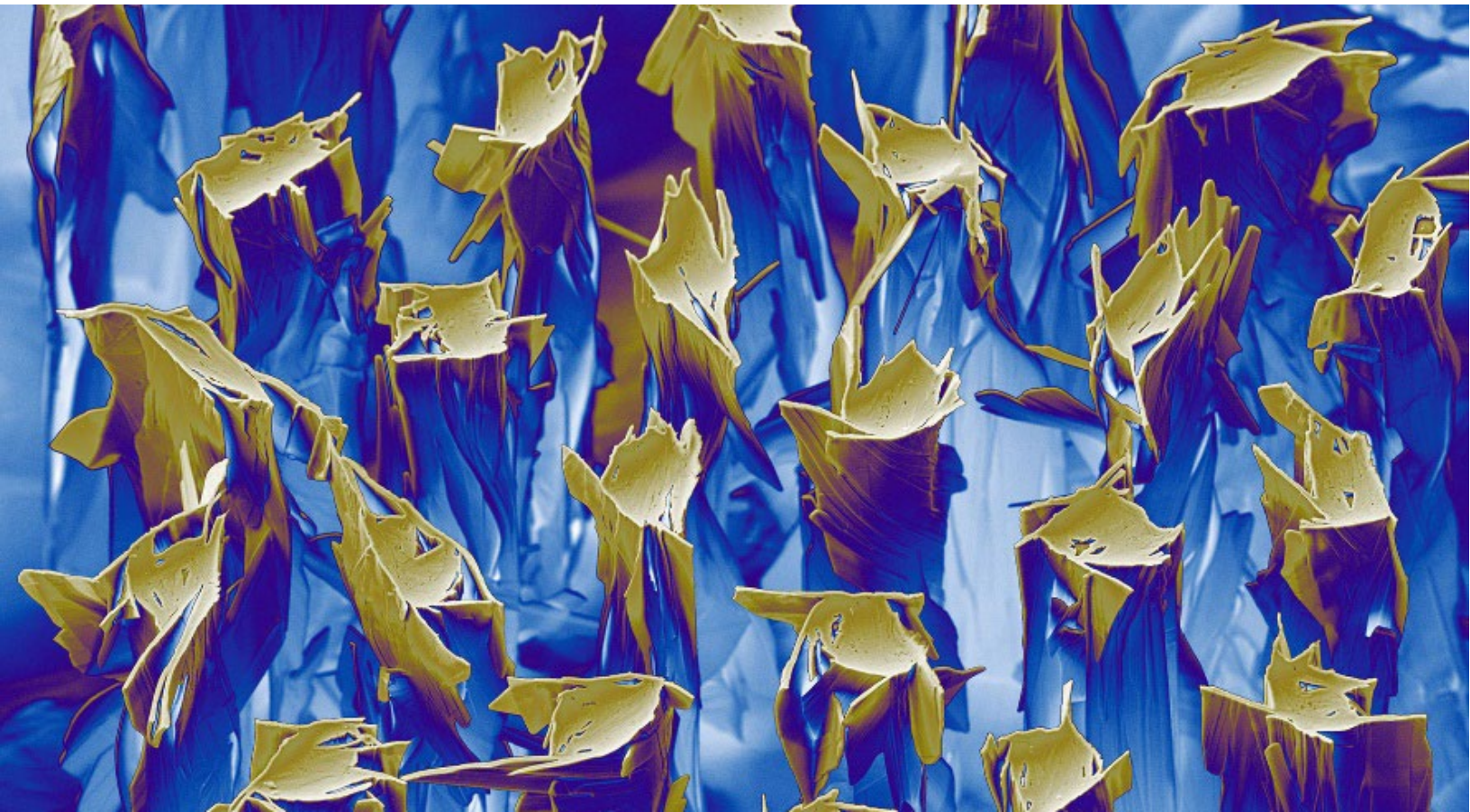
Macrosocopic look at superconducting wire Bi-2212. *Credit: Peter J. Lee*

Key Completed Actions

- Assembled the Project Reporting Improvement Team to implement actions to improve compliance on the timely submission of grant project reports across the agency.
- Implemented a suite of awardee self-assessment tools and fact sheets on subrecipient monitoring and participant support costs.
- Continued emphasis on its enterprise risk management process to enhance monitoring and oversight of award recipients.
- Completed triennial Payment Integrity Information Act risk assessment.

Key Ongoing Actions

- Assessing new and ongoing requirements of the CHIPS Act.
- Monitoring portfolio composition and potential increases of small and mid-size award recipients.
- Refining enterprise risk profiles around the NSF grants portfolio to account for future environment changes.
- Executing annual advanced monitoring site visits and desk reviews.
- Conducting annual baseline payments testing.

Managing the Intergovernmental Personnel Act Program

As part of its workforce strategy, NSF provides scientists, engineers, and educators the opportunity to temporarily serve as NSF program directors, advisors, and senior leaders. Most non-permanent staff members are individuals assigned under the *Intergovernmental Personnel Act* (5 U.S.C. §§ 3371 – 3376), who are not federal employees but are funded through grants and remain employees of their home institutions. These individuals — referred to as IPAs or rotators — bring in fresh perspectives from all fields of science and engineering to support NSF's mission. As we have previously reported, IPAs may have a higher risk of conflicts of interest while working at NSF because most come from institutions receiving NSF awards.[8] In addition, IPAs can spend up to 50 days each year on Independent Research/Development, and their salaries are not subject to federal pay and benefits limits.[9]

Our ongoing audit work shows that challenges remain with IPA program oversight. Increased coordination across the varying offices involved in the vetting and hiring process would further reduce the risks inherent to the IPA program and strengthen the control environment. This includes reducing the risk of hiring individuals who are ineligible to serve as IPAs, verifying IPA salary and employment history before appointment, and promptly adjudicating suitability and fitness determinations. In response to our audits, NSF has established an IPA Candidate Vetting Working Group to make recommendations to the NSF Chief Operating Officer regarding the approach to vetting candidates for IPA positions at NSF. It has also made changes intended to improve the process for vetting IPA candidates for Assistant Director positions.

We previously reported on NSF's pilot and implementation of its cost share policy, effective January 31, 2020, requiring that institutions provide at least 10 percent cost share for every full-time IPA agreement. NSF reported that in FY 2020, 90 percent of all IPA assignments had a cost share. NSF continues to seek ways to improve its management of the IPA program and monitor the costs of and participation in the Independent Research/Development program. NSF also continues to evaluate the cost and effectiveness of the IPA program, such as through its Evaluation and Assessment Capability Section's June 2022 report.[10]

KEY FACTS

- This challenge involves an operation that is critical to an NSF core mission. It also presents a risk of fraud, waste, or abuse of NSF or other government assets.
- IPAs or rotators are non-federal employees who temporarily serve as NSF staff.
- IPAs bring in fresh perspectives but may have a higher risk of conflicts of interest because most come from institutions receiving NSF-funded awards.
- Our ongoing audit work has found challenges with the IPA vetting and hiring process. In response, NSF established a working group to improve the vetting of IPAs.

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[8] OIG Report No. 17-2-008, NSF Controls to Mitigate IPA Conflicts of Interest, June 8, 2017
[9] Management Challenges for the National Science Foundation in Fiscal Year 2018, October 12, 2017
[10] Freyman, Christina. 2022. Rotator Study. Alexandria, VA: National Science Foundation.

NSF headquarters in Alexandria, VA. *Credit: Maria B. Barnes/NSF*

Key Completed Actions
- Established IPA Candidate Vetting Working Group.
- Made changes to improve the process for vetting IPA candidates for Assistant Director positions.
- Migrated Program Director and Executive IPAs to the USA Performance system for managing performance plans.
- Submitted the IPA Program Annual Report covering the prior fiscal year to NSF Director.

Key Ongoing Actions
- Addressing potential national and economic security threats, conflicts of interest, and improving the overall vetting process through the IPA Candidate Vetting Working Group.
- Continuing to develop and monitor internal controls related to the Independent Research/Development Program, including clear communication about program participation and policies.
- Applying enterprise risk management concepts to the IPA Steering Committee's risk environment to monitor metrics related to participation, demographic characteristics, annual costs, and cost share value.

Overseeing NSF-Funded Research Infrastructure

As part of its mission, NSF funds the development, design, construction, operation, and disposition[11] of research infrastructure; see Figure 1. Such awards include major multi-user research facilities (major facilities), like telescopes and ships, which cost more than $100 million to construct or acquire, and mid-scale research infrastructure (mid-scale) projects, including equipment and upgrades to major facilities, which cost between $4 and $100 million.
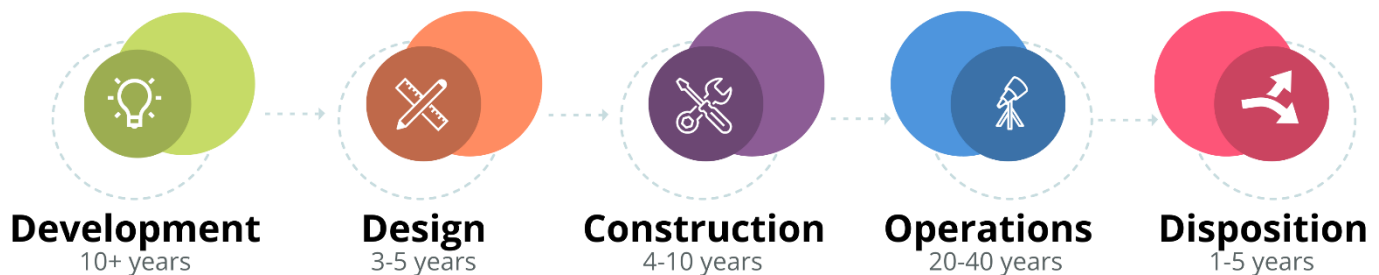
Major facilities and mid-scale projects are inherently risky because the infrastructure is one-of-a-kind and technically complex, and construction and operating costs are high. In FY 2021, NSF spent more than $160 million constructing and $967 million operating major facilities, and more than $180 million on mid-scale projects.

As we reported in *Management Challenges for the National Science Foundation in FY 2022*, NSF has cemented its major facilities program as a model program, implementing corrective actions over the past decade. NSF's centralized investment in mid-scale projects is newer, however, with the first awards issued in FY 2019. NSF's Office of Budget, Finance, and Award Management is developing the capacity needed to oversee these awards, and it is drawing upon its experience in the management of major facility projects to develop the appropriate approaches for mid-scale projects. NSF is taking a more flexible approach in applying some of the major facility controls to its mid-scale projects as deemed appropriate. We will continue to review management requirements in mid-scale solicitations, controls for mid-scale projects, and training and experience of NSF staff responsible for making and overseeing mid-scale awards.

KEY FACTS
- This challenge involves an operation that is critical to an NSF core mission. It also presents a risk of fraud, waste, or abuse of NSF or other government assets.
- Major facilities and mid-scale projects are risky because of their uniqueness, complexity, and high costs.
- With a decade of corrective actions implemented, NSF's major facilities program is a model program.
- NSF is applying some of its major facility controls to its mid-scale projects.

Figure 1. Major Facilities Life Cycle

Development 10+ years → **Design** 3-5 years → **Construction** 4-10 years → **Operations** 20-40 years → **Disposition** 1-5 years

Source: NSF OIG-depiction of NSF-provided data

[11] NSF previously referred to the disposition stage as "divestment."

Key Completed Actions

- Finished the Major Facilities Oversight Reviews standard operating guidance.
- Produced reports to track COVID-19 impacts on facilities' construction and operations.
- Implemented standard operating guidance on oversight and monitoring of property in the custody of recipients.
- Completed the major facilities portfolio workforce gap analysis.

Key Ongoing Actions

- Continuing to develop and implement the Program Management Improvement Accountability Act Course Curriculum Tool.
- Continuing to evaluate title to property (federally owned versus recipient-titled) and develop property transition plans, as necessary.
- Developing policies and processes to improve the planning and management of facility dispositions.

Star trails take shape around the 14-story Mayall Telescope dome at Kitt Peak National Observatory, a program of NSF's National Optical-Infrared Astronomy Research Laboratory (NOIRLab), in this long-exposure image.
Credit: NRAO/AUI/NSF, Jeff Hellerman (Creative Commons Attribution 3.0 Unported -- CC BY 3.0)

Mitigating Threats to Research Security

Safeguarding the U.S. research enterprise from threats of inappropriate foreign influence continues to be of critical importance. While significant challenges remain, U.S. funding agencies and academia have made progress in combating undue foreign influence, while maintaining an open research environment that fosters collaboration, transparency, and the free exchange of ideas.

NSF, and other agencies that fund research, continue to face challenges from foreign talent recruitment programs. According to the Office of Science and Technology Policy, a foreign government-sponsored talent program is an effort directly or indirectly organized, managed, or funded by a foreign government to recruit science and technology professionals in targeted fields. Nondisclosure of relationships with any such program adversely affects NSF decision-making on proposals. Although some of these programs are legitimate, many encourage or direct unethical and criminal behaviors, including the deliberate nondisclosure of the recruit's foreign position and associated foreign scientific funding. Contracts for participation in some programs include language that creates conflicts of commitment and/or conflicts of interest for researchers, such as requirements to attribute U.S.-funded work to a foreign institution; recruit or train other talent recruitment program members; circumvent merit-based processes; and replicate or transfer U.S.-funded work to another country.

KEY FACTS

- The issue presents a risk of fraud, waste, and abuse of NSF or other government assets.
- Federal agencies and academia have made progress in combating undue foreign influence on the U.S. research enterprise.
- NSF has worked to mitigate these threats, such as by developing guidelines for strengthening research security and created an Office of Research Security Strategy and Policy.
- NSF also has expanded research security training and educated the research community.
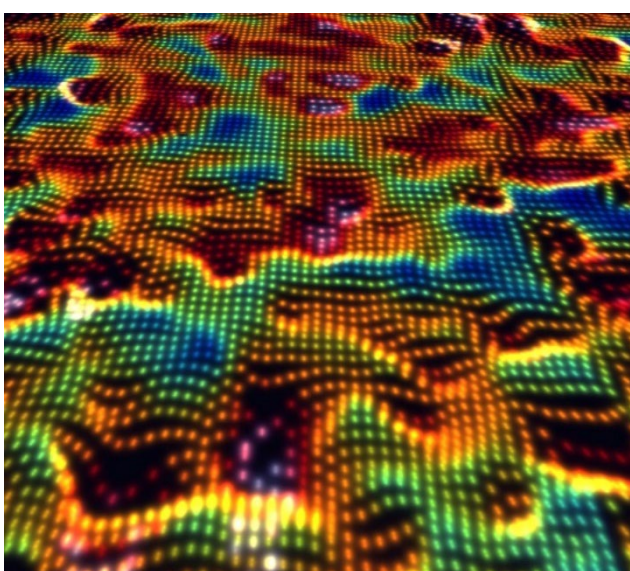
Electrons in a semiconductor distribute on surface in fractal patterns. *Credit: Roushan/Yazdani Research Group*

Over the past 4 years, NSF has taken meaningful action to mitigate threats posed by these programs. It strengthened disclosure requirements and processes is working to develop guidelines to strengthen research security. NSF has also provided compliance recommendations to U.S. academic institutions to ensure accurate disclosures to U.S. funding agencies. Further, it created an Office of Research Security Strategy and Policy, which has taken a leading role in the efforts of the federal government to combat this threat. It has expanded research security training and educated the research community. NSF should continue to assess and refine its controls in this area and ensure that it has sufficient staff and resources to address this challenge.

Key Completed Actions

- Created a Chief of Research Security Strategy and Policy (CRSSP) position in 2020, which was codified in the CHIPS Act.
- Created Chief Data Officer position.
- Launched the Research Security Strategy and Policy Group. Developed and implemented research security data analytics capability that captures nondisclosure of foreign affiliations, sources of funding, and collaborations that present conflicts of commitment or capacity.
- Communicated express prohibition of Foreign Talent Plan membership for all NSF staff, including rotators.
- Developed and implemented mandatory research security training for staff and rotators in direct communication with recipient organizations and principal investigators.
- Educated the research community about risks and compliance with NSF's policies and procedures.
- Strengthened disclosure requirements and processes, including implementing two new vehicles for submitting post-award information.
- Revised term and condition for foreign collaboration considerations in major facilities.
- Developed and implemented a new award term and condition for previously undisclosed information.
- Served as steward of the development of harmonized disclosure requirements for proposers and grantees that have been adopted by the U.S. government interagency community.
- Increased collaboration with NSF OIG, the Federal Bureau of Investigations, and other relevant stakeholders.

Key Ongoing Actions

- Overseeing operations of the Research Security Strategy and Policy Group.
- Capturing nondisclosure of foreign affiliations, sources of funding, and collaborations that present conflicts of commitment or capacity.
- Continuing to conduct and monitor mandatory research security training for staff and rotators in direct communication with recipient organizations and principal investigators.
- Continuing education of the research community about risks presented by foreign talent recruitment programs and the importance of compliance with NSF policies and procedures.
- Continuing stewardship of harmonized disclosure requirements for proposers and grantees that have been adopted by the U.S. government interagency community.
- Maintaining collaborative relationships with NSF OIG, the Federal Bureau of Investigations, and other relevant stakeholders.
- Developing guidelines for strengthening research security.

Mitigating Threats Posed by the Risk of Cyberattacks

Federal agencies need information technology (IT) systems and electronic data to carry out operations and to process, maintain, and report essential information. The security of these systems and data is vital to public confidence and national security, prosperity, and well-being. NSF continues to make progress on improving the security of its data and systems and implementing a zero-trust architecture (ZTA) in response to EO 14028.[12] However, new cybersecurity risks remain on the horizon. For example, recent developments in quantum computing have created threats to long-trusted public key cryptography. Decryption that used to take traditional supercomputers more than 2 days can now be accomplished by quantum computers in about 3 minutes. With the large-scale increase in NSF's resources and staffing authorized by the CHIPS Act, as well as more personal devices connecting to the NSF network due to the post-pandemic shift to hybrid workspaces, NSF will need increasingly effective measures to ensure the availability, integrity, and confidentiality of data.

KEY FACTS

- This challenge is related to key initiatives of the President.
- The security of IT systems and data is vital to national security.
- NSF continues to make progress on improving IT security and implementing a zero-trust architecture, but new cybersecurity risks remain.
- Growing use of personal devices that connect to the NSF network may increase security risks.
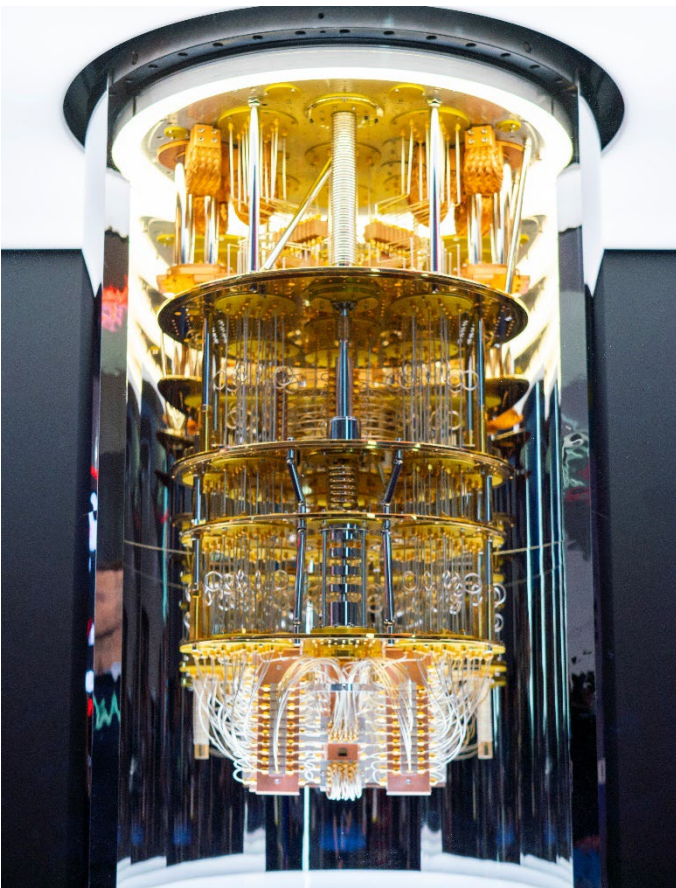
The U.S. Department of Homeland Security has provided guidance[13] to agencies to begin preparing for a transition to post-quantum cryptography. NSF could further prepare for this transition by identifying critical data and cryptographic technologies, identifying which public key cryptography is quantum vulnerable, and prioritizing systems for replacement based on mission requirements.

Our FISMA[14] audits have found that NSF has an effective information security program under current standards. NSF, however, could enhance its cybersecurity by implementing a Security Information and Event Management solution for its USAP network; implementing the use of PIV cards by USAP contractors; implementing security controls related to untrusted removable media devices; implementing a

Researchers programmed an IBM quantum computer to become a type of material called an exciton condensate.
Credit: Photo by Andrew Lindemann/IBM

[12] *Improving the Nation's Cybersecurity*, May 12, 2021
[13] *Policy Directive 140-15*, September 17, 2021
[14] *Federal Information System Modernization Act of 2014*, Pub. L. No. 113-283

formal monitoring program for the USAP employee screening process; and fully automating the annual recertification process for its service accounts.

Also, as NSF increases staffing in response to the CHIPS Act and continues to develop its post-pandemic hybrid approach to workspaces, it should assess its Virtual Private Network (VPN) and Virtual Desktop Infrastructure (VDI) capabilities to determine if changes or enhancements are needed to improve the availability, integrity, and confidentiality of NSF data.

Key Completed Actions
- Identified critical software.
- Implemented Login.gov as a multi-factor authentication option for external customers using Research.gov.
- Developed counterfeit detection awareness training for employees and contractors responsible for hardware and software acquisitions.
- Ensured USAP contractors who need privileged access to the USAP network are fully vetted.

Key Ongoing Actions
- Implementing a password review tool and updating the password policy.
- Identifying and analyzing potential vendors that can provide additional controls to prevent downloading, storing, and transferring sensitive data, including Personally Identifiable Information, to removable storage devices.
- Vetting and credentialing USAP contractors who need non-privileged access to the USAP network.
- Enforcing PIV use in all USAP locations.

Addressing Harassment in the Academic Community

Recently issued legislation and reports identify harassment in science as a pervasive issue, affecting participation in STEM. The CHIPS Act requires NSF to:

> expand research efforts to better understand the factors contributing to, and consequences of, sex-based and sexual harassment affecting individuals in the STEM workforce, including students and trainees; and to examine approaches to reduce the incidence and negative consequences of such harassment. The goal of this and other requirements is to combat harassment in science.[15]

The legislation includes findings from a National Academies of Sciences, Engineering, and Medicine 2018 report titled *Sexual Harassment of Women: Climate, Culture, and Consequences in Academic Sciences, Engineering, and Medicine*, which concluded that "sexual harassment is pervasive in institutions of higher education."

Additionally, as previously discussed, NSF received a report it commissioned, titled *Sexual Assault/Harassment Prevention and Response*, in June 2022, which detailed a needs assessment and recommended an implementation plan to address sexual harassment and sexual assault in the USAP. The report highlights a concern that providing effective oversight of awardee compliance may be particularly difficult for NSF in Antarctica and its associated research vessels and field sites due to lack of trust and reporting mechanisms.

KEY FACTS

- This issue involves an operation that is critical to an NSF core mission.
- The issue is related to key initiatives of the President.
- Recent reports and legislation indicate harassment is pervasive in institutions of higher education and a deterrent to participation in STEM.
- NSF commissioned a report highlighting concerns about providing effective oversight of awardee compliance in the USAP due to lack of trust and reporting mechanisms.
- NSF has taken additional action, such as implementing an award term and condition about reporting harassment or sexual assault; developing a USAP Code of Conduct; and setting expectations that research organizations establish and maintain clear and unambiguous standards of behavior.

NSF has stated it expects all research organizations to establish and maintain clear and unambiguous standards of behavior to ensure harassment-free workplaces wherever science is conducted.

NSF has taken additional action to address harassment by issuing statements to the academic community that harassment will not be tolerated and by implementing an award term and condition, effective October 22, 2018, requiring award recipients to notify the agency of any findings/determinations of sexual harassment, other forms of harassment, or sexual assault by an NSF funded Principal Investigator or co-Principal Investigator.[16] Additionally, NSF has developed a USAP Code of Conduct, and its current *Proposal & Awards Policies &Procedures Guide* states that NSF expects all research organizations to establish and maintain clear and unambiguous standards of behavior to ensure harassment-free workplaces.

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[15] Subtitle D, SEC. 10534, (a)

[16] This term and condition is being evaluated by the Evaluation and Assessment Capability Section, as stated in Focus Area #1 of the NSF Equity Action Plan, "Efforts to Address Sexual and Other Forms of Harassment."

Sunset on the Weddell Sea in Antarctica. *Credit: Photo by Mia Wege*

It is imperative that NSF continue working to address harassment in the academic community and undertake prevention and response efforts. As previously discussed, this will also help ensure NSF meets its strategic goal to empower STEM talent to fully participate in science and engineering.[17]

Key Completed Actions
- Implemented terms and conditions requiring institutions report to NSF findings of harassment or assault by an NSF funded principal investigator or co-principal investigator.
- Reaffirmed/reinforced NSF's stance on sexual harassment in the awardee community.
- Developed USAP Code of Conduct.
- Updated Proposal & Awards Policies & Procedures Guide.

Key Ongoing Actions
- Reviewing policies and procedures to identify areas for improvement.
- Identifying next steps based on the developed implementation plan.
- Evaluating terms and conditions as part of its Focus Area #1 of the NSF Equity Action Plan.

[17] NSF Strategic Plan for Fiscal Years (FY) 2022-2026

Additional Resources

Introduction/Multiple Challenges
- NSF, FY 2023 Budget Request to Congress, May 2022
- NSF, Draft FY 2022 Progress Report on OIG Management Challenges, Undated
- NSF OIG, Management Challenges for the National Science Foundation in FY 2022, October 12, 2021
- NSF, FY 2021 Agency Financial Report, November 2021

Increasing Diversity in Science & Engineering Education and Employment
- NSF, Diversity, Equity, Inclusion, and Accessibility (DEIA) Strategic Plan 2022-2024
- NSF, NSF Strategic Plan for Fiscal Years (FY) 2022-2026, March 28, 2022
- NSF, National Science Foundation Learning Agenda FY 2022-FY 2026, March 2022
- NSF, National Science Foundation Annual Evaluation Plan, FY 2023, March 2022
- NSB-2020-15, Vision 2030, May 2020

Overseeing the United States Antarctic Program (USAP)
- NSF OD-22-18, Establishment of a Director's Task Force for Implementation of Measures to Combat Sexual Assault and Harassment in the United States Antarctic Program (USAP), October 3, 2022
- NSF Director Statement on USAP SAHPR Report and Follow-on Actions, undated
- NSF Action Plan (in response to SAHPR report), September 27, 2022
- Department of the Interior's Federal Consulting Group, NSF/OPP/USAP Sexual Assault/Harassment Prevention and Response (SAHPR) Final Report, June 22, 2022
- NSF OIG Report No. 22-6-004, NSF Vetting of United States Antarctic Program Contractors, March 18, 2022
- NSF OIG Report No. 22-2-003, Performance Audit of NSF's Information Security Program for FY 2021, November 17, 2021

Overseeing Grants in a Changing Environment
- Pub. L. No. 117-167, HR 4346 – CHIPS and Science Act of 2022, August 9, 2022

Managing the Intergovernmental Personnel Act Program
- OIG Report No. 17-2-008, NSF Controls to Mitigate IPA Conflicts of Interest, June 8, 2017
- NSF OIG, Management Challenges for the National Science Foundation in Fiscal Year 2018, Oct. 12, 2017
- Freyman, Christina. 2022. Rotator Study. Alexandria, VA: National Science Foundation.

Overseeing NSF-Funded Research Infrastructure
- NSF OIG Report No. 22-2-006, Audit of NSF's Divestment of Major Facilities, Sept. 2, 2022
- NSF 21-107, Research Infrastructure Guide, December 2021
- NSF OIG Report No. 20-2-007, Audit of NSF's Monitoring of Government-Owned Equipment Purchased on NSF Awards, August 26, 2020

Mitigating Threats to Research Security
- U.S. Government Accountability Office (GAO), Protecting Federal Research from Foreign Influence, January 2021
- GAO-21-130, Federal Research: Agencies Need to Enhance Policies to Address Foreign Influence, December 2020
- The White House Office of Science and Technology Policy, Enhancing the Security and Integrity of America's Research Enterprise, June 2020

Mitigating Threats Posed by the Risk of Cyberattacks
- Pub. L. No. 117-167, HR 4346 – CHIPS and Science Act of 2022, August 9, 2022
- The White House, National Security Memorandum on Promoting United States Leadership in Quantum Computing While Mitigating Risks to Vulnerable Cryptographic Systems, May 4, 2022
- Thomas Corbett and Peter W. Singer, China May Have Just Taken the Lead in the Quantum Computing Race, April 14, 2022
- 22-2-003, Performance Audit of NSF's Information Security Program for FY 2021, Nov. 17, 2021
- Department of Homeland Security Policy Directive 140-15, Preparing for Post-Quantum Cryptography, September 17, 2021
- The White House, Executive Order on Improving the Nation's Cybersecurity, May 12, 2021

Addressing Harassment in the Academic Community
- NSF OD-22-18, Establishment of a Director's Task Force for Implementation of Measures to Combat Sexual Assault and Harassment in the United States Antarctic Program (USAP), October 3, 2022
- NSF Director Statement on USAP SAHPR Report and Follow-on Actions
- NSF Action Plan (in response to SAHPR report), September 27, 2022
- Department of the Interior's Federal Consulting Group, NSF/OPP/USAP Sexual Assault/Harassment Prevention and Response (SAHPR) Final Report, June 22, 2022
- NSF, NSF Strategic Plan for Fiscal Years (FY) 2022-2026, March 28, 2022
- NSF OIG Report No. 22-6-004, NSF Vetting of United States Antarctic Program Contractors, March 18, 2022
- NSF 2201, Proposal & Award Policies & Procedures Guide, Effective Oct. 4, 2021
- NSF, National Science Foundation Agency Equity Action Plan
- National Academies of Sciences, Engineering, and Medicine. 2018. Sexual Harassment of Women: Climate, Culture, and Consequences in Academic Sciences, Engineering, and Medicine. *Washington, DC: The National Academies Press.*
- OOP-POL_6000.01, National Science Foundation Office of Polar Programs Polar Code of Conduct, Effective July 2018

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