

**Report of the 2013 Committee of Visitors
Division of Chemistry
National Science Foundation**

**Meeting Dates
February 19-21, 2013**

**Submitted on behalf of the Committee by
Joseph S. Francisco, Chair**

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Report of the Committee of Visitors

Division of Chemistry National Science Foundation February 19-21, 2013

I. Executive Summary

The 2013 Chemistry Committee of Visitors (COV) applauds the Chemistry Division for its management and accomplishments over the past three years, despite formidable challenges in available resources. The integrity and efficacy of the Division's review process continues to be strong. The Program Officers' management of the review process is highly effective and is working well. The committee was impressed with the complex array of responsibilities assumed by individual Program Officers in the Division. The COV feels that the Chemistry Division cannot be asked to do more without additional Program Officers. Sufficient numbers of Program Officers are needed for continuity of programs and successful program management. Moreover, the Division faces challenges in the increasing number of proposals and the large number of deserving proposals that should be funded if sufficient resources were available. The difference between the available budget and funds needed to support the deserving proposals creates additional challenges for the Division and its Program Officers. Many of these challenges would be alleviated by a simple request for additional funds. However, the COV feels that this request is unrealistic and unlikely to be successful in the near term. The following recommendations are made in light of the current reality of fiscal shortages.

The COV review identified a number of areas in which the Division could optimize their review and management processes. The committee's recommendations are enumerated by the order they appear in the report and this ordering does not reflect a priority ranking of the recommendations.

Recommendation #1: Find mechanisms to further increase the efficiency and efficacy of the review process. These efforts should include establishing a database of reviewers and developing mechanisms for educating the reviewer pool on the importance of substantive reviews and reviews that provide constructive advice to PIs. *An essential aspect of this recommendation is to increase the clarity, transparency and integrity of the review process, particularly with respect to communication to PI's.* Two examples are transparency in identification and development of priority research areas and clarification of broader impacts. The Broader Impact criterion is an important component of competitive proposals, but there remains misunderstanding on what it is and how it is used in evaluation. Moreover, evaluation of the broader impact component should be consistent across programs of the Division. Finally, the Chemistry Division should continue its efforts to ensure that the composition of review panels is as diverse as possible, including members with high-levels of research activity and breadth, as well as young PIs.

Recommendation #2: Maintain continuity of Program Officers in programs over a period of time.

Recommendation #3: Increase the efficiency of operations and the number of Program Officers to improve program management. The COV recommends that the Division be given positions for additional personnel in order to decrease the workload currently imposed on Division staff, to ensure adequate oversight and program management, and to allow progress on new and existing programs and projects.

Recommendation #4: Reevaluate the distinction between the catalysis and synthesis programs and investigate best ways to categorize the programs in these areas.

Recommendation #5: Reevaluate the timing of the submission windows.

Recommendation #6: Commission a National Academies review/study of the Re-alignment of the Chemistry Division. The composition of the review should represent a broad cross-section of the chemistry community (i.e. industry, government laboratories, and universities). The COV has provided specific scope questions to guide the assessment.

Recommendation #7: Work to increase more industrial partnerships. The division should consider: (a) using Centers to even more effectively to bring about university/industry engagement; and (b) examining best practices at NSF to help facilitate faculty/industry partnerships using NSF-facilitated internships. It is important that the strength in fundamental research in the chemical sciences continue to further innovation, and the Chemistry Division can provide leadership to the community in identifying and promulgating successful industry/university collaboration mechanisms.

Recommendation #8: Explore ways to increase global engagement of the chemistry community, especially faculty and students involved in projects in other countries. CHE should seek to enhance participation in international collaborations by creating a chemical research world network of partnering agencies who share the CHE vision of a joint proposal-joint review-joint funding recommendation-parallel funding model. Exploring best practices from the Materials World Network (DMR) could provide direction on how to be effective in increasing global partnerships by the Chemistry Division.

II. Background

The Committee of Visitors for the Division of Chemistry (CHE) met for three days to review the activities of the Division during the three-year period 2010-2012. The meeting was held as scheduled between February 19th -21st, 2013 .Appendix B provides a list of the membership of the committee whose 25 members include a large number of national award winners in chemistry and related fields, and leaders in the chemical enterprise from industry, national agencies, and academe.

The COV was charged to address and prepare a report on:

- (a) the integrity and efficacy of processes used to solicit, review, recommend, and document proposal actions;
- (b) the quality and significance of the results of the Division's programmatic investments;
- (c) the relationship between award decisions, program goals, and Foundation-wide programs and strategic goals;
- (d) the Division's balance, priorities, and future directions;
- (e) the Division's response to the prior COV report of 2010; and
- (f) any other issues that the COV feels are relevant to the review.

In mid-January, prior to the meeting of the COV, a webinar was conducted to prepare the members for the review process. The members were given access to a number of electronic documents on the NSF External Collaboration Portal and the Electronic Jacket COV website. These documents included the 2010 COV report and the CHE responses to it over the 3-year period that is being evaluated, the CHE Strategic Directions document, information about the merit review process, and key statistics on CHE funding as well as highlights of outcomes of CHE funded programs.

The meeting of the COV began on February 19th, 2013 with the introduction of Dr. Jackie Gervay-Hague, incoming Division Director, CHE and Dr. Joseph Francisco, Chair, COV by Dr. Tanja Pietrass, Acting Division Director, CHE, who also welcomed the group. The charge was officially presented to the COV by Dr. Celeste Rohlfling, Deputy Assistant Director of the Math and Physical Sciences Directorate (MPS); the letter stating the formal charge appears in Appendix A of this report. Dr. Rohlfling's remarks were followed by a briefing on conflicts of interest by Dr. Kelsey Cook, Staff Associate for MPS. Dr. Tanja Pietrass presented an overview of the activities of CHE over the recent three-year period to be reviewed.

After the completion of all the formalities, the COV members were separated into eleven groups representing the different areas of CHE and provided with an introduction to the program by the appropriate Program Officer. The CHE programs that were reviewed include:

- CAT: Chemical Catalysis
- CMI: Chemical Measurement and Imaging
- CTMC: Chemical Theory, Models and Computational Methods
- CSDM: Chemical Structure, Dynamics and Mechanisms

- CLP: Chemistry of Life Processes
- EDU: Educational Activities (REU, CAREER, ACC/SEES Fellows)
- ECS: Environmental Chemical Sciences
- INSTR: (Chemical Research Instrumentation and Facilities)
- MSN: Macromolecular, Supramolecular and Nanochemistry
- SYN: Chemical Synthesis
- Centers: Centers for Chemical Innovation

Each group or subpanel was provided with access to a selected number of proposal “ejackets”. Ejackets were selected to represent some number of clearly fundable cases, some clear declinations, and a larger fraction of borderline cases. A few of the subpanels also requested additional ejackets for review, and these were promptly provided following a review for conflicts of interest. At the end of the day, each subpanel prepared a report addressing the Section A questions of the COV Report Template. Whereas COV members were assigned to subpanels on the first day according to their primary affiliation with a sub-discipline of chemistry, the members spent the morning of the second day in a different subpanel performing a “cross-read” review. The new subpanels prepared their second round reports, and the early afternoon was spent preparing merged reports by the combined membership of the first and second round subpanels. The membership of the subpanels and the complete agenda for the meeting is found in Appendices B through D. The final merged reports for each of the subpanels are included in Appendix F.

The remainder of the second day was spent in discussions of the two Consideration of Beyond the Portfolio questions. This was accomplished by again dividing into smaller groups for the purpose of facilitating discussion. The first question was “How to evaluate realignment?” and the second question was, “Evaluation of Portfolio Management.” Finally, the reports on the two questions were merged, and the group leaders met to write a combined report. A summary of their reports appears in the answers to Section B questions in Appendix F.

The third day of review started with a brief discussion of the reports from the scribes for sessions on the two questions, followed by a more general discussion of issues pertinent to the Division and the report to be presented to the Assistant Director of MPS, Dr. Fleming Crim. This morning session was conducted as a closed session with only the COV members present in the room in order to encourage frank discussion between members. Conversely, all CHE staff members were invited to the afternoon session during which the COV presented their findings to Dr. Fleming Crim. The COV members wish to commend the CHE staff for their highly professional organization of meeting materials and very helpful presentations and discussions throughout the process. The Program Officers, Executive Officers and Division Director were immediately available to the COV for questions, helpful suggestions, and explanations of the many difficult decisions made over the course of three years. Their open and friendly attitudes accelerated the COV review process and continue to add to the effectiveness of the CHE program overall. Special thanks are due to Dr Tanja Pietrass for her extraordinary devotion to the COV review process over a period of nine months and for all her assistance.

III. Specific Results of the Review

Part A. Integrity and Efficiency of the Program's Processes and Management

The Committee of Visitors met in two small groups for each Program to evaluate the effectiveness of the review and award process over a three year period: FY10, FY11, and FY12. They reviewed data and asked questions of the Program Officers, and then further analyzed data independent of the Program Officer's input.

The scribes, for each of the two groups, came together to create a single merged document. These documents were then reviewed by two Leaders who presented the findings to the entire COV for comments and discussion. Overall, there were many common themes in the Program reviews. The common themes that emerged are:

- 1) Overall, the review process is working well.
- 2) Reviewer selection is excellent, but still needs technical improvements. Creation of a database of reviewers would be enormously beneficial to the review process.
- 3) Program officers have appropriate flexibility in making funding decisions. However, the increasing workload on the program officers that has been brought about by increasing application numbers and by increasing time demands of cross-divisional funding is having a negative impact on the program officers' ability to manage programs rather than managing proposals.
- 4) Award portfolio has excellent quality and balance of funded projects. However, the dollar amounts have become limiting in what can be accomplished.
- 5) Broader impacts assessment and integration remains problematic for reviews, and assessment is uneven. More details on concerns in this area are provided in a separate section below.

In addition to the common themes, two areas of concern emerged for specific programs. The Catalysis and Synthesis programs that were created upon realignment have significant overlap. There is understandable confusion within the community, and a significant number of the SYN proposals reviewed by COV had a significant component of catalysis. Many researchers submit proposals to both programs. The COV felt that the division between CAT and SYN is largely artificial.

The COV also noted that it may be beneficial for the chemistry division at NSF to eliminate the CRIF program and encourage those proposals to be submitted to the MRI as other divisions at NSF have done. The COV feels strongly, however, that within NSF there should always be a mechanism by which chemists can apply for funding for instrumentation. Other specific comments worthy of highlighting that emerged from the COV program reviews appear at the end of this document.

Review Process

The COV found that Panels were working effectively and provide more objective, balanced, unbiased, and constructive review and feedback to the investigators as compared to having only ad hoc reviews. At this time, CDSM is the only program that still relies only on ad hoc reviews. Panels or a combination of panels plus ad hoc reviews are used for every other program in the chemistry division. A vast majority of reviewers provide substantive reviews and take their role in the process seriously.

An outstanding challenge is to construct panels that fulfill the need for an appropriate diversity without overloading a subset of the community and without compromising the breadth of expertise necessary to assist the program officer in assessing the quality of the proposals. As smaller virtual panels are becoming more common, these issues may become more critical. However, the COV felt that virtual (video) panels of up to 20 reviewers were possible, and that the NSF should consider running larger virtual panels. The COV also recommended that CSDM consider using panels, as they still rely on 100% ad-hoc reviews. The COV further recommends that, in the interest of improving the transparency of the review process, the names of panelists be released for larger panels.

The COV has some misgivings about projects being funded without any external review, as is the policy for the EAGER program. The COV recommends that, if possible, at least one external review should be solicited as part of the decision process for EAGER grants.

The COV felt that Program Officer comments were essential for PIs to get a good idea of the rationale for the award/decline decision. It appears that large latitude is given to program officers to make programmatic decisions within the Tier 2/Recommended for Funding classification. The COV supports maintaining this latitude, while increasing the accountability and transparency of the process. The COV felt that in cases where funding is declined the PIs should be provided with information regarding whether they are in the top, middle, or bottom of Tier 2. This will help the PIs to better understand the amount of revision that will be needed for resubmissions.

The COV recommends that the Current and Pending information not be provided to reviewers, since reviewers are meant to evaluate the proposed science rather than the funding record of the PI. Alternatively, reviewers should be provided with instructions regarding how the Current and Pending information should be treated in their reviews. In like manner, reviewers should be provided with guidance regarding how to rate past publication record when reviewing the science that is being proposed.

The COV recommends that the timing of the single submission window be reconsidered as soon as possible. The present schedule, which has proposals submitted during the months of September and October, can cause problems for academic departments, many of which start their academic years in late August or

early September. To avoid overlapping with Thanksgiving, the division may want to investigate the impacts of shifting the windows several weeks later.

The COV also recommends that the single submission window be evaluated after it has been in place for a few years to determine whether this is the most effective policy.

Reviewer Selection

The Program Officers are selecting appropriate reviewers who have the expertise and experience to review NSF proposals. However, this selection is still done without the use of a central database (much like journals utilize). The creation of a database was a key recommendation of the 2007 COV that has not yet been implemented. Given the current reviewer and Program Officer workloads, creation of the database should be of highest priority. This database would track which reviewers have been contacted so that they are not contacted by multiple programs at the same time. In addition, it would track their response rate and whether appropriate and comprehensive reviews are received.

Now that panels are commonly used, the membership of the panel should be made public. Revealing the identity of panel members would improve the transparency of the review process. The COV proposes a mechanism by which the applicants are informed of the members in the panel in advance, such as is common practice in NIH. The rationale for this suggestion is to give an opportunity to the applicants to make sure the appropriate expertise is included on panels, and to point out conflict of interests that are not public knowledge, or otherwise accessible, to the Program Officers. The COV notes that this suggestion arose from multiple members working in different areas of chemistry, not simply those who are working in NIH-funding priority areas.

The COV suggested that junior faculty (new investigators) should be invited as observers on panels to learn how the review process works, rather than serve as unfunded, inexperienced reviewers. However, it appears that panel observers are against Federal policy, and therefore, alternative ways to educate junior faculty about NSF peer review should be sought. There was discussion of an NIGMS mentoring workshop for junior faculty in chemistry that could serve as a model for helping the young NSF community.

Program Management

Program Officers have too much work to do, but they do it very well. The increase in the number of proposals that are submitted annually has not been accompanied by a commensurate increase in NSF staff. The use of rotators rather than permanent staff members to manage programs may cause problems with the continuity and advancement of programs. The COV felt that some rotators were extraordinarily effective in their limited time at NSF, and that the positive aspect of bringing in active researchers from the community should not be discounted.

Existing systems allow POs the fluidity to fund new, cutting edge ideas. The COV felt that many smaller cross/inter-disciplinary projects require enormous effort to fund across programs for very small sums of shared dollars. This does not appear to be an efficient use of limited Program Officer time. Processes should be streamlined so that these many different pots of money can be accessed more conveniently. Processes for collaboratively funding proposals across directorates, for example, might be more appropriately placed at the Directorate level than the Program Officer level. Another suggestion was to fund top tier grants for longer periods (perhaps five years) to relieve workload pressures on the program officers and on reviewers. The COV also recommends that program officers take advantage of Creativity Extensions to existing grants that are coming up for renewal.

Overall, the program officers are highly effective, but the COV feels that real efforts to streamline processes and avoid chronic overwork of the program officers should be a priority.

Award Portfolio

The Program portfolios covered a broad cross-section of Chemistry as well as included interdisciplinary projects. The awards were of excellent quality and represented a balance of scientific projects. The biographical and geographical distributions of awards are consistent with national demographics and population densities. Some portfolios were more geographically focused and more likely to fund top 100, particularly, if the proposal pressure was extraordinarily high in a particular program.

The COV is very concerned about the future of the funded portfolios. NSF Program Officers have done a wonderful job of balancing number of awards with size of awards within a limited budget. However, if the NSF budget remains flat with inflation (optimistic scenario), then a different approach to managing the award portfolios, rather than reducing or not increasing award budgets, will have to be taken. This will be a significant challenge; NSF will either have to reduce the overall number of awards or leverage funds from other sources.

Co-funding across multiple divisions increases the interdisciplinary nature of the portfolios but takes a lot of Program Officer time and energy. The COV recommends that these processes be streamlined. In particular, if the use of rotators continues, there is insufficient time to build the personal relationships between program officers required for assuring co-funding of proposals. For co-division reviewed proposals, a uniform grant format policy and uniform review template used by both divisions is necessary. Otherwise, reviewer and program officer time are wasted on delineating minor differences and ensuring compliance with multiple formats.

Broader Impacts

Many concerns about the implementation of the Broader Impacts component of NSF grants were raised during the COV review process. Clearly, there is continued confusion regarding the types of activities and importance of broader impacts in the review process and funding decisions. It is not clear that the importance of broader impacts is handled consistently across the programs in the chemistry division. Some proposals with very strong science were felt to have been given a “pass” on the broader impacts component, while broader impacts were in other cases listed as a reason for declination of a proposal. For NSF-CAREER proposals, integration of broader impacts is required. If PIs are truly expected to integrate broader impacts, then there should be accountability as to whether the broader impacts have been implemented as part of the progress report in an NSF renewal proposal. Alternatively, it would be appropriate to train PIs and reviewers to lower the expectation for increasingly extensive, exotic, and significant time commitments for activities outside the norm of traditional faculty workloads. A systematic investigation of the most effective and most appropriate activities for broader impacts, and continued education of the PIs, reviewers, and program officers about best practices for broader impacts, is encouraged. Finally, the COV would like to commend the Chemistry Division for continuing to take a leadership role on the issue of broadening participation by including PIs who are themselves and/or are dedicated to working with women, women of color, African-Americans, Hispanics, under-represented minorities, and people with disabilities. Efforts to educate the community on this issue should be continued and even amplified.

Other Comments

Specific noteworthy comments from COV reviews regarding individual programs are as follows:

ECS

We commend the program managers for developing and shaping this new program within chemistry. The environmental chemical sciences program builds the home for a very important group of scientists that address crucial environmental topics for the world. It is currently a small program that will likely grow by attracting PIs that are working on pressing issues with high impact.

CTMC

In the context of realignment, this program executed a clear vision to keep the projects that focused primarily on theoretical and computational methods, while distributing applications-oriented projects to other programs in the Division. The program has realigned and focused into a program on methods and software development that serves the broader community (including other NSF programs and beyond). This alignment has diversified the portfolio and has facilitated proposals that are not focused on methods development to find more appropriate homes in other NSF programs.

SYN

Although there is a new program alignment for proposal submissions, the review panels are still very narrow in focus and align more with the older program alignment in CHE. This limits the likelihood of cross-fertilization of ideas and the development of broadly impactful chemical research areas.

CAT/SYN

Catalysis is a field that lends itself to inter-, multi-disciplinary work. Even though the program is involved with other directorates of NSF, it still appears somewhat fragmented into specific research areas. A greater effort could be made to maximize the broader mission of catalysis by the development of panels that span the whole discipline. This would encourage the cross-fertilization and emphasis on research areas that are broadly impactful.

CAT

The program may benefit from a broader range of fields covered in its review panels. For example, forming joint panels with homogeneous and heterogeneous catalysis experts would be in better alignment with the new NSF program designations than the former.

CSDM

Our opinion is that CSDM is effective at cross-disciplinary reviews and effectively uses existing Program Officers' expertise. However, the current challenges are not likely to subside and new methods may be useful in the future. For example, it may be helpful to explore new modalities of the review process that incorporate some use of panels in addition to ad hoc mail reviews.

CLP

Given the newness of the CLP, it is critical that the future Program Officer leadership be in close contact with the research community, either as an active researcher (rotator) or as an active participant in research conferences. In addition, continuity of leadership for more than one year is essential. This type of leadership will ensure that the CLP portfolio evolves with the scientific directions defined by the active research community.

Part B. Quality and Significance of Division's Strategic Programmatic Investments

A review of the portfolio indicates that the program officers (POs) did an extensive amount of portfolio management during the current review period. The resulting portfolio was balanced with respects to both merit based and additional criteria. The results are impressive, considering unusual budget constraints and the high number of proposals reviewed between 2010 and 2012. These professionals should be commended for their exemplary talents. The COV would like to suggest additional changes that may be used to further enhance the portfolio in the future.

The role of Broader Impact in the Award/Decline Decision: The COV agrees that it is imperative to the continued efficacy of the CHE that the division funds the best science. These projects are distinguished from others by their exceptionally strong “potential to advance knowledge (intellectual merit)” and their “potential to benefit society and contribute to the achievement of specific, desired societal outcomes (broader impact)”. The best chemistry projects address both criteria by creating knowledge with the potential to change society, and consequently, transformative projects with strong intellectual merit must continue to be prioritized. Additional broader impact criteria should be considered if the intellectual merits of the proposal are strong.

Nevertheless, there continues to be confusion among PIs and reviewers as to what constitutes broader impact, and the weight commanded by broader impact in the evaluation of proposals. The CHE has worked tirelessly for many years to educate PIs and reviewers on types of activities that constitute good broader impact. However, the degree to which broader impact statements are developed in proposals varies widely. It is very likely that PIs have learned to recognize strong broader impact activities; nevertheless, there is no motivation to take broader impact criteria seriously if there is a perception that broader impact has little significant on the award/decline decision of a proposal. The COV discovered that there is a significant range in the quality broader impact statements in the active portfolio, which suggests that the weight reviewers and program officers give to the broader impact criteria, is inconsistent. Both PIs and reviewers would benefit from more specifically defined metrics that could be used to rank the merits of proposed broader impact activities in each proposal. The COV’s review of the existing portfolio suggests that most reviewers use weighting factors of approximately 80% for intellectual merit and 20% for broader impact, without any guidance as to what is appropriate for the CHE division. Clarity on the overall significance of broader impact on the proposal award/decline decision would help to standardize the discussion of broader impacts in proposals and the weight of the merits of broader impact equally in the overall ranking of proposals.

The use of additional criteria in the award/decline decision: The COV agrees that a well-managed portfolio prioritizes awards to proposals with strong intellectual merit and broader impact, but considers additional criteria to create a well balanced portfolio. The COV observed that the POs are actively managing proposals ranked in the “recommend” category during the review process, which is the best category for considering additional criteria in an award decision, assuming that proposals ranked higher based on merit alone have already been funded. The POs should be more transparent about the use of additional criteria in the award/decline decision, including identifying subsets of a division with low numbers of submissions. Additional criteria that must be considered include: the number of active awards made to an individual PI; topical diversity in division; the inclusion of high-risk/high-reward projects, geographical distribution of awards, and PI demographics such as award history, gender, and underrepresented group status. Failure to manage these

additional criteria appropriately inhibits broad participation within the chemical sciences, which is imperative to the future of the field.

The COV had several of concerns regarding the fact that principal investigators are strongly advised to submit only one proposal annually, which limits the total number of NSF awards a PI may manage simultaneously. At the same time, the budgets for CHE funded projects have been stagnant for years. This may have a synergistic effect of limiting the productivity of even the best research programs, which is clearly not the intent of the single proposal policy. Serving as co-PI could become risky for investigators who might lose their funding for their other projects; consequently, collaborative research may be reduced. Finally, how do centers, ICCs, PIREs, and related programs fit into this policy? It might be more realistic to limit the total cost of research awards solicited by a single laboratory/PI rather than the number of proposals submitted annually.

The COV was especially sensitive to the management of proposals submitted by investigators who have never served as a PI on an NSF funded project, especially those in the earliest stages of their careers. The COV agreed that new investigators should be trained to write good proposals, but was unable to identify the party responsible for training, or the best method of delivery. Some believed PI training was the responsibility of colleges and universities, while others believed the NSF should have a more active role. Methods of delivery discussed included workshops, webinars, and broadening the participation of new PIs on review panels. However, it was clear that there are things the NSF can do during the review process to assist in the development of new investigators. Reminding new PIs that funded proposals are accessible to the public, and the broad dissemination of program highlights, will provide new investigators with examples of successful projects they can use to inspire their own. It is essential to provide this population with adequate feedback on their proposals, even when a review panels uses the “do not discuss” option to control workload. Moreover, if CHE funds too many young investigators on a single, new, and even transformative area of research, there is a risk that some of these investigators will fail to distinguish their science from others and launch successful, independent careers. All investigators, including new PIs, should be educated as to which subsets in a division have several active proposals and which ones do not.

There was much discussion in the COV about the management of high risk, potentially transformative projects, especially EAGER proposals. The COV agrees that most panels are risk adverse, and groups may be dissuaded from recommending projects with too much inherit risk. In these special cases, the role of the program officer in the funding decision is imperative. Nevertheless, the COV was uncomfortable with funding decision being made without any input from the broader scientific community. Processes function best with proper checks and balances, and those in the EAGER program appear to be inadequate. The COV recommends that at least one ad hoc reviewer is solicited for future EAGER awards.

The COV agreed that the program officer is the best person to use additional criteria to make the award/decline decision. However, reviewers charged with assessing the intellectual merits and broader impacts of proposals are provided with Current and Pending Support forms. Although this is public information, the COV was not clear as to how understanding a PIs funding status assists in the merit review of a proposal. In current practice, PIs are penalized by some reviewers for failure to secure research support in the past, or judged as overly ambitious when working on several grants simultaneously. The COV recommends that these forms not be distributed to reviewers because they interfere with the process of merit review. Alternatively, reviewers should be provided with clear instructions regarding how the Current and Pending information should be used in their evaluation of a proposal.

Length of appointment for program officers: The COV agreed that the rapid turnover in POs created by the frequent use of rotators to serve in these positions can be detrimental to the management of portfolios. Short appointments do not enable POs to have an adequate understanding of how the portfolio was managed in the past, which can facilitate the decision making process for the active portfolio. Co-funding proposals is a mechanism to leverage the CHE budget to fund more science. Nevertheless, developing co-funding agreements is more efficient when the POs in the agreement have a prior history. The COV recommends that the CHE carefully considers the balance of rotators and permanent NSF employees serving as POs for the division.

Management of the Centers for Chemical Innovation: Members of the COV noted that the Centers for Chemical Innovation (CCI) form an important part of the Division's portfolio as they are a venue for high impact collaborative research and public outreach. Unlike IIA proposals, CCI proposals involve a number of application phases, and award oversight includes site visits. Furthermore, they are multidisciplinary by design, requiring reviewers and program oversight often spanning several disparate scientific disciplines. As a result, review and management of CCI proposals/awards are inherently more complex than in the IIA program and would benefit from having more human resources dedicated to the program. The COV recommends that the formidable task of inviting, reviewing and overseeing the CCI program include efforts by additional program officers.

Impacts of Moving to One Unsolicited Proposal Submission Window per Year: The COV agreed that although the move to a single window for the submission of unsolicited proposals each year helps the CHE distribute funds equitably, this change may impact continuity of funding for principal investigators. With one submission window per year, it is important that the PO has the authority to allow submission outside the window in special circumstances. These circumstances include nature-related catastrophes, health-related problems for the PI, or delays in prior notification. In addition, Creativity Extension Awards should be used more frequently to lengthen the duration of projects that are doing exceptionally well for up to five years. This not only provides continuity for the PI, but also reduces the workload for the PO by reducing the number of proposals that must be reviewed annually.

In summary, the COV makes the following recommendations with respects to program management:

- Continue to educate the chemistry community by providing examples of good broader impact and develop a metric to rank broader impacts in funding decisions.
- Increase transparency about the use of additional criteria in the award/decline decision, including identifying subsets of a division with high or low numbers of proposal submissions.
- Consider limiting the total cost of research awards solicited by a single laboratory/PI rather than the number of proposals submitted annually.
- Add at least one ad hoc reviewer in the review of future EAGER proposals.
- Assist in the development of new investigators by reminding new PIs that funded proposals are accessible to the public; broadly disseminating program highlight; providing substantive feedback on declined proposals; and educating potential PIs as to which subsets in a division have several active proposals and which ones do not.
- Current and Pending support funds must be submitted, but for review by the Program Officers only. If reviewers are to see this information, guidance should be provided in terms of how it is to be used in their evaluation of the proposal.
- CHE should carefully consider the balance of rotators and permanent NSF employees serving as Program Officers for the division.
- Additional Program Officers should be involved in inviting; reviewing and overseeing the CCI program include efforts by additional program officers.
- The Program Officer should have the authority to allow submissions outside the annual unsolicited proposal window in special circumstances.
- Creativity Extension Awards should be used more frequently to lengthen the duration of projects that are doing exceptionally well for up to five years.

Part C. Performance in Contributing to Division's Strategic Direction

The 2007 COV for the Chemistry Division recommended that the Division produce a document elucidating its strategic directions. With input for all segments of the chemical community this document was created in 2008 and entitled "U.S. National Science Foundation Strategic Directions: 2008-2012". In view of the fact that we are five years removed from this report and that Jacquelyn Gervay-Hague will assume the Directorship of CHE later this year, we encourage CHE to reexamine these strategic directions and the success of the Division's responses to these issues, and that CHE produces an updated document laying out strategic directions for the five year period, 2013-2018. The key directions highlighted in this report included:

1. Advancing American Competitiveness
2. Communicating Chemistry to the Public
3. Increasing Global Engagement
4. Increasing "Grand Challenge" Research through Centers
5. Broadening Participation

6. Addressing Funding Needs Across Career Stages
7. Assessing the Broader Impacts Criterion
8. Updating the Division Structure

Many of the initiatives have met with excellent progress, specifically communicating chemistry to the public, meeting “Grand Challenges” through Centers for Chemical Innovation, broadening participation, and updating the Division structure. We encourage CHE to maintain momentum in these critical areas. Specific comments on some of these issues are dealt with in other areas of the COV report.

The COV believes in the current climate there are enhanced opportunities for CHE to foster and advance programs in university/industry engagement and in global collaborations. In the following sections we offer CHE ideas and suggestions, which the NSF may want to consider in shaping strategic directions for 2013-2018.

1) University/Industry Engagement

There are several factors that suggest this area should receive increased attention during 2013-2018. These include the Administration’s emphasis on enhancing innovation and entrepreneurship (e.g, the American Competitive Initiative, the America COMPETES Act, the Administration’s interest in Advanced Manufacturing and the recently established manufacturing innovation centers), the increasing entrepreneurial activity by university faculty and the growing volume of technologies being spun out of universities, and the simple fact that the majority (>80%) of B.S., M.S. and PhD chemists will spend their careers in the chemical industry. Thus the COV suggests that CHE:

- a. Invigorate the GOALI program. The expressed goal in the 2008 report was to greatly expand the GOALI program. This hasn’t happened. The success rate is high, but only 7 awards were made during the three year period, 2010-2012. ***We recommend that CHE examine why this has happened (for example, are there IP issues, conflicting cultures in industry and academia, or the lack of publicity) and make efforts to resolve the problems uncovered and stimulate more GOALI submissions.***
- b. Encourage internships. The COV concludes that internships are remarkably valuable in exposing students to the culture of chemical industry and the career paths available. The rapidly growing entrepreneurial start-ups and new small companies may offer a particularly stimulating venue for internships. ***We recommend CHE explore mechanisms to encourage and facilitate such internships.*** Could supplements to regular NSF grants be a mechanism for this? Could such internships be a bridge to faculty, especially young faculty, to establish industrial partnerships?

- c. Facilitate linking of university faculty with industrial partners. Linking up with industrial partners can present a problem particularly for young investigators who have limited contacts. ***We recommend NSF explore ways to promote such partnerships.*** We believe an NSF/Industry workshop could serve to promote such linkages, to collect feedback as to industry interests/needs/possible modes of engagement and to identify solutions to barriers to such collaborations (e.g., IP issues?). The SCI (Society of Chemical Industries) could be useful in helping organize such a workshop.
- d. Make additional use of Centers of Chemical Innovation (CCIs). CCIs have extensive and deepening relationships with industrial partners. ***We suggest that CHE consider whether these contacts and interactions could be further leveraged for the community's benefit.***
- e. Make use of industrial chemists as reviewers. Efforts have been made in the past to increase the use of industrial reviewers and substantial barriers have been encountered. Nevertheless, as the new reviewer data base comes on line, ***we encourage CHE to make efforts to identify willing industrial participants and include them in the new data base.*** Recently retired chemists seeking to maintain intellectual stimulation may provide a pool of conscientious, insightful reviewers.
- f. Learn from other programs. There are other programs within NSF that promote and support industrial interactions, including DMR, BIO and Engineering Directorates. ***We encourage CHE to investigate whether learning from these programs could provide new mechanisms for industry/university interactions.*** The Chemistry Division should consider how to use STTR and SBIR programs to the advantage of the division.

2) *International Partnerships*

The expressed goal in the 2008 report was increase global engagement of the U.S. chemistry community, especially U.S. students going abroad, and to ensure that the U.S. is the most attractive destination for chemists. The plan to make a *World map* showing current CHE activity (research collaborations, conferences, joint awards, etc.), and publicize it, has not been accomplished.

Within the ICC program, the number of encouraged proposals has increased from 65 in 2008 to 194 in 2012. However, the ICC solicitation still includes only 7 countries. Two more (Germany and UK) have phased out of the solicitation. Many more researchers are partnering informally (not through the ICC mechanism) with international collaborators.

The COV believes that additional efforts should put emphasize on developing partnership programs with Europe (Germany) and South America (Brazil/Argentina). This recommendation is consistent with the goal expressed in the 2008 report to establish ties with strategically chosen countries, perhaps in strategic scientific areas.

One factor which suggests realignment with Europe should receive increasing attention, during 2013-2018, is that the Administration's transatlantic partnership for trade and investment between the European Union (EU) and the United States (US) is underway. In particular, Germany was discussed as the largest European producer of chemicals (25% of EU production), and the EU as the world's most important producer of chemicals (30% of the total world chemicals production, and >1/3 world's top thirty chemical companies with headquarters in the EU). Exploring the possibility of an NSF-Humboldt partnership was discussed by the COV as a recommended strategy for the CHE.

Another factor supporting the recommended opportunity for realignment of the CHE international partnership effort is the Administration's educational path-breaking initiatives for joint innovation with South America (e.g., Brazil, Argentina) through student exchange programs (e.g., the *100,000 Strong in the Americas* initiative with the goal to increase the numbers of Latin American and Caribbean students in the US to 100,000 each year, and to send 100,000 American students to the region over the next 10 years).

The COV believes the possibility of an NSF/ACS partnership should be explored to join efforts for example with the pilot ACS GREET (Global Research Experiences, Exchanges & Training) Pilot program. The aim is to encourage both faculty and graduate students or undergraduates to travel abroad to establish new international collaborations in both academic and industrial laboratories, allowing for a 2-3 week stay for faculty and 4-8 training periods for students.

The COV suggests that the realignment could also be orchestrated in conjunction with other NSF programs such as PIRE (Partnerships in International Research and Education) and the international undergraduate component (IREU) that also aim to foster international research and educational collaborations by enabling graduate students to spend time abroad with an appropriate project at an institution with PIRE and work with PIRE participating faculty. Other NSF programs that could have an enhanced representation from CHE are the international component of the IGERT (Interdisciplinary Grad Education Research Training) program, the STC (Science and Technology Centers), the GRFP (Graduate Research Fellowship Program) and the NSF EAPSI (East Asia & Pacific Summer Institutes) offering funding for 8-10 weeks of summer research in East Asia and the Pacific (Australia, China, Japan, Korea, and New Zealand). In particular, NSF-China CHE cooperation should be further explored.

Part D. How to Evaluate the Effectiveness of Program Re-alignment

In 2009, the Chemistry Division, after significant discussion with the broader community, realigned the programs in their portfolio. The alignment had a stated goal to “Create a Contemporary Structure for CHE”. CHE sought to guarantee that the very best projects in research, education, training, and infrastructure development are supported and to anticipate and respond to new developments in chemistry. Specifically, the new alignment created programs with names intended to match how chemistry research (not teaching) is currently done. The names needed to be clear to the community of PIs and mean something to the public.

The Committee of Visitors met in five small groups to discuss how to evaluate the effectiveness of the 2009 program realignment. A specific charge was provided to each group and is listed below.

The Division realigned its scientific programs in 2009. With three years of data on the new programs, the Division wishes to assess the impact of the realignment on the field of chemistry and the research community. The Division requests feedback from the COV on how to best structure such an assessment.

The leaders, of each of the five discussion groups, came together to create a single merged document, which was presented to the entire COV for comments. Overall, there was much commonality in the ideas from the five groups and four overarching discussion questions emerged:

- 1) Is the realignment accomplishing its stated goals?
- 2) What is different before and after realignment?
- 3) How are different stakeholders affected by realignment?
- 4) Who should be involved in the assessment of the realignment?

1) Is realignment accomplishing its stated goals?

The assessment should start by looking back at the stated goals of the realignment. Since the realignment, is the best science being funded? Do the new names reflect how research is being done and do the new categories encompass the entire field of chemistry? Do the names mean something to the community and public? The questions posed need to be asked of all the different stakeholders involved including PIs, students, postdocs, NSF program officers, the public, and the government. There was a feeling within the COV that the review of the program realignment should be dynamic, i.e. there should be an ongoing plan for assessment and not a one-time review. However, there was no consensus on how often assessment should be conducted, with ideas ranging from “continuous” to every five years. Additionally, the COV felt that the realignment assessment should not be an up or down vote on the “success” of the realignment; rather, it should determine what is working in the realignment and what is not working as well. Are some new programs better addressing the needs of the community, while others need adjusting? Two specific concerns were brought up. The COV

asked whether it is a problem that some of the new program names - specifically *Chemical Catalysis* and *Chemistry of Life Processes* – sounds like existing programs at the DOE or NIH. The mission of the NSF is distinct from those of DOE and NIH, and scientists appreciate the differences in the programs, but government officials might view the programs as redundant. Some care should go into the naming of these programs so that this problem is avoided. Also, as some of the groups get larger, do names like CSDM “A” and “B” carry adequate meaning outside of the NSF?

2) *What is different before and after realignment?*

The COV identified three different areas to examine: 1) proposal submission and review; 2) budgetary questions; and 3) outcomes. Some of these questions have begun to be asked by the Chemistry Division and should be included in a comprehensive assessment. The assessment of the effect of the realignment will be complicated by the subsequent influx of ARRA money and the change to a single submission window. Care should be taken to separate the effects of these additional factors.

Many questions are internal to CHE, which addresses the effect of the realignment on proposal submission and review. There is a sense that the realignment caused an overall increase in the number of submissions. Was the increase in submissions a result of the realignment? Has the pool changed or did the pool realign? Did the realignment result in an overall positive response from the chemistry community, cause an increase in new ideas stimulated by the realignment, and/or increase submissions by new investigators? Did the realignment increase collaborations, encourage multidisciplinary proposals, and/or increase the number of co-PIs? Are there more proposals coming from scientists who did not submit before? How much is coming from “traditional” chemists versus scientists from other disciplines? What effect did the realignment have on reviewing and funding decisions? Do proposals now fit clearly into a single program or is there an increase in “orphaned” proposals with no clear program home? Are there more proposals on narrow ranges of “bandwagon” topics within the new programs? Is it easier or harder to put together effective panels? Has the standard deviation of the MRR decreased or increased since the realignment? Is it easier or harder for program officers to evaluate reviews and make funding decisions in the new programs? How has the success rate been affected by the realignment? Another important question deals with budgeting according to proposal pressure. Are program officers able to judge proposal quality across the new programs to ensure that the quality is consistent across the new programs, and from year to year?

Additional questions examine the effect of the realignment on interactions external to CHE. In terms of the CHE budget, does the realignment help CHE leverage support from MPS and other directorates at NSF? Has cross-divisional funding of individual grants changed? Has the realignment increased research

productivity, and evidenced by an increase in the number of citations and publications in high impact journals? Are younger scientists empowered and are they and mid-career scientists taking leadership roles in shaping the field?

3) *How are different stakeholders affected by realignment?*

The COV felt that it was important to look at how all stakeholders are affected by the realignment. The stakeholders are identified as the PIs, students and postdoctorals, the NSF, and the public/government. How did the realignment influence participation of PIs and the demographics of the portfolio with regard to gender, minority status, career stage, and type of institution? Were the effects different in different programs? The alignments are distinct from the traditional distinction between coursework as taught in universities. Are students and postdocs aware of the realignment and do the new categories encourage more participation in chemistry by students in the pipeline, including women and minorities? Does the realignment influence research direction to the point that students are better prepared for a multidisciplinary workforce? Does it match the perceived needs of the graduate community? Over the longer term, are the needs of the scientific workforce being met, are students and post-docs from NSF-funded labs finding employment, and are they better prepared for the workforce?

The COV felt it is important to look at the effect of the realignment on the NSF and public as well. Is the realignment helping program officers meet the NSF mission goals? Is research under the realigned categories more responsive to national priorities? Does realignment help address shortages of science teachers and technically trained people to meet global needs?

4) *Who should be involved in the assessment of the realignment?*

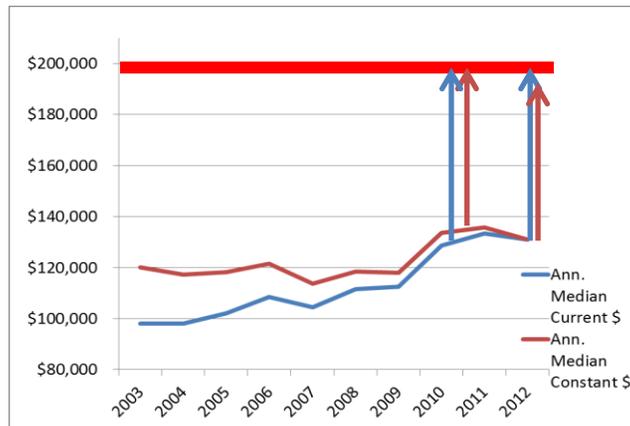
The COV felt that it was important to involve assessment professionals in the design of the study on the effects of realignment. Some suggested commissioning the NAS to run the study or asking the NSB to task a subcommittee with supervising the evaluation. Special care should be taken to ensure that there is input from PIs, reviewers, program officers and the broader community. At least some of the PIs and reviewers should have experience under the old and new systems. There was a sense that very strong or very weak proposals are not affected by the realignment, so there should be particular attention to Tier 2 proposals. Panelists should be asked if the current set of programs accommodate proposals being submitted. Do they see orphaned or redundant proposals? The POs should be asked about the pros and cons of the realignment. Do they perceive the new system as better? Do they have the resources to evaluate the proposals? The broader community could be polled at town halls at ACS or AAAS national meetings, and by questionnaires to PIs and reviewers.

IV. Response of the Chemistry Division to the 2010 COV Review

The COV considered the report of the previous (2010) COV carefully. CHE responded with sincerity, clarity and action on the 2010 COV report. Seven recommendations were highlighted in the 2010 COV report. Over the past three years, the Chemistry Division has made a concerted effort to address all of the recommendations that are under the Chemistry Division's control. Here we highlight the subset of items from the 2010 report that may require continued visibility and/or actions. We summarize these responses according to the points enumerated below.

Seven recommendations (in italics) were made by the 2010 COV. The Chemistry Division's response to each recommendation is described below.

1. *Senior should staff continue to stress the importance of investing in chemistry; highlight accomplishments:* The Division is actively involved in both of these activities. CHE and MPS have been developing a staffing plan beginning in 2010. The first priority was to increase the number of Program Officers. CHE staff members have worked with the NSF Office of Legislative and Public Affairs to publicize the successes of CHE-supported projects. The long term plan for administrative workforce development in the Division is to move from program assistants to program analysts who are skilled science writers.
2. *Grow the IIA budget; grow the Centers budget without compromising the IIA budget:* The Division requested increases for FY13 Centers budget (\$29.25 million, from \$24 million in FY11) and the individual investigator (IIA) core (\$185.2 million, from \$160.5 million in FY11). In FY11, the Division absorbed a 0.4% budget cut. The Centers program budget change relative to FY10 nevertheless increased by 1%, reflecting the Division's commitment to protecting this activity. Budgets have been essentially flat in the past three years. Flat current dollars correspond to a decrease in constant dollars. We recognize that the Division can only affect this issue in a limited way and the available budget is controlled elsewhere. The Division recognizes the need to balance funds for CCI and IIA programs.
3. *Grow the average size of the IIA budget to \$200 k/year:* The award amount in IIAs has not increased to the suggested amount. The figure below shows the median annual IIA size from 2003 to the present. The median award grew from \$131.3k in FY10 to \$132.5 in FY11, while the mean size decreased from \$156.9k to \$147.8k. An analysis of funding data shows that more awards on the lower end of the spectrum shifted to more awards of smaller size. While this trend is opposite to that desired by the 2010 COV, it allowed CHE to keep the funding rate constant. Given current political pressures, it seems unrealistic that this funding level will be realized. The Division should be lauded for not sacrificing programs by reducing awards to non-viable funding levels while striving to fund as many proposals as possible.



4. *Monitor funding rate across career stages*

The division is currently monitoring this information. Data was provided to the 2013 COV for proposal and award numbers as a function of career stage.

5. *Explore additional mechanisms for review:*

- (1) *Use of cyber-conferencing:* Implementation began in FY12 with the expectation of >90% in FY13.
- (2) *Inform ad hoc reviewers that their reviews will be read by a panel:* Change in practice is underway.
- (3) *Develop a more robust database for searching, assigning and tracking reviewers:* an NSF-wide effort has been underway for more than 2 years. Policy obstacles exist.
- (4) *Hire more program officers:* This action is not possible given current organization and allocation of resources.

6. *Educate the community about best practices in terms of Broader Impacts*

The merit review criteria were reassessed through NSB in FY12. CHE has increased efforts in reaching out to the community in a number of ways including a new newsletter, outreach visits, panels, Skype into Department meetings (new) and on-going Town Hall Meetings at ACS meetings.

7. (1) *Reassess and update the Strategic Directions document periodically:*

This issue is on the agenda for FY13/14 based on 2013 COV feedback.

(2) *Evaluate and refine the new interdisciplinary programs as needed:*

This issue is being worked on through continuing effort.

(3) *Continue to educate the community about the new programs:*

CHE reports that this action has been completed. Evaluation methods for the realignment will be proposed based on 2013 COV.



Appendix A Charge to the COV

**NATIONAL SCIENCE FOUNDATION
4201 Wilson Boulevard, Arlington, Virginia 22230**

**Office of the Assistant Director
Mathematical and Physical Sciences**

September 26, 2012

Dear Dr. Francisco:

Thank you for agreeing to serve on the FY 2013 Committee of Visitors (COV) for the Division of Chemistry (CHE). The COV Review will take place at the NSF in Arlington, Virginia, on Tuesday through Thursday, February 19-21, 2013; we expect to begin early Tuesday morning and conclude by 3:00 pm on Thursday.

The COV is an *ad hoc* subcommittee of the Mathematical and Physical Sciences Advisory Committee (MPSAC). Your appointment to the COV commences December 3, 2012 and ends with the discussion of the COV report by the MPSAC in early April, 2013 (the exact meeting date of the MPSAC meeting remains to be determined). Dr. Joseph Francisco has graciously agreed to be the chair of the COV.

By NSF policy, each program that awards grants and cooperative agreements must be reviewed at three-year intervals by a COV comprised of qualified external experts. NSF relies on their judgment to maintain high standards of program management, to provide advice for continuous improvement of NSF performance, and to ensure openness to the research and education community served by the Foundation. Reports generated by COVs are used in assessing agency progress in order to meet government-wide performance reporting requirements, and are made available to the public. The COV is charged to address and prepare a report on:

- the integrity and efficacy of processes used to solicit, review, recommend, and document proposal actions;
- the quality and significance of the results of the Division's programmatic

- investments;
- the relationship between award decisions, program goals, and Foundation-wide programs and strategic goals;
- the Division's balance, priorities, and future directions;
- the Division's response to the prior COV report of 2010; and
- any other issues that the COV feels are relevant to the review.

A more complete description of the charge to the COV is provided below.

Decisions to award or decline proposals are ultimately based on the informed judgment of NSF staff, based on evaluations by qualified reviewers who reflect the breadth and diversity of the proposed activities and the community. Systematic examination by the COV of a wide range of funding decisions provides an independent mechanism for monitoring and evaluating the overall quality of the Division's decisions on proposals, program management and processes, and results.

The review will assess operations of individual programs in CHE as well as the Division as a whole for three fiscal years: FY 2010, FY 2011, and FY 2012. The CHE programs under review include:

- Centers for Chemical Innovation
- Chemical Catalysis
- Chemical Measurement and Imaging
- Chemical Theory, Models and Computational Methods
- Chemical Structure, Dynamics and Mechanisms
- Chemical Synthesis
- Chemistry of Life Processes
- Environmental Chemical Sciences
- Instrumentation (Major Research Instrumentation and Chemical Research Instrumentation and Facilities)
- Macromolecular, Supramolecular and Nanochemistry
- Educational Activities (REU, CAREER, ACC/SEES Fellows)

All material for the review will be in electronic form only. Tanja Pietraß, the Deputy Division Director, (703-292-2170, tpietras@nsf.gov) will send you an agenda and access information for Fastlane. All information that is needed in preparation for your visit will be accessible via the Fastlane system. Around mid-January, we will conduct a webinar or webex session to prepare you for the visit, including hands-on instructions of the Fastlane COV module. Panel members will be given access to the awardrecords themselves two weeks prior to arrival at the NSF. Confidentiality rules prohibit providing knowledge of, or access to, declined proposals prior to the meeting. This information will be available upon arrival at the NSF on February 19, 2012.

The meeting itself will begin with brief introductory sessions that will provide background on the COV process by MPS Staff and an overview of the Division's programs and activities by the Division Director. Following these presentations, the COV

will have an opportunity to examine program documentation and results and to gather information for their report. The Committee will also be given time for general discussion and conversation with program staff. The last day of the meeting will be spent primarily drafting the report. The Chair of the COV will finalize and submit the full report at least four weeks prior to the MPSAC meeting in early April.

Please respond to Tanja Pietraß (tpietras@nsf.gov) with your interest in participating in the COV by November 8, 2012. If you agree to serve, Ms. Marla Stewart (703-292-8735, mastewar@nsf.gov) from the Chemistry Division will contact you with information about making travel and hotel arrangements.

Thank you again for your willingness to participate in this important activity.

Sincerely,

Celeste Rohlfin
Acting Assistant Director

Enclosures: Excerpt from COV guidelines
List of Members of FY 2013 CHE COV
cc: Dr. James Berger, Chair MPSAC

Enclosure: From Subchapter 300 of the NSF COV Guidelines:

366. The COV Core Questions and Reporting Template will be applied to the program portfolio and will address the proposal review process used by the program, program management, and the results of NSF investments. Questions to be addressed include

- a) the integrity and efficiency of processes used to solicit, review, recommend and document proposal actions, including such factors as:
 - (1) selection of an adequate number of highly qualified reviewers who are free from bias and/or conflicts of interest;
 - (2) appropriate use of NSF merit review criteria;
 - (3) documentation related to program officer decisions regarding awards and declines;
 - (4) characteristics of the award portfolio; and
 - (5) overall management of the program.
- b) the relationships between award decisions, program goals, and Foundation wide programs and goals;

- c) results of NSF investments for the relevant fiscal years, as they relate to the Foundation's current strategic goals and annual performance goals.
- d) the significant impacts and advances that have developed since the previous COV review and are demonstrably linked to NSF investments, regardless of when these investments were made. Examples might include new products or processes, or new fields of research whose creation can be traced to NSF-supported projects.
- e) the response of the program(s) under review to recommendations of the previous COV review

Appendix B

List of Members 2013 Division of Chemistry Committee of Visitors

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Appendix C

Agenda Division of Chemistry Directorate for Mathematical and Physical Sciences 2013 Committee of Visitors

Monday, February 18, 2013

7-9 PM (*optional*) Informal Gathering at Front Page (4201 Wilson Blvd. Arlington, VA 22230 – on the first floor of the NSF building – across the street from the hotel)

Tuesday, February 19, 2013

7:30 AM Continental Breakfast for COV Members – Room 130 (near NSF North Entrance)

8:15 AM Welcome – Room 110 –
Tanja Pietrass, Acting Division Director, CHE
Jackie Gervay-Hague, incoming Division Director, CHE
Joseph Francisco, Chair, CHE COV

8:30 AM Charge to the Committee of Visitors
Celeste Rohlfing, Deputy Assistant Director, Mathematical and Physical Sciences (MPS)

8:40 AM Overview of Division - Tanja Pietrass

9:50 AM Conflict of Interest Briefing
Kelsey Cook, Staff Associate, MPS

10:00 AM Break, Room 1020 and move to First Read Room Assignments (see below)

10:15 AM First Program Review - Introduction to Program by Program Directors

10:45 AM First Program Review

11:45 AM Working lunch in program review

3:30 PM Welcome and Break, Room 1020
Fleming Crim, Assistant Director, Mathematical and Physical Sciences (MPS)

4:00 PM Preparation of First Program Review Report

6:00 PM Adjourn, Dinner on your own

Wednesday, February 20, 2013

7:30 AM Continental Breakfast, Room 1020

8:00 AM Second Program Review (see below) - Introduction by Program Directors

8:30 AM Second Program Review

10:00 AM Break, Room 1020 (as for breakfast)

11:45 AM Working lunch in program review

12:15 PM Preparation of Second Program Review Report

1:15 PM Merge First and Second Program Review

2:45 PM Break, Room 1020

3:00 PM Consideration of Beyond the Portfolio Question 1: How to evaluate realignment

4:00 PM Consideration of Beyond the Portfolio Question 2: Portfolio Management

5:00 PM Group Leaders meet to merge reports for Beyond the Portfolio Questions 1 and 2

6:00 PM Adjourn, dinner with NSF or on your own

Thursday, February 21, 2013 –

- 7:30 AM Continental Breakfast, Room 110 (near NSF North Entrance)
- 8:00 AM Reports and Discussion (Programs and Questions), Room 110
- 10:00 AM Break, Room 130
- 10:30 AM Preparation for briefing the AD/Working Lunch, Room 110
- 12:30 PM COV briefs Fleming Crim, AD/MPS, on findings and recommendations, Room 110
- 1:15 PM Closed Discussion; COV and AD/MPS
- 1:30 PM Final Discussion
- 2:00 PM Adjourn

Appendix D

Breakout Groups Division of Chemistry Directorate for Mathematical and Physical Sciences 2013 Committee of Visitors

First Program Review (**Leaders (Scribes) in Red/Bold**) – Tuesday February 19 10:15 am Joe will be available in Room 1055.35

| CAT | Centers | CLP | CMI | CSDM | CTMC | EDU | ECS | INSTR | MSN | SYN |
|-------------------------|---------------------------|------------------------|-----------------------|-----------------------|------------------------|----------------------------|--------------------------|------------------------|------------------------|--------------------|
| 1050 | 1055.37 | 1055.07 | 1055.39 | 1046 | 1059 | 1055.27 | 1052 | 1054 | 1055.09 | 1020 |
| Rodriguez, Nelly | Brookhart, Maurice | Sampson, Nicole | Fowler, Joanna | Mullin, Amy | Batista, Victor | Collins, Sibrina N. | Johansen, Anne M. | Alvarado, Jorge | Mallouk, Thomas | Davies, Huw |
| Schrock, Richard | Olvera de la Cruz, Monica | Cloninger, Mary | Foster, Krishna | Gudmunds-dottir, Anna | McCoy, Anne | Paulus, Eugenia | Hatcher, Patrick | Mohler, Debbie | Frommer, Jane | Lees, Bob |
| | Hud, Nick | | | Miller, John | | Watkins, Linette, M. | | | | |

Second Program Review – Wednesday February 20 8:00 am Joe will be available in Room 1055.35

| CAT | Centers | CLP | CMI | CSDM | CTMC | EDU | ECS | INSTR | MSN | SYN |
|------------------------|----------------------|-----------------------|--------------------|-------------------------|-------------------------|------------------------------|----------------------------------|------------------------|------------------|-----------------------------|
| 1050 | 1055.37 | 1055.07 | 1055.39 | 1046 | 1059 | 1055.27 | 1052 | 1054 | 1055.09 | 1020 |
| Foster, Krishna | Frommer, Jane | Mohler, Debbie | McCoy, Anne | Hatcher, Patrick | Schrock, Richard | Gudmunds-dottir, Anna | Olvera de la Cruz, Monica | Cloninger, Mary | Hud, Nick | Watkins, Linette, M. |
| Davies, Huw | Miller, John | Fowler, Joanna | Alvarado, Jorge | Brookhart, Maurice | Mallouk, Thomas | Batista, Victor | Lees, Bob | Johansen, Anne M. | Rodriguez, Nelly | Sampson, Nicole |
| | Mullin, Amy | | | Collins, Sibrina | | | | Paulus, Eugenia | | |

Merge First and Second Program Review – Wednesday February 20 1:15 pm

| T | Centers | CLP | CMI | CSDM | CTMC | EDU | ECS | INSTR | MSN | SYN |
|-------------------------|---------------------------|------------------------|-----------------------|-------------------------|-------------------------|------------------------------|----------------------------------|------------------------|------------------------|-----------------------------|
| 1050 | 1055.37 | 1055.07 | 1055.39 | 1046 | 1059 | 1055.27 | 1052 | 1054 | 1055.09 | 1020 |
| Foster, Krishna | Frommer, Jane | Mohler, Debbie | McCoy, Anne | Hatcher, Patrick | Schrock, Richard | Gudmunds-dottir, Anna | Olvera de la Cruz, Monica | Cloninger, Mary | Hud, Nick | Watkins, Linette, M. |
| Rodriguez, Nelly | Brookhart, Maurice | Sampson, Nicole | Fowler, Joanna | Mullin, Amy | Batista, Victor | Collins, Sibrina N. | Johansen, Anne M. | Alvarado, Jorge | Mallouk, Thomas | Davies, Huw |
| | | | | | | | | | | |

Beyond the Portfolio: Question 1 - How to Evaluate Realignment – Wednesday February 20 3:00 pm
Beyond the Portfolio: Question 2 - Portfolio Management – Wednesday February 20 4:00 pm
Beyond the Portfolio: Group Leaders Merge Responses for Q1/Q2 – Wednesday February 20 5:00 pm
Sign-up sheets will be available on Tuesday morning--5 COV members per room listed below per question; group leaders for portfolio questions to be determined

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|----------------|----------------|----------------|-------------|----------------|
| 1055.37 | 1055.27 | 1055.35 | 1020 | 1055.39 |
|----------------|----------------|----------------|-------------|----------------|

Appendix E
FY 2013 REPORT TEMPLATE FOR
NSF COMMITTEES OF VISITORS (COVs)

The table below should be completed by program staff.

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| Date of COV: February 19-21, 2013 |
| Program/Cluster/Section: all programs in CHE |
| Division: Chemistry |
| Directorate: Mathematical and Physical Sciences |
| Number of actions reviewed: 142 Awards: 70 Declinations: 67 Other: 5 |
| Total number of actions within Program/Cluster/Division during period under review: Awards: 1547 Declinations: 5249 Other:81 |
| Manner in which reviewed actions were selected: Program Directors selected a combination of proposals that were either, i) clear-cut awards, ii) at the “decision interval”, or iii) clear-cut declinations. Efforts were made to minimize conflicts-of-interest (COI) with members of the COV to the maximum extent. Access was blocked for proposals where a COV member had a COI identified either before or during the onsite COV meeting. Some proposals were selected randomly by an NSF Information Technology Specialist. |

INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

Chemical Catalysis (CAT)

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(s) under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged.

I. Questions about the quality and effectiveness of the program's use of merit review process. Please answer the following questions about the effectiveness of the merit review process and provide comments or concerns in the space below the question.

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS | YES, NO, DATA NOT AVAILABLE , or NOT APPLICABLE |
|---|--|
| 1. Are the review methods (for example, panel, ad hoc, site visits) appropriate? Comments: The NSF has moved towards panels with ad hoc reviews only when needed to secure options of an expert on topics investigated by small communities. The panel method has the potential to distill divergent opinions and create thoughtful, constructive critiques that will move the research forward. Panel discussions are particularly useful when individual panelist had a wide range of initial ratings. The program may benefit from a broader range of fields covered in its review panels. For example, forming joint panels with homogeneous and heterogeneous catalysis experts would be in better alignment with the new NSF program designations than the former. | YES |

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| <p>2. Are both merit review criteria addressed</p> <p>a) In individual reviews? Occasionally, there are individual ad-hoc reviews that do not contain substantive comments on Broader Impacts.</p> <p>b) In panel summaries? Yes, there are substantial comments in the panel summaries for both categories. They successfully combine not only the comments of individual reviews, but report the issues that were discussed by the review panel to determine the recommendation.</p> <p>c) In Program Officer review analyses? Absolutely. More balance between both criteria was observed here than in either individual reviews or panel summaries.</p> <p>Comments:</p> | <p>YES</p> |
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| <p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>Comments: The quality of individual reviews varies substantially. In most cases, individuals give substantive comments. Sometimes it appears that individuals did not put much effort into the review process.</p> | <p>YES</p> |
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| <p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>Comments: Several very good panel summaries were reviewed by this COV committee.</p> | <p>YES</p> |
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| <p>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</p> <p>[Note: Documentation in the jacket usually includes a context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.]</p> <p>Comments: Yes, all of the material in the packet works together to rationalize award decisions. The program officer review analysis is generally very effective at summarizing the criteria used to award or decline a proposal.</p> | <p>YES</p> |
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| <p>6. Does the documentation to the PI provide the rationale for the award/decline decision?</p> <p>[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 in the PO Comments field or emailed with a copy in the jacket, or telephoned with a diary note in the jacket) of the basis for a declination.]</p> <p>Comments: The panel summary effectively discussed the criteria used to reach the award/decline decisions. The panel summary is particularly rich in specific concerns/merits used to assess the intellectual merit and broader impact of each proposal. The PO Comments were discussed extensively by this committee. There is a risk that the written response by the PO could be used to contest a decision. Nevertheless, these comments were refined to the extent that they focused on points the PI could use to improve their approach to the proposed research and/or presentation. In summary, sufficient information was provided to each PI to rationalize the award/decline decision.</p> | <p>YES</p> |
| <p>7. Additional comments on the quality and effectiveness of the program's use of merit review process: With regards to the EAGER program, the PO needs to make sure that the proposal could not be adequately reviewed by a regular panel.</p> <p>Individual reviewers should be instructed to give CONSTRUCTIVE criticism to all PIs, especially new investigators. For example, if an important citation is missing from the proposal, a reviewer should be encouraged to direct the PI towards that information.</p> | |

II. Questions concerning the selection of reviewers. Please answer the following questions about the selection of reviewers and provide comments or concerns in the space below the question.

| <p>SELECTION OF REVIEWERS</p> | <p>YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE</p> |
|---|---|
| <p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>Comments: The general quality of the review panels is very good. They seem to be stronger than they were historically. The program may benefit from a broader range of fields covered in its review panels. For example, forming joint panels with homogeneous and heterogeneous catalysis experts would be in better alignment with the new NSF program designations than the former. This recommendation will not be easy to implement, but it is important to the advancement of the field.</p> | <p>YES</p> |

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| <p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>Comments: The general NSF policy towards COI is effective. For example, in one of the proposals we saw a COI was identified during an active panel discussion and dealt with effectively. There was a proposal that teamed investigators in a way that did not justify the person-months assigned to each with the objectives of the proposal, which was appropriately denied.</p> | <p>YES</p> |
| <p>Additional comments on reviewer selection: It may be useful to construct panels that cover a variety of different fields to encourage cross-fertilization of research ideas.</p> <p>We support the COV 2010's development of a reviewer database. This database should keep track of the individual reviewer's ratings, and use this record to prevent the appointment of consistently abrasive reviewers from placement on panels.</p> | |

III. Questions concerning the management of the program under review. Please comment on the following:

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| <p>MANAGEMENT OF THE PROGRAM UNDER REVIEW</p> |
| <p>1. Management of the program.</p> <p>Comments: Generally the program is managing to fund as many types of proposals as it can within its funding constraints, while still identifying and investing in opportunities to support transformative research. Division provides continued support for strong programs, while investing in young investigators able to create strong, transformative proposals. Although, the funding situation for both groups is very challenging.</p> |
| <p>2. Responsiveness of the program to emerging research and education opportunities.</p> <p>Comments: This program shows initiative in pursuing emerging research opportunities by working with other directives, such as Sustainability Energy Pathways, to co-fund proposals. The EAGER program is another example of support for emerging research. Educational opportunities were occasionally addressed in broader impact sections of funded proposals.</p> |
| <p>3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.</p> <p>Comments: The programs must continue support transformative, quality proposals above others. At the same time, the portfolio included proposals strong in their response to external prioritization such as efforts to develop chemistry for sustainable energy.</p> |

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

Comments: EPSCoR and GAOLI partnerships are growing within this directorate. All panels are now virtual, which is consistent with 2010 COV report recommendations. Best practices in broader impact is addressed in a town-hall meeting formats for PIs (i.e. Host conversations at an ACS or other professional society meeting.). They have not been able to make progress in increasing the size of the grants due to budget constraints. It is recommended that SEP funding is leveraged by this directorate in the future.

IV. Questions about Portfolio. Please answer the following about the portfolio of awards made by the program under review.

| <p style="text-align: center;">RESULTING PORTFOLIO OF AWARDS</p> | <p style="text-align: center;">APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</p> |
|--|---|
| <p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>Comments: We do not have the information.</p> | <p style="text-align: center;">DATA NOT AVAILABLE</p> |
| <p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>Comments: Efforts should be continued to increase the size of budgets. Budget amounts have decreased since 2010, and the success rate for funded proposals is lower in this directorate. It would be expected that this program should be well placed to leverage additional funds from broad NSF directives, such as sustainability. The duration is appropriate.</p> | <p style="text-align: center;">APPROPRIATE</p> |
| <p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>Comments: Yes. An award to an SEP grant is an example of this.</p> | <p style="text-align: center;">APPROPRIATE</p> |
| <p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>Comments: Yes, the SEP grant is an example of this. This program is well positioned to leverage additional funding for multi-disciplinary projects.</p> | <p style="text-align: center;">APPROPRIATE</p> |
| <p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>Comments: Research is focused in select geographical areas.</p> | <p style="text-align: center;">MAYBE</p> |

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| <p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>Comments: The portfolio is currently heavily weighted towards the top 100 Ph.D. granting institutions. For example in the 2010 – 2012 review period the funding ratio was 3 :1 when comparing awards to top-100-PhD institutions to all others. This ratio benefits the continuation of potentially transformative projects, but may be damaging the broader research enterprise.</p> | MAYBE |
| <p>7. Does the program portfolio have an appropriate balance of awards to new investigators?</p> <p>NOTE: A new investigator is an investigator who has not been a PI on a previously funded NSF grant.</p> <p>Comments: The funding level for new PIs has decreased from 16% in 2010 to 11.25% in 2012. The rate of funding new PIs is too low. One of four COV reviews felt this funding ratio was appropriate.</p> | NOT APPROPRIATE |
| <p>8. Does the program portfolio include projects that integrate research and education?</p> <p>Comments: This is not an obvious strength of this program.</p> | APPROPRIATE |
| <p>9. Does the program portfolio have appropriate participation of underrepresented groups¹?</p> <p>Comments: The number is small, but the percentage awarded has greatly increased between 2010 (1 of 12) and 2012 (4 of 12) for underrepresented groups. Women were awarded 27% of the funded proposals 2010-2012.</p> | APPROPRIATE |
| <p>10. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports.</p> <p>Comments: It is one of the most highly relevant programs within NSF chemistry and is ideally placed to take a leadership role in many high-profile initiatives such as alternative energy and sustainability.</p> | APPROPRIATE |
| <p>11. Additional comments on the quality of the projects or the balance of the portfolio:</p> | |

¹ NSF does not have the legal authority to require principal investigators or reviewers to provide demographic data. Since provision of such data is voluntary, the demographic data available are incomplete. This may make it difficult to answer this question for small programs. However, experience suggests that even with the limited data available, COVs are able to provide a meaningful response to this question for most programs.

OTHER TOPICS

1. Please comment on any program areas in need of improvement or gaps (if any) within program areas.
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.
3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.
4. Please provide comments on any other issues the COV feels are relevant.
5. NSF would appreciate your comments on how to improve the COV review process, format and report template.

Catalysis is a field that lends itself to inter-, multi-disciplinary work. Even though the program is involved with other directorates of NSF, it still appears somewhat fragmented into specific research areas. A greater effort could be made to maximize the broader mission of catalysis by the development of panels that span the whole discipline. This would encourage the cross-fertilization and emphasis on research areas that are broadly impactful.

V. Beyond the Portfolio. Please answer the following questions.

1. How to Evaluate Realignment: The Division realigned its scientific programs in 2009. With three years of data on the new programs, the Division wishes to assess the impact of the realignment on the field of chemistry and the research community. The Division requests feedback from the COV on how to best structure such an assessment.

Please see the Sharepoint site for additional information.

Comments:

2. Portfolio Management: Award recommendations in the Division are based on intellectual merit and broader impacts (unless there are additional specific criteria spelled out in a solicitation), with additional consideration of demographics and portfolio goals, strengths, and weaknesses. The Division requests feedback from the COV if Program Directors should move to a more active management of the portfolio *within each Program*, considering factors such as the number of active awards that a principal investigator (PI) holds, PI demographics, submission processes, and the like.

Please see the Sharepoint site for additional information.

Comments:

Centers for Chemical Innovation (CCI)

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(s) under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged.

I. Questions about the quality and effectiveness of the program's use of merit review process. Please answer the following questions about the effectiveness of the merit review process and provide comments or concerns in the space below the question.

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|--|---|
| <p>1. Are the review methods (for example, panel, ad hoc, site visits) appropriate?</p> <p>Comments:</p> <p>The CCI program involves three levels of proposals. Solicitations for Pre-proposals generally results in 20-30-five page proposals, from which about 10 are invited to submit full Phase I proposals. Review of the approximately ten full Phase I proposals results in the selection of around three Phase I Centers, which are each funded for 3 years. During year three of Phase I these centers submit Phase II proposals, which typically results in the selection of one Phase II CCI. The CCI program proposal review is a highly rigorous process, from pre-Proposal, to Phase I proposal to Phase II proposal, leading to around a 3% overall success rate from the pre-proposal to the Phase II CCI.</p> <p>The mix of ad hoc, panel and site visit methods for review are very appropriate for the different levels.</p> <p>Pre-Proposals are evaluated by a panel of more than 10 reviewers, with typically 4 primary reviewers.</p> <p>Phase I proposals are evaluated by a panel of more than 10 reviewers, with additional ad hoc reviews.</p> | YES |

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| <p>The reviewing of Phase I proposals seems to have evolved over the years to bringing in a greater number of reviewers. This is seen favorably.</p> <p>Phase II proposals are evaluated by more than 10 panelists that participated in a site visit.</p> <p>The members of the COV feel that the number of reviewers and method of review is appropriate at each stage of the CCI award considering the number of proposals and the amount of the award. At all stages the review process works well for evaluating the strengths and weaknesses of proposals. The use of a panel, rather than only ad hoc reviews, for the pre-proposal and the Phase I proposals was considered most effective given the number of proposals being typically considered at these point in the CCI selection process. A site visit, or reverse site visit, is certainly appropriate for evaluation of the Phase II proposals.</p> | |
| <p>2. Are both merit review criteria addressed</p> <p>d) In individual reviews? Yes, written reviewers specifically provided separate comments regarding intellectual merit and boarder impacts.</p> <p>e) In panel summaries? Yes, the panel summaries contained separate sections that summarized the intellectual merits and broader impacts.</p> <p>f) In Program Officer review analyses? Yes, both areas were addressed in detail in the review analysis of these proposals.</p> <p>Comments: The COV was particularly impressed by the insightfulness and thoroughness of the Review Analysis.</p> <p>The amount of comments provided by reviewers and program officer (PO) on intellectual merits and broader impacts was appropriate with regard to the relative proposal space and emphasis of these areas in the proposal.</p> <p>Overall Yes – with substantive text at a satisfactory level of discussion of these big and complex proposals and centers.</p> | <p>YES</p> |
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| <p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>Comments: The reviewers of all proposals jackets examined provided justifications for the scores given to proposals, both on intellectual merits and broader impacts.</p> <p>While the amount of comments provided varied by reviewer, the amount of comments provided was considered sufficient in all cases, particularly for the intellectual merits. In some cases, reviewers focused on minor, less substantive, points.</p> <p>In cases of few reviewers, it's really important that ALL be qualified. We found a case (in a pre-proposal review) where the reviewer did not have the expertise to review.</p> | <p>YES</p> |
| <p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>Comments: The panel summaries were consistently found to correctly capture the consensus of the sum of the individual reviews. The panels made what were considered by the COV to be sound judgments regarding how to weight and resolve conflicting views presented by the individual reviews.</p> | <p>YES</p> |
| <p>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</p> <p>[Note: Documentation in the jacket usually includes a context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.]</p> <p>Comments: The COV was very impressed by the PO's analyses of reviews and panel reports. Reflections made by the POs on comments from the reviewers were thorough and insightful. S/he exercised good judgment on evaluating and weighting reviews that were substantive versus ones that focused on minor issues. The PO analyses of the reviews and panel summaries were deep and insightful. The POs were able to bring in other factors, such as whether the programs were focused on chemistry rather than other fields, focused on truly transformational research, whether "grand challenges" were apparent and whether there was likely to be a large impact in the specific focus area of science by the establishment of a particular center.</p> <p>The COV felt that the PO was 'spot-on' with regard to identifying what mix of science, potential contributions to innovation, integrative elements and leadership qualities will lead to a highly successful CCI.</p> <p>The COV noted a particularly challenging decision made by the PO to decline a specific proposal, and was pleased to see that good documentation for the decision was included in the proposal jacket. In this case, a declined Phase I proposal had received very positive written reviews on intellectual merit. However, the proposal was also characterized as lacking a "Grand Challenge," and the Integrative Elements were deemed "adequate" but not creative or well integrated. The COV understood why such criticisms would reduce the Program Officer's enthusiasm for awarding a grant.</p> | <p>YES</p> |

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| <p>However, some panel members commented that while usually handled in a well-documented transparent manner, the decision-making process was not always consistent between proposals.</p> <p>At times we had a difficult time reconciling the panel recommendation with the Program's decision to fund or decline.</p> <p>Overall, we feel we haven't enough proposals in our small sampling to draw stronger conclusions about the consistency of review documentation.</p> | |
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| <p>6. Does the documentation to the PI provide the rationale for the award/decline decision?</p> <p>[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 in the PO Comments field or emailed with a copy in the jacket, or telephoned with a diary note in the jacket) of the basis for a declination.]</p> <p>Comments: The reviewer comments, panel summary, review analysis, are generally very thorough and, taken together, provide quite a detailed rationale for the review decision. There are additional comments in the Review Analysis that could also be useful to a PI, but these are generally only transmitted over the phone. Perhaps a more uniform way to transfer these comments would help the PIs of a declined proposal?</p> <p>Concerning pre-proposals, the PO's rationale in the response to PIs was uniformly and appropriately brief.</p> | <p>YES</p> |
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| <p>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</p> <p>The COV is very impressed by the process by which the CCI proposals are reviewed. We compliment the PO and the Division of Chemistry on the high quality of reviewers selected and the use of their reviews in the decision process.</p> <p>The individual reviews of the proposal were, for the most part, quite detailed in documenting their ranking of the proposal and were considered consistent with the panel consensus summary. The reviews were therefore considered by the COV to be of high quality.</p> <p>Some panel members found that In some cases the panel recommendation was not factored in substantively.</p> <p>At times they had a difficult time reconciling the panel recommendation with the Program's decision to fund or decline.</p> <p>In one case there appeared to be a COI despite it's formally not falling into a COI category. It was felt this could be avoided by a choice of another reviewer.</p> | <p>YES, mostly. See comments.</p> |
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II. Questions concerning the selection of reviewers. Please answer the following questions about the selection of reviewers and provide comments or concerns in the space below the question.

| <p style="text-align: center;">SELECTION OF REVIEWERS</p> | <p style="text-align: center;">YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE</p> |
|---|---|
| <p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>Yes.</p> <p>Comments: The COV is very impressed by the large number of high quality reviewers obtained with appropriate expertise for the review of CCI proposals at all three levels. The COV appreciates that this must be a very challenging this task given the diversity of proposal topics in any review, and the large number of conflict of interest cases that must arise in the review of center proposals with multiple locations and PIs.</p> <p>Some panel members found that in pre-proposals, there appeared to be a small number of reviewers without the appropriate expertise to review.</p> | <p style="text-align: center;">YES</p> |
| <p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>Comments: The COV recognized that, as noted above, the number of potential conflict of interest cases for the review of any CCI proposal is substantial. The COV was therefore very impressed by the very low number of COIs that surfaced among the reviewers on CCI panels. The COIs were handled appropriately.</p> <p>In one case we saw a perceived COI which caused us to questions the choice of reviewers – an institutional conflict which, though perhaps not formally a conflict, still had the appearance of a conflict.</p> | <p style="text-align: center;">YES</p> |

III. Questions concerning the management of the program under review. Please comment on the following:

MANAGEMENT OF THE PROGRAM UNDER REVIEW

1. Management of the program.

Comments: The COV is very impressed by the growth of the CCI program, and the ability of the POs to successfully manage the substantial number of required reviews and site visits in what continues to be a growing program. The POs take a very active role in identifying areas of weakness in proposals and awarded centers, and in providing constructive advice for improvement. The POs take a much more active role in advising the members of a CCI than is typical for individual grants. Attendance of the POs at annual center meetings, which is a substantial commitment of travel for the POs, is considered by the COV to be of great value given the size and complexity of CCI awards. Careful oversight and guidance of CCIs is a daunting task, but one which the POs eagerly assume and which they do exceedingly well.

The CCI program sets itself apart by having large, complex, and visible centers.

The process for reviewing and oversight is complex.

The centers represent a big investment with high national public visibility.

With multi-phased centers, there needs to be continuity in NSF management.

Therefore we strongly recommend that this program strive to maintain continuity and be given the resources for multiple program officers to effectively manage it.

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

Comments: The CCI program is, by design, focused on supporting cutting-edge, innovative research that is high-risk and high-impact. The CCI program fosters the creation of interdisciplinary groups that are moving into new areas of research and engaging in education/broader impact opportunities that would be impossible for individual investigators. The emphasis placed on CCI centers being agile in their ability to alter research projects in response to new discoveries provides a rare mechanism for rapid movement into emerging areas of research.

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

Comments: From the existing portfolio of CCI Phase I and Phase II Centers, as well as from comments included in CCI proposal jackets, it is clear that the POs have taken seriously the benefits of balancing center topics with regards to "Grand Challenges" in chemistry.

For the CCI program with few and highly-visible awards, the portfolio is constrained in options for balancing.

As the portfolio approaches steady-state, the strategic planning by NSF POs will become ever more critical.

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

Comments: The previous COV was highly complementary of the CCI program. Moreover, this COV recognized that the CCI program is addressing some of the important recommendations of the COV to the overall Division of Chemistry, such as advancing American Competitiveness, communication of chemistry to the public, addressing grand challenges in Chemistry, and broadening participation. The program continues to grow the number of centers.

As recommended by 2010 COV with respect to the CCI program:

-The number and experience-level of reviewers has increased for Phase 1.

-The PO review analyses generally now provide a clear description for the motivation of a decision.

-Senior/leading personnel have an appropriately increased presence in centers.

-Participation by women has improved and continues to need improvement.

IV. Questions about Portfolio. Please answer the following about the portfolio of awards made by the program under review.

| RESULTING PORTFOLIO OF AWARDS | APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE |
|---|--|
| <p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>Comments: It was felt that there was an insufficient number of award statistics provided in the package for our review in the context of this COV timeframe. However, looking at the program as a whole even with the small number of centers, the CCI program to date has achieved an appropriate balance of awards.</p> | APPROPRIATE |
| <p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>Yes.</p> <p>Comments: The awards are of appropriate size and duration given the broad scope, associated integrated elements, and high potential impact of the scientific missions necessary for a successful CCI proposal.</p> | APPROPRIATE |
| <p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>Comments: A specific requirement for a CCI award is that the projects be innovative and potentially transformative. It is clear from the CCI proposal jackets that</p> | APPROPRIATE |

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| reviewers and POs take these facets of the CCI proposals into serious consideration during award selection. | |
| <p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>Comments: A major component of all CCI centers involves inter- and multi-disciplinary projects. It is clear to the COV that these features were taken seriously during award selection.</p> | APPROPRIATE |
| <p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>Comments: Given the relatively small number of CCI centers the geographical distribution of PIs is appropriate.</p> | APPROPRIATE |
| <p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>Yes.</p> <p>Comments: Although all current CCI centers are associated with an R1 university at which the center PI has an academic appointment, a good number of CCI centers have strong connections with non-R1 institutions that provide substantial benefits to these CCI-associated institutions, including research support through subcontracts.</p> | |
| <p>7. Does the program portfolio have an appropriate balance of awards to new investigators?</p> <p>Yes.</p> <p>NOTE: A new investigator is an investigator who has not been a PI on a previously funded NSF grant.</p> <p>Comments: Although the Directors of CCIs are generally senior investigators, most CCIs include young investigators as fully integrated members. We recommend that co-PIs continue represent a spectrum of experience levels.</p> | |
| <p>8. Does the program portfolio include projects that integrate research and education?</p> <p>Comments: Yes, all CCIs integrate research with education. For example, some CCIs offer summer schools and workshops for graduate students and postdocs in specialized research areas and short training sessions in other areas (e.g., use and applications of computational methods).</p> | |

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| <p>9. Does the program portfolio have appropriate participation of underrepresented groups²?</p> <p>Yes.</p> <p>Comments: The CCI has a rich program of engaging members from underrepresented groups. For example, most of the CCI centers are partnered with institutions that serve students from underrepresented groups. Additionally, a good number of educational programs, developed by individual CCIs, are focused on the mentoring of students from underrepresented group and for their inclusion in summer research programs.</p> <p>Certain members felt that participation of minorities was adequate but could be improved and suggested continued efforts and oversight in assessing centers' diligence in including underrepresented groups.</p> | |
| <p>10. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports.</p> <p>Absolutely.</p> <p>Comments: The CCI program addresses the national need to educate more students in the STEM fields. The CCI also directly responds to the calls made in the American Competitiveness Act by supporting research with the potential to result in scientific discoveries that will have positive economic impact on our nation.</p> | |
| <p>11. Additional comments on the quality of the projects or the balance of the portfolio:</p> <p>We recognize the challenge of the program to balance an unusually wide number of factors for which the program management needs to be well supported.</p> <p>Project officers are doing a good job in addressing a balanced portfolio with the challenges of the small number of centers and issues of diversity, geography, and cooperation with other funding agencies.</p> | |

OTHER TOPICS

1. Please comment on any program areas in need of improvement or gaps (if any) within program areas.
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.
3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.
4. Please provide comments on any other issues the COV feels are relevant.

With the NSF's increasing interest in global engagement, the centers might provide a facile mechanism for achieving international collaborations and exchange.

We encourage the NSF to explore and develop positive interaction between CCI and other chemistry-containing centers in areas that are complementary. For example, integration and joint support of outreach and public educational efforts, a shared interest by all centers.

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

This CCI program is sufficiently complex that it needs more attention for a thorough review. We recommend that the COV be supplied with more tools and materials to assess such a large, and complex program – it merits more thorough consideration.

As long as it remains within the CHE COV process, more statistics and COV members are required, for example. Perhaps as the CCI program matures, it can stage its own COV.

Regardless of whether the CCI has its own COV or participates in the CHE COV, the following recommendation is made for the composition of future COVs for CCIs: The review panel should reflect a considered balance between members of CCI centers and non-members of CCI centers. The presence of CCI members on a panel does impact the nature of that panel's discussions and output.

V. Beyond the Portfolio. Please answer the following questions.

3. How to Evaluate Realignment: The Division realigned its scientific programs in 2009. With three years of data on the new programs, the Division wishes to assess the impact of the realignment on the field of chemistry and the research community. The Division requests feedback from the COV on how to best structure such an assessment.

Please see the Sharepoint site for additional information.

Comments:

4. Portfolio Management: Award recommendations in the Division are based on intellectual merit and broader impacts (unless there are additional specific criteria spelled out in a solicitation), with additional consideration of demographics and portfolio goals, strengths, and weaknesses. The Division requests feedback from the COV if Program Directors should move to a more active management of the portfolio *within each Program*, considering factors such as the number of active awards that a principal investigator (PI) holds, PI demographics, submission processes, and the like.

Please see the Sharepoint site for additional information.

Comments:

Chemistry of Life Processes (CLP)

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(s) under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged.

I. Questions about the quality and effectiveness of the program's use of merit review process. Please answer the following questions about the effectiveness of the merit review process and provide comments or concerns in the space below the question.

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|--|---|
| <p>1. Are the review methods (for example, panel, ad hoc, site visits) appropriate?</p> <p>Comments: A mixture of ad hoc and panel reviews are used to great effect. The mail-in ad hoc reviews are an important way to get a more expert reviewer base especially from distinguished scientists, who would be less likely to serve on a panel. Using mail-in reviews gives the program officer, the panel, and the PI a more complete picture. The panel can then compare proposals on a broader level once the details have been scrutinized by mail-in experts.</p> | YES |
| <p>3. Are both merit review criteria addressed</p> <p>g) In individual reviews?</p> <p>h) In panel summaries?</p> <p>i) In Program Officer review analyses?</p> | YES |

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| <p>Comments: Review analysis is excellent and skillfully summarized the salient points for both merit criteria, which contributed to the funding decision. Dr. Berkowitz provided particularly detailed and excellent review summaries.</p> | |
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| <p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>Comments: Overall the independent reviews were very consistent and provide very constructive critiques that will be helpful to the PI on resubmission. Only rarely were reviews overly brief or cursory and thin. In one case an off hand comment “laundry list” to describe parts of a proposal was not appropriate.</p> | <p>YES, usually</p> |
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| <p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>Comments: The highlights of the discussion that resulted in the recommendation were always included. Panel summaries are generally very constructive and obviously were prepared after careful discussion and weighing of strengths and weaknesses for both merit criteria.</p> | <p>YES</p> |
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| <p>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</p> <p>[Note: Documentation in the jacket usually includes a context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.]</p> <p>Comments: Comments in the Review Analysis are very useful for the NSF and the COV. Elements of the Review analysis are captured in the PO comments to the investigator. When appropriate, for example when an unfunded proposal has a relatively high score, the PO comments focus and encourage discussions with the PI concerning resubmission. The Panel Summary and Review Analysis provide the rationale, although, the Diary/Panel Memo only gave statistics for numbers of proposals in each Tier in the recommended category. The Jacket language on rankings and recommendations is very inconsistent between program officers within a program and between programs. This inconsistency makes it difficult to fully analyze the award decision.</p> | <p>YES</p> |
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| <p>6. Does the documentation to the PI provide the rationale for the award/decline decision?</p> <p>[Note: Documentation to PI usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), and, if not otherwise</p> | <p>YES</p> |
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| <p>provided in the panel summary, an explanation from the program officer (written in the PO Comments field or emailed with a copy in the jacket, or telephoned with a diary note in the jacket) of the basis for a declination.]</p> <p>Comments: PO comments that are derived from the review analysis provide constructive feedback and invite resubmission when appropriate.</p> | |
| <p>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</p> <p>The POs did an excellent job of ensuring that useful and complete panel summaries were produced and that the documents were produced without compromising the integrity of the reviews.</p> <p>The admittedly small sample of proposals indicated that reviewers familiar with NIH type proposals seem to be driving decisions towards less creative, more application-apparent type proposals. Both types have merit, but NSF should be focusing on the longer term and funding creative proposals that have not yet found an application.</p> <p>As CLP matures after realignment, a clearer distinction between immediately biomedical and basic research underlying future biomedical discoveries needs to be better defined.</p> | |

II. Questions concerning the selection of reviewers. Please answer the following questions about the selection of reviewers and provide comments or concerns in the space below the question.

| SELECTION OF REVIEWERS | YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|---|---|
| <p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>Comments: It is appreciated that reviewers well known in the field were brought in through the ad-hoc system. These reviewers are more likely to be difficult to get on the panel, but their input is important. The panelists were also extremely qualified, and provided excellent reviews overall. The panelists and the reviewers represent diversity in institution type, gender and expertise.</p> | YES |
| <p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>Comments: Mention of conflicts is made in summaries, but there is no way to know if all conflicts have been identified. None were detected in the proposal selection that we reviewed</p> | Not easily analyzed |

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| <p>Additional comments on reviewer selection:</p> <p>The breadth and depth of reviewers are appropriate.</p> | |

III. Questions concerning the management of the program under review. Please comment on the following:

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| <p>MANAGEMENT OF THE PROGRAM UNDER REVIEW</p> |
| <p>1. Management of the program.</p> <p>Comments: The PO's make the most of limited resources and also partner creatively with other NSF programs to supplement funding in many cases when appropriate. CLP is new and growing rapidly. In FY 2011, the budget was not aligned with the number of proposal submissions due to the new/renewal split of funds. This discrepancy was partially corrected in FY 2012, and the correction should be continued. The funding success looks similar to other Programs, but the average size award is below average. Thus it appears smaller awards are being made to bring the success rate up. With the availability of BIOMaPS dollars, the funding success rate should be in the top decile of Division funding, not the bottom quartile. Otherwise, BIOMaPS dollars are effectively funding other programs within CHE and the initiative is not being fully supported.</p> <p>Dr. Berkowitz although "only" a rotator did an excellent job of stabilizing the program after a critical realignment.</p> |
| <p>2. Responsiveness of the program to emerging research and education opportunities.</p> <p>Comments: The rapid growth of CLP proposal submissions indicates a strong need for this program, and for the budget to match the growth. The awards that were made represent exciting contemporary science across disciplines. One example is the relatively large number of ICC grants that they fund.</p> |
| <p>3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.</p> <p>Comments: The first paragraph of the Current Program Description on the Website is sufficiently broad to keep the program dynamic and responsive. The second paragraph is dated, and should be rephrased to reflect what is currently in the Program and not what will be considered. PIs and future PIs should define the cutting edge directions of CLP through their proposal submissions.</p> <p>We noted that the PO tended to reduce the size of awards in order to create more awards. This approach was seen as important for supporting new investigators.</p> |

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

Comments:

1. PD is highlighting accomplishments
2. Budget growth for this new program is in progress. The prior COV highlighted the need to increase program funding. The PO has successfully identified opportunities to partner with other programs to supplement funding in many cases. Though the prior COV called for an increase in the award size, these PO's did the opposite slightly reducing the award size. However, we view this positively as it allowed the inclusion of more awards to fund exciting science in the portfolio.
3. See comments about Broader Impacts and expectations below.
4. This career/funding analysis should be performed in order to ensure that mid-career PIs are supported as demands for their service to the scientific community increase exponentially.
5. Doing a better job than other programs – it is important to have a PO with significant current research experience in the CLP arena and the management skills of Dr. Berkowitz identified immediately in order to transition the program to a new lead PO.
6. See comments about Broader Impacts and expectations below.
7. See comments about Web site statement.

IV. Questions about Portfolio. Please answer the following about the portfolio of awards made by the program under review.

| <p align="center">RESULTING PORTFOLIO OF AWARDS</p> | <p align="center">APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</p> |
|---|--|
| <p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>Comments: We received an excel sheet listing all of the awards in the CLP and it showed a breadth of disciplines and sub-disciplines addressing the CPL mission. There was a good representation of science at the interface of chemistry with engineering, biology and materials. The portfolio is broad and reflects the interdisciplinary nature of CLP.</p> | <p align="center">APPROPRIATE</p> |
| <p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>Comments: The duration is generally fixed at 3 years for IIAs and 5 years for career awards. Average grant size is lower than Division average. The PO has slightly reduced award size in some cases in order to fund more proposals. It is difficult to judge the impact of reduced award size on the ability of PI's to accomplish the proposed research, as the program is so new, that there are relatively few renewals submitted at this point in time. The renewal success rate should be carefully monitored over the next three to five years to assess the impact of award size and duration in this program.</p> | <p align="center">NOT APPROPRIATE</p> |

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| <p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>Comments: The PO funded three EAGER awards which by definition are high risk, high payoff potentially transformative research. One of these developed into a CAREER award. In addition, reviewers described many of the funded CAREER awards as transformative and revolutionary.</p> | <p>APPROPRIATE</p> |
| <p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>Comments: Yes, This was one of the greatest strengths of the portfolio both in terms of funding proposals submitted to the CLP but also in partnering to help to fund proposals submitted outside of the CLP.</p> | <p>APPROPRIATE</p> |
| <p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>Comments: The awarded proposals are distributed in line with the geographical concentration of research in the US.</p> | <p>APPROPRIATE</p> |
| <p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>Comments: The portfolio contains proposals from a range of institution types. There are CAREER awards from both PUI's and PhD granting institutions.</p> | <p>APPROPRIATE</p> |
| <p>7. Does the program portfolio have an appropriate balance of awards to new investigators?</p> <p>NOTE: A new investigator is an investigator who has not been a PI on a previously funded NSF grant.</p> <p>Comments: About 16% of awards are CAREER awards. CLP showed 15% overall success rate for new proposals over the last 3 years. This is in line with the 14-18% range for the CHE Division.</p> | <p>APPROPRIATE</p> |
| <p>8. Does the program portfolio include projects that integrate research and education?</p> <p>Comments: Both IIAs and CAREER awards in the sample generally do an excellent job of blending research and education. These awards include teacher training in the PI's lab, undergraduate research projects resulting in publications and popular outreach, for example of writing a book to educate the lay public on protein evolution.</p> | <p>APPROPRIATE</p> |

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| <p>9. Does the program portfolio have appropriate participation of underrepresented groups³?</p> <p>Comments: Awards made in CLP were to members of under-represented groups, were similar to the Division as a whole.</p> | <p>APPROPRIATE</p> |
| <p>10. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports.</p> <p>Comments: The program is generally relevant to the national priority of advancing science and innovation as well as the agency mission of outreach to the public. One example of this is that one of the proposals described a training program for science teachers.</p> <p>NAS report on “Transforming Glycoscience: A Roadmap for the Future”, 2012, should be taken into consideration for future funding.</p> <p>Limits of Organic Life in Planetary Systems, NAS, 2007 in conjunction with NASA has funded the Center. CLP awards are also in line with this workshop recommendation.</p> <p>Synthetic Biology is a major focus of BIO, it should be part of CHE as well (ACS Synthetic Biology is a new journal) http://www.sysbio.ox.ac.uk/international-workshop-on-systems-and-synthetic-biology</p> <p>Metabolomics is again a major focus of BIO http://www.nsf.gov/pubs/2011/nsf11527/nsf11527.htm?WT.mc_id=USNSF_25&WT.mc_ev=click) There are potentially needs for chemical tools to study these systems, in particular, tying in with glycoscience needs.</p> | <p>APPROPRIATE</p> |
| <p>11. Additional comments on the quality of the projects or the balance of the portfolio:</p> <p>Excellent quality and balance of scientific projects.</p> <p>It would be useful to see the distribution of CLP awards by date of PhD in order to compare to the Division-wide data. The previous COV noted that PIs 16-20 years since PhD had a lower number of awards.</p> | |

³ NSF does not have the legal authority to require principal investigators or reviewers to provide demographic data. Since provision of such data is voluntary, the demographic data available are incomplete. This may make it difficult to answer this question for small programs. However, experience suggests that even with the limited data available, COVs are able to provide a meaningful response to this question for most programs.

OTHER TOPICS

1. Please comment on any program areas in need of improvement or gaps (if any) within program areas. It would be extremely useful to eliminate reviewers who do a poor job, although we recognize that this is challenging. This should become easier with implementation of the reviewer database.
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.

BROADER IMPACTS

Integration of broader impacts is requisite for NSF-CAREER proposals. However, it is unrealistic at the funding levels provided by NSF to expect University-funded researchers to spend the time required on outreach beyond the University. If they are expected to do it, there should be accountability as to whether the broader impacts have been implemented as part of the progress report in NSF renewal.

The solution is to either fund fewer NSF-CAREER proposals at a higher level, commensurate with the expectations. Alternatively, lower the expectation for increasingly extensive, exotic, and significant time commitments for activities outside the norm of traditional faculty workloads (usually 20% for all consulting, i.e., grant review, proposal review, and these broader impacts.)

There is currently little assessment by PIs as to whether their broader impacts have the desired effect. The social scientists who research impacts or University offices organized to do outreach best handle this type of analysis. However, PIs who propose to utilize these types of offices or services are often penalized for not contributing enough individual effort to the process.

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

For co-division reviewed proposals, a uniform grant format policy and uniform review template used by both divisions is necessary. Otherwise, reviewer and program director time are wasted on delineating minor differences and ensuring compliance with multiple formats.

Once funded, co-division grants should not require PIs to respond to two sets of division reporting protocols. One division should be designated as the primary division responsible for oversight, that division could then ensure that the secondary division has access. Otherwise, PIs are put in the untenable position of saying "no" to a program officer.

Reviewers need to be reminded of the importance of ensuring the scores reflect the comments that they give proposals.

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

The ICC is an important program that enables global collaboration and utilization of international research facilities and expertise.

There seem to be many smaller cross/inter-disciplinary projects that require enormous effort to fund across programs for very small sums of shared dollars. This does not appear to be an efficient use of

limited PO time. Processes should be streamlined so that these many different pots of money can be accessed more conveniently. These might be more appropriately placed at the Directorate level than the PO level.

Given the newness of the CLP, it is critical that the future PO leadership be in close contact with the research community, either as an active researcher (rotator) or as an active participant in research conferences. In addition, continuity of leadership for more than one year is essential. This type of leadership will ensure that the CLP portfolio evolves with the scientific directions defined by the active research community.

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

One of the POs provided a detailed excel spreadsheet of all of the awards in the portfolio highlighting the different types of awards, institutions, demographic information of the PI. This was extremely helpful.

V. Beyond the Portfolio. Please answer the following questions.

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| <p>5. <u>How to Evaluate Realignment:</u> The Division realigned its scientific programs in 2009. With three years of data on the new programs, the Division wishes to assess the impact of the realignment on the field of chemistry and the research community. The Division requests feedback from the COV on how to best structure such an assessment.</p> |
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Please see the Sharepoint site for additional information.

Comments:

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| <p>6. <u>Portfolio Management:</u> Award recommendations in the Division are based on intellectual merit and broader impacts (unless there are additional specific criteria spelled out in a solicitation), with additional consideration of demographics and portfolio goals, strengths, and weaknesses. The Division requests feedback from the COV if Program Directors should move to a more active management of the portfolio <i>within each Program</i>, considering factors such as the number of active awards that a principal investigator (PI) holds, PI demographics, submission processes, and the like.</p> |
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Please see the Sharepoint site for additional information.

Comments:

Chemical Measurement and Imaging (CMI)

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(s) under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged.

I. Questions about the quality and effectiveness of the program's use of merit review process. Please answer the following questions about the effectiveness of the merit review process and provide comments or concerns in the space below the question.

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|---|---|
| <p>1. Are the review methods (for example, panel, ad hoc, site visits) appropriate?</p> <p>Comments: Reviewing methods have evolved from primarily ad hoc to panels over the three years. The program officer did a judicious job in communicating the core criticisms to the PI for a proposal that had a range of individual scores.</p> <p>One concern was with an EAGER proposal where there was little expertise within the foundation to evaluate its merits. The ultimate decision seemed appropriate.</p> | YES |
| <p>2. Are both merit review criteria addressed</p> <p>j) In individual reviews?</p> <p>k) In panel summaries?</p> <p>l) In Program Officer review analyses?</p> | YES |

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| <p>Comments: The criteria were clearly addressed. The individual reviews showed larger variability than the program manager or panel summaries, but that is to be expected.</p> <p>Intellectual merit is weighted heavily. However, broader impact discussions also included the impact of knowledge to be gained on the scientific community. Intellectual merit and broad impacts are often smoothly integrated and intertwined.</p> | |
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| <p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>Comments: While there is some variability, the PO was able to obtain a sufficient number of substantive reviews for all of the proposals.</p> <p>One observation that led to concern arose from the fact that feedback can enable or disable an individual PI particularly a new investigator. Reviewers should be encouraged and educated to present constructive criticism on the content of the proposal and dissuaded from personal or emotional comments regarding a PI's expertise in a specific area of research. The tone of a critique has the power to enable or disable individual PI's, potentially adversely affecting the diversity of the NSF's funding portfolio.</p> <p>For example: In one individual review, a comment has a dismissive tone. This contrasts to the tone of the panel comment on the same issue. Both are saying the same thing but the one is more sensitive and probably more appropriate as it opens the lines of communication.</p> <p>The PO comments to the PI addressed this sensitively and opened communication.</p> | <p>YES</p> |
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| <p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>Comments:</p> | <p>YES</p> |
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| <p>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</p> <p>[Note: Documentation in the jacket usually includes a context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.]</p> <p>Comments: The PO in general skillfully and accurately integrates and reflects the comments of the individual reviews and the panel review both in the Review Analysis and in the PO Comments to the PI. This is especially important for proposals which receive a relatively high score but which were declined. Constructive comments from the individual and panel reviews and the PO can set the stage and encourage a resubmission.</p> | <p>YES</p> |
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| <p>6. Does the documentation to the PI provide the rationale for the award/decline decision?</p> <p>[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 in the PO Comments field or emailed with a copy in the jacket, or telephoned with a diary note in the jacket) of the basis for a declination.]</p> <p>Comments: These were only provided for declined awards. In these cases, the documentation was good. For example, in one proposal with divergent scores, the PO skillfully summarized the factors which contributed to the award decision taking into account the input of the individual reviewers and in a tone that opened communication with the PI's.</p> <p>We did not see a need for such additional documentation from the PO when awards are funded.</p> | <p>YES</p> |
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| <p>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</p> <p>We encourage the division to investigate mechanisms for establishing a reviewer/panelist database that is easy for PO's to work with.</p> | |
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II. Questions concerning the selection of reviewers. Please answer the following questions about the selection of reviewers and provide comments or concerns in the space below the question.

| <p style="text-align: center;">SELECTION OF REVIEWERS</p> | <p style="text-align: center;">YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE</p> |
|--|---|
| <p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>Comments: Being outside the field, it's hard to know, but as a group they were able to provide constructive analysis of the proposals that we looked at. When additional expertise was needed, for example for a CHS co-funded proposal, a reviewer from a similar institution (museum).</p> | <p style="text-align: center;">YES</p> |
| <p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>Comments: It is not clear from the jackets exactly how this was addressed. From indirect evidence, it appears that the POs resolve these issues as they arise. For example, in the Review Analysis of one of the proposals, the PO described a process in which a potential COI for a panel reviewer was openly resolved.</p> | <p style="text-align: center;">Data not available</p> |
| <p>Additional comments on reviewer selection:</p> | |

III. Questions concerning the management of the program under review. Please comment on the following:

MANAGEMENT OF THE PROGRAM UNDER REVIEW

1. Management of the program.

Comments: The management is excellent, as exemplified by skillfully dealing with disparate reviews (see I.1).

One area of concern is how the lack of continuity of the staff (e.g. PO's) affects the smooth operation of this program. For example, there was a drop in getting co-funding in 2011, which was attributed to time required for PO's to establish relationships with PO's in other programs/divisions.

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

Comments: We were impressed by the cultural heritage grant solicitation that led to outreach to the art/museum community. The program also participates in international collaborative proposals. As an example, the PO sought additional funding from CHS to co-fund a museum proposal submitted to CMI. Although the scores were unanimous in the rating, there appeared to be an unusual urgency to prioritize this proposal for funding and to move up the start date. This PO decision appears appropriate to increase the overall visibility of chemistry in the eyes of the public and especially to engage young people.

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

Comments: The majority of the proposals are unsolicited, and the POs have little control over what comes in. Where specific solicitations were made, they led to interesting new directions for the program (e.g. the cultural heritage grant program)

See also the response to question III.2

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

Comments: Responses were appropriate. The one of general recommendations area where changes could be made at programmatic level (mechanisms for review) has seen significant evolution since the previous COV. In addition, in the review analysis from one of the awarded proposals, possible co-funding from OIP was mentioned to cover shortfall from the original budget request to CMI. This shows active engagement of program officers to get supplemental funding for their outstanding proposals which responds to one of the recommendations from the 2010 COV.

While realignment makes response to programmatic comments of the previous COV difficult to assess, it appears that CMI has responded to the programmatic suggestions made by the previous COV for the Analytical and Surface Chemistry program.

See also III.2 for program visibility

IV. Questions about Portfolio. Please answer the following about the portfolio of awards made by the program under review.

| <p align="center">RESULTING PORTFOLIO OF AWARDS</p> | <p align="center">APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</p> |
|---|--|
| <p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>Comments: As the program works with unsolicited proposals, some of the distribution reflects the range of submitted proposals. With that in mind, awards were judiciously granted to give a good range of awards to sub-disciplines within the CMI</p> | <p align="center">YES</p> |
| <p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>Comments: They are sufficient in size and duration, but somewhat limiting. The challenge with limited budgets is to balance award number against award size. While optimally awards would be larger, based on current budgetary constraints, the program is hitting a good balance between size and number. The program may want to explore if longer duration proposals, as suggested by the 2010 COV, might be appropriate to pursue at this time.</p> | <p align="center">YES</p> |
| <p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>Comments: The EAGER program is helping provide these opportunities.</p> <p>Based on the proposals we saw, the program does a good job of sorting out the “incremental” proposals and focusing funding to the more innovative and transformative projects. Examples include high profile CHS award and new analytical techniques that combine attributes of existing methodologies to create new and potentially powerful forms of instrumentation.</p> | <p align="center">YES</p> |

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| <p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>Comments: This is evidenced by extensive co-funding and the distribution of this co-funding among multiple directorates and division.</p> | <p>YES</p> |
| <p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>Comments: The distribution is representative of where PI's are working in this area within the US. More awards are made to organizations on the coasts and Midwest, and this is consistent with the regions of the country where there is a larger representation of individuals working in areas that could be funded by CMI.</p> | <p>YES</p> |
| <p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>Comments: It is appropriate, and it is nice to see a number of awards being made to non-PhD granting institutions including a museum.</p> | <p>YES</p> |
| <p>7. Does the program portfolio have an appropriate balance of awards to new investigators?</p> <p>NOTE: A new investigator is an investigator who has not been a PI on a previously funded NSF grant.</p> <p>Comments: While the number of awards to new investigators was lower than the chemistry division as a whole the 2010 and 2011, the average over the past three years is in line with the rest of the division.</p> | <p>YES</p> |
| <p>8. Does the program portfolio include projects that integrate research and education?</p> <p>Comments: Yes; the program portfolio included research projects that are integrated with educational objectives which in turn drives the research. This is strongly evident in the proposals that came in through the SciArt and Career proposal solicitations. A good example is the inclusion of undergraduates as authors. Another example is a 1-week experience for high school students.</p> | <p>YES</p> |
| <p>9. Does the program portfolio have appropriate participation of underrepresented groups⁴?</p> <p>Comments: Funding to underrepresented groups is in line with the demographics of faculty in chemistry departments at PhD-granting Universities in the United States.</p> | <p>YES</p> |

⁴ NSF does not have the legal authority to require principal investigators or reviewers to provide demographic data. Since provision of such data is voluntary, the demographic data available are incomplete. This may make it difficult to answer this question for small programs. However, experience suggests that even with the limited data available, COVs are able to provide a meaningful response to this question for most programs.

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| <p>10. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports.</p> <p>Comments: Yes, CMI seeks collaborative funding to enhance the public image of chemistry. An example is funding a highly visible museum project which applies an analysis method to develop new knowledge on ancient art which is broadly applicable to the art and antiquities communities and possible even forensics. In addition Measurement and Imaging contributes to the broad areas of health, education, sustainability and energy – as these are important nation priorities the program is certainly relevant to them.</p> | <p>YES</p> |
| <p>11. Additional comments on the quality of the projects or the balance of the portfolio:</p> <p>The program has a strong group of PI's and a well-defined scope. The program is well-organized and balanced.</p> | |

V. Beyond the Portfolio. Please answer the following questions.

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| <p>3. <u>How to Evaluate Realignment:</u> The Division realigned its scientific programs in 2009. With three years of data on the new programs, the Division wishes to assess the impact of the realignment on the field of chemistry and the research community. The Division requests feedback from the COV on how to best structure such an assessment.</p> <p><i>Please see the Sharepoint site for additional information.</i></p> <p>Comments:</p> |
| <p>4. <u>Portfolio Management:</u> Award recommendations in the Division are based on intellectual merit and broader impacts (unless there are additional specific criteria spelled out in a solicitation), with additional consideration of demographics and portfolio goals, strengths, and weaknesses. The Division requests feedback from the COV if Program Directors should move to a more active management of the portfolio <i>within each Program</i>, considering factors such as the number of active awards that a principal investigator (PI) holds, PI demographics, submission processes, and the like.</p> <p><i>Please see the Sharepoint site for additional information.</i></p> <p>Comments:</p> |

Chemical Structure, Dynamics and Mechanisms (CSDM)

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(s) under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged.

I. Questions about the quality and effectiveness of the program's use of merit review process. Please answer the following questions about the effectiveness of the merit review process and provide comments or concerns in the space below the question.

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
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| <p>1. Are the review methods (for example, panel, ad hoc, site visits) appropriate?</p> <p>Comments: In the 2010-2012 period, this program has relied solely on mail reviews due to the diversity of submitted proposals and thus this presents difficulty with assembling appropriate panels. The use of ad hoc reviewing is effective to get specialist input on proposals. The review summaries viewed here are well thought out and effectively synthesis the ad hoc comments. The lack of panel reviews did not seem to harm the thoroughness of the review process. It may prove useful in the future to use panels in some form when there are groups of similar-discipline proposals to alleviate proposal pressure on the program officers and the problems associated with non-responsive reviewers.</p> <p>With the split forthcoming to a and b subsections, there is very likely a need to consider panel reviews as an additional tool for evaluation.</p> | Yes |
| <p>2. Are both merit review criteria addressed</p> <p>m) In individual reviews?</p> <p>n) In panel summaries?</p> <p>o) In Program Officer review analyses?</p> | <p>a. Yes, mostly</p> <p>b. N/A</p> <p>c. yes</p> |

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| <p>Comments: Both merit review criteria were addressed in all instances, however, the weight that they were given in the decision making process is not clear. From the analysis it is clear that proposals on the margins benefitted from a strong broader impacts program plan.</p> | |
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| <p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>Comments: There was an occasional excellent rating where the reviews were essentially non-substantial. PO takes due care in weighting substantive reviews as opposed to those that are perfunctory. The quality of Individual ad hoc reviews is broad, both in depth and in addressing both review criteria. The tone of the reviews in general was professional and focused on the merits of the proposed work. Many reviews provided insightful comments and analysis that were clearly useful to program officers in their decision making. Some reviews however were disturbingly brief and lacked useful content. Others were brief but provided important review analysis. Some reviews did not comment sufficiently or at all about the broader impacts of the proposed work.</p> | <p>Yes in most instances</p> |
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| <p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>Comments: Program does not use panels.</p> | <p>N/A</p> |
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| <p>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</p> <p>[Note: Documentation in the jacket usually includes a context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.]</p> <p>Comments: The PO analysis provides a thorough and clear rationale and we compliment the PO for this. That coupled with the written reviews gives a high level of confidence in a clear rationale. Among the proposal sample, the Program Officer review analyses were excellent and adequately explained the program officers' assessment of both positive and negative comments. The analyses provided specific examples from the reviews that influenced the decision. The program officers are to be lauded for looking beyond superficial scoring of proposals and taking into account the significant comments (both positive and negative) in the review narratives.</p> | <p>YES</p> |
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| <p>6. Does the documentation to the PI provide the rationale for the award/decline decision?</p> <p>[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 in the PO Comments field or emailed with a copy in the jacket, or telephoned with a diary note in the jacket) of the basis for a declination.]</p> <p>Comments: In cases of award and decline decisions, the PI is referred to the reviewer comments for specific information. In cases of declined proposals, the program officer encouraged the PI to look at details of the reviews and to contact the PO prior to resubmission. We appreciate the need for a relatively terse explanation of a declination with the invitation for a more detailed follow-up discussion.</p> <p>In such cases, however, the PI may benefit from obtaining more substantive details especially in borderline cases.</p> | <p>Generally Yes</p> |
| <p>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</p> <p>The review process examined by this committee was thought to be uniformly thoughtful and credible. We applaud the officers due diligence and attention to detail. The rationale for the decisions was clear and consistent with high standards of peer review.</p> <p>We note that some proposals are more data driven rather than hypothesis driven and there is sometimes little discussion of the impact this has on analysis and eventual award or declination. We suggest, since hypothesis driven research is high on NSF's agenda, that the PO note that deficiencies in this regard could impact the eventual funding decision.</p> <p>The challenges faced by POs include nonresponsive reviewers, high proposal pressure and fallout of structural realignment in NSF chemistry, namely a less-homogeneous set of proposals. Our opinion is that CSDM is effective at cross disciplinary reviews and effectively uses existing PO expertise. However, the current challenges are not likely to subside and new methods may be useful in the future. For example, it may be helpful to explore new modalities of the review process that incorporate some use of panels in addition to ad hoc mail reviews.</p> | |

II. Questions concerning the selection of reviewers. Please answer the following questions about the selection of reviewers and provide comments or concerns in the space below the question.

| SELECTION OF REVIEWERS | YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
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| <p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>Comments: We are generally impressed with the appropriateness and high quality of reviewers for this program.</p> | YES |
| <p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>Comments: There were no examples of COI where an issue.</p> | No data available |
| <p>Additional comments on reviewer selection: Reviews were solicited from a broad range of institutions, thereby providing important feedback on the intellectual merits and broader impacts from a diverse perspective. Such a broad perspective is useful for decision making.</p> <p>We recommend that CHE consider some new strategies to increase reviewer participation, perhaps implementing techniques used by journal editors to secure manuscript reviews.</p> | |

III. Questions concerning the management of the program under review. Please comment on the following:

| MANAGEMENT OF THE PROGRAM UNDER REVIEW |
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| <p>1. Management of the program.</p> <p>Comments: Program seems well organized and managed. There is a good correspondence between reviewer comments and intentions with PO evaluations and the program is quite effective and consistent in selection of awardees, selection of reviewers, interfacing with other programs/divisions, and budget decisions. There is some concern that PO turnover might impact this effective management.</p> |

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| <p>2. Responsiveness of the program to emerging research and education opportunities.</p> <p>Comments: We applaud the responsiveness of the CHE by creating the 8 new focus areas. This assists in responsiveness to new and emerging research opportunities and encourages cross-discipline interactions. Shared funding of proposals with other programs inside and outside CHE provides the evidence that the division is taking advantage of emerging research and educational opportunities.</p> |
| <p>3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.</p> <p>Comments: Development of a well-crafted strategic plan appears to have crafted the program planning and prioritization process.</p> |
| <p>4. Responsiveness of program to previous COV comments and recommendations.</p> <p>Comments: We commend the programs under the CHE division in their responsiveness to previous COV comments and recommendations.</p> |

IV. Questions about Portfolio. Please answer the following about the portfolio of awards made by the program under review.

| RESULTING PORTFOLIO OF AWARDS | APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE |
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| <p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>Comments: This program encompasses a wide array of research directions and integrated over the three year period, the portfolio balance seems appropriate.</p> | APPROPRIATE |
| <p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>Comments: Grant sizes are appropriate but should increase rather than decline mainly because the cost of research at academic institutions is on the rise.</p> <p>It is clear that there are more deserving proposals than there are funds to support them. Deserving well-reviewed proposals are going unfunded due to the current (and on-going) bleak budget environment. This situation directly harms American competitiveness. Limited resources require that award size be balanced by the number of awards. The POs have wisely chosen adequate award size over funding more proposals. New challenges have changed the realities of an award. For</p> | APPROPRIATE |

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| <p>example, summer salary is increasingly being reallocated to student support due to limited award size.</p> <p>The three year duration is normal, but can be awkward with timing of the single submission date.</p> <p>The award size needs to cover the personnel and equipment/support costs of the research. While award size has increased in current dollars, but not in constant dollars. Research costs continue to rise and constant award size is detrimental to successful research. The recent trend in award size is decreasing and is in danger, if this trend continues, of reaching a substandard level. The operational challenge for the program is to balance award size and the number of awards to enable outstanding science in America. The CSDM program has maintained award size and decreased the number of awards.</p> <p>If more resources were available, additional deserving awards could be funded and more excellent science could be done. However, it is imperative that the number of awards not be reduced to enhance the size of a smaller number awards.</p> | |
| <p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>Comments: Most of the awarded grants seem to be innovative or potentially transformative.</p> | APPROPRIATE |
| <p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>Comments: The program appears to have multi-disciplinary foci as evidenced by the fact that CSDM partners with other programmatic areas inside and outside of CSDM. However, the small sampling of proposals we reviewed were not of a highly interdisciplinary nature nor were they highly collaborative.</p> | APPROPRIATE |
| <p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>Comments: The geographical distribution of awards is appropriately balanced.</p> | APPROPRIATE |
| <p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>Comments: The distribution of awards is appropriately balanced between types of institutions. The majority of awards are going to the top-100 PhD granting institutions, which is appropriate given the enhanced synergies and resources at these sites. Non-R1 institutions are represented and would benefit from more participation.</p> | APPROPRIATE |

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| <p>7. Does the program portfolio have an appropriate balance of awards to new investigators?</p> <p>NOTE: A new investigator is an investigator who has not been a PI on a previously funded NSF grant.</p> <p>Comments: The program portfolio has an appropriate balance of awards to new investigators. The percentage seems to follow the overall percentage of awarded grants in CHE. We are impressed with how many awards in 2012 went to new investigators. The lower success rate of new PIs is understandable given their inexperience. The CAREER program has been effective at bringing young PIs into the portfolio.</p> | <p>APPROPRIATE</p> |
| <p>8. Does the program portfolio include projects that integrate research and education?</p> <p>Comments: Most awarded proposals paid particular attention to Broader Impacts and developed a project plan to integrate research with education and outreach. The training aspects of the proposed research are taken seriously during the review process.</p> | <p>APPROPRIATE</p> |
| <p>9. Does the program portfolio have appropriate participation of underrepresented groups⁵?</p> <p>Comments: Underrepresented groups (women and minorities) participate in this program. However the number of applicants in each group is small and statistics are not as meaningful as if a larger sample was considered. The success rates for each group have wide year-to-year variation, but overall give evidence that these groups are being funded. It is hard to evaluate the effects of early career PIs and the type of institution on the statistical outcome of these groups.</p> <p>A low rate was noted in 2010 and 2011 but a dramatic increase was observed in 2012 which is an encouraging trend if it continues. We encourage the PO to continue to emphasize the broadening participation and success from underrepresented minorities in the CSDM program.</p> | <p>NOT APPROPRIATE</p> |
| <p>10. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports.</p> <p>Comments: The CSDM program has particular relevance in the following example areas:</p> <ol style="list-style-type: none"> 1. Development of a diverse workforce 2. Development of alternative and renewable energies 3. Funding of basic research that underpins the development of new technologies 4. Encouraging underrepresented populations to pursue STEM careers | <p>APPROPRIATE</p> |

⁵ NSF does not have the legal authority to require principal investigators or reviewers to provide demographic data. Since provision of such data is voluntary, the demographic data available are incomplete. This may make it difficult to answer this question for small programs. However, experience suggests that even with the limited data available, COVs are able to provide a meaningful response to this question for most programs.

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| 11. Additional comments on the quality of the projects or the balance of the portfolio: | |
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Outstanding proposals over a broad range of areas are funded. A positive outcome of tight dollars is an increase in the bar for proposal success. The program has risen to this challenge.

OTHER TOPICS

1. Please comment on any program areas in need of improvement or gaps (if any) within program areas. We encourage the program to put high priority on awards that are innovative and hypothesis-driven from proposals that provide a clear perspective on the focus and significance of the proposed research.
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.
3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.

There appears to be an issue regarding the weighting of Broader Impacts verses Intellectual Merit in the overall rating of proposals. What is specifically not known is the % contribution to the overall score that Broader Impacts have. We recommend that the reviewers specify the weight given to each of the two categories in arriving at their overall evaluation.

Chemistry truly is the central science and NSF chemistry needs more money to support important and deserving proposals. Many outstanding proposals are not funded. This situation reduces opportunities for training chemists to meet national needs. Growing numbers of underrepresented groups will be hardest hit by lack of opportunity in this area.

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

There are not enough program officers to meet the increasing proposal pressure. Program officers are encouraged to work with PIs in the transition to a single submission window.

The rule to include editorial colleagues on the two-page bio sketch should be eliminated. It is not an appropriate measure of collaborative activity and it takes away from the ability of a PI to fully describe their activities. Editorial information should be included as an appendix, such as is the rule for many Center/Multi-user proposals.

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

COV members should be given more specific instructions about the process and the components of the e-jacket. Tanja's e-mail instructions should have been made earlier.

V. Beyond the Portfolio. Please answer the following questions.

4. How to Evaluate Realignment: The Division realigned its scientific programs in 2009. With three years of data on the new programs, the Division wishes to assess the impact of the realignment on the field of chemistry and the research community. The Division requests feedback from the COV on how to best structure such an assessment.

Please see the Sharepoint site for additional information.

Comments:

5. Portfolio Management: Award recommendations in the Division are based on intellectual merit and broader impacts (unless there are additional specific criteria spelled out in a solicitation), with additional consideration of demographics and portfolio goals, strengths, and weaknesses. The Division requests feedback from the COV if Program Directors should move to a more active management of the portfolio *within each Program*, considering factors such as the number of active awards that a principal investigator (PI) holds, PI demographics, submission processes, and the like.

Please see the Sharepoint site for additional information.

Comments:

Chemical Theory, Models and Computational Methods (CTMC)

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(s) under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged.

I. Questions about the quality and effectiveness of the program's use of merit review process. Please answer the following questions about the effectiveness of the merit review process and provide comments or concerns in the space below the question.

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|--|--|
| <p>1. Are the review methods (for example, panel, ad hoc, site visits) appropriate?</p> <p>Comments: There is a healthy balance of panels + ad hoc reviewers. Strategies for ensuring commitment from ad hoc reviewers early on are encouraged. The number and content of the reviews generally appear to be adequate. In the group of proposals we saw, there were two that had relatively poor response from reviewers. Six were solicited and only 2-3 were returned. This may reflect the low quality of the proposals in question.</p> <p>One proposal was not reviewed externally because part of the EAGER program. While we have some misgivings about projects being funded without any external review, we don't have a good recommendation for how to fix the problem while maintaining the goals of the EAGER program.</p> | YES |
| <p>2. Are both merit review criteria addressed</p> <p>p) In individual reviews? Yes</p> <p>q) In panel summaries? Yes</p> <p>r) In Program Officer review analyses? Yes</p> <p>Comments: In general, the answer is yes. The emphasis in both the individual reviews</p> | YES |

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| and the summaries was on the intellectual merit. Merit review criteria are properly addressed for both individual reviews and panel summaries. It is clear the program manager is serving an important role in balancing the recommendations from the reviewers and panels, by looking globally at the overall range of critiques beyond the metrics of the system. Mentorship from the program manager has allowed new investigators to be successful in new submissions. | |
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| <p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>Comments: The reviewers in general gave detailed technical comments about the proposals. Many do provide substantive comments, although not all of the reviewers provided as substantive comments as one would like.</p> | YES |
| <p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>Comments: In all cases, the panel summaries provided the rationale for their recommendation, even in cases where there was not unanimity of opinions. The summary explained why they disagreed.</p> | YES |
| <p>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</p> <p>[Note: Documentation in the jacket usually includes a context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.]</p> <p>Comments: Yes, the documentation in the jacket provided the rationale for the award/decline decision.</p> | YES |

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| <p>6. Does the documentation to the PI provide the rationale for the award/decline decision?</p> <p>[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 in the PO Comments field or emailed with a copy in the jacket, or telephoned with a diary note in the jacket) of the basis for a declination.]</p> <p>Comments: Appropriate discussions and comments are available in the documentation</p> | YES |
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| provided to the PIs in cases of declination. The PI receives verbatim comments from the reviewers and review panel. In general the PO comments were brief. Even though the PIs have access to the reviews, they cannot see the review analysis. For proposals that are competitive but still declined, more detailed PO comments could be helpful to the PI. | |
| 7. Additional comments on the quality and effectiveness of the program's use of merit review process: Overall, the program shows high quality and effectiveness of use and implementation of the merit review process. | YES |

II. Questions concerning the selection of reviewers. Please answer the following questions about the selection of reviewers and provide comments or concerns in the space below the question.

| SELECTION OF REVIEWERS | YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|---|--|
| 1. Did the program make use of reviewers having appropriate expertise and/or qualifications? Comments: Yes, the program makes good use of appropriate expertise. An important question is how to improve on the number of returned reviews. Would incentives help? An outstanding challenge is to construct panels that fulfill the need for an appropriate diversity without overloading a subset of the community and without compromising the breath of expertise necessary to assist the program officer in assessing the quality of the proposals. As smaller virtual panels are becoming more common, these issues may become more critical. | YES |
| 2. Did the program recognize and resolve conflicts of interest when appropriate? Comments: COI are properly addressed. We did not detect any examples of conflicts of interest among these proposals. | YES |
| Additional comments on reviewer selection: Overall, the selection of reviewers is successful. The integration of panels with both expertise and the right demographics is a challenge that the program manager is addressing successfully. This challenge likely extends beyond this particular program. | YES |

III. Questions concerning the management of the program under review. Please comment on the following:

MANAGEMENT OF THE PROGRAM UNDER REVIEW

1. Management of the program.

Comments: Management is outstanding. The program officers have a clear vision for the program, which is to support primarily methods development that will be of broad utility to the community.

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

Comments: The POs are aware of trends in theoretical chemistry, including rising and declining areas of interest, and they seek to be responsive to new opportunities. The program has been seeking out co-funding opportunities rather aggressively, including co-funding in emerging areas.

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

Comments: In the context of Realignment, this program did execute a clear vision to keep the projects that focused primarily on methods, while distributing application-oriented projects to other programs in the Division. The program has realigned and focused into a program on methods and software development that serves the broader community (including other NSF programs and beyond). This alignment has diversified the portfolio and has facilitated proposals that are not focused on methods development to find more appropriate homes in other NSF programs.

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

Comments: It's not clear that the recommendations of the previous COV could be carried out at the individual program level. This program has made a large effort to co-fund projects with other programs and initiatives at NSF. In some measure, this has addressed the COV recommendation to improve the funding level and success rate of individual PI proposals. Some of the recommendations have been addressed, including the idea of exploring additional mechanisms for review. Several other suggestions with recommendations in terms of budget increase, minimum funding/proposal, etc., could not be fulfilled due to externalities outside the control of the program manager.

IV. Questions about Portfolio. Please answer the following about the portfolio of awards made by the program under review.

| <p align="center">RESULTING PORTFOLIO OF AWARDS</p> | <p align="center">APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</p> |
|---|--|
| <p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>Comments: The program includes an appropriate balance of awards on methods developments on Quantum Chemistry (45%), Simulations of Complex Condensed Matter Systems (20%), Statistical Mechanics (10%), Spectroscopy and Dynamics (25%), although research areas are partially overlapping. There is a strong emphasis on some areas (quantum chemistry, spectroscopy, and dynamics) that are considered very active and important by the community. The program balance seems to result from a natural evolution of interest among theoretical chemists.</p> | <p align="center">YES</p> |
| <p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>Comments: Award size and duration are appropriate. The project sizes and durations are about average for the Division of Chemistry. It is hard for us to evaluate whether that is appropriate for the scope of projects in the program.</p> | <p align="center">YES</p> |
| <p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>Comments: Yes, the spirit of the program with emphasis on methods development makes it natural and necessary for the PIs to propose innovative, transformative ideas. There were several among the proposals we saw that were described as transformative and innovative. One high-risk proposal was funded under the EAGER initiative and another was selected for funding despite some negative comments about risk by critical reviewers.</p> | <p align="center">YES</p> |
| <p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>Comments: The program deserves kudos for an outstanding track record on co-funding opportunities, leading to funding of inter/multidisciplinary projects. The spectroscopy and dynamics projects tend to involve close connections to experimental groups.</p> | <p align="center">YES</p> |
| <p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>Comments: The geographical distribution looks representative of the demographics of the field. The geographical balance is similar to that of other programs in the</p> | <p align="center">YES</p> |

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| Chemistry Division. | |
| <p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>Comments: The program portfolio does not have a balance of awards to different types of institutions since the type of work required for methods development in theoretical chemistry is not what can be carried out successfully at non-PhD graduate institutions. Predominantly, the awards go to top research institutions. There is a small number to B.S. and M.S. granting institutions.</p> | YES |
| <p>7. Does the program portfolio have an appropriate balance of awards to new investigators?</p> <p>NOTE: A new investigator is an investigator who has not been a PI on a previously funded NSF grant.</p> <p>Comments: Yes, the balance of awards to new investigators represents 20% of the submitted proposals, although only 12% are successful with the majority of the funded proposals funded under the Career program. However, there is concern the number of Career proposals has been smaller in recent years. This might be partially due to younger investigators getting funded through regular proposals. We don't have a good way to solve the problem, but we wish the success rate could be higher for new investigators.</p> | YES |
| <p>8. Does the program portfolio include projects that integrate research and education?</p> <p>Comments: Integration of research and education is successful through the broader impact component of the proposals, including some among the proposals we saw, particularly among the younger investigators.</p> | YES |
| <p>9. Does the program portfolio have appropriate participation of underrepresented groups⁶?</p> <p>Comments: The numbers are small so it's hard to tell. The success rate for women was as high as that for men. Participation of underrepresented groups appears to be tracking the general demographics of Chemistry departments (including 15% of females, and 6% other minorities). The success rate for these underrepresented groups is higher (35-37%) than the average success rate (22-32%).</p> | YES |
| <p>10. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports.</p> | YES |

⁶ NSF does not have the legal authority to require principal investigators or reviewers to provide demographic data. Since provision of such data is voluntary, the demographic data available are incomplete. This may make it difficult to answer this question for small programs. However, experience suggests that even with the limited data available, COVs are able to provide a meaningful response to this question for most programs.

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| <p>Comments: As far as we know, yes. Fundamental science in chemical theory underlies national technological goals in many areas. Methods development benefit a wide range of programs of national priority, including other NSF programs, and programs at NIH, DOE, DOD, etc.</p> | |
| <p>11. Additional comments on the quality of the projects or the balance of the portfolio:</p> <p>Overall, the program is in line with the emerging areas and current demographics of the field. The program selects meritorious proposals and seems to follow the goal of quality science as the deciding factor in selection of projects.</p> | |

V. Beyond the Portfolio. Please answer the following questions.

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| <p>7. <u>How to Evaluate Realignment:</u> The Division realigned its scientific programs in 2009. With three years of data on the new programs, the Division wishes to assess the impact of the realignment on the field of chemistry and the research community. The Division requests feedback from the COV on how to best structure such an assessment.</p> <p><i>Please see the Sharepoint site for additional information.</i></p> <p>Comments:</p> |
| <p>8. <u>Portfolio Management:</u> Award recommendations in the Division are based on intellectual merit and broader impacts (unless there are additional specific criteria spelled out in a solicitation), with additional consideration of demographics and portfolio goals, strengths, and weaknesses. The Division requests feedback from the COV if Program Directors should move to a more active management of the portfolio <i>within each Program</i>, considering factors such as the number of active awards that a principal investigator (PI) holds, PI demographics, submission processes, and the like.</p> <p><i>Please see the Sharepoint site for additional information.</i></p> <p>Comments:</p> |

Environmental Chemical Sciences (ECS)

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(s) under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged.

I. Questions about the quality and effectiveness of the program's use of merit review process. Please answer the following questions about the effectiveness of the merit review process and provide comments or concerns in the space below the question.

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
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| <p>1. Are the review methods (for example, panel, ad hoc, site visits) appropriate?</p> <p>Comments: Of the 12 proposals: - 4 proposals had been reviewed by a panel in addition to 4 ad hoc reviews, - 8 proposals had been reviewed by between 4 and 6 ad hoc reviews only, no panel</p> <p>We believe that the large number of mail reviews declined during 2010-11, forced the program manager to change to mostly panel reviews in 2012. A mix of panel and ad hoc seems appropriate for this program. Panels often allow a more objective comparison of the proposed research than ad hoc reviews. However, though large environmental projects are often reviewed best by a panel that includes experts with a broad vision, if there are fewer applications for specific topics, an ad hoc reviewing process may seem more appropriate.</p> | YES |
| <p>2. Are both merit review criteria addressed</p> <p>s) In individual reviews? Not always</p> <p>t) In panel summaries? Yes</p> <p>u) In Program Officer review analyses? Yes</p> <p>Comments: Broader impacts are often not addressed adequately in individual reviews. It seems that the understanding of the criteria by both applicants and reviewers is poor</p> | YES |

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| (the definition may be vague to provide an objective evaluation). In some “marginal” declined proposals the lack of broad impacts was used as a criterion for their rejection. | |
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| <p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>Comments: In general, yes. However, we found a couple of excellent ratings were given to proposals some weak points. These reviews were typically not substantiated and it is evident that these were not weighed strongly in the write-ups, which alerted the program manager of deficiencies in the proposed work. In the case of marginal declined proposals, non-justified approaches or collaborations were well documented.</p> | YES |
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| <p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>Comments: We accessed 4 proposals reviewed by panels. It seems that they do provide a summary that is supported by the individual reports. Moreover, in the “non-recommended” proposals a solid critique is provided.</p> | YES |
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| <p>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</p> <p>[Note: Documentation in the jacket usually includes a context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.]</p> <p>Comments: In general, the review analyses are very thorough and provide clear explanations of the rationale for awarding or declining the proposals. In a few cases of borderline proposals (frequently those in the range 3.5-4.25), it was not clear what the decisive factor was. It seems that additional information is used to decline or fund a proposal such as the fact that the faculty is early in his/her career and the work may be high-risk. In another instance, however, it was made very clear that a proposal with high rankings was rejected due to a strong overlap with a currently funded project in other programs. This is well documented in the jacket.</p> | GENERALLY YES |
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| <p>6. Does the documentation to the PI provide the rationale for the award/decline decision?</p> <p>[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 in the PO Comments field or emailed with a copy in the jacket, or telephoned with a diary note in the jacket) of the basis for a declination.]</p> <p>Comments: It seems that at times there is a lack of information regarding reasons for rejection that could help the application in a resubmission process.</p> | GENERALLY YES |
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| <p>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</p> <p>Instead of assigning the applications to one of three tiers (HR/R/NDR), we recommend broadening the rating system, such as for example to 5 tiers. This will help PIs know where his/her application stands and how to proceed.</p> <p>In addition, the COV for ECS proposes a mechanism by which the applicants are informed of the members in the panel in advanced, such as is common practice in NIH. The rationale for this suggestion is to give an opportunity to the applicants to make sure the appropriate expertise is included, and to point out conflict of interests that are not public knowledge, or otherwise accessible, to the program managers.</p> <p>It is apparent that other factors seem to play important roles in the POs final decision. Although these may be well justified, they are not always clearly evident in the review and panel summaries. e.g:</p> <ul style="list-style-type: none"> - giving preference to junior faculty, high risk - the relative importance of hypothesis driven research vs. continuing explorations - importance of broader impacts <p>Other informational items that seem to influence the POs final decision, but that reviewers and COV members do not have access to, are whether the PI has obtained past/current funds for the same or overlapping funding. To help the review process and PO, it may be beneficial for reviewers to have more access to past/present funding summaries.</p> <p>Another factor that seems to be weighed strongly by reviewers is past publication record. Perhaps it could be made clear to reviewers that the focus in on the quality of the proposal instead of past publication record.</p> <p>We realize that these types of comments were raised by the COV 2010 and that CHE responded by saying that this is one of the largest challenges.</p> | |
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II. Questions concerning the selection of reviewers. Please answer the following questions about the selection of reviewers and provide comments or concerns in the space below the question.

| SELECTION OF REVIEWERS | YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
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| <p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>Comments:</p> | YES |

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| <p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>Comments: We assume there were no conflicts of interest in the reviewing selection process. When reviewers are recommended, the program manager makes sure there are no conflicts of interest.</p> | <p>YES</p> |
| <p>Additional comments on reviewer selection:</p> <p>Few female reviewers, but perhaps this is a representative cross section.</p> | |

III. Questions concerning the management of the program under review. Please comment on the following:

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| <p>MANAGEMENT OF THE PROGRAM UNDER REVIEW</p> | |
| <p>1. Management of the program.</p> | <p>Comments: Program seems well organized and managed. The shift toward panel/ad hoc review seems to result in a better evaluation process.</p> <p>There seems to be a strong interaction with the GEO directorate. The POs seems to take advantage of co-funding proposals in different programs.</p> |
| <p>2. Responsiveness of the program to emerging research and education opportunities.</p> | <p>Comments: We applaud the responsiveness of the directorate by creating the 8 new focus areas. In particular we believe that many chemists are and will benefit immensely from the creation of the ECS program. Furthermore, by funding environmental research, fundamental scientific concepts can be taught to a multitude of students in an amenable and hands-on manner, thus expanding education further into the STEM fields.</p> |
| <p>3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.</p> | <p>Comments: We commend the program managers for developing and shaping this new program within chemistry. The environmental chemical sciences program builds the home for a very important group of scientists that address crucial environmental topics for the world. It is currently a small program that will likely grow by attracting PIs that are working on pressing issues with high impact. We recommend that more funds are provided and that the scope of the program be expanded (see suggested revision of program description in Other Topics 1).</p> |

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

Comments: The ECS did an excellent job responding to the previous COV comments regarding the need to strengthen the portfolio of proposals addressing environmental issues by creating a solid ECS program.

IV. Questions about Portfolio. Please answer the following about the portfolio of awards made by the program under review.

| <p align="center">RESULTING PORTFOLIO OF AWARDS</p> | <p align="center">APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</p> |
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| <p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>Comments: The awarded grants were representative of a wide range of environmental areas, with particular emphasis on surface processes and nanometer sized and atmospheric particles. More proposal submissions from other areas in the environmental field could be encouraged by changing the wording in the program announcement. See suggestion in Other Topics 1.</p> | <p align="center">APPROPRIATE considering current program description</p> |
| <p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>Comments:</p> | <p align="center">APPROPRIATE</p> |
| <p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>Comments: A few of the awarded grants seem to be innovative or potentially transformative.</p> | <p align="center">APPROPRIATE</p> |
| <p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>Comments: The field naturally brings together all sub disciplines within chemistry as well as geology, biology, and physics, thus, as expected the various research projects presented in the program portfolio are diverse and interdisciplinary. More multi investigator/institution collaborations could be encouraged as well as interactions with other programs with overlapping goals such as green chemistry funded in the SYN. Despite the fact that the program is relatively new, it attracts a wide range of proposals and as more investigators become aware of it, it will grow to include more cross disciplinary projects.</p> | <p align="center">APPROPRIATE</p> |

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| <p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>Comments:</p> | <p>APPROPRIATE</p> |
| <p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>Comments: The pool of proposals from 4-year institutions was very small. It is very likely that more applications will be received from PUI institutions once more investigators learn about this program.</p> | <p>APPROPRIATE given the distribution of submissions</p> |
| <p>7. Does the program portfolio have an appropriate balance of awards to new investigators?</p> <p>NOTE: A new investigator is an investigator who has not been a PI on a previously funded NSF grant.</p> <p>Comments: The percentage of new PIs funded is similar to other programs in the division.</p> | <p>APPROPRIATE</p> |
| <p>8. Does the program portfolio include projects that integrate research and education?</p> <p>Comments: The sampling of proposals viewed had standard broader impact statements, however, since environmental chemistry is a growing area with high interest we anticipate that stronger educational components will emerge as well as the use of the REU program.</p> | <p>APPROPRIATE</p> |
| <p>9. Does the program portfolio have appropriate participation of underrepresented groups⁷?</p> <p>Comments:</p> | <p>DATA NOT AVAILABLE</p> |
| <p>10. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports.</p> <p>Comments: Yes, it is well documented that this is an important area of research for the nation. This is well documented in various NRC reports including the 2007 Rising Above the Gathering Storm and subsequent studies.</p> | <p>APPROPRIATE</p> |

⁷ NSF does not have the legal authority to require principal investigators or reviewers to provide demographic data. Since provision of such data is voluntary, the demographic data available are incomplete. This may make it difficult to answer this question for small programs. However, experience suggests that even with the limited data available, COVs are able to provide a meaningful response to this question for most programs.

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| Funding aerosol work and on surfaces is of relevance to climate change and human health. | |
| 11. Additional comments on the quality of the projects or the balance of the portfolio: | |

OTHER TOPICS

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

Broaden the scope of ECS by not specifying particle interfaces, nanoparticles and laboratory work. See suggested edits to program description below in red and underlined:

The Environmental Chemical Sciences (ECS) Program supports basic research in chemistry that promotes the understanding of natural and anthropogenic chemical processes in our environment. Projects supported by this program enable fundamentally new avenues of basic research and transformative technologies. The program is particularly interested in studying molecular phenomena in order to understand the inherently complex and heterogeneous environment. Projects utilize advanced experimental, modeling and computational approaches, as well as developing new approaches. Topics include studies of environmental processes, the fundamental properties of water and water solutions important in environmental processes, dissolution, composition, origin and behavior of molecular scale systems under a variety of naturally occurring environmental conditions, chemical reactivity of synthetic substances and their molecular level interactions with the environment, and application of theoretical models and computational approaches to discover and predict environmental phenomena at the molecular scale.

The ECS program supports research in basic chemical aspects of our environment that do not require extensive field surveys to validate hypotheses. Biological Sciences, Engineering and Geosciences Directorates as well as other federal agencies address other aspects such as field studies.

Stress that hypothesis driven goals are essential for a successful proposal. Provide better guidelines on how to rate intellectual merit vs. broader impacts.

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.

We don't have program specific goals available.

3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.
4. Please provide comments on any other issues the COV feels are relevant.
5. NSF would appreciate your comments on how to improve the COV review process, format and report template.

While we received a large amount of information from the POs upon arrival, we needed some more to review and make suggestions. The process could have been sped up by providing more guidance on answering the COV questions, direct links to relevant information like the previous COV reports, lists of awards made in each program, program specific goals and objectives, how the jackets were selected. Providing detailed instructions, like the e-mail from Feb..7, 2013, earlier in the review process may also have reduced our time spent on reading the proposals. Overall, it is our impression that the review process went very smoothly and that everything was very well organized.

V. Beyond the Portfolio. Please answer the following questions.

9. How to Evaluate Realignment: The Division realigned its scientific programs in 2009. With three years of data on the new programs, the Division wishes to assess the impact of the realignment on the field of chemistry and the research community. The Division requests feedback from the COV on how to best structure such an assessment.

Please see the Sharepoint site for additional information.

Comments:

10. Portfolio Management: Award recommendations in the Division are based on intellectual merit and broader impacts (unless there are additional specific criteria spelled out in a solicitation), with additional consideration of demographics and portfolio goals, strengths, and weaknesses. The Division requests feedback from the COV if Program Directors should move to a more active management of the portfolio *within each Program*, considering factors such as the number of active awards that a principal investigator (PI) holds, PI demographics, submission processes, and the like.

Please see the Sharepoint site for additional information.

Comments:

Educational Activities (EDU)

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(s) under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged.

I. Questions about the quality and effectiveness of the program's use of merit review process. Please answer the following questions about the effectiveness of the merit review process and provide comments or concerns in the space below the question.

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|---|---|
| <p>1. Are the review methods (for example, panel, ad hoc, site visits) appropriate?</p> <p>Comments: Yes, the review methods are appropriate.</p> <p>REU and ACC-F proposals were reviewed exclusively by panel. Special project proposals greater than \$50k were reviewed ad hoc and proposals less than \$50k were not reviewed externally. These methods are appropriate for the review of these programs and panels should be the primary means of review of REU proposals.</p> <p>.</p> | YES |
| <p>2. Are both merit review criteria addressed</p> <p>v) In individual reviews?</p> <p>w) In panel summaries?</p> | <p>a) YES</p> <p>b) YES</p> <p>c) YES</p> |

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| <p>x) In Program Officer review analyses?</p> <p>Comments: While all individual reviewers commented on both review criteria, many reviewers did not address them equally. Some reviewers need more education on the importance of broader impact and guidance on evaluation of them.</p> <p>Panel summaries, in general, did a better job of addressing the broader impacts of the proposals in this jacket. The REU panel summaries listed both strengths and weaknesses of the intellectual merit and broader impact and this was viewed favorably. It would be beneficial if other panels addressed both the strengths and weaknesses of the merit criteria.</p> <p>The program officer review analyses were concise and clear, addressing both merit criteria with equal weight.</p> <p>In conclusion, the reviews gave the POs critical information to award/decline the proposals.</p> | |
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| <p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>Comments: Yes, many do provide substantive comments, although some of the reviewers provided more of a summary of the program than an assessment of the potential success. It might be valuable to provide reviewers with examples of well-written reviews as compared to poorly written reviews.</p> | <p>YES</p> |
| <p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>Comments: The panel summaries do provide the rationale for the panel consensus.</p> | <p>YES</p> |

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| <p>5. Does the documentation in the jacket provide the rationale for the award/decline decision? Yes, the documentation is complete and includes a detailed description of conflicting views and a thorough justification of the final decision.</p> <p>[Note: Documentation in the jacket usually includes a context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.]</p> <p>Comments: The program officer review analysis provided a more accurate, comprehensive rationale than the panel summary, which, in general provided a better rationale than many of individual reviews.</p> | <p>YES</p> |
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| <p>6. Does the documentation to the PI provide the rationale for the award/decline decision?</p> <p>[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 in the PO Comments field or emailed with a copy in the jacket, or telephoned with a diary note in the jacket) of the basis for a declination.]</p> <p>Comments: Appropriate discussions and comments are available in the documentation provided to the PIs with a complete set of reviews and an overall analysis in the PO comments.</p> <p>The PO comments provide a reasonable summary of the decision made. When the individual reviews were well written, less detail was provided by the PO, especially for proposals not considered by the panel. When there were conflicting individual reviews, more detail was provided by the PO. Overall, the documentation was adequate. When a proposal is not discussed in panel, the PO should ensure that the comments made by the individual reviewers are sufficient to inform the PI. The PIs of the proposals reviewed in this jacket provided adequate rationale; however, if the quality of individual reviews is not adequate, it may become necessary to provide more detailed PO comments.</p> | <p>YES</p> |
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| <p>7. Additional comments on the quality and effectiveness of the program’s use of merit review process:</p> <p>Overall, the program shows high quality and effectiveness of use and implementation of the merit review process. The program manager deserves kudos for addressing conflicting opinions and for ensuring that the review process is fair, balanced and constructive.</p> | <p>YES</p> |
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II. Questions concerning the selection of reviewers. Please answer the following questions about the selection of reviewers and provide comments or concerns in the space below the question.

| <p style="text-align: center;">SELECTION OF REVIEWERS</p> | <p style="text-align: center;">YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE</p> |
|---|---|
| <p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>Comments: Yes, the program makes good use of appropriate expertise, including reviewers with previous experience in REUs and special programs. There is an ongoing effort to optimize the heterogeneous aspect of reviewing groups by going to smaller (more homogeneous) virtual panels. Training mechanisms for reviewers such as examples of well-written and poorly-written reviews on strengths and weaknesses for both successful and declined applications, and mock-up panels and webinars could enlarge the pool and quality of reviewers. These mechanisms would facilitate the construction of panels that fulfill the need for an appropriate diversity with the appropriate breath of expertise necessary to assist the program officer in assessing the quality of the proposals. As smaller virtual panels are becoming more common, these issues may become more critical.</p> <p>The program review of the REUs might benefit from participation by experts from more diverse institutions, government labs, museums or industry.</p> | <p style="text-align: center;">YES</p> |
| <p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>Comments: COI are properly addressed. The provided examples demonstrate the program manager did an excellent job.</p> | <p style="text-align: center;">YES</p> |
| <p>Additional comments on reviewer selection: Overall, the selection of reviewers is successful. The integration of panels with both expertise and the right demographics has been addressed successfully with an excellent representation of women and other underrepresented groups in the review panels.</p> | <p style="text-align: center;">YES</p> |

III. Questions concerning the management of the program under review. Please comment on the following:

MANAGEMENT OF THE PROGRAM UNDER REVIEW

1. Management of the program.

Comments: The portfolio consists of three program- Special Projects, REU and ACC-F. The ACC-F program is not currently funded by CHE. It is important to have permanent program officers to oversee these programs and provide consistency in the management of them. Management is outstanding at establishing competitive programs with excellent research and educational training. Professional development and development of a workforce is achieved by exposing students including underrepresented groups to a unique research opportunity.

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

Comments: The ACC-F program did an excellent job in integrating research and education opportunities. It is not clear if the SEES program is serving this role in the place of the ACC-F program.

The Special Projects program is an excellent way in which CHE is able to address emerging research and education opportunities. The Special Projects program may need to have a faster turnaround time to be more responsive to timely opportunities.

The REU program seeks novel models and funds innovative ideas that directly impact broader participation. The program has naturally fostered research and education on emerging fields by supporting interdisciplinary proposals, and exploiting co-funding opportunities rather aggressively, including emerging areas in DMR, CHE, PHY and EF.

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

Comments: The programs in EDU directly address the strategic directions of the CHE division.

- a) ACC-F: advancing American competitiveness, funding of PIs across career stages, broadening participation, broader impacts.
- b) However, the program has realigned the post-doctoral program to emphasize interdisciplinary professional development of the workforce. The program has already provided encouraging metrics on successful careers in both industry and academia initiated by the ACC postdoctoral program.
- c) REU: communicating value of chemistry to public, broadening participation, broader impacts
- d) Special Projects: can address any of the strategic directions

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

Comments: Unfortunately, most of the previous COV recommendations in terms of budget increase, length of the programs, hiring more permanent program officers, minimum funding/proposal, etc., could not be fulfilled due to externalities outside the control of the program manager.

IV. Questions about Portfolio. Please answer the following about the portfolio of awards made by the program under review.

| <p align="center">RESULTING PORTFOLIO OF AWARDS</p> | <p align="center">APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</p> |
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| <p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>Comments: The REU program includes an appropriate balance of awards across a broad range of activities in Chemistry and interdisciplinary programs.</p> <p>The ACC-F program was fairly small so it difficult to assess whether the proposals funded were balanced across the disciplines.</p> | <p align="center">YES</p> |
| <p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>Comments: ACC-F: Award size and duration are appropriate and pre-established by the solicitation.</p> <p>REU programs are fairly standard and appropriate for the programs.</p> <p>The Special Projects awards vary greatly in size and are evaluated accordingly</p> | <p align="center">YES</p> |
| <p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>Comments: Yes, successful REU programs were built upon existing innovative/potentially transformative research efforts at the home institutions funded by NSF and other agencies. However, there still seems to be a conflict in the review community between innovation and likelihood of success.</p> <p>The ACC-F portfolio and Special Projects are focused on innovative and transformative work</p> | <p align="center">YES</p> |

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| <p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>Comments: The REU program is highly successful with a track record on co-funding opportunities, leading to funding of inter/multidisciplinary projects. Metrics on the outcome of the program in terms of human development beyond the summer research activities could provide valuable feedback for future evaluations of the programs. Funding was received and provided to other NSF directorates.</p> <p>In the Special Projects, funding from other agencies was also actively sought.</p> | <p>YES</p> |
| <p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>Comments: The geographical distribution looks representative of the demographics of the incoming applications.</p> | <p>YES</p> |
| <p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>Comments: The REU program portfolio does not have a balance of awards to different types of institutions although it reflects the demographics of the incoming pool of applications. Ph.D. granting institutions receive a significant portion of the funding. It is not clear if there needs to be a greater effort to encourage proposals from more diverse institutions, such as PUIs and minority serving institutions or if there needs to be more support for more diverse institutions</p> <p>The ACC-F program, by its nature, seems to draw from Top 100 PhD schools and would benefit from a more diverse set of institutions.</p> | <p>NO</p> |
| <p>7. Does the program portfolio have an appropriate balance of awards to new investigators?</p> <p>NOTE: A new investigator is an investigator who has not been a PI on a previously funded NSF grant.</p> <p>Comments: New investigators are discouraged from leading REU or special programs due to the administrative demands of running these types of programs. Exceptions are non-tenure track educators/administrators that have been hired full-time for running REU and special programs.</p> | <p>YES</p> |
| <p>8. Does the program portfolio include projects that integrate research and education?</p> <p>Comments: Integration of research and education is essential in all of these programs.</p> | <p>YES</p> |

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| <p>9. Does the program portfolio have appropriate participation of underrepresented groups⁸?</p> <p>Comments: Participation of underrepresented groups is successfully reflected in the percentages of women and underrepresented groups in both REU and post-doctoral programs. Actually the portfolio does a better than average job in broadening participation and should continue to emphasize the broadening participation aspect in its proposal solicitations, reviews and funding.</p> | <p>YES</p> |
| <p>10. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports.</p> <p>Comments: Educational programs are specifically designed to provide competitive training of the American workforce on interdisciplinary research.</p> <p>The REU program seeks to address American competitiveness by training the next generation of diverse scientists and providing a research opportunity for students that would otherwise not be able to participate in research opportunities.</p> <p>The ACC-F program addressed the need to provide fellowships for postdoctorals, giving them an opportunity to participate in a collaborative research experience with both professional development and broadening participation components. The program was put on hiatus to provide resources for the SEES program. It is not possible to determine if the SEES program is as effective as addressing the same needs.</p> <p>Special projects are not funded unless they address a division, directorate or agency priority and their appropriateness is addressed in the reviews and review analysis.</p> | <p>YES</p> |
| <p>11. Additional comments on the quality of the projects or the balance of the portfolio: Overall, the program is in line with the emerging areas and current demographics of the field.</p> | <p>YES</p> |

OTHER TOPICS

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

Some questions arose regarding the distribution of REU sites. Why are there so many PhD schools that have REU programs? Would the REU program benefit from having a more balanced distribution of schools- some focused on younger students and some focused on older students? If so, then the question of what it means to provide a research opportunity for students that otherwise would not have

⁸ NSF does not have the legal authority to require principal investigators or reviewers to provide demographic data. Since provision of such data is voluntary, the demographic data available are incomplete. This may make it difficult to answer this question for small programs. However, experience suggests that even with the limited data available, COVs are able to provide a meaningful response to this question for most programs.

an opportunity would come up. If a student at a community college participates in an REU after their sophomore year in a non-PhD school's REU program, would they be eligible for an REU at a Top 100 school after their junior year? Under the current solicitation, it seems as if this model would be discouraged.

The ACC-F program was a novel program to provide training for postdoctoral students, giving them the support and training needed to start their careers. It is not clear that the SEES fills the same need since the SEES was not under review.

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.

Overall, the programs under review are outstanding examples of programs that address specific goals and objectives. They are distinct in their approach, but are effective at broadening participation, and integrating research and education.

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

Assessment based on the comparative analysis of performance (both in terms of research productivity and career development) of NSF post-docs as compared to post-docs supported by PI's grants would provide valuable information on whether the NSF is better off funding post-docs directly, or within a research program conceived and designed by the PI.

The ambiguity on the importance of the broader impact criteria decreases the quality of the reviews. Additional training of the reviewers prior to their review of the proposals could help improve review quality. A lack of well qualified reviewers will continue to be a problem, but NSF should continue its effort to increase the pool of quality reviewers who understand the nature of both intellectual merit and broader impact.

4. Please provide comments on any other issues the COV feels are relevant.
5. NSF would appreciate your comments on how to improve the COV review process, format and report template.

An opportunity to interact by phone/Skype with some of the PI's or NSF fellows involved in ongoing programs could provide more information on the assessment of the needs of the program.

V. Beyond the Portfolio. Please answer the following questions.

3. How to Evaluate Realignment: The Division realigned its scientific programs in 2009. With three years of data on the new programs, the Division wishes to assess the impact of the realignment on the field of chemistry and the research community. The Division requests feedback from the COV on how to best structure such an assessment.

Please see the Sharepoint site for additional information.

Comments:

4. Portfolio Management: Award recommendations in the Division are based on intellectual merit and broader impacts (unless there are additional specific criteria spelled out in a solicitation), with additional consideration of demographics and portfolio goals, strengths, and weaknesses. The Division requests feedback from the COV if Program Directors should move to a more active management of the portfolio *within each Program*, considering factors such as the number of active awards that a principal investigator (PI) holds, PI demographics, submission processes, and the like.

Please see the Sharepoint site for additional information.

Comments:

Major Chemical Research Instrumentation and Facilities (INSTR)

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(s) under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged.

I. Questions about the quality and effectiveness of the program's use of merit review process. Please answer the following questions about the effectiveness of the merit review process and provide comments or concerns in the space below the question.

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
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| <p>1. Are the review methods (for example, panel, ad hoc, site visits) appropriate?</p> <p>Comments: The use of panels and site visits furnished informed reviews for instrumentation and facility proposals, respectively. Instrumentation subgroups that have smaller proposal numbers currently have virtual panels, while other subgroups have 1 or 2 day panels depending on the number of proposals.</p> <p>The COV recommends that virtual panels be utilized for all but the instrumentation subgroups with the largest number of proposals</p> | YES |
| <p>2. Are both merit review criteria addressed</p> <p>y) In individual reviews?</p> <p>z) In panel summaries?</p> <p>aa) In Program Officer review analyses?</p> | <p>YES</p> <p>YES</p> <p>YES</p> |

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| <p>Comments: Individual reviews varied considerably from very general to very detailed. Broader impacts were not always given as much weight by PIs of instrument proposal as by PIs in other proposal areas. NSF Instrumentation reviews are more formal and address the merit criteria very well. Panel summaries gave an explanation of the reasons for awarding or declining the proposal. The process is very transparent.</p> | |
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| <p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>Comments: For the most part, the individual reviewers selected are quite effective and detailed; and impressively, only a few reviews in the sample lacks substance.</p> | <p>YES</p> |
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| <p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>Comments: The quality of the rationale in the panel summary varied depending on the panel and scribe, but generally provided the rationale for making final decisions. Because of the PO's efforts to fund proposals across a wide range of instrumentation subgroups (commendable efforts), panel summaries sometimes provided an incomplete picture of the proposal's status.</p> | <p>YES</p> |
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| <p>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</p> <p>[Note: Documentation in the jacket usually includes a context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.]</p> <p>Comments: The process is very transparent. The reviewers provided, in most cases, good descriptions of strengths and weaknesses in merits and broader impacts. In general, the panel recommendations were followed; and in some cases funding decisions were made appropriately at the discretion of the program officers.</p> | <p>YES</p> |
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| <p>6. Does the documentation to the PI provide the rationale for the award/decline decision?</p> <p>[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 in the</p> | <p>YES</p> |
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| <p>PO Comments field or emailed with a copy in the jacket, or telephoned with a diary note in the jacket) of the basis for a declination.]</p> <p>Comments: With respect the merit and broad impact criteria, it does. The review process is very transparent; but the decision process may be less transparent to the PI (probably because of what program officers are and are not allowed to say), even though the context statement lists other factors that enter into the final decision process.</p> | |
| <p>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</p> <p>The quality and effectiveness of the program's use of the merit review process are high.</p> | |

II. Questions concerning the selection of reviewers. Please answer the following questions about the selection of reviewers and provide comments or concerns in the space below the question.

| SELECTION OF REVIEWERS | YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
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| <p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>Comments: Panels are more effective than ad hoc reviewing for providing the necessary expertise necessary for reviewing a group of proposals. Panelist's reviews were thorough and careful. Reviewers made appropriate analysis of whether the described science was appropriate for the instrumentation request.</p> | <p>YES</p> |
| <p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>Comments: Is not clear from the information provided in the jackets how this issue was addressed. Usually the conflict of interest is very well addressed during the individual panels.</p> | <p>YES</p> |

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| <p>Additional comments on reviewer selection:</p> <p>If possible, reviewers/panelists from industrial and government labs should be involved in the review process.</p> | |

III. Questions concerning the management of the program under review. Please comment on the following:

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| <p>MANAGEMENT OF THE PROGRAM UNDER REVIEW</p> |
| <p>1. Management of the program.</p> <p>Comments: From the outside point of view, the program is very well managed based on the availability of funds (both amount and timing) and increased proposal pressure. Dr. Murillo and the other program officers for CRIF have carefully managed this program and are to be commended for his efforts.</p> |
| <p>2. Responsiveness of the program to emerging research and education opportunities.</p> <p>Comments: The program officers do make an effort to fund some number of high risk-high payoff proposals in emerging research areas. In addition, the officers recognize the important role of instrumentation in educational settings.</p> |
| <p>3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.</p> <p>Comments: The proposals are grouped according to type of instrument to support multi-user instruments and facilities. Panel member are selected based on their expertise. The panel then selects a group of high quality proposals for final review by the program officer. The final decision is made by the program officer with the goal of providing infrastructure for research and education. Distribution among instrumentation categories so that each category is funded at approximately the same percentage is the strategy that is being followed. The COV does not recommend deviating from this policy.</p> |
| <p>4. Responsiveness of program to previous COV comments and recommendations.</p> <p>Comments: The previous 2010 COV noted that providing the program officer comments was an improvement over previous years; however, this occurs only for declinations.</p> <p>If broader impacts continue to be an area of significant emphasis, then NSF needs to require better accountability.</p> |

IV. Questions about Portfolio. Please answer the following about the portfolio of awards made by the program under review.

| <p align="center">RESULTING PORTFOLIO OF AWARDS</p> | <p align="center">APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</p> |
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| <p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>Comments: Awards in all sub-disciplines of chemistry are represented. Awards are well balanced across instrumentation subcategories.</p> | <p align="center">YES</p> |
| <p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>Comments: The awards are for three years to provide enough time to purchase the instrument, installation and learning and provide results (e.g, publications).</p> | <p align="center">YES</p> |
| <p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>Comments: Many of the awards will enhance and provide new research opportunities. In addition, the program will fund new research areas such as new instrumentation. The science described in the proposals justified the instrumentation for funded proposals.</p> | <p align="center">YES</p> |
| <p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>Comments: Proposals come from many areas of chemistry and across other disciplines</p> | <p align="center">YES</p> |
| <p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>Comments: The map distribution of the awards showed an appropriate distribution of instruments throughout U.S. Universities in rural areas is underrepresented (as</p> | <p align="center">YES</p> |

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| expected statistically). | |
| <p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>Comments : The program has a good distribution of awards shared between Ph.D.-granting institutions and B.S.-granting institutions and represents the distribution in the pool of submissions. However, PUIs are generally supported by MRI rather than CRIF at this time. The COV sees no problem with this.</p> | YES |
| <p>7. Does the program portfolio have an appropriate balance of awards to new investigators?</p> <p>NOTE: A new investigator is an investigator who has not been a PI on a previously funded NSF grant.</p> <p>Comments: The PI has to be the department head for CRIF proposals. This is reasonable because of the expectation that young faculty should focus on their own research primarily instead of writing proposals as service to the department.</p> | |
| <p>8. Does the program portfolio include projects that integrate research and education?</p> <p>Comments: Research and education are not well integrated in many proposals, despite the efforts of the program officer and solicitation to encourage this objective. Better accountability for the integration of education into the research plan for the instruments (as noted for broader impacts) is necessary.</p> | YES |
| <p>9. Does the program portfolio have appropriate participation of underrepresented groups⁹?</p> <p>Comments: Many of the proposals in the sample group discussed the inclusion of underrepresented groups as part of the broad impact of the instrument at the institution. The panelists and program officers appear to consider this issue appropriately.</p> | YES |
| <p>10. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports.</p> <p>Comments: To the extent that national priorities include science and education this</p> | |

⁹ NSF does not have the legal authority to require principal investigators or reviewers to provide demographic data. Since provision of such data is voluntary, the demographic data available are incomplete. This may make it difficult to answer this question for small programs. However, experience suggests that even with the limited data available, COVs are able to provide a meaningful response to this question for most programs.

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| program is relevant. Research and teaching infrastructure is important to the field of chemistry and its constituents. Thrust areas are defined by congress in some cases such as supported facilities. | |
| 11. Additional comments on the quality of the projects or the balance of the portfolio: | |

OTHER TOPICS

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

In providing 90% awards/declination decision within 180 days far exceeds NSF expectations.

3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.
4. Please provide comments on any other issues the COV feels are relevant.

It may be beneficial for the chemistry division at NSF to eliminate the CRIF program and encourage those proposals to be submitted to the MRI as other divisions at NSF have done. The COV believes there is a duplication of the programs and all CRIF proposals will qualify for MRI submission. The COV feels that within NSF there should always be a mechanism by which chemists can apply for funding for instrumentation.

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

We needed better information regarding which PIs were minority PIs. Also, stages of careers for PIs and reviewers are buried rather than immediately accessible.

A template that doesn't have yes/no questions would be less leading and would increase the likelihood of obtaining a broader spectrum of responses.

- V. Beyond the Portfolio. Please answer the following questions.

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| 3. <u>How to Evaluate Realignment:</u> The Division realigned its scientific programs in 2009. With three years of data on the new programs, the Division wishes to assess the impact of the realignment on the field of chemistry and the research community. The Division requests feedback from the COV on how to best structure such an assessment. |
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Please see the Sharepoint site for additional information.

Comments:

4. Portfolio Management: Award recommendations in the Division are based on intellectual merit and broader impacts (unless there are additional specific criteria spelled out in a solicitation), with additional consideration of demographics and portfolio goals, strengths, and weaknesses. The Division requests feedback from the COV if Program Directors should move to a more active management of the portfolio *within each Program*, considering factors such as the number of active awards that a principal investigator (PI) holds, PI demographics, submission processes, and the like.

Macromolecular, Supramolecular and Nanochemistry (MSN)

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(s) under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged.

I. Questions about the quality and effectiveness of the program's use of merit review process. Please answer the following questions about the effectiveness of the merit review process and provide comments or concerns in the space below the question.

| <p style="text-align: center;">QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</p> | <p style="text-align: center;">YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</p> |
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| <p>1. Are the review methods (for example, panel, ad hoc, site visits) appropriate?</p> <p>Comments: Over the past three years MSN has moved from mostly using ad hoc mail-in reviews to panel reviews. The number of reviewers per proposal and the number of panel members is appropriate for the number of proposals assigned to each panel.</p> <p>The proposal jackets we reviewed showed an effective balance of mail and panel reviews. In all cases there were a sufficient number of reviews to arrive at a consensus, although there were few cases where the number of reviews exceeded four. Our impression as a whole of the thirteen proposal jackets we evaluated was that the process was strongly merit-based. We note that the system of panel reviews is now changing to smaller panels that will not be physically present at NSF. This will be an interesting experiment. The smaller panels will reduce travel time and cost, and may give the program officers more discretion in guiding the selection of funded projects.</p> <p>In a highly competitive environment, it is possible for negative comments - some of which might be easily addressed by the PI - to sink a proposal. This is particularly</p> | <p style="text-align: center;">YES</p> |

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| <p>antithetical to the idea of supporting transformative, high-risk research. The PO should take an active role in filtering out "nit-picking" negative comments. The Division should consider possible mechanisms whereby PIs of otherwise meritorious proposals could respond to questions or singular negative comments before a decision is reached.</p> | |
| <p>2. Are both merit review criteria addressed</p> <p>bb) In individual reviews? Yes In all reviews examined comments were made on both the intellectual merits and broader impacts of the proposals. The reviewer comments were generally of high quality.</p> <p>cc) In panel summaries? Yes In all panel summaries comments were made on both intellectual merits and broader impacts of the proposals. Panel summaries were considered to be well written and representative of individual reviews.</p> <p>dd) In Program Officer review analyses? Yes The review analyses accurately captured comments on both intellectual merits and broader impacts. It is clear that broader impacts were considered along with intellectual merits in award decisions.</p> <p>Comments: We note that reviewers faithfully comment on broader impacts because a box devoted to that subject is part of the review form. We recommend that authors of proposals similarly be given some guidelines as to the number of pages they should devote to education, outreach, and other aspects of broader impact.</p> <p>Some proposals devoted little space to broader impact, whereas others took this criterion more seriously. In one case, the outreach and education section dominated the proposal, to its detriment in the review process.</p> | <p>YES</p> |

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| <p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>Comments: The comments given by the individual reviewers were considered very thoughtful, constructive, and substantive.</p> | <p>YES</p> |
| <p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> | <p>YES</p> |

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| <p>Comments: In all panel summaries examined the rationale for panel consensus was clear. In cases where very different opinions were provided by individual reviewers it was frequently apparent that a panel discussion had brought together those with different initial opinions, whereas in others where differences of opinion remained, these differences were aptly captured in the panel summary.</p> | |
| <p>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</p> <p>[Note: Documentation in the jacket usually includes a context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.]</p> <p>Comments: The POs' review analyses generally were very detailed, clearly reflecting that the PO had spent time reading and understanding the proposals, and resulting in a balanced presentation of the findings of the reviewers and panel. The review analysis also provided useful information on the PI's other support and its relationship to the proposal under review.</p> <p>In one case a proposal ranked in Tier 3 by the panel was selected for funding. This suggests that the POs are using their discretion in making funding decisions on proposals near the pay-line. We did not easily locate in the jacket information on the background or process by which the final decision was made.</p> | <p>YES</p> |

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| <p>6. Does the documentation to the PI provide the rationale for the award/decline decision?</p> <p>[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 in the PO Comments field or emailed with a copy in the jacket, or telephoned with a diary note in the jacket) of the basis for a declination.]</p> <p>Comments: Documentation to the PI included the essential elements of the PO's review analysis as well as verbatim copies of reviews and the panel summary.</p> | <p>YES</p> |
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| <p>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</p> <p>Overall a good job was done of finding reviewers to provide knowledgeable reports. The use of panels is considered to be very effective in giving a more objective, balanced, unbiased, and constructive review and feedback for the investigators as compared to having only ad hoc reviews.</p> <p>Overall the format of intellectual merit and broader impact was effective in soliciting and organizing reviewer feedback.</p> <p>We noted that some proposals are particularly well written whereas others are poorly written and organized. Young PIs in particular seem to need some coaching. We suggest that the Division could support workshops or webinars that might be organized by some of the authors of outstanding proposals on the subject of proposal preparation. Perhaps the reviewing load on these workshop organizers could be reduced to compensate them for their service to the community.</p> | |

II. Questions concerning the selection of reviewers. Please answer the following questions about the selection of reviewers and provide comments or concerns in the space below the question.

| SELECTION OF REVIEWERS | YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
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| <p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>Comments: See comment above. Reviewers with appropriate expertise were selected.</p> | YES |
| <p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>Comments: Yes, to the best of our knowledge and confidence in the NSF's handling of these matters. The MSN program follows the NSF guidelines for identifying reviewers with potential conflicts of interests. These guidelines and implementation within the</p> | YES |

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| MSN program are perfectly appropriate. | |
| <p>Additional comments on reviewer selection:</p> <p>A database of reviewers will help minimize reviewer overload (especially of reviewers who review for more than one division at NSF), but will also provide calibration of reviewers who may be particularly critical or uncritical. NSF should make an effort to engage reviewers from industry and national laboratories. This would have a number of benefits. It would relieve some of the pressure on academic reviewers, would provide input from the broader scientific community, and would help engage the broader community in basic science.</p> | |

III. Questions concerning the management of the program under review. Please comment on the following:

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| <p>MANAGEMENT OF THE PROGRAM UNDER REVIEW</p> |
| <p>1. Management of the program.</p> <p>Comments: The MSN maintains a portfolio that contains roughly 25% awards on macromolecules, 25% awards on supramolecular assemblies, and 50% in the area of nano-structures. Funding within these areas covers experimental measurements (physical and analytical), synthesis, and computational work. These areas of focus and the chemical disciplines involved are an excellent match with the stated goals of the program and cover very important areas within the chemical community. MSN interactions with other NSF programs, including the co-funding of proposals at interfaces between fields, are considered an added strength in the management of this program.</p> <p>The selection of projects is strongly merit-based. Program directors provide some advice when contacted by scientists who are interested in applying to the program. In addition, they conduct workshops and post on their website areas of special interest. The program officers use their discretion to guide the selection of funded projects, especially those in the Tier 2-3 category, and maintain a balance in the program.</p> |
| <p>2. Responsiveness of the program to emerging research and education opportunities.</p> <p>Comments: The program officers discuss areas of need in their scientific portfolio and try to respond to these in their selection of projects to support.</p> <p>The MSN program portfolio includes a substantial amount of fundamental science, which is at the cutting edge of multiple areas that can be considered “emerging” areas of science. The broader impacts activities of many proposals included involvement of researchers in education at different levels.</p> |

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

Comments: The current portfolio to a large extent represents the reorganization of the Chemistry Division that happened in 2010. Current projects reflect to a large extent the three categories of supramolecular, macromolecular, and nanoscale chemistry. The portfolio composition of MSN is largely driven by the interests of researchers that submit proposals to the program. The program officers make an effort to support highly meritorious proposals whether or not they fit precisely into these categories. One mechanism they use to achieve this is joint review and co-funding with other programs and divisions at NSF.

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

Comments: The 2010 COV recommended that the success rate of applications be monitored across different career stages. The 2013 COV saw that MSN is monitoring the success rates of senior investigators and new investigators for IIA awards. MSN is also monitoring the funding of junior investigators as Co-PIs of successful awards. The 2010 COV recommended the increased use of panel reviews to address the problem of low response on ad hoc review requests. MSN is now heavily utilizing cyber-based panel reviews with excellent results. The 2010 COV commended the Chemistry Division for the realignment of program areas, but said that it was too early to tell if the new system is working. Based upon the topics included within the grant applications and awards of the MSN portfolio, it appears that the realignment of program areas has improved the cohesiveness and appropriateness of review panels, and therefore has improved the overall process for review of proposals that are now within MSN.

IV. Questions about Portfolio. Please answer the following about the portfolio of awards made by the program under review.

| RESULTING PORTFOLIO OF AWARDS | APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE |
|--|--|
| <p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>Comments: The MSN program has very broad scope, as evidenced by the wide range of ~200 projects being supported. Roughly, half of these are in the nanochemistry area (broadly defined) and the others are equally divided between supramolecular and macromolecular chemistry. Funding within these areas covers experimental measurements (physical and analytical), synthesis, and computational work. These areas of focus and the chemical disciplines involved are an excellent match with the stated goals of the program and cover very important areas within the chemical community.</p> | YES |

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| <p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>Comments: The duration of projects, mostly 3-year awards, is considered appropriate. Based upon available data, the size average of IIA awards has not increased with the rate of inflation over the past few years. Thus, the size of NSF awards should increase. However, it is understood that, without an increase in the overall NSF budget, NSF programs must balance between increasing award size and the number of awards given each year.</p> | <p>YES</p> |
| <p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>Comments: The program portfolio includes a range of projects in relatively young and vibrant fields, which will lead to fundamental understanding that can ultimately underpin new technologies. The word "transformative" was included in reviewer comments and summaries of several of the successful proposals that we examined. However, the reviewers assume a conservative stance in their assessment of science that bears some risk, in both the successful and the unsuccessful proposals.</p> <p>We encourage the MSN program, and possibly the whole Division, to more proactively advise the community regarding the topical balance of proposals submitted. Trendy topics lead to duplication of effort, and it is particularly hard for young people to break in to crowded fields. We suggest prominent posting on the NSF website to discourage proposals on "bandwagon" topics that are already adequately supported. NSF should encourage more transformative projects, in which PIs use their background and expertise to break new ground scientifically.</p> | <p>YES</p> |
| <p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>Comments: Absolutely. Individual and collaborative grants within the program often include elements drawn from more than one of the traditional chemical disciplines, such as synthetic along with physical or computational chemistry. The projects co-funded with other programs are inherently inter-disciplinary.</p> | <p>YES</p> |
| <p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>Comments: The geographical distribution funded projects reflects population centers and presence of top research universities.</p> | <p>YES</p> |
| <p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>Comments: The program mostly funds projects at top research universities, but there is a balance that includes PUIs, MS-granting, Ph.D.-granting and R1</p> | <p>YES</p> |

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| universities. | |
| <p>7. Does the program portfolio have an appropriate balance of awards to new investigators?</p> <p>NOTE: A new investigator is an investigator who has not been a PI on a previously funded NSF grant.</p> <p>Comments: Over the past three years the average success rate for new investigators proposals in MSN is approximately one half the success rate of all proposals. Thus, while MSN is adding new investigators to its portfolio, it remains important that new investigators receive as much constructive feedback as possible on declined proposals.</p> | YES |
| <p>8. Does the program portfolio include projects that integrate research and education?</p> <p>Comments: Many projects contain educational initiatives as part of the broader impact.</p> | YES |
| <p>9. Does the program portfolio have appropriate participation of underrepresented groups¹⁰?</p> <p>Comments: The average award success rate for female investigators over the past three years is slightly higher than the overall proposal success rate. The average award success rate for minority investigators is slightly higher than the new investigator success rate, but still below the overall proposal success rate.</p> | YES |
| <p>10. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports.</p> <p>Comments: The MSN program is integral to the NSF mission “To support innovative research in chemical sciences, integrated with education, through strategic investment in a globally engaged workforce reflecting the diversity of America.” Examples of the MSN support of this mission include the funding of fundamental chemical research that has the potential for the development of new materials and processes of economic importance, as well as the education of young scientists by their direct participation in research projects and through outreach activities that are also supported by MSN grants.</p> <p>Polymer chemistry and nanoscale chemistry are relevant to emerging technologies in several fields (biomedicine, renewable energy, energy efficiency, sustainability, electronics, novel manufacturing methods...) that have recognizable societal</p> | YES |

¹⁰ NSF does not have the legal authority to require principal investigators or reviewers to provide demographic data. Since provision of such data is voluntary, the demographic data available are incomplete. This may make it difficult to answer this question for small programs. However, experience suggests that even with the limited data available, COVs are able to provide a meaningful response to this question for most programs.

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| relevance and are national priorities. These are also frontier science areas that are relevant to the basic science mission of NSF. | |
| http://www.iupac.org/news/news-detail/article/international-call-for-proposal-in-sustainable-chemistry.html | |
| 11. Additional comments on the quality of the projects or the balance of the portfolio: | |

OTHER TOPICS

1. Please comment on any program areas in need of improvement or gaps (if any) within program areas.
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.
3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.

A critical issue is the low funding rate for new investigators. One way this can be mitigated is to support more students on NSF pre-doctoral fellowships and reduce the size of grants across the board to PI's to make up the difference. This would help level the playing field between young and established investigators.

Now that panel reviews are being more widely used at NSF, senior members of the scientific community, including retired scientists, might be easier to engage as reviewers. Such reviewers could bring great value to a panel by drawing connections of proposed research projects to older and less widely read references.

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

Regarding open access to the results of research funded by the NSF, we would like the NSF to consider assuming a stance of requiring that published results from NSF-funded studies be freely available to the public. Precedence has already been established by the NIH:

The NIH Public Access Policy implements Division G, Title II, Section 218 of PL 110-161 (Consolidated Appropriations Act, 2008). The law states:

The Director of the National Institutes of Health shall require that all investigators funded by the NIH submit or have submitted for them to the National Library of Medicine's PubMed Central an

electronic version of their final, peer-reviewed manuscripts upon acceptance for publication, to be made publicly available no later than 12 months after the official date of publication: Provided, That the NIH shall implement the public access policy in a manner consistent with copyright law.

V. Beyond the Portfolio. Please answer the following questions.

3. How to Evaluate Realignment: The Division realigned its scientific programs in 2009. With three years of data on the new programs, the Division wishes to assess the impact of the realignment on the field of chemistry and the research community. The Division requests feedback from the COV on how to best structure such an assessment.

Please see the Sharepoint site for additional information.

Comments:

4. Portfolio Management: Award recommendations in the Division are based on intellectual merit and broader impacts (unless there are additional specific criteria spelled out in a solicitation), with additional consideration of demographics and portfolio goals, strengths, and weaknesses. The Division requests feedback from the COV if Program Directors should move to a more active management of the portfolio *within each Program*, considering factors such as the number of active awards that a principal investigator (PI) holds, PI demographics, submission processes, and the like.

Please see the Sharepoint site for additional information.

Comments:

Chemical Synthesis (SYN)

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(s) under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged.

I. Questions about the quality and effectiveness of the program's use of merit review process. Please answer the following questions about the effectiveness of the merit review process and provide comments or concerns in the space below the question.

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
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| <p>1. Are the review methods (for example, panel, ad hoc, site visits) appropriate?</p> <p>Comments: Primarily review panels are used and we think this is the best way to carry out the reviews unless there are exceptional circumstances. It would be worthwhile to consider whether a consistent review procedure should be used throughout the chemistry division.</p> <p>There is some concern about the division of the proposals among a larger number of smaller panels (as required for virtual panels) and whether there should be greater use of ad hoc reviewers for the panels to consider. Additionally, the distinction of Tier 2 proposals is not clear in the final evaluation. This could be resolve in different ways including have a more distinctions in the Tier 2 proposals or whether it would be possible to have a second review panel for upper level Tier 2 proposals. It would be reasonable to consider triage of the lowest tier proposals.</p> | YES |

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| <p>2. Are both merit review criteria addressed</p> <p>ee) In individual reviews?</p> <p>ff) In panel summaries?</p> <p>gg) In Program Officer review analyses?</p> <p>Comments: Individual reviews vary considerably from very general to very detailed reviews. Occasionally, the broader impact review was missing. The definition and criteria for merit in the broad impact topic is vague.</p> <p>It is clear that some individual reviewers either do not consider the broader impacts as a significant review criterion or they do not understand the role of the broader impacts in the evaluation. The panel summaries reflect much more emphasis on the intellectual merit and some PO review analyses, while giving credit to proposals with broader impacts, give proposals with strong intellectual merit a “pass” on the broader impact criteria, as long as it is mentioned.</p> | <p>NOT ALWAYS</p> <p>YES</p> <p>YES</p> |
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| <p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>Comments: Overall the reviews are informative and evaluative, particularly with regard to intellectual merit. We saw one or two that were just descriptive but these the exceptions.</p> | <p>YES</p> |
| <p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>Comments: The panel summaries were often rather terse and maybe not as thorough as they could be. The summaries for very highly ranked and very low ranked proposals were clear and well rationalized. However, there was no distinction given for proposals that were ranked in tier 2, especially across different panels. It would be helpful if distinction between the top, middle of bottom of tier two was made.</p> | <p>YES</p> |

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| <p>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</p> <p>[Note: Documentation in the jacket usually includes a context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.]</p> <p>Comments: The process appears to be transparent. The review analysis gave a clear explanation on how the final decision was reached. For high and low ranked proposals, the decisions are clear. For mid-ranked (Tier 2) proposals, the PO rationale needs to more clearly justify why one Tier 2 proposal was selected for funding over another proposal.</p> | <p>YES</p> |
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| <p>6. Does the documentation to the PI provide the rationale for the award/decline decision?</p> <p>[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 in the PO Comments field or emailed with a copy in the jacket, or telephoned with a diary note in the jacket) of the basis for a declination.]</p> <p>Comments: The PI does not get all the information that was in the program officer review analysis, even though some of that information would help in a resubmission application. In particular the PI does not get an indication if the proposal was close to funding or not, especially if the proposal was ranked in tier 2.</p> | <p>YES</p> |
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| <p>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</p> <p>Proposals appear to be reviewed by a small group of experts with little comparison across panels. If panels are grouped by expertise, how is consistency across panels maintained? Theoretically, the program officer has the overall picture after sitting on all the panels, but there are 4-6 different Program Officers sitting on these panels.</p> <p>Although there is a new program alignment for proposal submissions, the review panels are still very narrow in focus and align more with the older program alignment in CHE. This limits the likelihood of cross fertilization of ideas and the development of broadly impactful chemical research areas.</p> | |
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| <p>Recommend that panel reviews consider at least five discrete evaluation levels</p> <p>Tier 1 – Tier 5 [or Tier 1, Tier 2 (upper), Tier 2 (middle), Tier 2 (lower), Tier 3] and it should be communicated to the review panel that five evaluation levels are being used and to the PI where in the five levels the proposal was ranked.</p> <p>Now that panels are commonly used, there is no reason why the panel should not be made public. Several reasons exist for why it should be made public (appropriate expertise, conflicts, and transparency)</p> | |
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II. Questions concerning the selection of reviewers. Please answer the following questions about the selection of reviewers and provide comments or concerns in the space below the question.

| SELECTION OF REVIEWERS | YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|--|--|
| <p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>Comments: Panels appear to have the appropriate expertise in a narrow area.</p> | YES |
| <p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>Comments: The general policies are reasonable. We did not see any specific problems in the jackets that we examined but we are not in a position to comment about the whole process.</p> | YES |
| <p>Additional comments on reviewer selection:</p> <p>It seems that each panel is completely different from one round to the next. It would be worthwhile considering having some consistency in panel members in subsequent cycles to set the tone of the review process and perhaps promote some consistency.</p> | |

III. Questions concerning the management of the program under review. Please comment on the following:

MANAGEMENT OF THE PROGRAM UNDER REVIEW

1. Management of the program.

Comments: The program officers that we interacted with are very well qualified. They seem to be well versed in NSF policies and committed to fairness and objectivity. The program officer has to make difficult decisions regarding funding in the current budget situation. The balance between new awards and renewals, level of funding and grant size will continue to be a challenge given the significant proposal pressure for this popular program.

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

Comments: The program is driven by the applications that come in. A “Dear Colleague Letter” was sent indicating the importance of sustainable chemistry but in general they do not drive specific scientific initiatives. We have no sense of the responsiveness to emerging areas, although there are two EAGER proposals in the current portfolio.

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

Comments: We are not aware of major or systematic prioritization. If all things were equal there seems to be preference to synthetic methodology over total synthesis.

The distinctions between the Catalysis and Synthesis are listed in the Program descriptions on the website, but there seems to be significant overlap and contradictory statements.

From CAT: “This includes the design and synthesis of catalytic species on the molecular, supramolecular, and nanometer scales as well as studies of the dynamics of homogeneous and heterogeneous catalytic processes.”

From SYN: “Proposals containing a synthesis component but have a major focus on the mechanistic study of catalytic reactions should be submitted to the Chemical Catalysis program.”

There is understandable confusion within the community and a significant number of the SYN proposals reviewed by COV had a significant component of catalysis. Many researchers also submit proposals to both programs.

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

Comments: The program seems to have greatly improved the quality of the individual reviews with regards to intellectual merit and this should be commended. However, it appears that “systemic and long-term investigation of the useful and activities in the Broader Impacts” has not taken place. There is continued

confusion regarding the types of activities and importance of broader impacts in the review process and funding decisions.

Funding size has not gone up but this was to avoid a severe drop in funding percentile (this decision was beyond the program's prerogative). Also a decision has been made to fund a higher percentage of the grants in full during the first year)

Doing more cyber review

Ad hoc reviews are being read at the panel meetings. Panel members have been advised more than in the past on how to review broader impacts of a proposal

IV. Questions about Portfolio. Please answer the following about the portfolio of awards made by the program under review.

| <p align="center">RESULTING PORTFOLIO OF AWARDS</p> | <p align="center">APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</p> |
|---|--|
| <p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>Comments: Success rate in the synthesis program compared with other programs is reasonable. We do not have a break-down of the specific awards within the synthesis program</p> | <p align="center">YES</p> |
| <p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>Comments: The duration is OK but the size is too small. It is very difficult to achieve transformative research with this level of funding.</p> | <p align="center">NO</p> |
| <p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>Comments: The top tier proposals are highly innovative and transformative. Some of the funded second tier proposals that we saw are of mixed merit. The criterion was not directly addressed in most reviewed.</p> | <p align="center">YES</p> |

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| <p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>Comments: These were very limited, apparently because of the existence of a new multidisciplinary research program. A small percentage (~10% of total awards or 4% of funding dollars) were co-funded. PO should continue to pursue joint funding opportunities.</p> | <p>YES</p> |
| <p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>Comments: Most states are well represented and grants are distributed by population.</p> | <p>YES</p> |
| <p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>Comments: It seems reasonable but RUI/PUI funding continues to be a challenge.</p> | <p>YES</p> |
| <p>7. Does the program portfolio have an appropriate balance of awards to new investigators?</p> <p>NOTE: A new investigator is an investigator who has not been a PI on a previously funded NSF grant.</p> <p>Comments: It would be nice to have a higher new PI funding rate but we are not convinced that a lower funded rate for established PIs is justified. Maintaining the large pool of renewals while bringing new investigators into the pool will remain a challenge.</p> | <p>MAYBE</p> |
| <p>8. Does the program portfolio include projects that integrate research and education?</p> <p>Comments: Virtually every funded project discusses integration of research and education</p> <p>The CAREER proposals must integrate research and education and the education component is reviewed in detail. The majority of the individual investigator awards do not directly address this criterion, although all the proposals involve training of students in the research lab.</p> | <p>YES</p> |

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| <p>9. Does the program portfolio have appropriate participation of underrepresented groups¹¹?</p> <p>Comments: The program officer is clearly giving preference in borderline cases to underrepresented groups (women and minorities). The success rate is appropriate but the participation rate is lower than would be desirable.</p> | <p>YES</p> |
| <p>10. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports.</p> <p>Comments: The program area is a foundational area of research to increase American competitiveness in the global economy.</p> | |
| <p>11. Additional comments on the quality of the projects or the balance of the portfolio:</p> <p>The overall quality of the projects would go up if larger budgets were funded</p> | |

OTHER TOPICS

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

There is a bit of a discontinuity in the synthesis portfolio because it is interrupted by the catalysis portfolio. There is a continuum from inorganic synthesis, catalyst design (from an inorganic perspective), catalyst design (from an organic perspective), to organic synthetic methodology development. There is a big gap between inorganic synthesis and organic synthetic methodology development, once the catalysis component is removed. Consequently the Synthesis program is required to have two distinct types of review panels, covering the two remaining topics in synthesis. Consequently, there is little cross-fertilization of ideas within the Synthesis program. NSF Chemistry should consider if this is a desirable situation.

The portfolio would also benefit from increased global engagement.

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.

¹¹ NSF does not have the legal authority to require principal investigators or reviewers to provide demographic data. Since provision of such data is voluntary, the demographic data available are incomplete. This may make it difficult to answer this question for small programs. However, experience suggests that even with the limited data available, COVs are able to provide a meaningful response to this question for most programs.

The program appears well positioned to lead the SusChEM initiative in the coming years. The program has done an excellent of encouraging submissions in this area as evidenced by the program description on the website.

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

The PhD school classification is not straightforward. It would be helpful if there was a distinction between PhD schools and PhD departments. This distinction would make it easier to evaluate the breadth of the portfolio and it would enable a balanced comparison of proposals with similar resource bases.

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

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

V. Beyond the Portfolio. Please answer the following questions.

3. How to Evaluate Realignment: The Division realigned its scientific programs in 2009. With three years of data on the new programs, the Division wishes to assess the impact of the realignment on the field of chemistry and the research community. The Division requests feedback from the COV on how to best structure such an assessment.

Please see the Sharepoint site for additional information.

Comments:

4. Portfolio Management: Award recommendations in the Division are based on intellectual merit and broader impacts (unless there are additional specific criteria spelled out in a solicitation), with additional consideration of demographics and portfolio goals, strengths, and weaknesses. The Division requests feedback from the COV if Program Directors should move to a more active management of the portfolio *within each Program*, considering factors such as the number of active awards that a principal investigator (PI) holds, PI demographics, submission processes, and the like.

Please see the Sharepoint site for additional information.

Comments:

