FY 2010 REPORT TEMPLATE FOR
NSF COMMITTEES OF VISITORS (COVs)

The table below should be completed by program staff.

Date of COV: April 11, 12, and 13, 2011 rescheduled for September 19, 20, and 21, 2011
Program/Cluster/Section:
Division: **OD**
Directorate: **Office of Cyberinfrastructure**
Number of actions reviewed: **Awards: 2008 – 16** **2009 – 26** **2010 - 22** **Declinations:** **2008 – 40** **2009 – 20** **2010 – 41** **Other: At the request of the COV, the awards/declines for the following programs were made available: HPC Track 1, DataNet, and Networking.**
Total number of actions within Program/Cluster/Division during period under review: **Awards:** **2008 – 98** **2009 – 192** **2010 - 165** **Declinations:** **2008 – 403** **2009 – 144** **2010 – 661** **Totals:** **2008 - 501** **2009 - 336** **2010 - 826** •

Manner in which reviewed actions were selected:
For the analysis, the awards and declinations for each year were separated by the program element code that NSF uses to track submissions to each program. A random number generator was used to select awards from each program element code 1 award for each 10 awards made in that fiscal year. ARRA jackets were not excluded from the selection. Though the ARRA portfolio will have separate questions, those awards are also part of the overall portfolio. Because the number of awards varies from year to year, so do the number of jackets representing each year. 64 award jackets and 101 declined jackets were pulled for review.

PART A. INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

Briefly discuss and provide comments for *each* relevant aspect of the program's review process and management. Comments should be based on a review of proposal actions (awards, declinations, and withdrawals) that were *completed within the past three fiscal years*. Provide comments for *each* program being reviewed and for those questions that are relevant to the program under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged.

A.1 Questions about the quality and effectiveness of the program's use of merit review process. Provide comments in the space below the question. Discuss areas of concern in the space provided.

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	**YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE[1]**
1. Are the review methods (for example, panel, ad hoc, site visits) appropriate? Comments: It is clear that OCI did an excellent job obtaining the required reviews for the proposals and using the best review method for a given program. For example, for the DataNet program, which awards $20M over 5 years, each proposal had 15 to 20 reviews. Another example is the Track 1 program, which awards $200M for a single site, the reviews included a site visit. For the small to medium scale proposals, such as PetaApps, each proposal had 3-4 reviews. Source: Jackets, PIMS, and the EIS.	**YES**
2. Are both merit review criteria addressed a) In individual reviews? b) In panel summaries? c) In Program Officer review analyses? Comments: OCI did an excellent job in insuring that both review criteria were addressed in the panel summaries and the Program Officer review analyses. While the individual reviewers addressed both criteria, as expected, the level of detail	 **YES** **YES** **YES**

[1] If "Not Applicable" please explain why in the "Comments" section.

given varied among the reviewers. Source: Jackets and EIS	

3. Do the individual reviewers provide substantive comments to explain their assessment of the proposals? Comments: The individual reviewers provided sufficient comments with respect to the two review criteria. The level of detail, however, varied among the reviewers. Source: Jackets	**YES**
4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)? Comments: The panel summaries were very detailed and provided a good summary of the strong points and concerns for the proposals. Source: Jackets	**YES**
5. Does the documentation in the jacket provide the rationale for the award/decline decision? (Note: Documentation in jacket usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.)	**YES**

During FY 2009, NSF permitted reversal of a declined decision for funding through ARRA for proposals declined after October 1, 2008. (NOTE: This question does not apply to programs for which the reversal decline option was not used.) i) Were the reversals of the decision to decline based on both the high quality* of the reviews received on the initial submission and the lack of available funding at the time the origin was made? *Rated "Very Good or above" or the functional equivalent by review panels. ii) Is documentation provided, including a revised Review Analysis, to support the award decisions? Comments: The documentation in the jackets provided great detail about the factors that led to a decision by the program officer. Source: Jackets	**N/A** **N/A**

6. Does the documentation to PI provide the rationale for the award/decline decision? (Note: Documentation to PI usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), and, if not otherwise provided in the panel summary, an explanation from the program officer (written or telephoned with diary note in jacket) of the basis for a declination.) Comments: The documentation to the PI included the individual reviews along with the panel summary. These documents provided the rationale for the award/decline decisions. In some cases, there were email correspondences between the PIs and the program directors, which provided further information about the rationale for the decisions. Source: Jackets	**YES**
7. Is the time to decision appropriate? Note: Time to Decision --NSF Annual Performance Goal: **For 70 percent of proposals, inform applicants about funding decisions within six months of proposal receipt or deadline or target date, whichever is later**. The date	**YES**

of Division Director concurrence is used in determining the time to decision. Once the Division Director concurs, applicants may be informed that their proposals have been declined or recommended for funding. The NSF-wide goal of 70 percent recognizes that the time to decision is appropriately greater than six months for some programs or some individual proposals. Comments: In general, the dwell time for the small to medium proposals was within guidelines. While it is expected that the dwell time for the large-scale grants would be much longer that the normal 6 month, there were a few proposals that stood out as having very large dwell times in the DataNet programs. For example, one DataNet proposal was submitted on 15 May 2009. The reverse site visit took place in December 2009, with the actual site visit in February 2010. These dates are within the expected dwell time for large-scale grants. However, the call about the budget did not take place until December 2010. This proposal was recommended for award in August 2011. Source: Jackets and EIS-Web COV module. Select "Report View", then select "Average Dwell Time," and select any combination of programs or program solicitations that apply.	

8. Additional Comments
   a) Additional comments on the quality and effectiveness of the program's use of merit review process.

The COV observed that OCI makes effective use of the merit review process with respect to selection of reviewers, the review method used for a given program, documented rationale for the decisions, and information returned to the PI. With the exception of proposals in DataNet, the dwell times were within expected norms. It is, however, important to maintain transparency with the community about overall program funding, especially when major changes occur as what happened with DataNet. In this case, the transparency did not happen and there was considerable unhappiness and anxiety in the community.

The HPC XD program is another example of where transparency is needed. The original XD "Dear Colleague" letter came out in 2008. Full proposals were submitted in 2009. These proposals were turned into "planning grants" as opposed to full awards. The decision to utilize the awards as planning grants was made after the full proposal submissions. Again, this caused anxiety about this program in the community. The XD presentation at the COV meeting, however, indicated that the XD program is now headed in the right direction with full awards being made and the focus on services and reliability.

   b) To what extent does the documentation in the jacket or otherwise available provide the rationale for use of ARRA funding?

OCI did not have to reverse any decisions with respect to ARRA funding. As such, the documentation for the ARRA funded proposals was consistent with that for non-ARRA funded proposals.

A.2 Questions concerning the selection of reviewers. Provide comments in the space below the question. Discuss areas of concern in the space provided.

SELECTION OF REVIEWERS	YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE[2]
1. Did the program make use of reviewers having appropriate expertise and/or qualifications? Comments: The program officers did an excellent job getting reviewers with the needed expertise. It is recognized that a significant number of conflicts exists with the large-scale grants. For such cases, it was obvious that the program officers went the extra mile to get the appropriate reviewers. Source: Jackets, NSF Library Resources, internal OCI documents	**YES**
2. Did the program use reviewers balanced with respect to characteristics such as geography, type of institution, and underrepresented groups? Note: Demographic data is self reported, with only about 25% of reviewers reporting this information. Comments: To the extent that reviewers provided information on race and gender, the COV found that the program officers used balanced reviewers along multiple dimensions. Source: Jackets and EIS-Web COV module.	**YES**

[2] If "Not Applicable" please explain why in the "Comments" section.

3. Did the program recognize and resolve conflicts of interest when appropriate? Comments: Reviewer conflicts were well documents and appropriate actions were taken (e.g., reviewer recusal during discussion of a proposal). Source: Jackets	**YES**

4. Additional comments on reviewer selection: The COV had no additional comments about reviewer selection.

A.3 Questions concerning the resulting portfolio of awards under review. Provide comments in the space below the question. Discuss areas of concern in the space provided.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE[3], OR DATA NOT AVAILABLE

[3] If "Not Appropriate" please explain why in the "Comments" section.

1. Overall quality of the research and/or education projects supported by the program. Comments: Currently, OCI has an excellent portfolio of research programs. Through the programs, OCI has funded top research and education projects. Many of the research projects, especially the large-scale efforts, integrate research with education. Source: Jackets and program information	**APPROPRIATE**
2. Does the program portfolio promote the integration of research and education? Comments: The COV found that the OCI program portfolio promotes the integration of research and education very well. Many of the programs, especially the large-scale programs, require an education component. Furthermore, OCI has increased the number of REU supplements in addition to having REU sites, for which the COV commends OCI. Source: Jackets and individual program information	**APPROPRIATE**
3. Are awards appropriate in size and duration for the scope of the projects? Comments: The COV found that the grants were appropriate in size and duration for the scope of the projects, with the exception of DataNet. The solicitation for DataNet entailed the awarding of 5 grants, each for $20M over five years. The first cohort included the funding of two centers -- one funded at $20 million for five years and the second is currently being discontinued. The remaining three centers are being funded at a much reduced amount of $8M each, instead of $20M each. Source: Jackets and EIS-Web COV module has a “Report View” that gives average award size and duration for any set of programs or program solicitations you specify.	**APPROPRIATE**
4. Does the overall program portfolio (including ARRA funded awards) have an appropriate balance of innovative/potentially transformative projects? ARRA Specific Question: Does the ARRA funded portfolio have an appropriate balance of innovative/potentially transformative projects?	**APPROPRIATE** **APPROPRIATE**

Comments: The COV found that OCI uses EAGERS and RAPID very effectively to encourage innovative new ideas that are in the early stages. Furthermore, the COV found that the portfolio of grants had an appropriate balance of innovative and potentially transformative projects. Source: Jackets and program information.	
5. Does the program portfolio have an appropriate balance of: • Inter- and Multi- disciplinary projects? Comments: The COV found that the OCI program portfolio has an appropriate balance of single-discipline and multi-disciplinary projects. Further, it is good to see that 14.4% of the award funding involves co-funding from other directorates, indicating involvement from the other directorates. Source: Jackets, program information, and some people use as a proxy data on jointly funded projects. See EIS-Web COV module, "Report Review" and select "co-funding from" and "co-funding contributed to" to find jointly supported awards.	**APPROPRIATE**

6. Does the program portfolio have an appropriate balance considering, for example, award size, single and multiple investigator awards, or other characteristics as appropriate for the program? Comments: The COV found that OCI program portfolio has an appropriate balance considering award size, number of investigators and other characteristics. Source: Jackets, program information, and EIS-Web COV module for information on award size.	**APPROPRIATE**
7. Does the overall program portfolio (including ARRA funded awards) have an appropriate balance of awards to new investigators? ARRA Specific Question: Does the ARRA funded portfolio have an appropriate balance of awards to new investigators? NOTE: A new investigator is defined as an individual who has not served as the PI or co-PI on any award from NSF (with the exception of doctoral dissertation awards, graduate or postdoctoral fellowships, research planning grants, or conferences, symposia & workshop grants.) Comments: The COV found that the OCI awards, including the ARRA awards, had an appropriate balance of awards to new investigators. Of the total number of awards over three years, approximately 25% went to new investigators. Source: EIS-Web COV module on "Funding Rate," filtered by PI Characteristic.	**APPROPRIATE**
8. Does the program portfolio have an appropriate balance of: • Geographical distribution of Principal Investigators? Comments: The COV found that the awards had an appropriate balance of geographical distribution of PIs.	**APPROPRIATE**

9. Does the program portfolio have an appropriate balance of: • Institution types? Comments: The COV found that the program portfolio had an appropriate balance of institution types, especially with respect to the small to medium awards.	**APPROPRIATE**
10. Does the program portfolio have an appropriate balance: • Across disciplines and subdisciplines of the activity? Comments: The COV recognizes that OCI has to balance the research focused on advancing CI with multidisciplinary research utilizing CI. The COV found that OCI has a good balance with its current research portfolio. Source: Jackets and program information	**APPROPRIATE**
11. Does the program portfolio have appropriate participation of underrepresented groups? Comments: To the extent that the groups have identified race, ethnicity, gender and disability, the COV found a good balance of participation from underrepresented groups. It is noted that the self-identification includes a large percentage of non-classified participants. Source: EIS-Web COV module, using "Funding Rate" with the pop-up filter (this allows you to see female and minority involvement, where involvement means being PI or co-PI).	**APPROPRIATE**
12. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports. Comments: The COV found that OCI is critically important to the broad field of computational and data science and engineering. OCI established 6 Task Forces in 2009, for which significant community input was involved via workshops, BOFs, and in-person meetings. The COV commends OCI for establishing some programs, such as SI^2, resulting from the Task Force reports. It is important that OCI continue tracking the outcomes from the reports in addition to utilizing various mechanisms to continue to obtain community input.	**APPROPRIATE**

Source: Program information	

13. Additional comments on the quality of the projects or the balance of the overall portfolio (including ARRA funded awards).

The COV does not have any additional comments with respect to portfolio balance.

ARRA Specific Comments: Additional comments regarding the portfolio of ARRA awards addressing the NSF or program-specific priorities for ARRA funding?

The COV does not have any additional comments with respect to the ARRA awards.

A.4 Management of the program under review. Please comment on:

1. Management of the program.

Comments:

Overall OCI is doing well with the management of its programs, especially given the rapid turnover of program directors. The current program directors are excellent and it is obvious that significant time is spent managing the programs. The two issues with Track 1 and DataNet, however, emphasize the need for program directors of large-scale programs to have the following skill set: large program management experience and subject matter expertise. Furthermore, it is important to have permanent program managers of the large-scale programs, similar to other large-facility programs at NSF (e.g., MREFC). With respect to the skill set needed, it should be noted that there

are multiple ways to achieve this goal – having the skill set in one person or having the large-programs managed by a permanent staff and an IPA with complementary skills.

Lastly, when panels are used to monitor the progress of sites receiving large awards, it is important to emphasize the need to provide recommendations in addition to concerns. Panel recommendations are the primary mechanisms heavily used at NSF to provide community input about major concerns. It was noted with the Blue Waters Track 1 award, the panels provided a summary of concerns with very few and minor recommendations.

2. Responsiveness of the program to emerging research and education opportunities.

Comments:

The COV found that OCI does well with respect to utilizing RAPID and EAGER grants to respond to emerging research and education opportunities. We commend OCI for providing REU and CAREER programs, which respond to an important need in the computational and data science and engineering community. Furthermore, DataNet, is another program that reflects the response of OCI to the emerging need for research in the data area. Moreover, we note that OCI created six Task Forces in 2009 that allowed for significant community input into the key CIF21 areas. The resultant recommendations are having an input on OCI with respect to new programs such as SI^2. This is another example of OCI responding to research and education opportunities identified by the community.

In addition to being responsive to emerging opportunities, it is recognized that OCI has significant convening power combined with the leverage of the NSF to foster further investments in cyberinfrastructure by other entities such as campuses, individually and via regional consortia where appropriate. This fostering of further investments can be accomplished by convening focused workshops and organizing pilot programs with small seed grants; such grants can stimulate subsequent deployments of cyberinfrastructure by universities. These activities can occur through the establishment of a Campus Bridging portfolio.

3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.

Comments:

The current OCI program portfolio is excellent, as it responds to internal (through working groups so as to engage other directorates) and external (workshops, task force reports, IPAs, etc.) input with the CIF21 vision providing the context by which the programs are related. As OCI has limited resources, with respect to funding and people, prioritization is important. It is important that OCI develop a prioritization process that can be easily articulated within OCI as well as with the other directorates. This is a good time to define this process, as OCI program portfolio is evolving in a very good way.

4. Responsiveness of program to previous COV comments and recommendations.

Comments:

OCI has been very responsive to the prior COV recommendations. Some of these responses included an increase in activities to support education with the establishment of REU sites, CAREER awards, etc.; an increase in program directors to support the increase in the research program portfolio; the creation of a reviewer database; the effective use of panels; and sufficient reviews of the proposals for the different programs.

5. Additional comments on program management:

Additional Questions:
1. Does OCI have adequate staff to do all that is required for quality program implementation and management?
2. Is the current staff performing in an acceptable manner with respect to proposal pressure, peer review, and post award management?

With respect to the program directors, the COV noted the need for the program directors of the large-scale programs to have skills related to large program management experience and subject matter expertise. Furthermore, it is important that the program directors of such programs involve permanent staff to facilitate the ability to address issues in a very timely manner.

With respect to office staff, the COV recognized the need for OCI to increase in this area. While the program directors have increased since the last COV, the office staff has remained the same, yet the program portfolio has increased. It is important for OCI to increase the office staff for efficiency and efficacy.

PART B. RESULTS OF NSF INVESTMENTS

The NSF mission is to promote the progress of science; advance national health, prosperity, and welfare; and secure the national defense (NSF Act of 1950).

In this Section, the COV is asked to comment on (1) noteworthy achievements based on NSF awards in the portfolio under discussion; (2) ways in which funded projects have collectively affected progress toward NSF's mission and the strategic outcome goals of Discovery, Learning, and Research Infrastructure: and (3) expectations for future performance based on the current set of awards.

NSF investments produce results that appear over time. Consequently, the COV review may include consideration of significant impacts and advances that have developed since the previous COV review and are demonstrably linked to NSF investments, regardless of when the investments were made.

In addition to identifying particularly noteworthy accomplishments or "highlights," the COV is encouraged to comment on the impact of NSF supported contributions to the field. For example, the COV report may include comments on NSF supported work in context of contributions to advance a field, impact of NSF investments to stimulate emerging new areas, and potential for transformative impact in research or education.

To assist the COV, NSF staff will provide award "highlights" as well as information about the program and its award portfolio. The COV is asked to use this information, members' own knowledge of the field, and other appropriate information to develop its comments for this section.

B. Please provide comments on the activity as it relates to NSF's Strategic Outcome Goals. Provide examples of outcomes ("highlights") as appropriate. Examples should reference the NSF award number, the Principal Investigator(s) names, and their institutions.

B.1 OUTCOME GOAL for Discovery: "*Foster research that will advance the frontier of knowledge, emphasizing areas of greatest opportunity and potential benefit and establishing the nation as a global leader in fundamental and transformational science and engineering."* This category includes NSF's disciplinary and interdisciplinary research in science and engineering, education research, and centers.

Outward on the Spiral: Petascale Inference in Earthquake System Science (SCEC PetaShake Project)

Highlights of the 07/25/2011 Annual Report for Award 0905019,
Principal Investigator: Tom Jordan at the University of Southern California

This PetaApps award has resulted in M8 simulations showing that SCEC's AWP-ODC deterministic 3D wave propagation software can scale to simulate any earthquake in the standard California earthquake rupture forecast up to 2Hz. Significant seismic hazard findings from SCEC M8 simulations relate to three important areas: (1) the likelihood that large ruptures on the San Andreas fault will transition from sub-shear speeds during rupture propagation; (2) the importance of directivity and basin effects in ground motion amplification at high frequencies; and (3) the need to model off-fault plastic yielding and non-linear site effects at frequencies above 1 Hz.

Training and Development:

The PetaShake2 project includes researchers at a variety of stages in their careers. Undergraduate students are involved through SCEC UseIT, an IT-related intern summer program, in which these students helped to create visualization tools for SCEC computational data models. Graduate students contribute significant original research results in both geoscience and computer science. The project has provided opportunities for SCEC research to participate in national and international geoscientific and computer science conferences describing their research and learning about related research groups. A SCEC post-doc on PetaShake2 recently received a post-doc at Argonne National Laboratory.

Comment:

This research is advancing the frontier of seismic knowledge, particularly along the San Andreas fault, but transferable to other areas of the world prone to earthquakes. Considering recent earthquake events, this new knowledge and the scientists being trained by the project will benefit society and the scientific community.

Collaborative Research: New Coupling Strategies and Capabilities for Petascale Climate Modeling.

Highlights of the 07/25/2011 Annual Report for Award 0749165,
Principal Investigator: Benjamin Kirtman at the University of Miami Rosenstiel School of Marine and Atmospheric Science.

The focus of this PetaApps project work is improving the capabilities of the Community Climate System Model (CCSM). The CCSM is a community model used by hundreds of researchers, and is one of the models used in the International Panel on Climate Change (IPCC) assessments. They have worked to improve the performance and scalability of the CCSM code base and their initial development focus has been on the extension of the Flux Coupler (CPL), the hub of the CCSM where the complexity of performing generalized redistribution and regridding of multiple, overlapping grids in parallel is performed. The CPL, then, is also the next logical place on which to focus attention for scalability and performance on massively parallel computers.

This PetaApps project is pioneering the effective use of large processor counts in high-resolution climate simulation. Most significantly this year, the team has completed a milestone 155-year high-resolution climate control run using 5844 cores on Kraken. The computational science innovations and key software engineering developments described below have played a significant role in overcoming obstacles and achieving these goals. Several performance improvements were developed and applied to CCSM4_alpha over the course of the second year of the PetaApps project. These advances include a variety of improvements to the I/O subsystem, refinement and optimization of load-balancing strategy and significant reductions memory used by each MPI process. All of these improvements were made in response to issues discovered during large-scale production runs on Kraken, a Cray XT5 system at the National Institute for Computational Science.

The result of this work has produced a number of significant climate science achievements. Specifically the multidecadal control run of the high-resolution CCSM made possible the diagnosis of several important features of the Earth's climate:

- A stable climate simulation can be achieved with high-resolution components models of atmosphere, land surface, oceans, and sea ice;
- The atmosphere, even with 0.5 degree grid spacing, responds to ocean eddies (resolved at 0.1 degree grid spacing) and produces a negative feedback in the mid-latitudes;
- Intraseasonal variability in the tropics, usually associated with the Madden- Julian Oscillation, appears to be more of a standing oscillation than the observed propagating one;
- Large atmospheric circulations like the south Asian monsoon, which are strongly influenced by topography, are better represented at high atmospheric resolution, while resolving the ocean eddies has a relatively small impact on the simulation;
- The apparent sensitivity to initial ocean conditions has a major bearing on Arctic sea ice; and
- The linear kinematic features that appear in the sea ice, which are thought to result from anisotropy in the material properties, despite the isotropic treatment of sea ice in the CCSM.

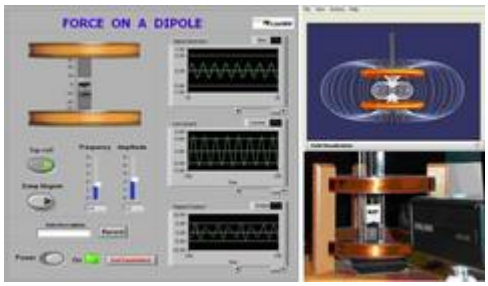
Comment:

The achievements of this project are significant in the climate science community and already advancing the frontier of knowledge in this area. Potential benefit to society is great in terms of weather and storm prediction worldwide.

B.2 OUTCOME GOAL for Learning: "*Cultivate a world-class, broadly inclusive science and engineering workforce, and expand the scientific literacy of all citizens.*"
This category includes K-12, undergraduate, graduate, and postdoctoral education and training; public understanding of science; and lifelong learning.

FY09 Broader Impact Highlight – CI-Team – Joan Peckham – Program Director – CI-TEAM Implementation Project - The iLab Network: Broadening Access to Hands-on STEM Learning via Remote Online Laboratories
Highlight ID: 19220

The Center for Educational Computing Initiatives at the Massachusetts Institute of Technology is joining with the Office of STEM Education Partnerships at Northwestern University to expand a robust cyber-infrastructure with a proven track record at the postsecondary level to new audiences in traditional and online high schools. MIT's iLab cyber infrastructure is a scalable, open-source, standards based platform for remote lab access based on a web-services architecture. It has already proved its effectiveness in sharing remote labs across continents and widely different university communities. This new project will create a remote laboratory infrastructure for STEM education that will offer access to real experimental devices to high school students, teachers, science museum visitors, and other informal science audiences. Our partners include traditional schools, e.g. Chicago Public Schools (an urban school district with 86% low income families), as well as online (virtual) schools, e.g. the Illinois Virtual High School (a state-funded online school). Less affluent school districts stand to benefit from this project by being able to access experiment resources from around the world to enrich their existing high school curriculum. The project has the potential to transform secondary STEM education through dramatically increasing a student's exposure to laboratory experiences.



The force on a dipole experiment couples real-time control of the current entering a Helmholtz coil with a synchronized visualization of the resulting magnetic fields generated by the coil and the suspended magnetic dipole.
Credit: MIT
Permission Granted

The **broader impact** is the outreach to so many varied participants, students, teachers, science museum visitors and other informal science audiences. This project addresses the NSF goal of public understanding of science.

Comment:

The COV was impressed by the educational outreach of this CI-TEAM project. It not only has proven to be a benefit to K-12 education but to the community at large.

FY09 Broader Impact Highlight – TeraGrid Program – Barry Schneider – Program Director - EOT – K-12

Kids and Adults Say WOW to WiiMD

Highlight ID: 16883, Version:

PSC scientist Shawn Brown demonstrates WiiMD to a group of school children
Credit: Pittsburgh Supercomputing Center
Permission Granted

With an innovative hybrid of game technology and supercomputing, a team at the Pittsburgh Supercomputing Center (PSC) is winning new friends, young and old, to the excitement of discovery and learning. Their interface, called WiiMD, integrates the controller of the popular Nintendo Wii game console, the WiiMote, with molecular dynamics (MD) simulation software. The result for a wide range of audiences is an experience both entertaining and informative. The package of simulations includes, for instance, buckyball bowling, in which participants use the WiiMote to impel a "buckyball" carbon molecule to smash a 10-pin formation of other buckyballs.

At the heart of WiiMD is sophisticated MD and visualization software (NAMD and VMD, both developed by the Schulten group at the University of Illinois Urbana-Champaign) used by researchers world-wide on the largest supercomputing resource available. Jordan, a University of Pittsburgh student, adapted the WiiMote controller for use with VMD to enable fully 3-D control over the molecular systems. PSC scientists Shawn and Philip - relying on PSC-developed software called PDIO for real-time, interactive visualization - connected the programs with the flagship CrayXT3 platform, BigBen.

Children are drawn to the familiar gaming device and captivated by the colorful display of molecular shapes, changing in response to movements of the WiiMote. The **broader impact** is that along with students from K-12, WiiMD has drawn enthusiastic attention from teachers and the general public. By keeping a diverse audience interested, WiiMD demonstrations allow the science and technology behind the system to be explained.

Comment:

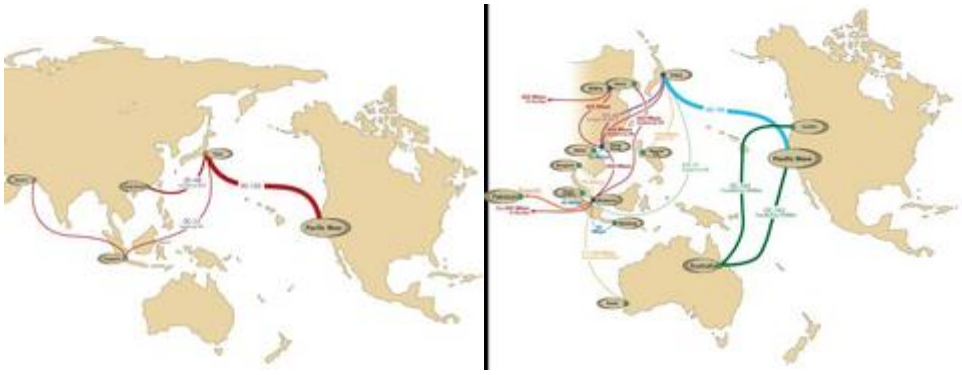
WiiMD also drew enthusiastic attention from the COV, with some members determined to try it. A project which combines scientific learning with such an attractive and timely game environment stands to benefit the scientific community significantly in terms of attracting more young people into science.

B.3 OUTCOME GOAL for Research Infrastructure: "*Build the nation's research capability through critical investments in advanced instrumentation, facilities, cyberinfrastructure and experimental tools.*"

This category includes facilities, research instrumentation, and cyberinfrastructure.

FY09 Science Highlight – IRNC Program – Kevin Thompson – Program Director - Extending Research and Education Connectivity to Pakistan

Highlight ID: 16866



Map of The Pakistan and Education Research Network (PERN)
Credit: Indiana University
Permission Granted

Map of The Pakistan and Education Research Network (PERN)
Credit: Indiana University
Permission Granted

The Pakistan and Education Research Network (PERN) is the current network interconnecting the research and education community within Pakistan (~ 60 public and private universities and institutes are currently connected.) While the initial PERN network has been upgraded in the past, a new generation network, PERN2, is planned to overhaul the network and its capabilities. PERN2 is expected to provide gigabit-level connectivity to connected institutions, extend the reach of the network to additional public institutions, including libraries, health centers and schools.

To complement and enhance the planned network upgrade of the PERN network, the US National Science Foundation (NSF) and the Pakistan Higher Education Commission (HEC) have agreed to split the costs of providing high speed international research and education network connectivity between the US and Pakistan. Contracts have been signed as of July 3, 2008. A circuit 155Mbps circuit is expected to be delivered between PERN2 at Karachi and the TransPAC2 point of presence in Singapore in August 2008. This connection will provide researchers in Pakistan with connectivity to their US colleagues and to the global internet. Two diagrams are attached. The first shows the TransPAC2 connection from the US to Tokyo, Japan, from Tokyo to Singapore and then to Karachi. The second diagram illustrates how this R/E network will connect Pakistan to the cluster of global network connection in Asia.

The activity also resulted in several meetings with officials from the HEC, including the Chairman, Dr. Atta-ur-Rahman and tours various universities and research institutes. Seminars on high performance networking were presented to the HEC and a number of Pakistan university faculty and administrators at the HEC offices in Islamabad.

The **broader impact** is that the goal of this project is to increase science cooperation between the

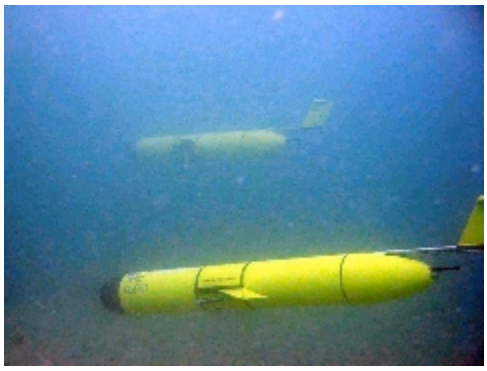
US and Pakistan. The establishment of high performance network connectivity between the US and Pakistan is only a first step. Between three and six months after the network connection is actually up (expected August 2008), the project will host a US-Pakistan science collaboration seminar in the US. This seminar will bring together 3-4 sets of discipline researchers from the US and Pakistan to discuss in detail how this network connection can enhance their research. Based on feedback and success of this first seminar a companion seminar will be held in Pakistan six to nine months following the first seminar. A preliminary web site for this project can be found at http://pakistan.indiana.edu

Comment:
The COV saw this project as an excellent example of building not only a research infrastructure but also a social network between scientists in Pakistan and the U.S. These social networks can become a basis for future scientific collaborations that have the potential to enhance relations between these two countries.

Connecting the Dots: Bridging Federal Data Repositories for Science and Society

Highlight ID: 21474, Version: AC/GPA

As technology advances, growing networks of sensors and sophisticated computer models are generating torrents of data. This wealth of information data makes possible vital insights into urgent science and engineering challenges from climate change to predicting floods, developing drought-resistant plant species, and more. But until now, the diverse data collections have largely remained isolated islands or "silos." This makes it difficult for scientists from different fields to share this rich data across disciplinary lines - an indispensable step for weaving together the strands of their distinct disciplines into an integrated fabric of knowledge.



Nine collaborating Federal and state projects working with the Data Intensive Cyber Environments Center (DICE Center) at the University of North Carolina (UNC) at Chapel Hill have been "federated" or connected together. This interconnection, which allows discovering and moving data between them, uses an advanced NSF supported "data grid" system known as iRODS, the Integrated Rule-Oriented Data System.

The "repositories" have also been federated with supercomputing centers including RENCI and the Texas Advanced Computing Center (TACC). This lets scientists compare new climate data with older archived records to detect major changes, and also use climate observations in supercomputer model simulations to drive major improvements in predictions of future events like regional climate change, severe flooding events, and more.

Other iRODS-based repositories federated in this effort include the RENCI visualization data grid at UNC, which works closely with the DICE Center; and CIBER-U engineering education collections. For long term

"Connecting the dots" of Federal Repositories for New Science Climate data gathered by autonomous ocean-crossing underwater gliders in the NSF Ocean Observatories Initiative (OOI) will flow freely thanks to "federation" that connects repositories to enable new cross-disciplinary science. For example, hydrology researchers studying severe flooding will be able to access ocean climate data from the gliders preserved in NOAA's National Climatic Data Center. These climate observations can also be accessed by supercomputing centers for comparison with earlier observations, and to help improve model predictions of global climate change impacts. Credit: Rutgers University's Coastal Ocean Observation Laboratory.
Credit: RUCOOL
Image Provided by: jorcut@ucsd.edu

preservation, Federal agency records can flow to the National Archives and Records Administration (NARA) Transcontinental Persistent Archives Prototype (TPAP). In the big picture, the researchers added, scientific research is becoming increasingly collaborative, and the ability to federate and interconnect digital data collections is now a fundamental requirement for advancing science and engineering in the US and around the globe.

The **broader impact** is two fold - it demonstrates the cooperation and coordination between many institutions and federal agencies in addressing the issue of data preservation. And it shows the reach of the data that needs to be addressed which covers almost every aspect of everyday life from climate problems to medical records to financial data.

Comment:
The bridging of federal data repositories has contributed to enhancing the nation's research capability by making the multiple data sites available to a number of researchers from many different fields for whom it was previously difficult to access more than one or two such sites. The COV saw this as a good example of cyberinfrastructure improvements making a significant difference for the entire scientific community.

PART C. OTHER TOPICS

OCI's Guiding Questions:

- ***How can OCI work toward effective coordination/integration across programmatic communities to advance NSF's strategic goals and the CIF21 initiative?***
- ***How can OCI best determine the downstream efficacy of its CI investments and integrate lessons learned across disparate groups? What role should "potentially transformative" projects/programs have in this?***
- ***How can interests be better aligned across directorates and OCI in guiding and supporting shared CI investments?***

C.1. Please comment on any program areas in need of improvement or gaps (if any) within program areas.

The COV found that OCI does a good job with regular program development and review. The Committee also views OCI as an important part of NSF, with an essential mission and vision for the future. That said, OCI has had two major controversies in the past several years. One concerns the Blue Waters Track 1 project, which is currently in a state of uncertainty. The principal, private-sector partner, IBM Corporation, has pulled out of the project altogether and returned the money it received to date. The institution that won the award, the University of Illinois at Urbana-Champaign and its National Center for Supercomputer Applications, has developed an alternative plan that is now being considered. Blue Waters was one of NSF's largest projects, certainly the largest cyberinfrastructure project, and OCI's largest project. The press coverage of IBM's withdrawal from the project has been extensive. The second controversy surrounds the DataNet program, which started off with an ambitious plan and has come up far short of that plan.

It is difficult for the COV to know all the details related to Blue Waters or DataNet. The COV does support OCI's investment in high-performance computing as embodied in Blue Waters, and OCI's commitment to issues of "big data" as embodied in the DataNet program. In no case should the COV's comments on Blue Waters or DataNet be construed as criticism of OCI's decisions to invest in those areas of work. Moreover, the COV is not criticizing any of the decisions regarding the awards that were made or changes in the awards that have transpired since. One can readily argue that a high-risk, high-return strategy inevitably entails risk, and the problems encountered were entailed in that risk. The COV points to Blue Waters and DataNet as evidence that OCI can and should learn more about how best to conceive and manage large-scale projects in the cyberinfrastructure domain.

The COV's primary concern about Blue Waters – a lack of in-house project management expertise within OCI – extends to other areas of OCI's work. It is likely that stronger project management skill in OCI would have enabled the office to assess and address concerns about Blue Waters project management raised by the review panel early in the process. Given that some of these concerns eventually were borne out by experience, it seems quite important to address the structural weaknesses of OCI in this area. Similar concerns were noted with respect to DataNet and new ventures such as the Software Institute initiative and the Earth Cubed; such large-scale programs would likely benefit from such in-house expertise. The new OCI Director has taken steps to address this need, and the COV encourages him to continue in this direction.

OCI is both an old organization and a new organization. It is old in that it has roots going back to the early-mid 1980s when the Supercomputer Centers were created and the Directorate for Computer

and Information Science and Engineering was created by bringing together computing-related research programs from various parts of NSF and merging them with the Supercomputers program. For over two decades CISE was home to what grew from "supercomputing" to "cyberinfrastructure," including collaboratories. The Atkins report of 2003 found that cyberinfrastructure was important across all areas of science and engineering, and recommended that cyberinfrastucture be taken out of CISE and made into a separate office under the Director of NSF. In 2006 the creation of the Office of Cyberinfrastructure was underway, and the new office was operational by 2007.

This mix of old and new creates special challenges for OCI. On one hand, OCI is deeply engaged with a well-established community of science and engineering work that has grown up around high-performance computing over a period of two decades. Major centers for such work, including the San Diego Supercomputer Center, the National Center for Supercomputer Applications, and the Pittsburgh Supercomputer Center, have established themselves as major global players in this community, and other centers have emerged as the price:performance of computing technology has improved. OCI thus deals with an incumbent constituency that is important and powerful, and that had learned to operate within the old model within CISE. On the other hand, OCI is attempting to create a new community around data-intensive science and this is a long-term effort that requires patience and persistence. Within NSF, OCI is also a relatively new organization and faces the many challenges of establishing itself as a new organization while trying to attend to the long-established needs and expectations of an incumbent community in addition to creating a whole new community. Among the many challenges facing OCI are the following:

- OCI naturally focuses on infrastructure, which requires long-term attention and stability. However, many of the key players (Director, Program Officers, etc.) are IPAs and therefore are temporary. Rapid turnover of key players is not conducive to long-run development of infrastructure. Having permanent people in such roles can bring problems of its own (e.g., regulatory capture), but at the moment the COV is concerned about rapid turnover when longer-term engagement is desirable.

- OCI serves an incumbent community, but it is also charged with nurturing an emergent community including newcomers from disciplines that have traditionally not been at the forefront of computational and data-intensive science. As those disciplines move more completely into CI activity, newcomers from disciplines that have historically not been big users of computational and data-intensive methods will start to embrace such methods. This might be manageable if OCI's resources were growing to meet demand, but OCI resource growth has been constrained since the office was created. This creates severe competition for resources. Incumbents can feel they are actually losing ground compared to what they previously had, and emergents can feel they are not receiving the support they expected to receive from OCI.

- OCI ostensibly provides support for cyberinfrastucture "across the foundation." Authoritative sources, including the Atkins report, argue that cyberinfrastructure is becoming important to all areas of science and engineering. These two facts, taken together, imply that OCI must do much of its work in partnership with other parts of NSF, especially the directorates. Moreover, if cyberinfrastructure is becoming more important, it seems likely that overall investment in cyberinfrastructure must grow. Among those who believe that "research" is separable from "infrastructure," it is easy to assume that OCI will simply take care of infrastructure for everyone. OCI does not have – and likely will never have – the resources to do this even if it was a good idea. In fact, it is not a good idea. Infrastructure is ***part of the research***. The most sensible role for OCI is to work at the leading edge, and to focus on driving innovations in cyberinfrastructure in the context of the research supported by the directorates. To serve this role, OCI can partner with the directorates to discover, exploit and

sustain cyberinfrastructure as part of the overall research goals. This fundamental issue appears not to have been resolved within NSF, and the history of directorate partnerships with OCI has been uneven. Some of the partnerships appear to be informal, with disagreements over whether commitments have been honored as initially developed. Better mechanisms of engagement and agreement should be developed and implemented.

- OCI deals with technologies that are inherently volatile due to the rapid evolution of technology. Fortunately, this volatility tends to be in the direction of improved price:performance, with computation, data storage, and networking all becoming increasingly powerful as a function of cost. Nevertheless, this volatility creates two major problems. One is the lack of equilibrium; it is virtually impossible for any endeavor to be the "best" for very long. The constantly changing leaderboard of the "Top 500" supercomputers is merely one example of this. If OCI is to support the "best" cyberinfrastructure, this is problematic. The other is the challenge of doing "potentially transformative" work when it is difficult to know how innovative technology proposals will work out. To be truly committed to "high-risk, high-return" science and engineering, NSF and more particularly OCI, must take risks, and this occasionally results in expectation failure. If such failure is punished, the willingness to take risks diminishes. Yet it is important for NSF to continue to learn how to manage risk well. Given rapid turnover, it is tempting (indeed, almost unavoidable) to blame people no longer in OCI for problems that show up subsequently. This makes the problems "individual" rather than "organizational," and OCI does not become more expert at running high-risk, high-return projects. The COV commends OCI for the CIF21 initiative, which moves in the direction of both foundation-wide commitment to infrastructure and high-risk, high-return investment. It is important that the CIF21 initiative evolve from concept to implementation in a coordinated and sustainable manner.

- Because OCI's research portfolio includes large-scale programs requiring NSB approval, it is important that OCI maintain a good relationship with NSB.

C.2. Please provide comments as appropriate on the program's performance in meeting program-specific goals and objectives that are not covered by the above questions.

The COV commends OCI on its progress. It is noteworthy that OCI has remained focused on Learning and Workforce Development and on Virtual Organizations. LWD should emphasize post-secondary learning (undergraduate, graduate, post-doc and mid-career academics) across all areas of OCI. VOSS should continue its focus on new organizational forms including collaboratories and on sociotechnical research. The addition of Research Coordination Networks is a positive step, and it is hoped that the CIF21 initiative includes mechanisms to improve collaboration in practice. The issues addressed by LWD and VOSS are not limited to OCI, but it is good that OCI is providing leadership in these areas. Similarly, the International Research Network Connections program appears to be doing quite well. Networking is an essential component of cyberinfrastructure, and progress in networking – both development and deployment – is necessary for continued progress in OCI generally.

Software is vitally important. The Software Development for Cyberinfrastructure (SDCI) program is transforming into Software Infrastructure for Sustained Innovation SI^2. The COV only notes that software has long been a difficult matter as addressed by the CISE Directorate as well as centers of focus within DoD, DoE and other agencies. There is much to be learned from prior efforts, and the SI^2 program is encouraged to learn from them.

The COV was pleased to see an increase in REUs as well as the use of REU supplements. It

recommends that the undergraduate participants be followed as they continue in their careers and that this data be disseminated Foundation wide to further improve the NSF REU program. OCI's engagement in other NSF LWD activities include the Graduate Research Fellowships Program, the Cyberlearning Transforming Education Program, the Computing Education for the 21st Century Program, the Partnerships for International Research and Education, the Integrative Graduate Education and Research Traineeship Program, and the CAREER Program.

The committee was pleased to see that the rapid turnover of office support staff has decreased and that the current office manager and staff are capable, efficient and contributing to the overall success of the program. It is recommended that support staff be added as needed and working conditions be kept such that the staff continues to thrive. This includes providing promotional pathways so that talented support staff members have the opportunity to advance within OCI.

The COV commends NSF for charging OCI with taking the leadership on developing the implementation plan for CIF21, in collaboration with the other directorates. The CIF21 program highlights the importance of the cyberinfrastructure ecosystem to facilitate new knowledge in science and engineering. Hence, the full participation from all science directorates in collaboration with OCI is critical for the success of the program.

Partnerships with other directorates are key to the mission of OCI, it is critical that OCI continue nurturing a collaborative relationships with the other directorates with the support of the NSF Leadership. To foster such relationships, the COV recommends that OCI makes clear the scope and mission of OCI such that connections are well formulated and fostered.

The panel strongly agrees with OCI's emphasis on research data, including the tools and methodologies for data management, curation, and long-term preservation. The initial program in this area, DataNet, was envisaged as a $100 million initiative with five major centers each funded at $20M for five years. Things have not worked out according to plan for DataNet. At most, one center will be funded at $20 million for five years. In fact one of the first cohort centers -- Data Conservancy at Johns Hopkins – is being discontinued and only the DataONE center at the University of New Mexico will be continued from the first cohort. A second cohort of three DataNet awards has been made at $8 million each. The proposal review process was well managed, but continuity was broken as initial program managers left NSF. Furthermore, the COV learned that the National Science Board raised concerns that prompted one Board member to provide comments to OCI about the initiative; this did not help the situation. OCI's relationships with the Directorates were troubled, as well. The CISE Directorate argues that its co-investment was based on participation by other directorates, and that it was right to curtail its commitment when this participation did not materialize. Had DataNet been targeted at a broader portfolio of projects with a lower level and a shorter duration of funding, things might have been different.

OCI must pursue HPC, which is a nexus of innovation. The largest single project in the OCI-HPC area, Blue Waters, has run into difficulties: the main private partner, IBM, has withdrawn and will not deliver a key component for the $208M sustained Petascale facility proposed. The COV recognizes that high-risk, high-return efforts like Blue Waters entail risk: it was difficult in 2007 to evaluate an architecture with a target delivery date of mid-2011, two generations ahead. Blue Waters was managed in part by reviews carried out three times a year by an expert panel, and these reviews raised early concerns about management. Those concerns were addressed with new hires in 2008, but that might have been late. The statement of work for IBM was not finalized until approximately a year after the award, and the reviews subsequently raised serious and detailed concerns about vendor progress. The experience of Blue Waters should not be used to question the importance of HPC or the need to take risks in pursuing high-risk, high-return endeavors, but it should draw attention to OCI's abilities in large-scale project management, and the need to strengthen these skills. At present it appears to the COV that the only options available to OCI for project

management at this scale were to monitor progress of the Blue Waters project with frequent review panels, and then to either continue the award or cancel it. Modification of the award in response to the realities of the vendor's ability to deliver key aspects of the facility seemed not possible until the vendor withdrew and a critical situation became an inescapable crisis.

C.3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.

OCI has been asked to lead a transformation in science and engineering research and education, but the resources (including political resources) required to lead such a transformation do not match the difficulty of the task at hand. Transformation is harder to do than to say.

The transformation OCI is expected to lead is Foundation-wide. There is no way OCI can lead this transformation without the support and guidance of the Foundation's leadership. At a time of flat or declining resources, it is particularly difficult to take on anything that looks like transformation because this is threatening to the established order of things. It would be better, as a practical matter, for OCI to be relieved of any expectation that it must lead a transformation without the support necessary to accomplish this. That would at least bring the expectations for OCI more clearly in line with what OCI currently has available. However, that decision would probably be bad over the long run, given the growing importance of cyberinfrastructure for all of science and engineering. It is laudable that NSF has recognized this importance, but without the action necessary to support the transformation it implies, NSF's recognition of the issue is moot.

Beyond the need to deal realistically with OCI's mandate and mission, NSF should address the difficulties OCI faces in trying to address abiding infrastructure challenges with a professional workforce that is largely temporary and ephemeral. The right balance of permanent staff and rotators is essential to OCI's success, and right now the balance is not right. There is too much work for the existing OCI staff to handle, and the fact that most of the OCI staff members are rotators makes it difficult to provide sustained attention and direction for infrastructure development and sustainment. Special skills are required for management of large-scale, abiding infrastructure, and these skills must be present over long periods of time. This is a case for increasing permanent staff but not at the expense of rotators --- rotators with research expertise and credentials are vital for moving forward the vision and mission of OCI, especially as OCI undertakes new programs in partnership with other directorates, such as the EarthCube with GEO.

C.4. Please provide comments on any other issues the COV feels are relevant.

OCI and its mission are important for NSF. The decisions to embrace high-performance computing as an important new modality of science and engineering work and to create OCI were prescient. The NSF leadership should consider carefully the role of OCI in the Foundation and more broadly across the fields of science and engineering, and should commit to reconciling OCI's mandate with its fiscal and political resources. In some cases, the NSF leadership might find it necessary to scale-back expectations for OCI to meet the resource constraints. In other cases, the NSF leadership might provide OCI with the resources required to meet expectations. In any event, OCI needs serious attention and action at this time. Most likely, priorities will shift over time, and OCI will need support from NSF leadership to deal with shifting priorities and the political fallout such shifts carry.

C.5. NSF would appreciate your comments on how to improve the COV review process, format and report template.

There are two objectives for the COV: to provide what might be called “process quality assurance” review of the processes by which programs are created and awards are made; and to comment on what might be done to improve the overall direction of the enterprise under review. This COV was convened to look at the whole of OCI, which is a complicated entity. OCI has a curious mix of programs and processes, ranging from EAGER and RAPID awards, workshop awards, routine grant awards, cooperative agreements, and special funding made through “Dear Colleague” letters. The Committee is in no position to compare OCI’s portfolio in this regard with that of the rest of the Foundation, however it seems plausible that OCI engages in a wider range of award models *relative to its overall budget* than other NSF offices or directorates. If so, OCI is more complicated in terms of its routine work than its peers in NSF. This creates challenges for any COV process, and this Committee ran into a number of challenges.

- It was not easy for the COV to understand the array of award mechanisms and the ways each are used. A primer on this might have been helpful.

- The Non-Disclosure Agreements involved in the Blue Waters project made it difficult to get a clear picture of what went on there. NSF has an established culture of having external reviews of programs on a regular basis. To facilitate adequate reviews, it is important that documents that must be reviewed not contain NDA information.

- The NSF has in the MREFC process mechanisms to encourage attention to project management. It is possible that mechanisms of this kind can be adopted and adapted to fit OCI projects of large scale and visibility. But this was not an easy matter for the COV to consider given that OCI projects are typically not MREFC projects. In fact, it is probably not within the scope of the COV to address such issues.

SIGNATURE BLOCK:

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For the Office of Cyberinfrastructure Committee of Visitors
Valerie Taylor
Chair