

# Report of the 2024 Committee of Visitors for the Division of Chemistry at the National Science Foundation

Meeting Dates  
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Submitted on behalf of the Committee by  
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*The Committee of Visitors is part of a Federal Advisory Committee. The function of Federal Advisory Committees is advisory only. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the Advisory Committee, and do not necessarily reflect the views of the National Science Foundation.*

## Table of Contents

|      |   |     |
|------|---|-----|
| I.   | Executive Summary .....   | 3   |
|      | Recommendation 1 .....  | 3   |
|      | Recommendation 2 .....  | 4   |
|      | Recommendation 3 .....  | 4   |
|      | Recommendation 4 .....  | 4   |
|      | Recommendation 5 .....  | 5   |
|      | Recommendation 6 .....  | 5   |
| II.  | Committee of Visitor Process .....  | 5   |
| III. | Detailed Responses to the Charge .....  | 8   |
|      | Charge Item 1 .....   | 8   |
|      | Charge Item 2 .....   | 10  |
|      | Charge Item 3 .....   | 12  |
|      | Charge Item 4 .....   | 12  |
| IV.  | Program Reviews .....   | 16  |
|      | Summary Information Table .....   | 16  |
|      | Chemical Catalysis (CAT) .....  | 18  |
|      | Centers for Chemical Innovation/Institutes (CCI/Institutes) .....                                   | 31  |
|      | Chemistry of Life Processes (CLP) .....   | 46  |
|      | Chemical Mechanism, Function and Properties (CMFP) .....  | 60  |
|      | Chemical Measurement and Imaging (CMI) .....  | 70  |
|      | Chemical Structure and Dynamics (CSD) .....   | 85  |
|      | Chemical Theory, Models and Computational Methods (CTMC) .....                                      | 98  |
|      | Environmental Chemical Sciences (ECS) .....   | 112 |
|      | Major Research Information/Facilities (MRI/Facilities) .....  | 123 |
|      | Macromolecular, Supramolecular and Nanochemistry (MSN) .....  | 138 |
|      | Research Experiences for Undergraduates/Special Projects/Broadening Participation (REU/SP/BP) ..... | 152 |
|      | Chemical Synthesis (SYN) .....  | 168 |
| V.   | Appendices .....  | 182 |
|      | Appendix A: 2024 Division of Chemistry Committee of Visitors Membership .....                       | 182 |
|      | Appendix B: Division of Chemistry – Charge to 2024 Committee of Visitors .....                      | 184 |
|      | Appendix C: Division of Chemistry Committee of Visitors On-Site Meeting Agenda .....                | 186 |
|      | Appendix D: Division of Chemistry Committee of Visitors Subpanel Assignments .....                  | 188 |

## I. Executive Summary

The 2024 Committee of Visitors (COV) for the Chemistry Division (CHE) of the National Science Foundation (NSF) was charged with assessing and reporting on the integrity and efficacy of the Division's 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; and the Division's response to the 2020 COV Report. This review covered the inclusive funding interval from FY 2020 through FY 2023 and covered the extraordinary period of time encompassing the COVID-19 pandemic. The 37 members of the COV completed this assignment during the summer of 2024 through a detailed analysis of representative previous proposal decisions made available by selected access to the NSF Electronic Jacket (eJacket) system and extensive program data provided by NSF CHE staff through briefings and through the COV Tableau Dashboard.

The COV can state with confidence that the state of CHE at NSF is robust and healthy by almost all metrics, leading to its strong support among the communities it funds. Strong and visionary CHE leadership buoyed by an exceptionally knowledgeable, dedicated and hard-working staff allow CHE to effectively and efficiently manage the merit review process of the proposals it receives while nimbly responding to emerging scientific trends and areas of national and/or societal need while maintaining a portfolio of supported research and educational activities at the cutting-edge of the molecular sciences.

The COV notes with immense gratitude the heroic efforts of CHE during the enormously disruptive COVID-19 pandemic. CHE staff continually reached out to its Principal Investigators and offered whatever additional assistance and flexibility they could in the management of grant awards during this difficult time. As a result, the majority of the community was able to sustain some level of productivity during this period, despite the challenges of doing so. The community recognizes and greatly appreciates the efforts that CHE staff made to facilitate their continued work; these efforts engendered enormous goodwill among the community that will not likely be forgotten anytime soon. The COV strongly commends CHE for their outstanding support of the chemistry community during this extraordinary time!

After its comprehensive analysis, the COV identified many strengths of the management of and processes used within CHE to achieve its mission "to support innovative research in chemical sciences, integrated with education, through strategic investment in developing a globally engaged U.S. chemistry workforce reflecting the diversity of America",<sup>1</sup> along with a few areas for consideration and possible improvement. The recommendations of the COV that follow are offered in the spirit of facilitating the necessary continued evolution of a strong program to meet the needs of an evolving U.S. scientific community in the context of potentially impactful but highly competitive emerging opportunities and enhanced expectations of the nation in a rapidly changing global environment.

**Recommendation 1: The Division of Chemistry Budget needs to be increased significantly to meet the needs of the community and the nation.** The COV finds that CHE is an excellent steward of the funds it receives. However, during the time period of the review, costs to support research have skyrocketed due to significant inflation and supply chain issues resulting from the COVID pandemic as well as other factors such as the increasing unionization of graduate student and postdoctoral researchers, which have greatly increased costs for salaries and benefits. Tension between grant size and the number of awards leaves

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<sup>1</sup> As reported in the CHE Division Overview briefing to the COV in June 2024.

CHE with no good options. In the short term, the lost opportunity costs of un- and underfunded research will relegate the U.S. to a subordinate position among the world's leading nations in science and technology areas that drive the economy and improve the lives of all Americans. In the long term, shortsighted un- and underfunding of research will erode the U.S. workforce by supporting fewer young researchers who are the lifeblood necessary to sustain the U.S. scientific enterprise and maintain U.S. leadership in critically important science and technology areas that not only underpin our economy but which contribute to a strong national defense, enhance national security, and position the U.S. to rapidly respond to emerging threats and global crises. CHE should continually explore ways to best quantify these broad lost opportunity costs to be well positioned with strong arguments for additional support when warranted.

**Recommendation 2: Continue efforts to facilitate deeper understanding of the Broader Impacts merit review criterion among Investigators and Reviewers.** The COV finds that, despite extensive efforts within CHE and more broadly NSF agency-wide, investigators and reviewers are still flummoxed by the apparently fluid definition of Broader Impacts and the criteria by which Broader Impacts should be assessed. The COV is particularly concerned with how to review thoroughly and equitably the Broader Impacts of proposals and how the Broader Impacts and the review of Broader Impacts of a given proposal are weighted in award/decline decisions within CHE. Although the COV understands the reluctance of NSF to more narrowly define expectations for Broader Impacts, the COV suggests consideration of a more structured review of Broader Impacts in proposal evaluation for greater equity and transparency in the review process. Finally, the COV wonders whether sufficient attention is paid to Principal Investigator (PI) accountability for Broader Impacts outcomes of previous awards in later funding decisions and worries that the increasing inability to collect demographic data going forward, especially in certain regions of the country, will impede further efforts at longitudinal assessment of such outcomes.

**Recommendation 3: Employ panels in the review process when possible and improve panelist guidance.** The COV finds that the panel review process works well and provides a balanced assessment of the diverse proposals in CHE. Most proposals should go through review panels. In cases where more precise expertise is required, *ad hoc* reviewers are a good approach. The COV encourages the consideration of strategies through which *ad hoc* reviewers could participate, possibly remotely, in panel discussion of the proposal to better incorporate their specific expertise in the evaluation. Both in-person and virtual panels have been used extensively in CHE. The Division should evaluate which version is better for the review process and for the chemistry community. The COV suggests that fuller use of the NSF review template by reviewers, with detailed evaluative commentary for both Intellectual Merit and Broader Impacts criteria expected, might provide a more balanced assessment of proposals. The COV suggests that better training of new and established reviewers may provide improved reviews and a more systematic assessment of Intellectual Merit and Broader Impacts review criteria.

**Recommendation 4: NSF should explore mechanisms to separate funding of MRI instrument development projects from MRI multi-user instrumentation purchases to encourage more submissions for instrument development.** The COV finds that few proposals submitted to the MRI program are for instrument development despite the critical role that new measurement technologies play in advancing the scientific enterprise. The critical role that such instruments play in chemistry is exemplified in new instruments that have been developed over the past several decades that allow molecular processes to be studied on the length scale of individual atoms and the time scale of molecular processes (i.e. covalent and non-covalent bond making and breaking), none of which could have been developed within the budget of a regular single investigator grant award. Despite the acknowledged importance of instrument development as a contribution to scientific advancement and, equally important, training of a critical

workforce, the current mechanism for MRI proposal solicitations at the institutional level leads to lower priorities often being assigned to instrument development proposals in favor of multi-user new instrumentation purchases, especially for the Track 1 level. In a competitive landscape in which only two Track 1 proposals per institution may be submitted, many instrument development proposals may be trapped at the institutional level and never submitted due to the higher internal institutional demand for multi-user instrumentation acquisition and regeneration. CHE should encourage consideration of ways to enhance instrument development proposal submission within the MRI framework.

**Recommendation 5: Develop new approaches to promote greater inclusion for the scientific enterprise.**

CHE can only support grant awards from proposals that are submitted. CHE should explore better mechanisms to solicit competitive proposals from research-active but less-well-funded institutions, including PUIs, MSIs, HBCUs, and institutions in geographically dispersed regions. While funding rates for women and minority PIs were similar to more established male counterparts, the actual number of these awards are small and not representative of the chemistry population. The COV encourages CHE to explore options, including focused mentoring and workshops, to encourage more proposal submissions from underrepresented scientists. The CHE CAREER workshop is an excellent example of a program that appropriately addresses a similar issue as is the HBCU EIR funding mechanism that allows course release for faculty with heavy teaching loads.

**Recommendation 6: Better define how the current no-deadline proposal submission pilot in three programs in CHE will be assessed.**

CHE started testing a no-deadline proposal submission pilot in the CLP, CSD (formerly CSDM-A) and CTMC programs in the final year of this review period. In the first full year of this pilot, significant decreases in proposal submissions were experienced in all three programs. During this review, the COV heard little discussion about CHE plans for assessment of this pilot. The COV urges CHE to begin to develop a detailed strategy and timeline to assess the success/failure of this proposal submission pilot. As a critical component of this assessment, broader community input will be needed that will require clear and expansive communication with chemistry community stakeholders.

## II. Committee of Visitors Process

The COV for CHE met on-site at NSF for two days (August 8<sup>th</sup> and 9<sup>th</sup>, 2024) to review the activities of the CHE for the period 2020 to 2023. The COV was led by co-Chairs Dr. Jeanne E. Pemberton and Dr. Scott D. Rychnovsky. The 37 members of the COV also included Dr. Karen Goldberg, a liaison representing the Directorate of Mathematical and Physical Sciences (MPS) Advisory Committee, and prominent scientists from academia, industry, government laboratories, and other federal agencies selected by CHE. Appendix A lists the members of the COV and their affiliations.

The FY 2024 CHE COV was 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 response to the 2020 COV report;
- any other issues that the COV feels are relevant to the review.

In June and July of 2024, prior to the on-site meeting of the COV, several Zoom teleconferences were conducted by CHE staff to prepare the COV members for the review process. These Zoom sessions were led by the CHE Acting Division Director Dr. Lin He, Acting Deputy Division Director Dr. George Richter-Addo, Dr. Catalina Achim (MPS), and other members of the CHE staff.

The presentations included:

- a discussion of conflicts of interest and confidentiality.
- a tutorial on how to access selected proposals in the NSF Electronic Jacket (eJacket) system.
- introduction to the newly developed COV Tableau Dashboard, which provided the committee interactive access to CHE divisional data, that included, among other information, the number of proposals received, reviews requested and received, and funding rates among several demographic categories.

The COV members were also provided with the 2020 COV Report along with the CHE Division responses to the report comments and recommendations over the four-year period from 2020 to 2023.

After the introductory Zoom sessions, the COV members each attended two additional briefings by CHE Program Leads on data for their programs, according to the assignments for each COV member. These presentations provided relevant information including program scope, proposal statistics, funding rates, and demographic information about awards and declinations pulled from the COV Tableau Dashboard.

Following these introductory meetings, each COV member was given electronic access to a representative number of eJackets (~30) from each of their two assigned programs, chosen by CHE staff (see Section IV, Table 1, *vide infra*). To address the charge of the COV, the committee members were asked to review the materials within their assigned eJackets along with the extensive information made available on the COV Tableau Dashboard. Each COV member was provided a template for the anticipated COV report to help guide them to the relevant information found in the eJackets and COV Tableau Dashboard.

Prior to the COV on-site meeting, each COV member was assigned as a specialist to a subpanel according to their primary expertise in chemistry. Each member was also assigned to a second subpanel, performing a more generalist review. Each COV member was asked to review the proposals in their specialist and generalist CHE Programs prior to attending the on-site meeting. Proposal information was shared with COV members by providing them selected access to the NSF eJacket system. During the time period in which eJacket access was available to the COV, NSF Program Officers (POs) made themselves extensively available for questions about the system and the review process in general through open on-line office hours and email access. In addition to individual preparation, Zoom meetings of most subpanels were held, led by the assigned scribe of the subpanel (one of the panelist members from each subpanel), allowing the individual COV panel members to be better prepared for the on-site meeting at which the results of the review by the subpanels were discussed and merged.

The on-site COV meeting began on August 8<sup>th</sup> at NSF headquarters with a welcome by Directorate for Mathematical and Physical Sciences Deputy Assistant Director, Dr. Tie Luo, who presented the charge to the COV. Immediately following, Acting Division Director Dr. Lin He, as well as Acting Deputy Division Director Dr. George Richter-Addo, and the two co-Chairs of the COV, Dr. Jeanne Pemberton and Dr. Scott Rychnovsky, welcomed the COV members. After this, a short re-briefing on conflicts of interest (COIs), led by Dr. Catalina Achim from MPS, ensued. Due to disruptions to travel from the remnants of a hurricane, six COV members participated from off-site through Zoom conferencing. This Zoom conferencing was

enabled so that the off-site COV members were able to participate in all of the general meeting sessions as well as the individual program and subpanel sessions without interruption.

The programs or initiatives that were reviewed include:

- Chemical Catalysis (CAT);
- Centers for Chemical Innovation (CCI);
- Chemistry of Life Processes (CLP);
- Chemical Mechanism, Function and Properties (CMFP);
- Chemical Measurement and Imaging (CMI);
- Chemical Structure and Dynamics (CSD);
- Chemical Theory, Models and Computational Methods (CTMC);
- Environmental Chemical Sciences (ECS);
- Major Research Instrumentation (MRI) (combined with Facilities for the COV);
- Macromolecular, Supramolecular and Nanochemistry (MSN);
- Research Experiences for Undergraduates Sites (REU);
- Special Projects and Initiative Investments (combined with REU for the COV);
- Broadening Participation (combined with REU for the COV); and
- Chemical Synthesis (SYN).

The two co-Chairs of the COV had conflicts with one or more of the 14 programs, and those were managed through the NSF COI management process by limiting access to program eJackets and limiting participation in specific subpanel discussions.

On Day 1 at the on-site meeting, the specialist subpanels had breakout sessions in which they discussed their review of the proposals available through eJacket and other information about the program available from the COV Tableau Dashboard. Breakout sessions were held subsequently for the subpanels comprised of COV members assigned as generalists. The POs were accessible to COV members by phone, text or email during these breakout sessions for questions. The subpanel responses to the template questionnaire and comments from these individual subpanel sessions were recorded in real-time on the secure Sharepoint website by the assigned scribes for each subpanel. These subpanel reports were then available for reading, commenting and editing by all COV members. This process enabled active participation by all members in the generation of the review document for each program. The two scribes from the specialist and generalist subpanel sessions met at the end of Day 1 to coordinate and merge the information collected from the subpanels about a given Program. Other members who were not scribes of a subpanel met to draft the COV process section of the report during this time. The merged subpanel reports for each program were saved as separate documents on the Sharepoint website and COV members were assigned to read, comment and edit these program reports as homework on the evening of Day 1.

On Day 2 of the on-site meeting, the entire COV met in total for brief report-outs on each program, presented by the two subpanel scribes. For each program, scribes were instructed to limit their comments to summarizing one main strength and one main concern of the program. This section of the COV meeting then had one last group review of the drafts of the program level reports in small breakout sessions.

On the afternoon of Day 2, COV members participated in a collective dialogue to identify the main recommendations for the Executive Summary of the COV Report, as facilitated by the co-Chairs of the

COV. Subsequently, members of the COV were placed in subgroups to consider and write the draft report sections by “Charge Bullet Point” based on the previous discourse by the entire group. Again, scribes were assigned for the four main bullet points and off-site members participated by Zoom. Four separate sessions were conducted. The full COV came back together to make sure any remaining issues were identified.

The final on-site meeting agenda item was a discussion in which the COV chairs reported a preliminary overview of the major findings of the COV to MPS Acting Assistant Director Dr. C. Denise Caldwell, MPS Deputy Assistant Director Dr. Tie Luo, CHE Acting Division Director Dr. Lin He, CHE Acting Deputy Division Director Dr. George Richter-Addo, and CHE staff. Following the presentation and ensuing discussion, the COV was adjourned with thanks for their hard work from Dr. C. Denise Caldwell.

### III. Detailed Responses to the Charge

#### **Charge Item 1: Address and report on the integrity and efficacy of processes used to solicit, review, recommend, and document proposal actions.**

The COV considers the merit of the review process to be worthwhile and valuable. The integrity and efficacy of processes used to solicit, review, recommend, and document proposal actions is demonstrably maintained throughout the entire proposal lifetime. In general, the panel process has a tempering factor built-in during panel discussions which moderates the most enthusiastic or more modest reviews. The overwhelming majority of proposals are reviewed by a panel, which the COV fully supports, rather than relying on *ad hoc*/mail-in or internal review.

Reviews, both *ad hoc* and by panelists, were generally agreed to be thorough, informative and complete. Across all programs, it was noted that most panelists prepared reviews with substantive comments on intellectual merit. However, it was also noted that some reviews were less extensive than others. These initial reviews together with *ad hoc* reviews (if applicable) clearly formed the basis for the panel discussion and deliberations. The COV suggests that the POs remind their panelists to develop more detailed reports to aid the whole panel as well as inform and educate the PI.

Virtual panels are seen as working well and allowing broad participation from the chemistry community. In-person panels have an advantage of valuable discussion and networking opportunities. The COV is interested in understanding the efficacy of in-person, hybrid and virtual panels. The COV asks if there is a feedback mechanism for panelists regarding their experience with the review and panel processes. This feedback could aid in determining which panel methods are more appropriate for each program. For example, in order to obtain qualified reviewers for the REU programs, it would help the COV committee to know the reviewers’ experience with REU programs (former mentor, former PI, etc.) One suggestion is for the POs to include a sentence that addresses this in the eJacket (specifically in the Review Analysis). The COV suggests that CHE consider including *ad hoc* reviewers (virtual) in the panel discussion for the relevant proposal.

Commentary on Intellectual Merit (IM) sections were all considered to be strong. However, the COV found that additional training and guidance is needed for reviewers and PIs concerning Broader Impacts (BI). NSF has received critiques about BI concerns in previous COV reports but appears to be having challenges addressing these issues. Examples of Broader Impacts are clearly given on the NSF website (<https://new.nsf.gov/funding/learn/broader-impacts>). Despite this, nearly all program subpanels felt that

BI discussion, both in the proposals and the reviews, was the weaker aspect of the review process. In addition, the expectations for BI and their relative weighting in decisions appears to vary between different panels, reviewers, and POs leading to inconsistencies in funding decisions. BI are clearly a challenge for PIs to author; moreover, this section of proposals is more subjective to review, and quickly evolving. A suggestion for NSF is to further improve the section describing Broader Impacts in the NSF Proposal & Award Policies & Procedures Guide (PAPPG). There is a dissonance between the BI discussion in the PAPPG and what is found on the NSF website. Finally, despite being clearly highlighted on the main CHE webpage ([https://www.nsf.gov/mps/che/che\\_broader\\_impacts\\_links.jsp](https://www.nsf.gov/mps/che/che_broader_impacts_links.jsp)), the NSF website for BI still has not been adequately utilized by some PIs and reviewers. CHE should continue its efforts to advertise this valuable resource, as it would improve overall awareness of BI activities suggested by the NSF.

Suggestions to aid the review process of Broader Impacts are: a) reviewers across all divisions should be encouraged to make full use of the review template during their review process by providing detailed evaluative comments for both IM and BI criteria; b) consider adding a separate supplemental document in proposals describing Broader Impacts that needs to be uploaded, analogous to the Research at Primarily Undergraduate Institutions (RUI) impact statement; c) provide clear guidance under the PAPPG; d) provide reviewer training to better understand the Broader Impacts criterion and ensure consistency in the application of review criteria. It was noted in one program that site visits often assist with better understanding of the BI for the panel and PO. Another suggestion is to have reviewers rank the IM and BI sections independently, as well as ranking the proposal as a whole. Inclusion of the requirement for a separate BI statement would allow PIs to craft a more thoughtful and considered BI discussion. PIs should also be encouraged to include matrices to assess success of proposed BI activities and any plans to sustain these activities beyond the funding period. As not all PIs have the necessary expertise or resources for acquisition and management of such assessment, any additional guidance that NSF might provide on its website would be helpful. Guidance in the PAPPG could be expanded to clearly delineate the features for discussion in the BI, e.g. internal (institute) education, external/outreach opportunities.

It was noted during the on-site meeting that NSF already has separate IM and BI scoring in place for the NSF Graduate Research Fellowship Program (NSF GRFP), so there is a system in place at the NSF that can be considered for guidance. This might aid in deliberations and identifying areas of concern or improvement in the proposal process. One concern that the COV has raised is the apparent lack of accountability of PIs for outcomes of their proposed BI. It is not clear from available information if BI outcomes are reported and tracked for (or by) PIs following an award or if these outcomes are considered by CHE POs in funding decisions of subsequent proposals.

Review summaries and the PO Review Analysis (RA) were seen to reflect the overall sentiment of the review panel. In some cases, it was noted that the RA style changed, and the tenor of the commentary provided by the PO was different, yet still thorough. Universally, the RAs were clear on the rationale behind the decision to award or decline a proposal. It should be noted that there were multiple instances in which a disparity between the perceived quality (merit ranking) of a proposal and what is awarded was mentioned. The NSF might consider including reviewers whose tenure spans several panels (be they in the same year with rolling submissions, or a two-year commitment) to help moderate this disparity. This being stated, the deliberations of the panel do seem to self-correct. POs are rigorous in maintaining clear records of all activities over a proposal's lifetime within the eJacket system.

Should a proposal be rejected, there is a mechanism to indicate and address the concerns raised by reviewers upon resubmission of the proposal. This is not necessarily utilized by PIs and could be encouraged by POs during discussion with the PI following the award/decline announcements. There is a

mixed view among the COV on the efficacy of this additional page (allowed through NSF guidelines) versus incorporating the responses directly in the revised proposal.

The COV noted a trend to select reviewers from more populous regions of the country; this is also reflected in the number of submissions from those areas. It is recommended that a concerted effort be made to recruit reviewers from diverse demographic and geographic locations and institutional levels when possible. One suggestion is to establish a streamlined process allowing potential reviewers to register their personal information for a database of reviewer selection and emphasizing this resource during outreach activities. This could benefit early career researchers, who may not yet have established themselves, and increase visibility for underrepresented groups (URG) and female researchers. This may also provide the opportunity for a wider cross-section of the community to witness and understand the review process prior to submitting proposals. With this understanding, stronger proposals could be written increasing the chance of success for PIs. Some programs could employ the “high-risk” approach, similar to the Early-concept Grants for Exploratory Research (EAGER). For some proposals that are not reviewed by a panel, e.g. EAGER, it was noted that, while these proposals have the potential for high risk/high reward work, the addition of an *ad hoc* reviewer might help round out the deliberation on award or declination of the proposal. In addition, some programs could use more reviewers suggested by PIs.

Award budgets are generally flat across all programs and have not kept up with inflation; this is a universal problem. In some cases, the flat funding problem is complicated with other initiatives (CHIPS Act, rolling submission deadlines). NSF needs to push for more funding overall to support all of the Foundation’s activities.

Overall, the review process is perceived as a successful and self-moderating practice. NSF is encouraged to seek feedback from the scientific community to improve the merit review process, including surveys of proposal PIs, workshops and NSF-sponsored conferences, and analysis of funding outcomes. The POs are commended on their diligence and guidance throughout the review process. Notable concerns of the review process are the continued lack of diversity of submitting institutions and in review panels, and pervasive issues regarding the Broader Impacts narrative and review.

**Charge Item 2: Address and report on the quality and significance of the results of the Division’s programmatic investments.**

The mission of CHE is to facilitate research and train the future workforce in all areas of chemical science. CHE programmatic investments are critical to stimulate global competitiveness and prepare the future workforce in the chemical sciences. In this context, CHE does a remarkable job of carrying the NSF mission forward. We encourage CHE to continue to explore ways to encourage innovative research and workforce development and to identify and collect the data necessary to evaluate its impact. The COV explored and discussed the following sub-themes:

1. *Are the funding mechanisms and review processes well suited for enabling innovation in chemistry, and can CHE do more to stimulate innovation and facilitate the exploration of new areas?*

CHE solicits proposals covering a broad range of topics in the chemical sciences and encourages submissions describing cutting-edge science. The COV found that a robust review mechanism has been used to identify and support innovative and potentially transformative projects in disciplinary programs within the CHE division, as well as projects that are multidisciplinary. CHE also utilizes specific research initiatives like the Centers for Chemical Innovation (CCI), Critical Aspects of Sustainability: Innovative

Solutions to Sustainable Chemistry (CAS-SC), Quantum Algorithm Challenge (DCL), Future of Semiconductors (FuSe), among others, to solicit and support projects. Outcomes from these programs have advanced the frontier of scientific knowledge. Some of the emerging research topics backed by CHE include the role of atmospheric aerosols in the transport of viruses, or the role of computer learning in chemical synthesis, spearheaded by the CHE CCIs.

In conjunction with its programmatic investments, CHE participates in NSF-wide initiatives meant to encourage the participation of researchers from MSIs such as the Excellence in Research (HBCU-EiR) program. The COV noted that the number of applications and the success rate of applications from PIs in these institutions is low. CHE is encouraged to explore the reasons underlying these outcomes and take the necessary steps to address them.

Additionally, CHE utilizes mechanisms such as EAGER and large Centers for Chemical Innovation to encourage novel science. The COV noted that EAGER proposals are reviewed exclusively by POs, and raised questions as to whether this is the best way to evaluate these projects, or whether *ad hoc* reviews would be helpful. Although there was no consensus, it was thought that the advantage of *ad hoc* reviewers would be having different perspectives and clear expertise in the evaluation of EAGER proposals. To address the tendency of reviewers to be risk-averse, it may be helpful to train a community of reviewers who would be prepared to evaluate EAGER proposals. We would encourage CHE to investigate this possibility.

*2. Are there untapped pockets for potential CHE innovation within the U.S. population?*

Given that a diverse workforce and trainee pipeline is important for stimulating innovation, equitable access to CHE support for diverse researchers and trainees across different types of institutions was viewed as central to this charge. The COV raised the concern that there is untapped potential for innovation at institutions (e.g., MSIs, PUIs) and in geographic locations (e.g., EPSCoR states) that are not being supported in adequate numbers within the current CHE portfolio. We encourage CHE to increase and improve outreach to and dialog with these institutions to identify new mechanisms for fostering increased research productivity and training. Additionally, CHE is encouraged to consider ways to better tailor some aspects of the review process to facilitate fair consideration of proposals from different types of institutions.

With regards to inclusion of faculty from underrepresented groups (URGs) (e.g., HBCUs/MSIs/PUIs), from whom the number of proposals submitted is low, the COV suggests that the CHE hold listening sessions with these PIs so that CHE better understands the needs of faculty. Additional ideas suggested by the COV are to consider 4-year grant awards and to allow expenses for teaching release in the budget; this would also provide much needed leverage for faculty at institutions where teaching release for research is not otherwise permitted. Another idea is to develop workshops much like those for Early Career faculty. To further encourage submissions from HBCU faculty, another suggestion is to encourage and inform potential PIs of the HBCU-EiR program. A final suggestion for Research at Undergraduate Institutions (RUI) proposals is to consider ways to streamline the five-page Impact Statement.

*3. Do we have the data to be able to assess whether CHE's investments are effectively training and broadening participation in the future chemistry workforce?*

The COV appreciated the new COV Tableau Dashboard system used by CHE to share materials, reviews, and demographic information with COV members. However, it is not clear that NSF collects all appropriate

data that would be needed to fully address this question. Specifically, although NSF collects data about participants of grant awards, it is not clear that data is collected about *outcomes* of participants of grant awards (e.g. K12 students entering STEM undergraduate programs, undergraduate students entering graduate programs, graduate and postdoctoral researchers entering academia, industry, government labs, etc., especially for members of underrepresented groups) The COV encourages CHE specifically (and NSF more broadly) to consider compiling this type of longitudinal data when possible to better assess whether its investments are effectively training and broadening participation in the future chemistry workforce.

**Charge Item 3: Address and report on the relationship between award decisions, program goals, and Foundation-wide programs and strategic goals.**

CHE does an outstanding job of funding basic science in all sub-areas within chemistry; this focus on fundamental science makes CHE unique among all federal funders of research in the molecular sciences. The breadth of the CHE portfolio touches all areas of chemical sciences from basic to applied. The diverse grant portfolio ranges from excellent single PI grants to highly collaborative center awards. Research and education are supported at institutions ranging from R1 to PUIs and include MSIs, HSIs and HBCUs. CHE programs successfully engage co-funders from within CHE as well as with other NSF divisions and initiatives enabling them to lead or substantially contribute to Foundation-wide Programs and Strategic goals. In the past four years, CHE has funded research aligned with NSF-wide initiatives including those in Sustainability, Climate Solutions, Clean Energy, Biotechnology, Quantum Information Science, Artificial Intelligence, Advanced Manufacturing, Semiconductor and Microelectronics.

The chemical enterprise plays a crucial role in the US economy (25% of the U.S. GDP). According to a 2022 National Academies Report, 4.1 million jobs are supported by the U.S. Chemical Industry. The strategic investment of CHE allows the U.S. to continue to train and develop this key high-skilled workforce. CHE has invested heavily in growing a diverse geographically-distributed workforce. Significant strides have been made in the past four years to increase representation and continuing efforts in this area are encouraged. Much of the information supplied to the COV concerned PIs and reviewers. The COV encourages CHE to also look more deeply at the identities and outcomes of the students who participate in NSF-supported research work; doing so will allow future COVs to better project the success of these NSF-supported workforce initiatives.

**Charge Item 4: Address and report on the Division's response to the 2020 COV report.**

Five recommendations were made by the 2020 COV. Assessment of the CHE response to each recommendation is provided below.

***COV 2020 Recommendation 1: The Division of Chemistry Budget needs to be increased significantly to meet the needs of the community and the nation. The Committee of Visitors (COV) believes that the Division (CHE) is an excellent steward of the funds it receives. The Division is also active in, and successful at, securing co-funding to increase its ability to support transformative science. However, the combination of flat overall budgets, participation in Foundation-wide initiatives, and increasing costs to PI is leading to a tipping point for chemistry funding for the Division. Excellent science goes unfunded each year. An NSF award "buys" fewer person hours, trains fewer people, and limits the number and impact of critical new findings. Support of the core chemistry research that is the heart of CHE is at risk of being contorted as the community attempts to fit into top-down initiatives. Finally, creative risk-taking science is hampered by short award***

*durations. The Division can advocate for resources on behalf of the chemistry community, but this recommendation is aimed squarely at the Foundation and its ability to expand its overall funding.*

The COV recognizes that addressing the budget is not entirely within the purview of CHE. Additionally, this recommendation has been a constant among COV reviews of the recent past. Although small incremental increases in budgets have occurred, these changes have not kept pace with increased costs of graduate student stipends, the growing costs of supplies, equipment and instrumentation costs, and high proposal pressure. The essentially flat budget in the 2020-2023 period reflects a tangible loss due to significant inflation. The budgetary concerns put forth in the 2020 COV report remain, but unfortunately, during the interlude between the 2020 report and the meeting of the 2024 COV, the essentially flat budget is moving toward a crisis wherein the international competitiveness of U.S. science has become seriously threatened.

***COV 2020 Recommendation 2: Further the impressive moves towards transparency in the review process.*** *The 2016 COV recommended that the Division work to enhance the transparency of the review process. The current COV finds that considerable progress has been made. Panel reviews and summaries are substantive and communicate reviewer and panel rationales. The Program Officer (PO) Review Analyses (RA) are clear, detailed, and persuasive. The COV found somewhat greater variability in the quality of ad hoc reviews, but they do not comprise the majority of the review portfolio and did not generate deep concern. The thrust of this recommendation is that the COV would like to see PO comments and feedback to PIs expand to include more of the constructive information contained in the RAs. The COV believes PIs would benefit from the PO comments that provided the sort of detailed and reasoned discussions contained in the RAs, because this would not only enhance transparency, but also provide PIs with greater guidance for future submissions.*

The data presented to the COV shows an excellent level of information regarding the award/decline decisions and appears to be greatly improved compared with what was observed by the 2020 COV. It is clear that relevant data are conveyed to the PIs through the reviews, panels summary and PO comments. The COV would like to note that the POs are doing excellent work in facilitating the development of useful panel summaries, providing guidance to the PIs through the corresponding PO comments, and assembling comprehensive Review Analyses.

***COV 2020 Recommendation 3: Employ panels in the review process when possible.*** *The COV finds that the panel process provides excellent feedback to PIs. The Division currently does the bulk of its reviewing by panel, and the COV urges that panels continue to be central to the efforts of CHE. In addition to the benefits to PIs, panels also serve to acculturate new PIs and provide important networking opportunities. Some concerns were raised about the time commitments required of in-person panels on faculty, but other COV members felt that PIs could decide for themselves, and that in-person panels should remain the norm. The COV also urged the Division to seek broader participation from the community in the review process especially noting a desire to enhance the diversity of its reviewers across the many dimensions of diversity. The COV asks that the Division find ways to engage the community in a discussion of panels and the challenges and opportunities they present.*

It is clear that, in all programs reviewed, panels are now being employed as a routine matter. There remains the occasional all-mail review that is clearly borne out necessity and regular *ad hoc* participation, that, although viewed as appropriate, the COV believes can be further improved. In terms of the concerns of time commitment, it is clear that the COVID pandemic has expedited the advent of virtual panels. Thus,

in some programs, all panels were virtual. Although there remains a need to assess the efficacy of in-person compared to virtual and hybrid panels, it is clear that decisions deriving from a panel, whether it be in-person or virtual, are preferred to individual *ad hoc* reviews. Additionally, CHE is praised for its facile response and commitment to virtual panels during the serious restrictions imposed by the COVID-19 pandemic.

***COV 2020 Recommendation 4: Seek greater community clarity with respect to Broader Impacts.***

*The COV believes that Broader Impacts are a critical part of the assessment of proposals to the NSF. However, the COV found that the attention paid to Broader Impacts by reviewers and panels varied considerably across the proposals we examined. Further, it was sometimes unclear how the assessment of Broader Impacts factored into the funding decision. The community as a whole has widely varying perceptions of what Broader Impacts are, and how to fulfill them. Finally, the COV believes that the ability to assess Broader Impacts lags the ability to assess Intellectual Merit. The chemistry community seeks guidance and education on this issue, since it is clear that confusion persists among proposal writers and reviewers. The COV suggests that the Division find ways to engage the community in discussions about the Broader Impacts and perhaps use these conversations to further educate the community and generate clarity around what they mean to everyone. For example, a series of workshops should be held, out of which community consensus might emerge. Community norming of this type would be of immense benefit to young PIs and also be helpful to reviewers and POs who are asking those reviewers to assess proposals.*

The 2024 COV would like to commend the NSF on their efforts to define the meaning and intentions of the Broader Impacts merit review criterion through the creation of online tools and web pages. The COV suggests further dissemination, visibility, and findability of these resources to help promote community awareness. The COV feels that additional efforts remain in educating PIs and reviewers on the relevance of Broader Impacts compared to Intellectual Merit for given programs. The 2024 COV specifically suggests further improvements related to the Broader Impacts criterion in Recommendation 2 above and in the discussion contained in Section III in response to Charge Item 1.

***COV 2020 Recommendation 5: Continue efforts to promote inclusion for the scientific enterprise.***

*The 2020 COV echoes the 2016 COV with this recommendation. The Division should continue outreach to institutions that educate historically underserved populations and primarily undergraduate institutions. The COV recognizes that there may be ways for the Division to promote cross-institution mentoring for PIs at small institutions, where their expertise is singular. The COV recommends that the Division encourage and facilitate a new generation of organizations that promote inclusion at the faculty level. As an example, the Division could promote a database of all new hires in chemistry-related departments across (sic) from across the country so as to develop formal and informal networks that continue to support and mentor women and PIs from under-represented backgrounds beyond the impressive CAREER workshop the Division holds. The COV recognizes that many of the most creative ideas have come from the community, which is an essential partner with CHE in order to improve access and inclusion, and it would welcome opportunities to be active participants to support these efforts.*

The 2024 COV recognizes that promoting inclusion in the scientific enterprise is a challenging issue that remains. Particularly valuable in the period since the 2020 COV is the development of the COV Tableau Dashboard which has enabled not only the COV but the POs in CHE to easily assess with greater resolution where deficiencies exist and the effects of programmatic changes. The NSF is to be commended for clear efforts that are underway in attempting to address these issues both internally and externally, including

the formation of the Chemistry Broadening Participation, Diversity and Inclusion Committee (BPDI), participating in the Excellence in Research program (EiR), and conducting outreach initiatives. Stimulating greater numbers of submissions from HBCUs, HSIs and MSIs, along with programs promoting excellence in research for all demographics for the next period is supported. The 2024 COV specifically suggests further improvements related to promoting inclusion in Recommendation 5 above and in the discussion contained in Section III in response to Charge Item 2.

## IV. Program Reviews

### 2024 REPORT TEMPLATE FOR NSF COMMITTEES OF VISITORS (COVs)

The information below should be completed by program staff.

**Table 1 - Summary Information**

| Summary Information  |
|--|
| <b>Date of COV: August 8-9, 2024</b>   |
| <b>Program/Cluster/Section: All programs in CHE</b>  |
| <b>Division: Chemistry</b>   |
| <b>Directorate: Mathematical and Physical Sciences</b>   |
| <b>Number of actions reviewed:</b> 384 (344 projects, 32 collaboratively linked) + 8 Preliminary CCI<br><b>Awards:</b> 176 (158 projects)<br><b>Declinations:</b> 191 (177 projects)<br><b>Other:</b> Invited: 4 (4 projects); Not Invited: 4 (4 projects); Other: 9 (9 projects)  |
| <b>Total number of actions within Program/Cluster/Division during period under review:</b><br><b>Awards:</b> 2065 (1911 projects)<br><b>Declinations:</b> 3805 (3531 projects)<br><b>Other:</b> Invited: 49 (49 projects); Not Invited: 84 (84 projects); Other: 50 (46 projects)  |
| <b>Manner in which reviewed actions were selected:</b><br><p>A spreadsheet was created of the 5920 competitive actions (5489 distinct actions and 431 non-lead linked collaboratives) ascribed by the NSF database to the Chemistry Division in FY 2020 - FY 2023. For all proposals (including those in the "no-deadline" pilot), FY attribution is based on the date action was completed, rather than on the submission date. In most instances, the two are the same; exceptions are proposals submitted in a September window (the Federal FY starts October 1) and CAREER proposals (which are generally received in July of FY [N-1] and processed in FY [N]). A separate spreadsheet was generated for the 133 CCI preliminary proposals.</p> <p>A random number generator was used to place the proposals in a completely random order. A grid was created for each of the reviewed programs, containing as columns the four FY being reviewed and as rows the types of actions (clear and marginal awards and declinations) and major types of proposals (CAREER, RUI). Proposals were drawn from the top of the randomized list to fill the slots on the grid, skipping entries</p> |

for which there were institutional or individual conflicts of interest with COV members. Single proposals were also drawn from the top (where available) for major initiatives, for EAGERs, and for Accomplishment-Based Renewals. Finally, the grids were checked to ensure that each program officer actively engaged in the program was represented; additional proposal(s) were drawn from the top of the list as needed to assure this representation. To avoid duplication or overrepresentation, only the leads of collaboratively linked proposals were considered. From a total of 40 proposals (including four non-leads) returned without review during the COV period, one proposal (only) was selected for each program from the top of the randomized list.

Because of the complexity and small number of proposals involved, the Centers for Chemical Innovation program was treated differently. A representative set of 8 unconflicted preliminary proposals (invited and not invited) and 12 full proposals (awarded and declined), was selected in sequence from the top of the randomized lists.

For the Instrumentation program, clear and marginal awards and declinations were included for each year for Track 1 proposals (under \$1 M until 2023, then under \$1.4M) from PhD-granting (244) and non-PhD-granting (195) institutions. In addition, a sampling of awards and declinations was selected from among Track 2 proposals (41, including 4 from non-PhD-granting institutions; over \$1M until FY 2023, then over \$1.4M). In the NSF-wide competition, there were separate pools of funds for Track 1 from non-PhD-granting institutions, and for Track 2. The only unconflicted midscale proposal was also selected.

This process resulted in selection of 384 proposals (352 projects) total, or roughly 6% of the pool. 30 of these (~8%) were leads of collaboratively linked proposals, roughly matching the representation of collaboratives (~7%) in the pool. A few additional proposals were added (after screening for conflicts of interest) in response to specific requests during the meeting. Access was blocked for proposals where a COV member had a COI identified either before or during the onsite COV meeting.

## INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

### Chemical Catalysis (CAT)

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, returns without review, and withdrawals) that were *completed within the review period (generally the prior four 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.

**Table 2 - Quality and Effectiveness of the Merit Review Process**

| <p><b>QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</b></p>  | <p><b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b></p> |
|--|--|
| <p>1. Are the review methods (for example, panel, <i>ad hoc</i>, site visits) appropriate?</p> <p>Comments:</p> <p>The program relies mostly on panels, with some extra <i>ad hoc</i> reviews requested to capture specific areas of expertise or to supplement the panel review. The combination of different review methods appears to meet the needs of the program. Panel membership may limit the reviewers that the Program Officers (POs) can draw from for a particular review (e.g. if the panel does not contain a person from industry then it will not be possible to get industry input on GOALI proposals), but the ability to discuss proposals among a group of reviewers in a panel seems to generate more uniform outcomes; the COV therefore concludes that the advantages of panels outweigh any limitations. The COV suggests that NSF consider, under circumstances where an <i>ad hoc</i> reviewer is desirable, bringing that person onto the panel just for the discussion of that proposal. This could be done in either an in-person or virtual format depending on individual circumstances.</p> <p>Some proposals reviewed by the panel were not discussed (NDP) due to their low-priority nature (significant weakness or concern). For these proposals, it would be helpful if Principal Investigators (PIs) received detailed written comments from the POs to guide them moving forward.</p> <p>Some COV members believe that EAGER proposals, which are generally only reviewed internally, would benefit from at least one external review; other COV members were less sure about the appropriateness of such an additional review given the early concept nature of these proposals.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 6</b></p> | <p>Yes</p>   |

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS   | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|---|--|
| <p>2. Are both merit review criteria addressed:</p> <ul style="list-style-type: none"> <li>a) In individual reviews?</li> <li>b) In panel summaries?</li> <li>c) In Program Officer review analyses?</li> </ul> <p>Comments:</p> <p>All merit review criteria were addressed in most individual reviews, panel summaries, and Program Officer (PO) review analyses (RA), promoting high standards in scientific research. However, the COV noted that a number of individual reviews did not clearly distinguish review comments on Intellectual Merit (IM) and Broader Impacts (BI) components of the proposed effort, and in some cases, the BI reviews were superficial.</p> <p>For most proposals, it appears that successful funding decisions weighed the IM components of the effort more heavily than the BI aspects. CHE Division and CAT POs should continue efforts to help PIs understand how to better articulate and reviewers understand how to better evaluate BI components. Some reviewers do not provide detailed review comments for both criteria; the COV recommends that CHE require <i>all</i> reviewers to write separate review comments on IM and BI aspects of proposals. The COV suggests that NSF ask PIs to write a full 2-page BI statement that would require PIs to more thoughtfully define the scope of BI work proposed and how it will be evaluated. This format would be analogous to the required RUI Impact statement that NSF requires for RUI proposals. The COV also recommends that CHE provide reviewers with more guidance by which to judge BI merits.</p> <p><b>Data Source: Jackets</b></p> | <p>Yes</p>                                     |

| <b>QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</b>  | <b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b> |
|---|---|
| <p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>Comments:</p> <p>Mostly, yes, as the majority of reviews are substantive and nicely detailed. However, we noted that not all reviewers provide the same level of detail in their reviews. Specificity in reviews is helpful. The COV recommends that CHE continue its efforts to train reviewers about what constitutes an exemplary review and help reviewers understand the value of providing specific information rather than writing in vague generalities. Substantive reviews are particularly important for the lower-ranked proposals, for which constructive and detailed suggestions for improvement would be useful.</p> <p>Most reviews and ranking scores were closely consistent for the same proposals. However, in several awarded and declined proposals, rating scores were highly divergent, presumably due to different perspectives of the reviewers. Sometimes, these discrepancies are resolved through the panel discussion. Some members of the COV believed that, if such changes in opinion emerge from the panel discussion, reviewers should be required to modify their ranking and score post-discussion accordingly; other COV members felt that there was value in allowing PIs to see the initial scores. Given these varying opinions, it is recommended that POs continue their practice of allowing reviewers to change their scores post-panel discussion if they are so inclined.</p> <p><b>Data Source: Jackets</b></p> | <p>Yes</p>  |

| <b>QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</b>   | <b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b> |
|--|---|
| <p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>Comments:</p> <p>After considering individual reviews and panel summaries for a number of CAT proposals, the COV felt that the rationale behind the panel discussion was generally made clear. Often, the panel summaries highlight both strengths and weaknesses of the proposal. However, it was not always clear from the panel summary which aspects were weighed more heavily than others in the final ranking.</p> <p>The COV noted significant differences in the style of panel summaries. Some of the COV felt that a bullet list can be very efficient in communicating information to the PI. In most cases when panel consensus was not reached, adequate documentation of the divergent opinions was provided in the summary.</p> <p><b>Data Source: Jackets</b></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:</p> <p>The documentation in the eJacket, particularly the much more detailed Review Analysis (RA), provides the rationale for award or declination decisions on proposals. In general, the statements are clear and concise. However, the COV noted that more details could have been provided for some proposals from PIs at PUIs. The COV encourages POs to encourage panels to provide as much detailed information as possible in the panel summary and for the PO to include as much detailed information as possible in their written comments to the PI.</p> <p><b>Data Source: Jackets</b></p> | <p>Yes</p>  |

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS  | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|--|--|
| <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:</p> <p>Most panel summaries provide useful insights into the panel assessment of the proposal; these are generally very helpful to the PI, especially when proposals are declined. Although the RA offers the most detail in explaining the rationale behind final decisions, the COV understands why the full RA is not shared with the PI. That said, the COV believes that PO written comments describing the decision rationale that go back to the PI should be as extensive and detailed as possible. Overall, the COV found the documentation on proposal decisions clear and concise.</p> <p>It is important for POs to continue encouraging PIs to directly contact the PO to discuss the proposal reviews and decision. Additionally, the COV strongly encourages POs to be more proactive in calling PIs after proposal decisions, especially those early in their careers.</p> <p>Concern was expressed that proposals not discussed by the panel do not receive the benefit of a panel summary. For these proposals, it is particularly important that the PI receive the PO comments and that the PO comments be detailed enough to help the PI understand the strengths and weaknesses of their proposal and to have information to help guide future revisions and resubmissions. We recommend that the PI be encouraged to talk with the POs on the phone or over Zoom</p> <p><b>Data Source: Jackets</b></p> | <p>Yes</p>                                     |

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS   | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|---|--|
| <p>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</p> <p>Overall, POs seem to do a good job synthesizing information from the panel and considering other necessary factors in proposal decisions. It seems clear that POs strive to include necessary expertise among reviewers. POs have largely been successful in organizing an appropriate distribution of institution types among the reviewers used for proposal reviews.</p> <p>It would be helpful to PIs if information regarding how panels are formed and how proposals are assigned to different panels was provided in the CHE proposal guidelines.</p> <p>Recognizing that it is impractical to review RUI proposals in a separate panel, when RUI proposals are included in a panel, having two or more PUI panelists is helpful. The COV additionally recommends CHE to develop additional rubrics or guidelines for panels to review RUI proposals objectively. Alternately, <i>ad hoc</i> reviewers from PUIs could be used and then brought to the panel to participate in discussion of the proposal(s) they reviewed.</p> <p>It is important that in evaluating renewal proposals, reviewers consider productivity during the tenure of the previous grant award in terms of the <i>quality</i> of the work published and the extent to which the work published did or did not address the aims of the prior proposal and not simply evaluate productivity in terms of the number of papers published. This is important, because often, one well-written and well-integrated paper is of greater benefit to the community than several more fragmented papers.</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.

**Table 3 - Selection of Reviewers**

| <b>SELECTION OF REVIEWERS</b>  | <b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b> |
|--|---|
| <p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>Comments:</p> <p>The CAT program leverages the expertise of a broad pool of reviewers, typically including experienced researchers from diverse backgrounds and institutions. The participation of female reviewers and early-career PIs as panelists was viewed as a strength. It is also good practice to include at least one PUI panelist for RUI proposals or one industrial expert for GOALI proposals.</p> <p>Most panelists chosen were knowledgeable and capable of reviewing the proposals appropriately. However, the COV noted that panels rarely included suggested reviewers, who are often experts in the field.</p> <p>Reviewers provided substantive comments and focused on different aspects of the proposals, leading to thoughtful reviews (results).</p> <p><b>Data Source: Jackets</b></p> | <p>Yes</p>  |
| <p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>Comments:</p> <p>The CAT program handles COIs well in a very professional way!</p> <p><b>Data Source: Jackets</b></p>   | <p>Yes</p>  |

| <b>SELECTION OF REVIEWERS</b>   | <b>YES, NO,<br/>DATA NOT<br/>AVAILABLE,<br/>or NOT<br/>APPLICABLE</b> |
|---|---|
| <p>3. Additional comments on reviewer selection:</p> <p>The COV did not get a sense of the response rate of solicited reviewers in the assembly of panels from the information provided. That said, the CAT program does assemble very good panels; the COV would have liked a better idea of how difficult this task is, as it is critical to CHE and to CAT to keep the quality of review panels high.</p> <p>The COV wonders if internally reviewed proposals (e.g. EAGER proposals) would benefit from having at least one external reviewer. Some members thought that this might improve proposal review, while others were less certain.</p> |   |

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

**Table 4 - Management of the Program Under Review**

| <b>MANAGEMENT OF THE PROGRAM UNDER REVIEW</b>   |
|---|
| <p>1. Management of the program.</p> <p>Comments:</p> <p>The CAT program, which receives a relatively large number of proposals, has been well managed. The COV noted a strong management team with timely decisions. The COV notes that reviewers do not appear to utilize the full range of proposal ratings available to them.</p>   |
| <p>2. Responsiveness of the program to emerging research and education opportunities.</p> <p>Comments:</p> <p>The CAT program seems responsive to emerging research and education opportunities, particularly with an emphasis on sustainable chemistry, electrocatalysis and electrosynthesis. This is well aligned with agency and directorate-wide focus areas (<a href="https://new.nsf.gov/focus-areas/chemistry">https://new.nsf.gov/focus-areas/chemistry</a>). The GOALI program helps to link academy and industry, in ways that can potentially help research and education. Can GOALI-type collaborations be increased and expanded to other industries, while still maintaining the NSF commitment to basic research? Active GOALI awards are currently focused primarily on the pharmaceutical industry.</p> |
| <p>3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.</p> <p>Comments:</p> <p>POs seem aware of division-wide initiatives and are able to take advantage of additional or shared funding opportunities (as judged by post award relabeling of proposals). POs have a vision for the development of their portfolio. It is important that POs continue to attend conferences, including smaller conferences like GRCs, so that they can stay abreast of new directions in the field. Catalysis is a broad area of chemistry, so it is important as well that POs in this area continue to communicate with other POs who manage proposals that involve catalysis (e.g. chemical engineering, synthesis, computational catalysis, enzymes).</p>           |

## MANAGEMENT OF THE PROGRAM UNDER REVIEW

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

Comments:

- The program has dramatically reduced their reliance on *ad hoc* reviews. All proposals were reviewed in a panel with *ad hoc* reviews requested when appropriate.
- The COV applauds the inclusion of at least one PUI panelist for RUI proposals and one industrial expert for GOALI proposals.

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

**Table 5 - Resulting Portfolio of Awards**

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</b> |
|--|--|
| <p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>Comments:</p> <p>Overall, the balance seemed reasonable. Areas covered appear to strike the right balance.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 8</b></p>  | <p>Appropriate</p>   |
| <p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>Comments:</p> <p>The award size is generally modest. As tuition, supplies, and instrumentation costs are rising at the institutions, the COV believes it will be crucial to aim for increased budgets across the board.</p> <p>The COV also noted that the sizes of RUI awards are generally smaller than awards to PIs at more research active institutions. The COV suggests that CHE develop better metrics to guide appropriate support for RUI projects.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 4</b></p> | <p>Appropriate</p>   |
| <p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>Comments:</p> <p>Innovative and transformative projects are prominently featured in the portfolio of funded projects. The CAT program also acknowledges that transformation is a gradual process, often extending beyond a single funding cycle. Consequently, awards are also granted to long-established programs that continue to drive transformation within the field.</p> <p><b>Data Source: Jackets</b></p>  | <p>Appropriate</p>   |

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|--|--|
| <p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>Comments:</p> <p>The COV noted a lot of co-funding between programs.</p> <p><b>Data Source: If co-funding is a desired proxy for measuring inter- and multi-disciplinary projects, the Co-Funding from Contributing Orgs and Co-Funding Contributed to Recipient Orgs reports can be obtained using Enterprise Reporting, COV Dashboard, Question 7</b></p>                              | Appropriate  |
| <p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>Comments:</p> <p>The geographic distribution of PIs is generally appropriate based on the institutions of higher education per state. The awards also tend to mirror state populations (e.g., maps), although the COV recognizes untapped potential in some geographic regions.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 2</b></p> | Appropriate  |
| <p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>Comments:</p> <p>Yes. The COV is impressed that PUIs (MS and 4-year institutions) have a comparable funding rate to R1 institutions. Low numbers of submissions from HBCUs might merit outreach from CHE to support more high-quality submissions from these institutions.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 3</b></p>      | Appropriate  |

| <b>RESULTING PORTFOLIO OF AWARDS</b>  | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|---|--|
| <p>7. Does the program portfolio have an appropriate balance of awards to new and early-career investigators?</p> <p>NOTE: A new investigator is an individual who has not served as the PI or Co-PI on any award from NSF (with the exception of doctoral dissertation awards, graduate or post-doctoral fellowships, research planning grants, or conferences, symposia and workshop grants.) An early-career investigator is defined as someone within ten years of receiving his or her last degree at the time of the award.</p> <p>Comments:</p> <p>The question for the community is whether early-career investigators are able to get NSF funding and get their careers off the ground. The COV found this difficult to judge from the information provided. The funding rate for investigators &lt;10 years after the Ph.D. is lower than for other groups. The difference in funding rate for new PIs compared with that for established PIs might be expected in that more established PIs are likely applying for renewals, but this remains an area for the CAT program to attend to. The COV also noted that the concentration of awards to PIs who are 5-15 years from the PhD was appropriate.</p> <p><b>Data Source: Information on new PIs available via Enterprise Reporting, COV Dashboard, Question 6</b></p> | <p>Appropriate</p>   |
| <p>8. Does the program portfolio include projects that integrate research and education?</p> <p>Comments:</p> <p>Yes, as all funded projects include student training and educational activities, especially in CAREER and RUI projects.</p> <p><b>Data Source: Jackets</b></p>   | <p>Appropriate</p>   |

| <b>RESULTING PORTFOLIO OF AWARDS</b>  | <b>APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</b> |
|---|--|
| <p>9. Does the program portfolio have appropriate participation of underrepresented groups<sup>2</sup>?</p> <p>Comments:</p> <p>The program has done a very good job of promoting equity in its funding decisions. There appears to be a slightly lower funding rate for PIs from underrepresented groups, but this is difficult to assess, since some PIs do not identify their ethnicity. To more fully assess this, the COV would need information on all participants impacted by CHE-funded projects.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 5</b></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:</p> <p>Yes, the CAT program has an impressive record in funding research in sustainable chemistry, clean energy as well as international and multi-disciplinary projects!</p> <p>Program activities focus on sustainability and clean energy, which are important national priorities. However, NSF's unique strength is its focus on basic research so an overreliance on meeting national priorities is counter to a key strength of NSF. The CAT program attends to issues of economic and technological prowess of the country as well as workforce development.</p> <p><b>Data Source: Jackets</b></p> | <p>Appropriate</p>   |
| <p>11. Additional comments on the quality of the projects or the balance of the portfolio:</p> <p>Overall, the COV was impressed by both the funded science and the overall portfolios for evaluation.</p>  |  |

<sup>2</sup> 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.

Panel discussion is a very valuable part of the review process. The COV suggests that CHE consider bringing *ad hoc* reviewers into the panel to be part of the discussion(s) of the proposal(s) they review. Similarly, the COV encourages CHE to find improved mechanisms for getting all key concerns/ideas considered during the panel discussion and reflected in the panel summary, and for ensuring that PO comments underpinning decisions get delivered to PIs. The COV recommends that CHE strike the word “young” from reviews in order to use less ageist language (encourage reviewers to do so, but if not, do post-review editing).

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.

Costs of graduate students and postdoctoral researchers have outpaced funding levels and CHE and NSF must address this issue critical to both workforce development and research efforts.

The CAT program has been responsive to previous COV comments and recommendations. Still, some comments and recommendations remain relevant. The significance of broader impacts in award decisions and how they are defined and evaluated remain murky. CHE has done the things recommended in recommendation #4, and still, it doesn’t seem as though the community, or reviewers, have more clarity on what BIs are and how they should be evaluated. To what extent do broader impacts need to tie to the project and to what extent should broader impacts be tied to the PI? Is the broader impact an expectation that the PI contribute to their community and to what extent is the broader impact tied to the broad impacts of the science? Saying that it can be both makes clarity harder to find.

CHE needs to continue to work to increase its budget.

CHE can help increase the number of proposals submitted from underrepresented group PIs by supporting the training of students from URG institutions. While broader impacts often include a commitment to recruit diverse group members, the COV did not see any information about the diversity of the people supported/impacted by CHE-funded grant awards. Having this information would help the COV evaluate the effectiveness of CHE's response to increasing diversity. Might NSF consider different models of supporting students, including direct support for students from underrepresented groups or support for training grants to institutions?

**Time to decision:** Typically, it takes 5 months for declined proposals and 6 to 9 months for awarded proposals. Reducing the time from proposal submission to decision notification for declined proposals, along with providing individual reviews, panel summaries, and constructive PO comments, will help PIs understand their strengths and weaknesses and improve their proposals for future submissions.

**Annual reports.** We noted a big variation in the annual reports from the PIs. A clearer guidance is needed for the PIs for the preparation of annual reports, especially how much detail is expected for the Significant Results section.

4. Please provide comments on any other issues the COV feels are relevant, bearing in mind that COV reviews do not include assessment or evaluation of the outcomes or long-term impacts of program investments.

The COV wonders if there are mechanisms by which CHE can support administrative resource sharing or the development of open access resources to help level the playing field between well-resourced institutions with a lot of administrative grant support and others with less grant support. A simple idea might be the development of a single one-stop guide for NSF grant preparation that is a little more accessible than the standard NSF program announcements.

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

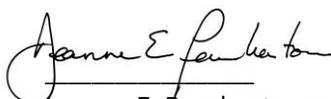
We want to commend CHE for giving us access to the ejackets and to the COV dashboard well in advance of our two-day panel. It was very helpful to have time to review this material and think about it. Touching base with the subgroup members ahead of the meeting also helped to form good working relationships. Having two separate subgroups review the material and then combine comments is an effective way of integrating diverse opinions.

The COV recommends that CHE explore additional mechanisms for soliciting feedback from the community. Broad feedback from all relevant stakeholders would greatly benefit this review process.

*The Committee of Visitors is part of a Federal Advisory Committee. The function of Federal Advisory Committees is advisory only. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the Advisory Committee, and do not necessarily reflect the views of the National Science Foundation.*

**SIGNATURE BLOCK:**

For the 2024 COV

  
\_\_\_\_\_  
Jeanne E. Pemberton  
Co-Chair

  
\_\_\_\_\_  
Scott D. Rychnovsky  
Co-Chair

## INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

### Centers for Chemical Innovation (CCI)

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, returns without review, and withdrawals) that were *completed within the review period (generally the prior four 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.

**Table 2 - Quality and Effectiveness of the Merit Review Process**

| <p><b>QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</b></p>  | <p><b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b></p> |
|--|--|
| <p>1. Are the review methods (for example, panel, <i>ad hoc</i>, site visits) appropriate?</p> <p>Comments:</p> <p>Reviewing CCI proposals poses a unique challenge due to their size, monetary commitment, and technical scope. The review methods implemented by CHE do seem appropriate in meeting these challenges. The COV felt the review techniques such as panels and <i>ad hoc</i> reviews offer a suitable level of specific technical expertise. Given the diversity of research in the proposals, <i>ad hoc</i> reviewers are used frequently to supplement the panel reviews. Furthermore, the site visit, used for Phase 2 proposals, is highly valuable for evaluating the intellectual merit and the ability of the proposed team to accomplish the vision for the research they are proposing. These are key to evaluating the effectiveness of these consortium-type of research efforts.</p> <p>One concern identified by the COV was that the ratings for awarded and declined Phase 2 proposals were close. For such a slim distribution of scores, the concern was expressed that a single dissenting review might throw off the validity of a review process. However, discussions with an experienced Program Officer (PO) alleviated these concerns. MRR values are, frankly, of limited use and any reviews that are outside of reason and rigor are easily spotted. This is an area where PO interpretation is critical.</p> <p>The COV did identify demographics of review panel participants, PO rotators, and proposing PIs as areas of concern. Low participation from under-represented groups in all of these areas should be closely evaluated. The COV panel does acknowledge, however, that they've seen only a small fraction of the total proposals handled; the limited window of the COV review period precluded a fuller exploration of this issue in the data available on the CHE Dashboard. Lastly, although attention has been paid on increasing representation amongst submitting PIs, increasing representation within CHE, among rotators in particular, could be an effective stepping-stone for increasing representation amongst PIs.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 6</b></p> | <p>YES</p>   |

|   |            |
|---|------------|
| <p>2. Are both merit review criteria addressed</p> <ul style="list-style-type: none"> <li>a) In individual reviews?</li> <li>b) In panel summaries?</li> <li>c) In Program Officer review analyses?</li> </ul> <p>Comments:</p> <ul style="list-style-type: none"> <li>a) In individual reviews? There is significant variability in the individual reviews. For Phase I proposals, some reviewers gave minimal attention to broader impacts while others gave none! It seems natural or instinctual that reviewers (typically working scientists and group leaders) give more attention to technical issues than to broader impacts. This is expected since these people are trained as scientists and issues of communication, teaching and outreach, etc., may not be among their top skills. This was less the case for Phase 2 proposals, for which reasonable attention to broader impacts was paid.</li> <li>b) In panel summaries? The COV felt that panel summaries were somewhat better at addressing broader impacts. This may be simply due to being in the presence of POs or others that held the panels responsible for addressing these issues. The CCI Phase 2 proposals also make a clearer point in identifying explicitly where these broader impacts are made. The COV recommends that CHE continue to encourage reviewers to pay attention to these issues. The four specific sub-categories under broader impact (Innovation, Education, Broadening participation, Science communication) assist in giving appropriate weight to the broader impact area of the review. The incorporation of CCI-specific review criteria helps panelists to assess the relative importance of both the intellectual merit and broader impacts which is primarily done for the Phase 2 competition, since reviewers and panelists are asked to comment on program-specific review criteria that address both of these aspects directly. This is understandable, given that Phase 1 grants are smaller, more limited in scope, and exploratory.</li> <li>c) In Program Officer review analyses? Lastly, program officers did acknowledge the importance and impact of the Broader Impacts more than either panel or individual reviews. They likely have much more experience evaluating and understanding of where, when, and how broader impacts can be made. The COV also notes that during discussions with a CCI program officer, the COV learned that previous efforts have been made to bring in panel members with specialized expertise in broader impacts and that inclusion of such experts was somewhat ineffective due to the particular focus these panel participants showed. Nevertheless, it is worth considering how informed evaluation of a proposed program's broader impacts can be made. The Review Analysis documents provided were also viewed as helpful with their very detailed write-up and elaborations on both intellectual merit and broader impacts.</li> </ul> <p><b>Data Source: Jackets</b></p> | <p>YES</p> |
|---|------------|

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS  | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|--|--|
| <p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>Comments:</p> <p>Some reviewers are more thorough than others. For the most part this is not a critical failing, particularly for Phase 1 proposals. However, for Phase 2 proposals, this weakness can have significant impact. The fear is that well-thought out and thorough reviews are given the same weight as cursory ones. However, the COV acknowledges that this was addressed by a program officer who said these cursory reviews are clearly spotted and weighted appropriately. The absolute numerical rating is not the deciding factor.</p> <p>Given the quality of Phase 2 proposals considered during this review period, the numerical ratings provided limited information to assist the PO in making final recommendations.</p> <p><b>Data Source: Jackets</b></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:</p> <p>Panel summaries were very detailed, provided good rationales and accountings of the consensus of the panel along with the basis for recommending awarding or declining a proposal.</p> <p><b>Data Source: Jackets</b></p>   | <p>YES</p>                                     |

| <b>QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</b>  | <b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b> |
|---|---|
| <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:</p> <p>The review analysis is very detailed and thorough and provides the most meaningful rationale for the award/decline decision. This includes relative rankings, but this information is typically not provided to the PIs. The COV believes this type of information could also be valuable to the PIs in helping them understanding the rationale for a decision.</p> <p>During discussion with a program officer, two important questions faced by POs arose. First, which proposal would make an interesting center? Secondly, what is the review panel ranking. Review panels are key. Their recommendations do seem appropriate when considering the panel response, discussions with NSF management, etc. There is the question of how to utilize all the different types of information provided (interim reviews, site visits, previous accomplishments, etc.). In fact, there are even possibilities to not fund any Phase 2 proposals when there isn't an exceptional proposal and (a slight possibility that) there might be potential to fund two if they are both exceptional proposals.</p> <p><b>Data Source: Jackets</b></p> | <p>YES</p>  |

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS  | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|--|--|
| <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:</p> <p>The Panel summary and the PO comments are especially valuable for the PI, with communication between POs and PIs almost always a good thing. However, in the case of Phase 2 CCI proposals, there is already quite a bit of interaction. The PIs are presented with reviews and critiques, subject to site visits and interim reviews, and then allowed to present their case and address critiques. This likely provides more than sufficient feedback and documentation to PIs regarding award/declination of their proposal.</p> <p>The COV panel also found that the Review Analyses produced by the POs are typically appropriate in degree of summary and incorporation of the thoughts and evaluations of review panel participants.</p> <p>Reports from site visits for established Centers, were also very detailed and gave valuable information to the PIs.</p> <p><b>Data Source: Jackets</b></p> | <p>YES</p>                                     |
| <p>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</p> <p>The guidance provided in the funding opportunity for CCIs has well-defined criteria for both intellectual merit and broader impacts which encourages the proposers to address each of the criteria effectively.</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.

**Table 3 - Selection of Reviewers**

| <b>SELECTION OF REVIEWERS</b>  | <b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b> |
|--|---|
| <p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>Comments:</p> <p>In general, the reviewers demonstrate a strong understanding of the proposals under evaluation. In certain instances, the need for synergy between reviewers is evident, aligning with the expectations of the CCI program. The program has done an effective job bringing a diverse expertise with <i>ad hoc</i> reviewers and multiple reviewers.</p> <p>Consideration was given to the suggested reviewers from the PIs, yet in rare occasions, the PI did not provide a list of suggested reviewers.</p> <p>CCIs have not traditionally invited reviewers specifically for Broader Impacts or Data Management. The program Officer reports that focusing solely on broader impacts has sometimes proved less successful or even at odds with evaluating intellectual merit. However, there has been greater success in identifying reviewers who are passionate about both intellectual merit and broader impacts, such as education and broadening participation. For topics like broader impacts or innovation, <i>ad hoc</i> reviewers have proven to be more effective, especially when considering the broad nature of the research and impact proposed in the proposals. In general, the large number of reviewers of varying background is a major strength of the review process. This is particularly commendable given the challenge of avoiding conflict of interests.</p> <p><b>Data Source: Jackets</b></p> | <p>YES</p>  |
| <p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>Comments:</p> <p>The POs have done a good job identifying and moderating conflicts of interest.</p> <p><b>Data Source: Jackets</b></p>  | <p>YES</p>  |

| <b>SELECTION OF REVIEWERS</b>   | <b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b> |
|---|---|
| <p>3. Additional comments on reviewer selection:</p> <p>The composition of the reviewers and panels was balanced, with a wide range of expertise across various chemical disciplines. The panels were also notably diverse, with a good representation from early-career researchers. Also, reviewers included a strong representation from both Primarily Undergraduate Institutions (PUIs) and PhD-granting institutions.</p> <p>If proposals involve outreach activities to PUI students in Phase 2, the COV suggests that CHE perhaps consider enhancing the review expertise with panelists from PUIs or MSIs.</p> | <p>YES</p>  |

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

***Table 4 - Management of the Program Under Review***

**MANAGEMENT OF THE PROGRAM UNDER REVIEW**

1. Management of the program.

Comments:

The Program Officers have been available to the Management team PIs and all other PIs in the CCIs. Especially during the evaluation of proposals, communication between PIs and POs has been crucial to continue the success of the program. Examples include updates of applications and guidance on site visits, which has ensured the success of the programs.

In declined proposals, occasionally, the POs worked with the PIs to redirect the proposal to other programs or agencies.

The management of the program review process is overall consistent and on a positive trend. Examples are that the panel size is consistent and the dwell time for proposals is on average 3.5 months, showing the review process is efficient.

The materials provided about the program management show there are Phase 1 Interim Reviews, which are important for feedback as these Centers compete for Phase 2 funding. Phase 2 awards receive oversight that shows there is guidance to success for these Centers. For example, Phase 2 regularly scheduled site visits in years 2, 4, 7 and 8 ensure there is appropriate assessment and guidance for the program as well as promoting optimal scientific advances, societal impacts, and innovation.

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

Comments:

This CCI program not only funds a Center comprised of academics but also promotes collaborations with government labs, FFRDCs, and industry, promoting a path for transformative research from academia to industry. This breadth of collaboration also leads to multiple educational activities to include educational outreach efforts with broad geographic reach.

Broader impacts have improved education for undergrads, grads, and postdocs. The COV noted an increasing level of connection between CCIs through education and professional development activities. The COV suggests incentivizing this cross-CCI collaboration more.

## MANAGEMENT OF THE PROGRAM UNDER REVIEW

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

Comments:

Planning and prioritization for CCIs have been effectively guided by previous COVs and the MPSAC, with additional input from the National Science Board and program officers. CCIs have done a good job innovating and predicting trends in chemistry, largely by the insights of PIs. For example, CCIs anticipated the rise of machine learning before the surge of AI in 2023. This foresight is partly based on analyzing the ability of the program to provide awards in response to proposal trends within NSF, including CAREER proposals, to understand the evolving landscape of chemistry.

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

Comments:

The CCI program has responded effectively to previous COV reports by implementing several key changes. For instance, CCI proposals now include a comprehensive description of the data management program, with POs emphasizing its importance to the synergistic aspects of a center in its panel discussions, providing guidance to reviewers, and in discussions to increase funding levels. The program has also encouraged partnerships with industry, particularly in relation to innovation. Additionally, there has been a continuous effort to broaden the diversity of faculty participants.

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

**Table 5 - Resulting Portfolio of Awards**

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</b> |
|--|--|
| <p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>Comments:</p> <p>Proposals exhibit broad area coverage ranging from mechanical control of chemistry to adapting flaws-to-features to interfacial ionics to MXenes synthesis. The multidisciplinary nature of proposals allows for broad coverage of sub-disciplines.</p> <p>Phase 1 and Phase 2 CCI awards represent a good balance across disciplines.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 8</b></p> | <p>Appropriate</p>   |
| <p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>Comments:</p> <p>Good outcomes from the investments made suggest that the projects are of reasonable size and duration.</p> <p>To achieve the favorable, high-impact research outcomes that the CCI program has been established to produce, more funding is required. With rising costs of research, this should be considered.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 4</b></p>  | <p>Appropriate</p>   |

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|--|--|
| <p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>Comments:</p> <p>The funded programs emphasize transformative research; based on review of project reports, their goals are being achieved. The internally funded projects tended to be high risk-high reward (most failed, but something was learned). This is an essential goal of these Centers to produce innovative and transformative research. From the documentation it is clear this has been achieved.</p> <p><b>Data Source: Jackets</b></p> | <p>Appropriate</p>   |
| <p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>Comments:</p> <p>Most of the awards are to projects that are highly inter- or multidisciplinary.</p> <p><b>Data Source: If co-funding is a desired proxy for measuring inter- and multi-disciplinary projects, the Co-Funding from Contributing Orgs and Co-Funding Contributed to Recipient Orgs reports can be obtained using Enterprise Reporting, COV Dashboard, Question 7</b></p>  | <p>Appropriate</p>   |
| <p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>Comments:</p> <p>Awards appear to follow populations.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 2</b></p>   | <p>Appropriate</p>   |

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|--|--|
| <p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>Comments:</p> <p>The COV noted that there do not appear to have been any awards to MSIs. Considering the nature of this type of program, highly-intensive research academic institutions are more likely to have successful applications.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 3</b></p>   |  |
| <p>7. Does the program portfolio have an appropriate balance of awards to new and early-career investigators?</p> <p>NOTE: A new investigator is an individual who has not served as the PI or Co-PI on any award from NSF (with the exception of doctoral dissertation awards, graduate or post-doctoral fellowships, research planning grants, or conferences, symposia and workshop grants.) An early-career investigator is defined as someone within ten years of receiving his or her last degree at the time of the award.</p> <p>Comments:</p> <p>Because of the nature of this Center program, a new PI is very unlikely to be a Center lead PI but could be a co-PI. However, the program is encouraged to promote early-career investigators to participate as senior personnel in these centers. However, the COV does recognize that there can be challenges for early-career investigators to be involved in a large collaborative effort.</p> <p><b>Data Source: Information on new PIs available via Enterprise Reporting, COV Dashboard, Question 6</b></p> | Appropriate  |

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|--|--|
| <p>8. Does the program portfolio include projects that integrate research and education?</p> <p>Comments:</p> <p>Project descriptions for most projects (reviewed project descriptions) clearly indicate integration of research and education while a small number did not. The funding for graduate and postdoctoral researchers is clearly stated in the guidelines. The program-specific criteria for Phase II specifically highlight educational activities as a review component.</p> <p><b>Data Source: Jackets</b></p> | Appropriate  |
| <p>9. Does the program portfolio have appropriate participation of underrepresented groups<sup>3</sup>?</p> <p>Comments:</p> <p>Through broader impact activities, there is an emphasis on including underrepresented groups. Only a small number of PIs and co-PIs from underrepresented minority groups were reflected among the awards. Efforts should be made to continue to improve in this area.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 5</b></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:</p> <p>The programs are addressing important issues that face our nation. The program officer indicates that trends are determined from CAREER proposals, national academy-sponsored workshops, and the like.</p> <p><b>Data Source: Jackets</b></p>   | Appropriate  |

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<sup>3</sup> 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.

| <b>RESULTING PORTFOLIO OF AWARDS</b>  | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|---|--|
| 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.

For CCI, the COV recommends establishing some sort of database to capture and track (for as long as reasonable) the students who are trained and/or graduate from a Center. One of the major outcomes of a Center is the students who are produced that go on to other jobs and contribute.

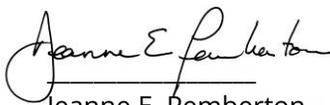
2. Please provide comments as appropriate on the program's performance in meeting program-specific goals and objectives that are not covered by the above questions.
3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.
4. Please provide comments on any other issues the COV feels are relevant, bearing in mind that COV reviews do not include assessment or evaluation of the outcomes or long-term impacts of program investments.
5. NSF would appreciate your comments on how to improve the COV review process, format, and report template.

The COV found it a bit confusing to sort through the eJackets/review materials provided, because there was no example of a successful Phase 2 proposal with previous review cycles (Phase 1 to Phase 1 Full Proposal invited to Phase 2 proposal invited). Understanding we are reviewing the process and not the research, this choice of eJackets does not prevent an effective review, but this aspect of the proposals chosen caused some confusion with COV members without much experience with the CCI program.

*The Committee of Visitors is part of a Federal Advisory Committee. The function of Federal Advisory Committees is advisory only. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the Advisory Committee, and do not necessarily reflect the views of the National Science Foundation.*

### SIGNATURE BLOCK:

For the 2024 COV



Jeanne E. Pemberton  
Co-Chair



Scott D. Rychnovsky  
Co-Chair

## INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

### Chemistry of Life Processes (CLP)

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, returns without review, and withdrawals) that were *completed within the review period (generally the prior four 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.

**Table 2 - Quality and Effectiveness of the Merit Review Process**

| <p><b>QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</b></p>  | <p><b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b></p> |
|--|--|
| <p>1. Are the review methods (for example, panel, <i>ad hoc</i>, site visits) appropriate?</p> <p>Comments:</p> <p>Reviewers for both <i>ad hoc</i> evaluations and panels (in-person or virtual) consisted of experts that seemed to reflect gender, geographic, and institutional diversity. The majority of the proposals were reviewed by panels rather than <i>ad hoc</i>, despite the SARS-CoV2 pandemic. These panels during the review period were conducted virtually, except in 2020 and 2023 during which both in-person and virtual panels were utilized. The COV was pleased to note no noticeable differences in the style or quality of the reviews between the <i>ad hoc</i>, virtual, hybrid, and in-person panel reports. The priority ranking system that follows panel discussion (high, medium, low) continues to be an appropriate way to sort proposals efficiently. The previous COV report suggested the implementation of hybrid panels, which was carried out in 2019, but in 2023 were only in-person or fully virtual. The COV encourages the re-implementation of hybrid panels when/where appropriate to improve representation and broaden participation while allowing for in-person networking opportunities.</p> <p>Reviewer training concerning bias in the form of audio-visual handouts, to be studied voluntarily prior to the meetings, appears to have had some positive impact. It is noted that no specific evidence of these training materials was provided to the COV. The COV noted that there may be remaining issues regarding reviewer training, as bias was evident for at least one proposal. The COV recommends that all reviewers are required to provide evidence of completion of bias training prior to panel participation.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 6</b></p> | <p>YES</p>   |

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS  | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|--|--|
| <p>2. Are both merit review criteria addressed</p> <p>a) In individual reviews?</p> <p>    a. Yes, although there are inconsistencies both in format, organization, and level of detail in the initial reviews.</p> <p>b) In panel summaries?</p> <p>    a. Yes</p> <p>c) In Program Officer review analyses?</p> <p>    a. Yes, for the most part, the PO review analyses are consistently of high quality. However, a few reports from one PO were found to be terse while others from this PO were more detailed.</p> <p>Comments:</p> <p>Discussion of the Broader Impacts criterion was reported before virtual panels. Intellectual merit and Broader Impact review criteria are addressed in the majority of the individual reviews, in all panel summaries, and in the Program Officers review analyses. With respect to the Program Officers' review analyses, the COV commends the POs for thorough analysis, which offered special deliberation to outlier scores and bringing together all the reviewers' comments. In addition, the POs provided keen analysis and insight into how a specific panel functioned, which might impact funding decisions.</p> <p>The COV recommends that all programs in CHE consistently require the use of the NSF review template.</p> <p>Clearer guidance from the CHE on the level of detail needed for both the individual reviews and the review analyses is advised.</p> <p>PIs would benefit from a more consistent level of detail/constructive remarks in individual reviews, especially if a reviewer finds the proposal lacking.</p> <p><b>Data Source: Jackets</b></p> | <p>YES</p>                                     |

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS  | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|--|--|
| <p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>Comments:</p> <p>The majority of individual reviews include substantive comments about the Intellectual Merit and Broader Impacts. However, the level of detail in the written reviews varies, possibly because of different personal styles, experience levels, etc.</p> <p>While the previous COV noted evidence of the “halo effect” in some individual reviews, this was not observed in the current period, although there are a few reviews where the critiques do not match the rating.</p> <p>As noted by the 2020 COV, inconsistency in time and effort spent reviewing the Intellectual Merit (IM) versus Broader Impacts (BI) has persisted. In many cases, reviewers write much shorter sections assessing the BI. For some proposals, POs make explicit comments about reviewers not providing substantive comments on broader impacts in their reviews.</p> <p>There continue to be uneven expectations for BI depending upon PI career stage and perceived research productivity. More emphasis seems to be increasingly placed on long-term assessment of proposed BI activities even though this is not formally required by the NSF nor a skillset all PIs may possess. Some PIs have the institutional and personal know-how that enables them to request budgetary support for paid consultants to do this work, while others without this knowledge or institutional support may suffer lower ratings.</p> <p>A large number of proposals describe BI plans that involve outreach to minoritized groups. The outcome of these efforts, however, is not clear in individual annual or final reports, and it is not clear to the COV whether the NSF is tracking the societal impact of the proposed BI plans in funded grants. NSF has not put in place standardized ways to assess the longitudinal impact of BI activities.</p> <p>Overall, the COV is not of one opinion regarding BI review. Some members commented on the appropriateness of the BI review and only raised concerns about the apparent lack of long-term assessment of BI efforts, whereas other members have significant reservations regarding the lack of information about what CHE and CLP in particular deem as appropriate BI activities and how these can be assessed in proposal review.</p> <p><b>Data Source: Jackets</b></p> | <p>Yes</p>                                     |

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS  | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|--|--|
| <p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>Comments:</p> <p>For proposals that were discussed, the panel summary provides clear rationale for the panel consensus. Most panel summaries reflected the ranking of the proposal, for example with strengths in intellectual merit and broader impacts outweighing weaknesses falling in medium priority. A number of proposals were not discussed in their panels (NDP, number varies by panel), which streamlined the review process for many panels. A significant benefit of panel discussion is that both overly critical and over-enthusiastic reviews may be tempered or corrected by the discussion; <i>ad hoc</i> reviews do not benefit from this discussive process.</p> <p><b>Data Source: Jackets</b></p> | <p>Yes</p>                                     |

| <b>QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</b>  | <b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b> |
|---|---|
| <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:</p> <p>The documentation in the Jacket provides appropriate rationale for award or declination decisions. The PO Review Analyses provided information on panel selection, COI information, overall ranking of the proposal, summaries of individual reviews, information on panel discussions, PO observations (e.g. one reviewer ranks almost all proposals as “very good”), “outlying reviews”, and other relevant information.</p> <p>The numerical ranking of the proposal provided in the PO Review Analysis, among all other pieces of information, helped to give a sense of the overall standing of the proposal and the justification for award/decline decisions.</p> <p>The summaries and review analyses also provided interesting insights into the panel discussions and showed how they reached consensus for their ratings. The PO correspondence and diary notes are helpful in matters where co-funding requests are made to strengthen the portfolios of multiple divisions (CBET and EPSCOR). The COV commends the POs for the level of detail included in the review analyses.</p> <p>The documentation in the jacket provided adequate information to justify the action for one proposal being returned without review.</p> <p>Implementation of the ChemRA - Standard CHE Review Analysis Template in 2022 resulted in greater consistency in the Review Analyses written by POs.</p> | <p>YES</p>  |

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS   | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|---|--|
| <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:</p> <p>Correspondence to the PI does include the rationale for the award or declination decision. The individual reviews and panel summary (when applicable) gives clear feedback regarding strengths and weaknesses of the proposal. Phone calls and correspondence between the PO and PI are documented in the ejacket and contain additional input/feedback that is extremely helpful for the PI. The PO comments, especially to early career PIs, are insightful and will help them craft better proposals.</p> <p>PIs would benefit from a more consistent level of detail/constructive remarks in individual reviews, especially if a reviewer finds the proposal lacking.</p> <p>Mandatory use of the NSF review template would increase consistency across Individual reviews.</p> <p><b>Data Source: Jackets</b></p> | <p>YES</p>                                     |
| <p>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</p> <p>Funding decisions without any external review included EAGER and RAPID COVID-19 proposals. The COV suggests CHE solicit <i>ad hoc</i> reviews when possible to ensure the best insight into the innovation of the proposals.</p> <p>While the merit review process is found to be rigorous and robust, formalized mandatory bias and review training and required use of the review template is recommended.</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.

**Table 3 - Selection of Reviewers**

| <b>SELECTION OF REVIEWERS</b>   | <b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b> |
|---|---|
| <p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>Comments:</p> <p>The COV commends the CLP program officers and CHE directors for the outstanding selection of reviewers and management of the reviewing process. CLP identified experts for panels and for <i>ad hoc</i> review. The majority of the reviewers were from PhD-granting institutions. A smaller number of experts from 4-year and other institutions were also included. In general, the program drew reviewers from a broad geographic area. Several regions were more represented including CA, TX, NC and the Northeast (NY, PA), likely reflecting the number of experts and density of institutions in those states. The program officers used the suggested reviewer lists from the PI, reviewer databases (Suggested reviewers, NSF database of reviewers), and other tools to identify people with appropriate expertise. They also sought to incorporate reviewers of different ranks (Assistant through Full) on panels.</p> <p>The prior COV report noted a lack of diversity (i.e. gender, race, and institutions) amongst the reviewers. The CLP is making advances in diversity in terms of gender and institutions. It is a little more difficult to gauge other types of diversity as self-reporting does not always capture this. The COV encourages the CLP program to continue to improve diversity in the review process, as a wider range of perspectives enhances innovation.</p> <p><b>Data Source: Jackets</b></p> | <p>Yes</p>  |

| <b>SELECTION OF REVIEWERS</b>  | <b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b> |
|--|---|
| <p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>Comments:</p> <p>Yes, the program used EAC tools, PDF searches, self-reporting, and special consideration for the 4-month submission window to check for COIs. In addition, before the start of the panel, panelists were reminded of COI rules.</p> <p>If a conflict arose, reviewers were moved to a waiting room (virtual panel) or left the room for an in-person panel. If the PO had a conflict of interest, a different PO was in charge of the review process for that particular proposal.</p> <p><b>Data Source: Jackets</b></p>  | <p>Yes</p>  |
| <p>3. Additional comments on reviewer selection:</p> <p>The 2020 COV committee found the “List of Suggested Reviewers and Reviewers Not to Include” was underutilized. Given the review analyses seen by this COV, it seems that POs did take this suggestion and considered the “List of Suggested Reviewers” and “List of Suggested Reviewers and Reviewers Not to Include” much more frequently during the 2020-2023 period.</p> <p>The COV commends significantly higher gender diversity in the CLP reviewer program during the current period compared with the overall CHE Division.</p> <p>As noted in the previous COV report, hesitancy to report demographic information may impede ongoing efforts to evaluate reviewer diversity.</p> |   |

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

***Table 4 - Management of the Program Under Review***

**MANAGEMENT OF THE PROGRAM UNDER REVIEW**

1. Management of the program.

Comments:

The management of the program is appropriate. The CLP has a solid mix of experienced program officers, with a team of 5-7 people including rotators from a range of institutions. The workload amongst the POs appears to be well-balanced and equitable. The POs have diverse expertise over biochemistry, bioinorganic chemistry, bioorganic, biophysics, chemical probes, computation, enzymology, inorganic/organic and structural biology. The Chem RA- standard CHE Review Analysis was implemented in FY 2022. Proposal handling and processing are clearly outlined. CHE transitioned in FY 2023 to a no-deadline pilot for submissions for 3 programs. The full impact of this move is unclear. Interestingly, fewer proposals were received under the no-deadline pilot. The move to no-deadline decreased the number of proposals by approximately one half during the first year of the no-deadline pilot.

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

Comments:

CLP is highly responsive to emerging research and provides funding for multiple educational opportunities across a broad range of levels. The CLP program is broad in scope and identifies excellent science. Funded proposals clearly address new chemistry knowledge as directed toward biologically relevant questions. Initiatives over this period included the CARES Act, Understanding the Rules of Life, and Molecular Foundations for Biotechnology. The CLP also participates in other initiatives such as COVID19 RAPID, Harnessing the Data Revolution, Data-Driven Discovery Science in Chemistry and Bioeconomy. The program utilizes both internal (e.g. retreats, program officer discussions and updates on program synopses) and external methods to identify emerging fields and new initiatives. External methods include workshops, sponsored NASEM studies, Conferences, Webinars and requests for Information. For example, the 2024 National Academies Report on "Charting a Future for Sequencing RNA and Its Modifications" falls under CLP's area of interest.

Collaborative initiatives enable a symbiotic relationship between partner institutions to facilitate research and educational opportunities. RAPID and EAGER proposals allow the flexibility to fund emerging areas.

## MANAGEMENT OF THE PROGRAM UNDER REVIEW

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

Comments:

The program planning and prioritization is clear, as the focus is strongly on intellectual merit as well as broader impacts.

Both internal and external resources were used to guide the development of the portfolio. For internal resource, POs formulated action plans via retreat, program synopsis updates/discussions, active PO discussions within the program, informal discussions with other programs and division leadership. For external resources, POs participated in workshops, sponsored NASEM studies, attended conferences, interacted with applicants in office hours.

The COV encourages CLP POs to reach out more to the community and attend a variety of research conferences. For example, smaller focused conferences provide ample opportunities for interaction with meeting attendees and provide rich opportunities for the PO to be exposed to trends of the research field and get acquainted with grantees and aspiring PIs for feedback.

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

Comments:

The program has been responsive to previous COV recommendations, particularly in providing guidance to reviewers on topics related to implicit bias and RUI /PUI proposals. Efforts to enhance reviewer diversity and inviting *ad hoc* reviewers to supplement the panel are recognized. Several recommendations led to effective changes as stated in the Response to the 2020 COV.

Broader impacts were less emphasized in individual reviews compared to the panel summary. The prior COV suggested that the program could provide more guidance and training to reviewers. The CLP responded to this recommendation by including a pre-panel discussion about broader impacts. In general, most individual reviews now address BIs with detailed analysis of strengths and weaknesses.

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

**Table 5 - Resulting Portfolio of Awards**

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</b> |
|--|--|
| <p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>Comments:</p> <p>The program portfolio covers a broad range of chemistry applied to biological problems including carbohydrates, chemical probes, computation, enzymes, lipids, proteins, metalloproteins/enzymes, and nuclei acids. In general, there is a good balance of award types across the portfolio including EAGER and D3SC awards. Not many CDS&amp;E, RUI, CAREER, or Collaborative Research proposals were awarded during this evaluation cycle.</p> <p>The COV found it difficult to judge whether there was a balance across the scientific sub-disciplines, as adequate data for this was not provided.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 8</b></p> | <p>Data not available</p>                                  |
| <p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>Comments:</p> <p>During the 2020 - 2023 timeframe, the average award duration increased slightly, while the median duration held steady. This increase likely comes from CAREER awards (5-years) as well as 4-year individual investigator awards. The exact number of awards in each category was not clear. The size of the awards also grew, likely a reflection of this increase in duration. The number of awards also dropped significantly over this period, an unfortunate outcome of a flat overall budget.</p> <p>Because of the recent significant increase of research costs, it is challenging to maintain the innovative science funded by CLP awards.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 4</b></p>  | <p>Appropriate</p>   |

| <b>RESULTING PORTFOLIO OF AWARDS</b>  | <b>APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</b> |
|---|--|
| <p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>Comments:</p> <p>Reviewers and panels look specifically for transformative science as part of the Intellectual Merit criteria, with POs selecting the best projects for awards. Program officers also rate RAPID and EAGER proposals for their potential to produce transformative, high risk-high reward science. The portfolio includes innovative proposals that develop new chemical tools and investigates new approaches to sustainability. Emerging Frontier proposals span several NSF divisions and often pair experimental science with Machine Learning / AI prediction.</p> <p><b>Data Source: Jackets</b></p> | Appropriate  |
| <p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>Comments:</p> <p>Yes, the program co-funds over 50 inter- and multidisciplinary projects among the CAREER, EPSCoR, RUI awards, also including Understanding the Rules of Life and Bioeconomy/Biotechnology initiatives. In addition, CLP co-funded awards with CBET, CMI, CMFP, HBCU-EiR, and MCB.</p> <p><b>Data Source: If co-funding is a desired proxy for measuring inter- and multi-disciplinary projects, the Co-Funding from Contributing Orgs and Co-Funding Contributed to Recipient Orgs reports can be obtained using Enterprise Reporting, COV Dashboard, Question 7</b></p>   | Appropriate  |
| <p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>Comments:</p> <p>CLP awards are distributed throughout the continental United States as well as Hawaii and Puerto Rico. Given the density of PhD-granting institutions, there are a larger proportion of awards from large states as well as in high-density population regions of the country. There is generally strong representation from EPSCoR states among the awards.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 2</b></p>  | Appropriate  |

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|--|--|
| <p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>Comments:</p> <p>The majority of awards go to research-active, PhD-granting institutions, as they submit a larger percentage of the proposals. In addition, 4-year institutions, including HBCUs, HSIs, MSIs, PUIs, and Masters-granting institutions also received awards.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 3</b></p>   | <p>Appropriate</p>   |
| <p>7. Does the program portfolio have an appropriate balance of awards to new and early-career investigators?</p> <p>NOTE: A new investigator is an individual who has not served as the PI or Co-PI on any award from NSF (with the exception of doctoral dissertation awards, graduate or post-doctoral fellowships, research planning grants, or conferences, symposia and workshop grants.) An early-career investigator is defined as someone within ten years of receiving his or her last degree at the time of the award.</p> <p>Comments:</p> <p>New investigators received an appropriate number of awards from CLP. As expected, the award success rate is lower for PIs with no prior support than for established investigators, given that time is needed to develop projects and grantsmanship. CHE's efforts to cultivate the next generation investigators, such as Early Career Workshop and CAREER awards, are well recognized by the community. The COV encourages CHE to continue these efforts and possibly find additional ways to help new investigators developing their career as researchers and educators.</p> <p><b>Data Source: Information on new PIs available via Enterprise Reporting, COV Dashboard, Question 6</b></p> | <p>Appropriate</p>   |

| <b>RESULTING PORTFOLIO OF AWARDS</b>  | <b>APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</b> |
|---|--|
| <p>8. Does the program portfolio include projects that integrate research and education?</p> <p>Comments:</p> <p>Yes, all the CAREER proposals integrate research and educational activities. In addition, many other proposals routinely integrate education into their research projects to enhance their broader impacts.</p> <p><b>Data Source: Jackets</b></p>   | <p>Appropriate</p>   |
| <p>9. Does the program portfolio have appropriate participation of underrepresented groups<sup>4</sup>?</p> <p>Comments:</p> <p>Only a small percentage of proposals to CLP were submitted by persons from URGs (as self-reported). This may reflect actual low submission numbers, or an unwillingness/inability to be identified. These low numbers should be addressed.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 5</b></p> | <p>Appropriate but should be improved</p>                  |

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<sup>4</sup> 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.

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|--|--|
| <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:</p> <p>The CLP program supported projects investigating impactful projects under the CARES Act, Understanding the Rules of Life, and Molecular Foundations for Biotechnology. The CLP also participated in other initiatives including COVID19 RAPID, Harnessing the Data Revolution, Data-Driven Discovery Science in Chemistry and Bioeconomy, and New Approaches to Sustainability. The CLP program also supported grants that frequently contain educational components in the BI section to help prepare a workforce in the chemical sciences that is essential to society. The research directly benefited the U.S. economy and created job opportunities. The program's efforts align with the nation's need to maintain technological/economical prowess and made contributions to ensure the prosperity and security of the country.</p> <p><b>Data Source: Jackets</b></p> | <p>Appropriate</p>   |
| <p>11. Additional comments on the quality of the projects or the balance of the portfolio:</p> <p>The CLP clearly funds high quality proposals. To truly evaluate the balance of the portfolio, more data is needed.</p>   |  |

## OTHER TOPICS

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

General comment – In Broader Impacts, many reviews cited a lack of assessment as a weakness. CHE should provide additional guidance to PIs on what types of assessments are appropriate and expected.

CLP should consider tracking the declining number of submissions from URGs and see if it tracks with the increase in submissions from groups unwilling to provide that information.

The decline in the number of proposals to CLP is concerning. The program should monitor the no-deadline impact over the next few cycles.

NSF should increase the visibility and advertisement of new resources on the NSF website (<https://new.nsf.gov/funding/learn/broader-impacts>) about BI assessment and implementation. This would have the additional advantage of also standardizing and capturing this information and would help as an additional tool for reviewer training in addition to the COV recommendation for required reviewer training in bias.

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.

The COV commends CHE for identifying and providing funding for transformative science that aligns with the agency's mission. The COV recognizes the slight increase in budget over the last few years. But in order to meet national priorities and support transformative science, more investment will be needed.

Information mined from the Annual reports could be used to advocate for an increase in budget.

4. Please provide comments on any other issues the COV feels are relevant, bearing in mind that COV reviews do not include assessment or evaluation of the outcomes or long-term impacts of program investments.

It was not clear to the COV how long the pilot for the no-deadline submission would be. How does the decrease in number of submissions of CLP track with other programs that have also moved to no deadlines?

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

Additional study and further data would be helpful in evaluating the appropriateness of balance of the CLP portfolio. For example, it would be useful to track over time the participation of URGs, geographical distribution, and institution type.

*The Committee of Visitors is part of a Federal Advisory Committee. The function of Federal Advisory Committees is advisory only. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the Advisory Committee, and do not necessarily reflect the views of the National Science Foundation.*

**SIGNATURE BLOCK:**

For the 2024 COV

  
\_\_\_\_\_  
Jeanne E. Pemberton  
Co-Chair

  
\_\_\_\_\_  
Scott D. Rychnovsky  
Co-Chair

## INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

### Chemical Mechanism, Function and Properties (CMFP)

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, returns without review, and withdrawals) that were *completed within the review period (generally the prior four 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.

**Table 2 - Quality and Effectiveness of the Merit Review Process**

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS  | YES, NO,<br>DATA NOT<br>AVAILABLE, or<br>NOT<br>APPLICABLE |
|--|--|
| <p>1. Are the review methods (for example, panel, <i>ad hoc</i>, site visits) appropriate?</p> <p>Comments:</p> <p>The COV recognizes that this program has made tremendous strides in transitioning to primarily reviews by panels. The overwhelming number of reviews were conducted via virtual panels, with some supplementary <i>ad hoc</i> reviews. We believe that further efforts are needed to limit the number of reviews that are solely mail-in/<i>ad-hoc</i>, as this does not allow for the calibration of review rankings that are typically done in panel discussions. For proposals that do not fit well in a particular panel, the COV recommends that every effort should be made to ensure that all proposals are included in a panel, even if these proposals have to be supplemented with 1-2 additional <i>ad-hoc</i> reviews.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 6</b></p> | <p>Yes, for the most part</p>                              |

| <b>QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</b>   | <b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b> |
|--|---|
| <p>2. Are both merit review criteria addressed</p> <p>a) In individual reviews?</p> <p>b) In panel summaries?</p> <p>c) In Program Officer review analyses?</p> <p>Comments:</p> <p>In general, the intellectual merit portion continues to be addressed well in the individual reviews and panel summaries. However, the broader impacts criteria continue to be a challenge, as it is not clear from the reviews and panel summaries how much weight is placed (or should be placed) on this aspect of the proposal. This is also not clear to the PIs. The COV recommends that there should be clearer specific guidelines for BIs. For example, what proportion of the proposal should be devoted to BIs and how should this aspect of the review criteria be assessed?</p> <p>The POs do an effective job in the review analyses providing the rationale for funding decisions. The prior COV report noted that individual reviewer ratings (E, V, G, etc.) are sometimes inconsistent with the comments. This continues to be the case and again emphasizes the importance of panels where ratings can be calibrated.</p> <p><b>Data Source: Jackets</b></p> | <p>Yes</p>  |
| <p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>Comments:</p> <p>Individual reviews, though varied in length and detail, do provide PIs with substantive information to explain their assessment of proposals. However, as noted above, the individual rankings are not always consistent with the outcomes of the review panels.</p> <p><b>Data Source: Jackets</b></p>  | <p>Yes</p>  |

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS   | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|---|--|
| <p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>Comments:</p> <p>The panel summaries provided a reasonable overview of the panel discussion. However, we often found that the PO Review Analyses were most informative.</p> <p><b>Data Source: Jackets</b></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:</p> <p>The PO Review Analysis was the most useful component of the jacket. The program made it clear from the documentation why certain proposals were ranked the way they were. Discrepancies in the individual rankings and the panel summaries are often clarified. When a proposal is reviewed in a panel, the number of proposals reviewed, and their relative rankings are usually provided. In cases where there is a discrepancy, the PO, in consultation with the program, makes a final award/decline recommendation. The PO rationale is not always clear, however, as a need to balance the portfolio is often used as a basis for a decision. This is not as helpful, since it is not clear what criteria (size of subdivision, number of submissions, proposal type, diversity, etc.) are used to balance the portfolio.</p> <p><b>Data Source: Jackets</b></p> | <p>Yes, for the most part</p>                  |

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS  | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|--|--|
| <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:</p> <p>Where we could see award emails to the PIs, the PO summaries were informative and provided clear rationales for the decision. However, this could be strengthened if some of the information included in the review analyses, like relative rankings, were provided to the PI.</p> <p><b>Data Source: Jackets</b></p> | <p>Yes</p>                                     |
| <p>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</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.

**Table 3 - Selection of Reviewers**

| <b>SELECTION OF REVIEWERS</b>   | <b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b> |
|---|---|
| <p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>Comments:</p> <p>Overall, the program made good use of reviewers with the appropriate expertise. We noticed that, in this program, suggested reviewers were not often utilized, and it was not made clear why. A likely compromise would be to ask one suggested reviewer and to balance them out with panel reviewers. It would also be useful if the career stage of the reviewer (early, mid, late) and affiliation (academic, industry or national labs) were made more explicitly clear to the COV. This would enable a more accurate assessment of the diversity of reviewers. The program does a good job to include a PUI reviewer for RUI proposals in most cases.</p> <p><b>Data Source: Jackets</b></p> | <p>Yes</p>  |
| <p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>Comments:</p> <p>The program did a good job of resolving conflicts of interest and took appropriate precautions by removing those with conflicts from panel discussions.</p> <p><b>Data Source: Jackets</b></p>  | <p>Yes</p>  |
| <p>3. Additional comments on reviewer selection:</p>  |   |

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

***Table 4 - Management of the Program Under Review***

| <b>MANAGEMENT OF THE PROGRAM UNDER REVIEW</b>  |
|--|
| <p>1. Management of the program.</p> <p>Comments:</p> <p>The program appears to be well-managed and consists of four program officers which is appropriate for the size of the program. The name change from CSDM-B to CMFP was important and may lead to more submissions to this program and a minimization of submissions of proposals that do not fit. We would encourage the program to do its best to clarify why some proposals that are ranked Medium Priority receive funding and why others don't, based upon the comments provided. It may be useful for programs more generally (not just CMFP) to have award recipients from Medium Priority address negative comments before receiving the award to ensure that these comments are fairly addressed.</p> |
| <p>2. Responsiveness of the program to emerging research and education opportunities.</p> <p>Comments:</p> <p>The program is responsive to emerging research areas, including QIS, energy research, and sustainable chemistry. In addition, the program also took advantage of special programs such as GOALI and EIR.</p>   |
| <p>3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.</p> <p>Comments:</p> <p>The process seems reasonable, but it would have been helpful to have had more information about the nature of the PO discussions and what conferences the POs attended. We realize that it may be challenging for this program to select clear directions, because this is a diverse program that serves many interests. At times, the program seems like a needed 'catch-all' program. The COV appreciates that this program attempted to rename itself for clarity.</p>  |
| <p>4. Responsiveness of program to previous COV comments and recommendations.</p> <p>Comments:</p> <p>The program was responsive, in part, to 2020 COV comments. Funding size did increase, but not at a rate that kept up with student and material costs. There seemed to be a stronger link between reviewer ratings and proposal comments since 2020.</p>  |

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

**Table 5 - Resulting Portfolio of Awards**

| 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:</p> <p>Proposals were organized into seven areas for panel discussion. This was in response to the types of proposals submitted to this program and the areas of interests. Proposals that did not fit in these categories were reviewed by <i>ad-hoc</i> reviews and not discussed in a panel. The program panels illustrated the breadth of disciplines in the portfolio. The program awards seem reasonably balanced, although the number of proposals handled by panels in two new areas (electrochemistry and QIS) was significantly smaller than those handled by other panels and in general resulted in higher success rates than from other panels. Perhaps these two areas could be combined into one panel. In addition, every effort should be made to minimize the number of proposals that are reviewed <i>ad-hoc</i> only.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 8</b></p> | <p>Appropriate</p>                                  |
| <p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>Comments:</p> <p>The size and duration of the projects in this program are comparable to those in other programs. There are arguments in favor of larger award sizes and durations. In some cases, moving to 4-year awards would be preferable. For example, for the RUI program, given the complexity of performing research with primarily undergraduates, and slower pace of research productivity at these institutions, the grants for these programs should be four years instead of three.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 4</b></p>   | <p>Partially appropriate</p>                        |

| RESULTING PORTFOLIO OF AWARDS  | APPROPRIATE,<br>NOT APPROPRIATE,<br>OR DATA NOT<br>AVAILABLE |
|--|--|
| <p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>Comments:</p> <p>The program does fund innovative and transformative research; in part, special programs such as GOALI and EAGER facilitate this.</p> <p><b>Data Source: Jackets</b></p>  | <p>Appropriate</p>   |
| <p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>Comments:</p> <p>The nature of the portfolio is interdisciplinary, including topics in QIS and electrochemistry. Some proposals are co-funded with DMR.</p> <p><b>Data Source: If co-funding is a desired proxy for measuring inter- and multi-disciplinary projects, the Co-Funding from Contributing Orgs and Co-Funding Contributed to Recipient Orgs reports can be obtained using Enterprise Reporting, COV Dashboard, Question 7</b></p> | <p>Appropriate</p>   |
| <p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>Comments:</p> <p>The geographical distribution of CMFP's portfolio seemed comparable to that of other experimental programs. Geographical acceptance rates seemed fair and relatively equal across states.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 2</b></p>  | <p>Appropriate</p>   |

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|--|--|
| <p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>Comments:</p> <p>HBCUs, MSIs, and Master’s institutions submit fewer proposals, but also have lower funding rates. This suggests that there may be a gap in resources or grant preparation skills such as lack of time due to the typical teaching loads at these institutions. The development of initiatives that would support researchers from these types of institutions, such as training programs or an increased emphasis of including researchers from these types of institutions in panel reviews, as well as early career researchers may also help with this.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 3</b></p>   | <p>Appropriate</p>   |
| <p>7. Does the program portfolio have an appropriate balance of awards to new and early-career investigators?</p> <p>NOTE: A new investigator is an individual who has not served as the PI or Co-PI on any award from NSF (with the exception of doctoral dissertation awards, graduate or post-doctoral fellowships, research planning grants, or conferences, symposia and workshop grants.) An early-career investigator is defined as someone within ten years of receiving his or her last degree at the time of the award.</p> <p>Comments:</p> <p>This program appears to have a good balance between early-career and later-career investigators. A significant proportion of investigators are less than 10 years from their PhDs. The funding rate for established (or previously funded) PIs is much higher than that for new investigators. It is recommended that more programs like the EARLY CAREER WORKSHOP be established and that they continue to be funded.</p> <p><b>Data Source: Information on new PIs available via Enterprise Reporting, COV Dashboard, Question 6</b></p> | <p>Appropriate</p>   |

| <b>RESULTING PORTFOLIO OF AWARDS</b>  | <b>APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</b> |
|---|--|
| <p>8. Does the program portfolio include projects that integrate research and education?</p> <p>Comments:</p> <p>Most integration occurs in the CAREER awards, as in other programs. Most grants have some component of education. As noted earlier, the evaluation of this aspect of the program via the Broader Impacts review criteria continues to be a challenge for reviewers. This is because greater clarity from the NSF is needed on the relative importance of these sections and how these sections should be assessed. The integration of research and education is generally much better in special programs like the CAREER program because of the requirement for such integration. As one mechanism to address this ambiguity, an identical requirement might also be used for standard proposals, in order to better facilitate the evaluation of the Broader Impacts criterion.</p> <p><b>Data Source: Jackets</b></p> | <p>Appropriate</p>   |
| <p>9. Does the program portfolio have appropriate participation of underrepresented groups<sup>5</sup>?</p> <p>Comments:</p> <p>The representation of URGs among funded proposals does not represent the overall population, but likely represents the diversity of PIs in PhD-granting institutions. The COV suggests CHE explore additional funding mechanisms that support PhDs and postdocs in route to careers in academia such as CMFP-funded postdocs. ASCEND and LEAPS-MPS mechanisms could be expanded.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 5</b></p>   | <p>In part</p>   |

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<sup>5</sup> 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.

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|--|--|
| <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:</p> <p>The program has important and well-defined priorities such as sustainable chemistry, biotechnology, and the CHIPS and science act. In one case, the program officer mentioned the funding decision based on the relative importance to programmatic priorities/emphasis such as earth-abundant metals.</p> <p><b>Data Source: Jackets</b></p> | <p>Appropriate</p>   |
| <p>11. Additional comments on the quality of the projects or the balance of the portfolio:</p>   |  |

## OTHER TOPICS

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

Particularly given the recent program name change, it may be helpful to more clearly delineate what this program funds. This program could better advertise itself, which could potentially increase the number of electrochemistry or quantum information science proposals. As noted above, the program should be encouraged to continue efforts to include all proposals in panels rather than fully ad-hoc 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.

This program had 100% virtual panels, which can be effective, but are not as useful for early-career researchers seeking to build their networks or for offline discussion. That said, virtual panels allow participation by reviewers for whom travel is difficult.

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

The size of the program's awards needs to be carefully considered, given increases in graduate student pay and material and staff costs. The NSF could also do a better job of articulating how Broader Impacts should be reviewed. Four-year awards for RUI grants should be considered. The template for reviewer reports could be expanded to include prompts for assessing results of prior support.

4. Please provide comments on any other issues the COV feels are relevant, bearing in mind that COV reviews do not include assessment or evaluation of the outcomes or long-term impacts of program investments.

Information regarding how programs compare to others along different dimensions (e.g., funding of RUIs, diversity) would have been helpful.

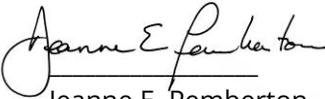
5. NSF would appreciate your comments on how to improve the COV review process, format, and report template.

The process could be improved if all of the information were placed in one location. We received many emails: those could have been put in one place. A single platform also would have been preferred. Additionally, given summer travel, it would have been easier if many resources were more readily downloadable or could be perused while offline. The dashboard was a worthwhile innovation but could still be improved. The COV strongly applauded the virtual meetings of sub-group members before the in-person meeting to facilitate discussion.

*The Committee of Visitors is part of a Federal Advisory Committee. The function of Federal Advisory Committees is advisory only. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the Advisory Committee, and do not necessarily reflect the views of the National Science Foundation.*

**SIGNATURE BLOCK:**

For the 2024 COV



Jeanne E. Pemberton  
Co-Chair



Scott D. Rychnovsky  
Co-Chair

## INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

### Chemical Measurement and Imaging (CMI)

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, returns without review, and withdrawals) that were *completed within the review period (generally the prior four 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.

**Table 2 - Quality and Effectiveness of the Merit Review Process**

| <p><b>QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</b></p>   | <p><b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b></p> |
|---|--|
| <p>1. Are the review methods (for example, panel, <i>ad hoc</i>, site visits) appropriate?</p> <p>Comments:</p> <p>The combination of methods used in the program work well. The program uses panel reviews for most proposals. Each proposal has a minimum of three individual reviews. Panelists have access to all proposals and can participate in all discussion. After panel discussion, the PO makes a recommendation based on the individual reviews, the panel summary and panel discussion, as well as the PO's overall assessment. <i>Ad hoc</i> reviewers were used for most proposals.</p> <p>The panel discussion plays an important role in calibrating the wide range of individual review ratings. The review process is consistent and thorough. The PO summaries were excellent in terms of incorporating information from the individual reviews, the panel summaries, and including their expert perspective on the broader aspects of the program portfolio.</p> <p>Virtual panels worked well during the pandemic, but a gradual return to flexible in-person panels is recommended. Virtual panels have the advantage of potential availability of reviewers who might not be able to travel to NSF. At the same time, it creates the potential disadvantage of reviewers who might be less engaged, leading to a less diverse pool of opinions than would be provided by in-person panels. Hybrid panels give more flexibility with the advantage of availability of reviewers who might not be able to travel to NSF, although it opens the possibility of different contributions for comments from in-person or virtual reviewers.</p> <p>It is important to weigh these issues when selecting the type of panel; the COV recommends having smaller panels when there is a virtual component, to maximize the panelist engagement with proposals not initially reviewed.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 6</b></p> | <p>YES</p>   |

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS  | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|--|--|
| <p>2. Are both merit review criteria addressed</p> <ul style="list-style-type: none"> <li>a) In individual reviews? YES</li> <li>b) In panel summaries? YES</li> <li>c) In Program Officer review analyses? YES</li> </ul> <p>Comments:</p> <p>Individual reviews are written with a wide range of detail and depth. Some reviews are comprehensive, and some are short. In general, panels and review analyses comment on both merit review criteria.</p> <p>There were instances where individual reviews comment less fully on broader impacts, and in those cases the panel discussion often fills in this gap. Panel summaries capture the discussions from individual panelists as well as the <i>ad hoc</i> reviewers who are not present in the panel. Panel discussions also serve to calibrate the range of individual ratings.</p> <p>Broader impacts tend to fall into two distinct dimensions: (i) the societal impacts of the scientific activities, and (ii) the impacts of proposed complementary activities. To provide more clarity to PIs and individual reviewers about what is sufficient to meet the broader impacts criterion, the COV suggests providing more explicit guidance about whether one of the two mentioned dimensions is sufficient, or whether both are needed. In cases where complementary activities are proposed as part of the Broader Impacts, some members of the COV thought that they should be specific to the proposal, well integrated with the scientific activities, evaluated, and properly reported.</p> <p>For NSF announcements with specific criteria, the specific criteria are not always addressed, or they are addressed very superficially. The COV recommends that CHE place an increased emphasis on having individual reviews explicitly assess the specific program criteria, specifically addressing the fit into the specific program and why the proposed effort does not fit into existing programs.</p> <p><b>Data Source: Jackets</b></p> | <p>YES</p>                                     |

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS  | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|--|--|
| <p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>Comments:</p> <p>Most but not all reviews provide substantive comments that justify their rankings. Some Individual reviews are detailed and clear, while others might be too concise making it more difficult to assess the details. The COV recommends that panels be strongly encouraged to ensure that proposals not likely to be funded receive sufficient constructive feedback.</p> <p><b>Data Source: Jackets</b></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:</p> <p>The panel summaries are thorough in considering both merit criteria. They generally capture the essence of the discussion and the <i>ad hoc</i> reviews. They also successfully capture both majority and minority opinions.</p> <p>In many instances the Data Management Plan was only rated as “acceptable” without any justification. For proposed projects that includes data-intensive work and/or computation, the Data Management Plan is an important component of the proposal in which PIs should further show feasibility, resources, and sensitivity to disciplinary norms. The COV recommends that reviews and panelists provide more detailed assessment of the data management plan, especially in cases of data-intensive or computational work.</p> <p><b>Data Source: Jackets</b></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:</p> <p>For the vast majority of the proposals, the reviews, summary, and RA had clear information about the recommendation process. Individual reviews, panel summaries and PO review analysis provide the rationale for the decisions. The rankings from the panel summary generally support the award decisions, with a few instances where the rationale for the PO recommendation was not clearly derived from the jacket material.</p> <p>The eJacket provides excellent documentation of communications with PIs, and among different programs evaluating potential co-funding, although this was not found universally. For some proposals, the eJacket version available to the COV did not fully capture a synopsis of all communications; for example, a summary of the individual conversations of the PO with the PI, panel logistics letters, and the review instructions sent to the panelists were missing from the jacket. This is likely a result of technical issues for COV access to the material and the missing information was considered not needed to formulate opinions.</p> <p>The diary notes provide valuable information regarding decisions for special cases, with the panel summary and review analysis providing the most informative rationale for the recommendation. Although not common, among the eJackets reviewed, there were a few cases where the RA and panel summary showed some discrepancies or where individual reviews and panel summary for different proposals were very similar, but the RA recommendation was not (one funded, one declined).</p> <p>In some instances, a “lack of innovation” is used as a substitute for a more substantive critique of a proposal and some terminology is interpreted differently among reviewers.</p> <p>It is important to maintain transparency and provide clarity; the COV recommends that the eJacket contain evidence addressing specific discrepancies between a panel summary and the RA, as well as any additional information utilized by the PO to make the final recommendation.</p> <p>The COV suggests that CHE explore how to better normalize terminology, such as “incremental” or “transformative”, in introductory comments at the beginning of panels. Given that there are different opinions of how these terms might apply to individual proposals, reviewers and POs could be encouraged to rely less on using lack of innovation as a substitute for other critiques and instead provide more specific feedback, supported by evidence, regarding potential weaknesses.</p> | <p>YES</p> |
|---|------------|

| <b>QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</b>  | <b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b> |
|---|---|
| <b>Data Source: Jackets</b>   |   |
| <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:</p> <p>The collective documentation to the PI provides rationale for the decision.</p> <p>The PO consistently invites individual PIs to communicate directly and to have a conversation about the rationale for the decision, providing constructive feedback, and suggestions for revising subsequent submissions.</p> <p>It is appreciated that even for awards, the information provided to the PIs still points out weaknesses and areas of improvement as important constructive criticism for the PI to consider when they perform the work.</p> <p>In a few instances, the process leading to the recommendation seems to be better described for funded proposals than for declined ones. This is a most crucial consideration for declined proposals, where it is vitally important to justify why the proposal was declined, since this information is the base for the PI's approach to improve the proposal for future submission.</p> <p>Recommendation:</p> <p>The COV encourages the program to continue to strive for clarity and transparency in those cases where proposals are declined for reasons that might not have been made clear during reviews/panel discussions. It would be helpful for the PO comments to include more of the information from the RA. This would help the PI to better understand the recommendation and how to improve the proposal for future submission.</p> <p><b>Data Source: Jackets</b></p> | <p>YES</p>  |

| <b>QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</b>  | <b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b> |
|---|---|
| <p>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</p> <p>The program's use of the merit review process was excellent and extremely effective.</p> <p>Awards are granted to deserving proposals both through individual rankings from reviewers and panel comments. Both closely related experts and related field expertise individuals are used in the review process. This provides a comprehensive evaluation of each proposal for the PO to base their recommendation.</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.

**Table 3 - Selection of Reviewers**

| 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:</p> <p>All reviewers were qualified to participate in the panels and provide reviews. The focus of the panelist expertise varies, and given the broad range of proposals, sometimes it is not possible to have the same depth of expertise for all the proposals. In those cases, it is important to obtain ad-hoc reviews. From the eJacket review, it is common to see that ad hoc reviews provide more comprehensive comments, likely due to their expertise in the field.</p> <p>The COV recommends the continued use of <i>ad-hoc</i> reviews in addition to panelists where needed to guarantee that all proposals have at least one reviewer (either from the panel or <i>ad-hoc</i>) with the proper technical expertise.</p> <p><b>Data Source: Jackets</b></p> | <p>YES</p>                                     |
| <p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>Comments:</p> <p>The NSF conflicts of interest assessment is thorough.</p> <p><b>Data Source: Jackets</b></p>  | <p>YES</p>                                     |

| <b>SELECTION OF REVIEWERS</b>   | <b>YES, NO,<br/>DATA NOT<br/>AVAILABLE,<br/>or NOT<br/>APPLICABLE</b> |
|---|---|
| <p>3. Additional comments on reviewer selection:</p> <p>It is apparent that the program has several tools to select reviewers. However, it is unclear how the reviewers were selected or not selected from the PI's suggested reviewers list.</p> <p>To evaluate the expertise of reviewers, COV members had to rely on their individual knowledge or look for the information outside (google the name of the reviewers).</p> <p>The COV recommends that CHE continue to encourage reviewers to update their NSF database information so that their expertise is directly linked to the reviewer's name.</p> |   |

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

***Table 4 - Management of the Program Under Review***

| <b>MANAGEMENT OF THE PROGRAM UNDER REVIEW</b>   |
|---|
| <p>1. Management of the program.</p> <p>Comments:</p> <p>The overall management of the program and the contributions of the POs to maintain excellence is outstanding. There is exceptional attention to details, excellent interpretation of panel opinions, and overall assessment by the POs of the proposals in the context of the program portfolio is superb. The POs were also highly compassionate to the PIs whose proposals were declined and genuinely wanted to provide useful feedback and guidance to make each PI more successful.</p>   |
| <p>2. Responsiveness of the program to emerging research and education opportunities.</p> <p>Comments:</p> <p>The program has participation in many of the Division and NSF-wide special calls increasing their contribution to emerging research and education opportunities. For example, there was effective funding following the call for proposals related to COVID in 2020 with several awards made as part of the COVI19 RAPID program.</p>   |
| <p>3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.</p> <p>Comments:</p> <p>It was clear that there is an established prioritization process. There is a broad range of subject areas appropriate to CMI that are funded. However, it is not always clear how the different priorities are applied to individual proposals.</p> <p>The CMI program does a great deal of co-funding with other fields within and outside of Chemistry, particularly BIO, PHY, and ENG, as well as cross-cutting programs such as EPSCOR and OSI.</p> |

## **MANAGEMENT OF THE PROGRAM UNDER REVIEW**

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

Comments:

The program has provided reasonable responses to the previous COV recommendations. In responding to the request for more outcome data from awards, the publication data and the number of participants were provided to the COV. It would be helpful for the COV if the program provided more information about specific actions taken based on the previous recommendations.

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

**Table 5 - Resulting Portfolio of Awards**

| <b>RESULTING PORTFOLIO OF AWARDS</b>  | <b>APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</b> |
|---|--|
| <p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>Comments:</p> <p>The portfolio has awards across 8 main disciplines/sub-disciplines, (including a small CHMET sub-field), and in 2023, it also included a HELIUM recovery component. This last one has been now shifted into the MRI track 3.</p> <p>The rate of awards within each sub-field are relatively uniform which seems to indicate a balanced distribution across subfields, although given the number of subfields, the number of awards in each of them is small making it hard to evaluate the full distribution. In general, it seems that it depends on proposals that are submitted to the program.</p> <p>The COV noticed some overlap between the CMI and the CSD programs. In a few instances, proposals in the CMI program were focused not necessarily in developing measurement tools, but on using known techniques to answer more fundamental questions, matching well within the CSD program. Although from the eJacket, it is clear that there is strong interaction among the POs from these two programs, the COV encourages CHE to consider additional evaluation of proposals for potential rerouting before they are reviewed.</p> <p>The COV noticed that the number of proposals in the relatively new sub-field within CMI of Chemometrics/Chemoinformatics (CHMET) is very low; hence it might be useful to consider carefully how to evaluate them. For proposals in this area aimed at developing new techniques, CMI is the proper program, but proposals applying CHMET as a tool can be funded by other programs.</p> <p>Given the small number of proposals submitted to CHMET, the COV wonders if there is currently another program or agency funding the community of those who are developing new methods. One could anticipate, for example, needing new tools to accommodate ever expanding “big data”.</p> <p>The COV recommends continued efforts to clearly delineate which proposals are appropriate under CMI purview and to do outreach to further engage those involved in development of new tools.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 8</b></p> | <p>APPROPRIATE</p>   |

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|--|--|
| <p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>Comments:</p> <p>It is appropriate for the funds that are allocated to the program. However, the average size of grants has not kept pace with inflation resulting in award amounts that are substantially less than what is necessary to perform much of the proposed research from proposals that are awarded.</p> <p>CMI covers a field that supports homemade state-of-the-art instrumentation which requires funding to maintain and fix such instruments. The funding has remained flat in the last 4 years, while at the same time instrument components have become considerably more expensive.</p> <p>It is important to also notice that as the costs increase, the detrimental effects might be more pronounced for PIs from smaller institutions or MSI (which often can provide less institutional support) or PIs without other sources of funding (whether within NSF or other agencies).</p> <p>It seems that a commensurate increase in the size of the awards is warranted. The COV strongly recommends that CHE search for ways to increase average award sizes without affecting the number of proposals currently funded.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 4</b></p> | <p>APPROPRIATE</p>   |
| <p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>Comments:</p> <p>Innovation was an important factor in the enthusiasm of the reviewers, panels, and program directors and this was reflected in the award decisions. There is clear evidence that the program portfolio includes projects that are innovative or potentially transformative.</p> <p>Multiple awards have been given to projects identified as high risk and potentially high impact and transformative; even more, innovation has been used to make funding decisions in close cases.</p> <p><b>Data Source: Jackets</b></p>  | <p>YES</p>   |

| RESULTING PORTFOLIO OF AWARDS  | APPROPRIATE,<br>NOT APPROPRIATE,<br>OR DATA NOT<br>AVAILABLE |
|--|--|
| <p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>Comments:</p> <p>The success of the PO in securing co-funding from multiple programs is impressive and commendable. It shows that CMI is supporting a wide range of multi-disciplinary projects and is a central program to chemistry. Co-funding from physics, bio, materials, and engineering show that good levels of interdisciplinary projects are supported by the program.</p> <p><b>Data Source: If co-funding is a desired proxy for measuring inter- and multi-disciplinary projects, the Co-Funding from Contributing Orgs and Co-Funding Contributed to Recipient Orgs reports can be obtained using Enterprise Reporting, COV Dashboard, Question 7</b></p> | <p>YES</p>   |
| <p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>Comments:</p> <p>The program has awarded a high number of proposals with EPSCoR co-funding. However, some awards from EPSCoR states did not receive EPSCoR co-funding. Is there a reason why not?</p> <p>It was not straightforward to analyze the metrics for appropriate geographical distribution of PIs. The COV suggests that funding rates for each state, rather than raw numbers, be provided for future COVs in order to facilitate assessment of the geographical distribution.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 2</b></p>   | <p>APPROPRIATE in general. See comments.</p>                 |

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|--|--|
| <p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions ?</p> <p>Comments:</p> <p>Effort to increase the representation of PIs from MSI have not led to discernable changes. While it is clear that this is a priority for the program, it is also clear that more actions need to be implemented to induce a real change, although this opinion was not shared by all COV members.</p> <p>As an example, we consider HBCU institutions, where no proposals have been funded in the 4 yr period under evaluation. This is concerning, even when taking into account the small number of proposals submitted.</p> <p>The COV recommends that CHE consider conducting workshops specifically targeted towards PUI and minority-serving institutions in order to help improve the number of proposals received and funded. See the comment below (Q7) for additional ideas for helping new investigators develop their grant writing skills. The COV committee members also consider the possibility of conducting the workshops directly onsite (at MSI or PUI), which can provide the additional benefit of helping administrators of these institutions to understand how to successfully support the PIs applications.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 3</b></p> | <p>APPROPRIATE</p>   |

| <b>RESULTING PORTFOLIO OF AWARDS</b>  | <b>APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</b> |
|---|--|
| <p>7. Does the program portfolio have an appropriate balance of awards to new and early-career investigators?</p> <p>NOTE: A new investigator is an individual who has not served as the PI or Co-PI on any award from NSF (with the exception of doctoral dissertation awards, graduate or post-doctoral fellowships, research planning grants, or conferences, symposia and workshop grants.) An early-career investigator is defined as someone within ten years of receiving his or her last degree at the time of the award.</p> <p>Comments:</p> <p>We note that funding rates for new investigators is noticeably lower than that for those with prior funding. As importantly, the submission rate from MSI is particularly low.</p> <p>The COV suggests that CHE find ways to help increase funding and submission rates for new investigators. Some ideas to tackle this issue include:</p> <ul style="list-style-type: none"> <li>• NSF could provide examples of good proposals and/or panel review templates to help new, and early-career investigators write more competitive proposals.</li> <li>• New investigators could be invited to participate in the panel review process as observers to better understand the review process.</li> <li>• Continue the successful Early Career Workshops</li> </ul> <p><b>Data Source: Information on new PIs available via Enterprise Reporting, COV Dashboard, Question 6</b></p> | <p>APPROPRIATE in general. See comments</p>                |

| <b>RESULTING PORTFOLIO OF AWARDS</b>  | <b>APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</b> |
|---|--|
| <p>8. Does the program portfolio include projects that integrate research and education?</p> <p>Comments:</p> <p>CAREER proposals are specifically required to integrate an educational component. As stated in NSF program statement, CAREER support leads to outstanding researcher and educator interaction.</p> <p>Other awards also integrate education and research. An example of an integrative project was noted in the ejackets, and there are likely more examples. Many proposals include educational activities as part of their broader impacts. In these cases, the educational activities are not always well integrated.</p> <p>Some members of the COV believe that when educational activities are proposed, it is expected that these activities be well integrated with the scientific component. Other members believed that this may be inconsistent with the NSF-wide position on Broader Impacts. Nonetheless, the COV recommends that CHE require education activities be properly reported in the annual reports and final outcomes, and carefully evaluated.</p> <p><b>Data Source: Jackets</b></p> | <p>YES</p>   |
| <p>9. Does the program portfolio have appropriate participation of underrepresented groups<sup>6</sup>?</p> <p>Comments:</p> <p>EPSCoR and RUI proposals were supported, although participation of PIs from unrepresented groups is still minimal.</p> <p>As an initial metric, it would be useful to compare the participation of PIs from underrepresented groups with the faculty distribution populations. This would help assess the appropriateness of the distribution and PI demographics within the portfolio.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 5</b></p>  | <p>APPROPRIATE in general. See comments.</p>               |

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<sup>6</sup> 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.

| <b>RESULTING PORTFOLIO OF AWARDS</b>  | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|---|--|
| <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:</p> <p>CMI covers a range of topics that are of high importance to all areas of the chemical sciences, and its interface with biology and physics. Many of the techniques and methods that have been developed through this program are important to measurements in industry, especially the US chemical and pharmaceutical industry.</p> <p><b>Data Source: Jackets</b></p> | <p>YES</p>   |
| <p>11. Additional comments on the quality of the projects or the balance of the portfolio:</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.

The reviewer ratings of E, V, G, F, P and combinations, e.g., E/V, V/G, etc. may be interpreted differently by different reviewers. It may be worth considering replacing this system with a numerical rating, for example, 10 being outstanding and 1 being unacceptable with little or no merit in both review criteria. Reviewers could be provided with a clear explanation of the delineation of the range of rankings either in the current rating system or with a numerical ranking system. This may help reduce the sometimes-wide range of evaluations from different reviewers for the same proposal.

The NSF conflicts of interest assessment is thorough. It would be desirable to make this uniform among all federal funding agencies, such as NIH. The different criteria for different agencies vary widely for reasons that are not entirely apparent. It is not clear why this should be so. The lack of uniformity may lead to the perception that some federal organizations allow conflicts whereas others do not.

Merit review criteria asks: "How well qualified is the individual, team, or institution to conduct the proposed activities?"

There were several opinions about this criterion and how to evaluate it. Common to all the opinions was the need to have a more explicit and integral assessment of both the PIs' relevant expertise, recent productivity (and perhaps not just from prior NSF support) as well as an evaluation of information provided in final outcomes from other awards (specifically for PIs with previous or current additional NSF funding). Although some reviewers and panels considered these criteria to some extent, this was not universally the case.

- For some members of the COV, it is clear that a person's recent past performance is often a useful indicator of future performance and considered that the panel's consideration of PIs relevant expertise and recent productivity would lead to better outcomes.
- Others brought up the disconnect sometimes found between the award and the reported activities in the annual reports. The quality of the annual reports and outcomes varies greatly, with some cases showing verbatim components repeated in multiple NSF awards and most strikingly, missing information on any of the activities proposed as part of the Broader impacts.
- It was also noticed that sometimes the IM was greatly focused on the PI's important contributions to the field and not as much as the new proposal.

4. Please provide comments on any other issues the COV feels are relevant, bearing in mind that COV reviews do not include assessment or evaluation of the outcomes or long-term impacts of program investments.

Overall funding levels for Chemistry are much lower than would be expected based on the importance of chemistry to US industry and manufacturing that is responsible for a large fraction of the US gross national product.

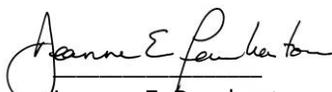
5. NSF would appreciate your comments on how to improve the COV review process, format, and report template.

The communication between NSF staff and POs with the COV was outstanding.

*The Committee of Visitors is part of a Federal Advisory Committee. The function of Federal Advisory Committees is advisory only. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the Advisory Committee, and do not necessarily reflect the views of the National Science Foundation.*

**SIGNATURE BLOCK:**

For the 2024 COV

  
\_\_\_\_\_  
Jeanne E. Pemberton  
Co-Chair

  
\_\_\_\_\_  
Scott D. Rychnovsky  
Co-Chair

# INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

## Chemical Structure and Dynamics (CSD)

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, returns without review, and withdrawals) that were *completed within the review period (generally the prior four 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.

**Table 2 - Quality and Effectiveness of the Merit Review Process**

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS  | YES, NO,<br>DATA NOT<br>AVAILABLE, or<br>NOT<br>APPLICABLE |
|--|--|
| <p>1. Are the review methods (for example, panel, <i>ad hoc</i>, site visits) appropriate?</p> <p>Comments:</p> <p>The review process is comprehensive, well-described, and well-executed. The POs are commended for their dedication and hard work.</p> <p>The <i>ad hoc</i> reviews and panel summaries point to an effective and appropriate review process. Most review panels are virtual. It would be useful to find metrics to evaluate the efficacies of in-person and virtual panels to allow the CSD programs to make the best decisions possible.</p> <p>The EAGER proposals are reviewed internally. There may be instances where input from a technical expert in the form of an <i>ad hoc</i> review is valuable.</p> <p>Over the last two years, the CSD program has moved to a "no-deadline" model and has modified the organization of the review process. The new process includes identifying reviewers for a 4-month term. In the next few years, it will be important to follow the data to evaluate the effectiveness of the modified review process.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 6</b></p> | <p>Yes</p>   |

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS   | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|---|--|
| <p>2. Are both merit review criteria addressed</p> <p>a) In individual reviews? Yes</p> <p>b) In panel summaries? Yes</p> <p>c) In Program Officer review analyses? Yes</p> <p>Comments:</p> <p>In majority of the cases reviewed, both merit review criteria are addressed in detail in the individual reviews, panel summaries and the RA.</p> <p>The POs are commended for their work and encouraged to continue to educate the <i>ad hoc</i> reviewers and panel members to address specific review criteria especially as they pertain to broader impacts.</p> <p><b>Data Source: Jackets</b></p>  | <p>Yes</p>                                     |
| <p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>Comments:</p> <p>In most cases, the individual reviewers are detailed in their comments regarding the intellectual merit of the proposal. This highlights the excellence in the reviewer selection process, as the scientific insight and knowledge demonstrated by the reviewers is commendable.</p> <p>Reviewers should be encouraged to evaluate the broader impacts criteria with the same rigor and in as much detail as the intellectual merit review criteria.</p> <p><b>Data Source: Jackets</b></p> | <p>Yes</p>                                     |

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS   | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|---|--|
| <p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>Comments:</p> <p>The panel summaries include the rationale for panel consensus. There is considerable detail in outlining the strengths and weaknesses for each review criteria. This is important because sometimes the panel discussion results in magnifying or minimizing certain aspects of the <i>ad hoc</i> reviews. These discrepancies are to be expected because the panel discussion can compare several proposals and can provide a “calibration” of the individual reviews.</p> <p>There were no examples reviewed where the panel did not reach consensus.</p> <p><b>Data Source: Jackets</b></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:</p> <p>The POs are commended for their thorough work in providing documentation that details the rationale for the funding decision (positive and negative). RAs are insightful and provide much needed context into the panel discussion and valuable summary of the <i>ad hoc</i> reviews. The careful documentation by the POs is essential for the integrity of the review process. It is imperative to carefully document the rationale for the decision in cases where two similarly ranked proposals have different outcomes.</p> <p><b>Data Source: Jackets</b></p> | Yes  |

| <b>QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</b>  | <b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b> |
|---|---|
| <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:</p> <p>In most cases, clear commentary is provided by the PO to the PI. In some cases, the PO provides considerable extra information to clarify and aid the PI in resubmission/improvement of the proposal.</p> <p>There may be cases where information in the RA would be useful to include in the PO comments. In some cases where the decision was very close, it would be beneficial for the PO to preemptively reach out to the PI and schedule a meeting to discuss the review process and next steps.</p> <p>The program is commended for the quality of the communications to the PI. The COV encourages CHE leadership to provide training and support to all new POs to maintain the consistency in clarity and thoroughness of the documentation provided to the PI.</p> <p><b>Data Source: Jackets</b></p> | <p>Yes</p>  |

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS  | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|--|--|
| <p>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</p> <p>CHE has collected very useful resources for writing and reviewing the "broader impact" sections of the proposal and the review. It would be very helpful to have these resources linked to the web form filled out by the reviewers.</p> <p>It would be useful to consider using the PI's research productivity (previous award and outcomes and recent research activities) as a criterion for evaluation by reviewers and panels to maximize efficient use of NSF's scarce resources. The program should be mindful of calibrating their review criteria based on the institution type (PUI, HBCU, PhD granting, etc.).</p> <p>The merit review process is clearly an effective method for evaluating proposals. Reviewers appear to genuinely care about the comments and feedback that is provided to the PI. The PO follows these recommendations within the limits of the program and available budget resources. To continue the effectiveness of the process and to maintain trust from the community, there must be detailed explanations to the PI and in the eJacket documentation.</p> <p>Even though NSF CHE has provided detailed information about broader impacts, there are inconsistencies in the proposal review process by <i>ad hoc</i> reviews and panel members. The Broader Impacts sections cover a range of issues and <i>ad hoc</i> reviewers value different aspects and use different weights for their evaluation.</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.

**Table 3 - Selection of Reviewers**

| 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:</p> <p>The reviewer selection appears to appropriately cover the necessary expertise for the proposals. This is evidenced by technically detailed comments and critiques. Most reviewers appear to be qualified enough to provide substantive recommendations on the proposals. <i>Ad hoc</i> reviewers are crucial for providing technical expertise (i.e., feasibility of the proposed experiments or computations) when the panel composition does not include a technical expert in all sub-fields. If feasible, the <i>ad hoc</i> reviewer might join the virtual review panel to discuss the proposal they reviewed.</p> <p>It is noted that there is parity in the fraction of women-led proposal submissions and the representation of women on the panels.</p> <p>It would be helpful to have an updated database of the scientific expertise of NSF reviewers.</p> <p><b>Data Source: Jackets</b></p> | <p>Yes</p>                                     |
| <p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>Comments:</p> <p>The NSF does an excellent job of recognizing and resolving COIs. It is clear that program officers at the NSF take COI avoidance very seriously. Where noted, the COIs have been appropriately handled. Notably, review panel members with COIs are moved out of the virtual room to a waiting room during discussion. Given that the majority of CSD panels are virtual, this is appropriate management.</p> <p><b>Data Source: Jackets</b></p>   | <p>Yes</p>                                     |

| <b>SELECTION OF REVIEWERS</b>   | <b>YES, NO,<br/>DATA NOT<br/>AVAILABLE,<br/>or NOT<br/>APPLICABLE</b> |
|---|---|
| <p>3. Additional comments on reviewer selection:</p> <p>To provide continuity in panel reviews, it might be interesting to explore the possibility of a couple of reviewers participating in multiple subsequent panels.</p> <p>To expand the pool of reviewers it is important to provide opportunities for new reviewers to “observe” the workings of a real panel. The early career workshop does provide opportunities for some scientists to participate in a mock review panel.</p> |   |

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

***Table 4 - Management of the Program Under Review***

**MANAGEMENT OF THE PROGRAM UNDER REVIEW**

1. Management of the program.

Comments:

There was a strong consensus that the program is well managed and that decisions are made with sound rationale. The program officers are commended for their excellent work. The jacket documentation provides detailed justification for funding decisions.

The CSD program is unique in the breadth of research areas and techniques that are spanned. This makes it a challenge to constitute panels with expertise in every experimental technique used to study the varied scientific problems. The continued use of *ad hoc* reviewers as technical experts is encouraged for all proposals.

The proposal processing for the "no deadline" model will need to be evaluated in 2-3 years when sufficient data has been accumulated. In particular, the question whether this model allows the program leadership to make the best decision given budget constraints will need to be addressed.

The new panel organization captures the breadth of the portfolio in an effective way and will make it easier to group panelists with the necessary expertise to evaluate proposals appropriately.

To maintain the strength of the program and the qualities of the reviews, efficient knowledge transfer between permanent POs and rotators is crucial.

## MANAGEMENT OF THE PROGRAM UNDER REVIEW

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

Comments:

Given the breadth of its portfolio, CSD is uniquely positioned to identify, fund, and build a critical mass of researchers in nationally identified emerging research areas. This has enormous implications for workforce development and for maintaining US competitiveness in the world. Currently, there are few proposals funded in NSF-identified emerging areas of research.

The EAGER mechanism for funding is underutilized by the community. It is unclear whether this is because researchers are unaware of this funding avenue and/or it has not been linked with emerging research areas.

The division could utilize "Big Data" approaches to track emerging fields. These could consist of following fiscal distributions of funds, personnel movements into fields, publications in fields (e.g. keyword searches of journal articles to compile data). This might guide directives in emerging research fields and educational focus points.

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

Comments:

CSD is an established program in CHE. It is important for the POs to attend targeted workshops/conferences to learn about new advances impacting their portfolio and to get ideas on reshaping their portfolio over time.

It is noted that programs such as EAGER have the potential to stimulate research into new and emerging fields; however, there appear to be very few EAGER applicants. Perhaps advertising this vehicle would stimulate more applications and more opportunity to discover important new fields.

Given the breadth in the CSD portfolio, there is an opportunity to host joint workshops on emerging areas of research with other federal agencies.

To maintain connections with the evolving field, regular or early working groups to discuss emerging topics, or a division-specific advisory board might be considered.

## **MANAGEMENT OF THE PROGRAM UNDER REVIEW**

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

Comments:

The program is endeavoring to improve in areas identified in the previous COV. It will be interesting to watch the evolution and test the effectiveness of the "deadline free" proposal review process. The CHE division has provided very detailed information about broader impacts in response to the previous COV comments and recommendations. The goal moving forward will be to make sure that this information is provided to all proposal writers and reviewers.

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

**Table 5 - Resulting Portfolio of Awards**

| <b>RESULTING PORTFOLIO OF AWARDS</b>  | <b>APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</b> |
|---|--|
| <p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>Comments:</p> <p>The panel sees proposals spanning quantum sciences, electrochemistry, surface molecular dynamics, etc. These varied proposals demonstrate the balance of research across multiple disciplines that advance the frontiers of physical chemistry.</p> <p>The current data reflects that the program portfolio is tracking proposal pressure. In other words, the funding rate for each broad area (e.g., gas-phase, condensed phase, surface science, etc.) matches the percentage of proposals submitted. It would be worth considering if this is the best way to address emerging areas or to address workforce development in emerging areas.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 8</b></p>   | <p>Appropriate</p>   |
| <p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>Comments:</p> <p>CSD portfolio contains experimental physical chemistry and is responsible for workforce development in critical areas of research. It is extremely important that the award size in the future is responding to the increasing costs of doing experimental science (student/postdoc salaries, equipment costs, etc.). In the past two years, there has been a significant steep increase across the country in the costs of students and postdocs. In addition, there are increasing costs for developing and maintaining equipment and cutting-edge instrumentation.</p> <p>The CSD portfolio contains programs that necessitate longer than 3-year grants. The program should be open to discussion with PIs regarding increasing the length of the proposal to 3+ years. An additional PO-only review at Year 3 could be implemented to provide additional oversight and input during a 3+ year project.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 4</b></p> | <p>Appropriate</p>   |

| <b>RESULTING PORTFOLIO OF AWARDS</b>  | <b>APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</b> |
|---|--|
| <p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>Comments:</p> <p>It is difficult to define “transformative,” as it could apply to several things. One might work to transform technology, education, advance research techniques, etc. However, we do note that multiple awards are given to proposals that present research that is pushing the boundary of basic research. The impact that the proposed research topics might have in the field is clear from reviewer’s comments, who are knowledgeable in these fields.</p> <p>As mentioned earlier, there is an opportunity to increase high-risk projects in emerging areas perhaps through the EAGER mechanism.</p> <p><b>Data Source: Jackets</b></p>  | <p>Appropriate</p>   |
| <p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>Comments:</p> <p>This program is receiving and funding inter- and multi-disciplinary proposals. This is evidenced from pairings of experimentalists and theorists in projects to proposals covering basic phenomena across multiple different sub-disciplines (catalysis, gas-phase spectroscopy, electronic/magnetic response of molecular systems, quantum-relevant spectroscopy, etc.).</p> <p>Additionally, proposals are co-funded with other CHE programs and other MPS divisions, and other NSF divisions and division-wide programs.</p> <p><b>Data Source: If co-funding is a desired proxy for measuring inter- and multi-disciplinary projects, the Co-Funding from Contributing Orgs and Co-Funding Contributed to Recipient Orgs reports can be obtained using Enterprise Reporting, COV Dashboard, Question 7</b></p> | <p>Appropriate</p>   |

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</b>                   |
|--|--|
| <p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>Comments:</p> <p>We find that there are more proposals submitted and awards made from more densely populated areas of the country. However, it might be useful to normalize the numbers for submitted and awarded proposals by the number of PhD granting and research institutions in each state.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 2</b></p>  | <p>Appropriate</p>   |
| <p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>Comments:</p> <p>There have been NSF-wide efforts for developing specific programs targeting MSIs, including HBCUs, etc. However, there are many co-variable functions occurring here. Should the fraction of submitted proposals match the fraction of MSIs in the country? Should award rates between MSIs and PhD institutions match? The NSF should define what their mission is here and that would define how they approach this issue at the program level. We note that MSI submittal rates appeared consistent with their fraction of total universities in the US; however, submittal rates from HBCUs were disproportionately lower than their fraction of US universities. The program is strongly encouraged to increase proposal submission rates from HBCUs.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 3</b></p> | <p>Appropriate – but attention needs to be paid to proposals from HBCUs.</p> |

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|--|--|
| <p>7. Does the program portfolio have an appropriate balance of awards to new and early-career investigators?</p> <p>NOTE: A new investigator is an individual who has not served as the PI or Co-PI on any award from NSF (with the exception of doctoral dissertation awards, graduate or post-doctoral fellowships, research planning grants, or conferences, symposia and workshop grants.) An early-career investigator is defined as someone within ten years of receiving his or her last degree at the time of the award.</p> <p>Comments:</p> <p>There is an appropriate balance of awards to new and early career investigators. New researchers are submitting proposals. Efforts by the NSF like the Early Career Workshop will help to encourage and train early career scientists for proposal submission.</p> <p>The NSF has limited funding opportunities for postdocs. Perhaps designing awards specifically for postdocs would also train younger scientists on the application process.</p> <p>The PO has an important role to play in advising and mentoring PIs submitting proposals for the first time. It is clear from the jacket documentation that POs take their role in educating new faculty very seriously and they are commended for their efforts.</p> <p><b>Data Source: Information on new PIs available via Enterprise Reporting, COV Dashboard, Question 6</b></p> | <p>Appropriate</p>   |

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|--|--|
| <p>8. Does the program portfolio include projects that integrate research and education?</p> <p>Comments:</p> <p>In most cases, it appears that the program includes projects that integrate research and education. Strong proposals appear to incorporate both research (the primary thrust of most proposals) as well as strong broader impact/outreach. There are some proposals where the outreach efforts are not integrated to the research that is being proposed.</p> <p>As mentioned earlier, there are instances where the broader impact sections of the proposal do not receive adequate review attention by <i>ad hoc</i> or panel reviewers; however, the program officer summaries are careful to provide attention to these review criteria.</p> <p>The program encompasses CAREER awards that integrate research and education.</p> <p><b>Data Source: Jackets</b></p> | <p>Appropriate</p>   |
| <p>9. Does the program portfolio have appropriate participation of underrepresented groups<sup>7</sup>?</p> <p>Comments:</p> <p>It is noted to that the numbers of proposals submitted by underrepresented groups are consistent with the faculty demographics at US institutions.</p> <p>It is important for NSF to track the demographics of the students and postdocs being trained by the funded proposals. The development of a diverse workforce will help increase the participation of underrepresented groups in all NSF program portfolios.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 5</b></p>   | <p>Appropriate</p>   |

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<sup>7</sup> 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.

| <b>RESULTING PORTFOLIO OF AWARDS</b>  | <b>APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</b> |
|---|--|
| <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:</p> <p>The CSD program has a history of serving broad and diverse fields encompassing physical chemistry, biophysics, materials science, and emerging quantum materials.</p> <p>The CSD program is extremely relevant to national priorities and has a real opportunity to grow a critical number of researchers in these emerging fields by funding high-risk research.</p> <p>For example, the “Advancing Chemistry and Quantum Information Science: An Assessment of Research Opportunities at the Interface of Chemistry and Quantum Information Science in the United States” by the NAS ( <a href="https://doi.org/10.17226/26850">https://doi.org/10.17226/26850</a>), states that, “Because chemistry is the study of manipulating properties and behaviors across different length scales, from subatomic to macromolecular levels, this discipline will certainly play a central role in guiding QIS toward future designs and measurements.” The CSD portfolio is ideally designed to play a role in designing, manipulating, and measuring QIS phenomena. More importantly, CSD is ideally positioned to develop QIS workforce. Given the timing of the CHIPS Act, there is an underutilized opportunity to expand and future-proof the CSD portfolio.</p> <p><b>Data Source: Jackets</b></p> | <p>Appropriate</p>   |
| <p>11. Additional comments on the quality of the projects or the balance of the portfolio:</p> <p>Future US science and technological capability and competitiveness is dependent on workforce training and development. Therefore, there must be continued vigilance on the part of CSD leadership to remain relevant by broadening participation by underrepresented groups and managing their portfolio to encourage high-risk research in emerging research areas identified as national priorities. Both of the above points are crucial for the development of a diverse and excellent workforce trained to address challenges in the future.</p>   |  |

## OTHER TOPICS

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

This program is foundational to maintaining US competitiveness in chemical sciences. It is extremely important to maintain the excellence of this program to meet the needs of the chemistry community and to develop the next generation of leaders. At the same time, the program must continue to evolve to address emerging scientific challenges and national priorities.

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

The COV would like to emphasize the value of specific calls targeted to HBCUs and PUIs, which have unique programmatic needs (e.g., teaching relief, administrative assistance in proposal submission, etc.).

5. The NSF has curated very useful information on Broader Impacts. This information has to be conveyed clearly to both proposers and reviewers.

Given the recent and rapid increase in costs of graduate students and postdocs, and the maintenance of expensive equipment, it is necessary for the grant sizes to increase to enable the research that is being proposed.

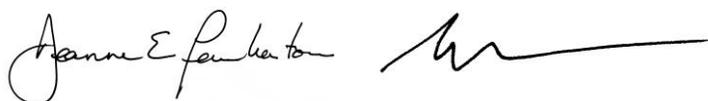
6. Please provide comments on any other issues the COV feels are relevant, bearing in mind that COV reviews do not include assessment or evaluation of the outcomes or long-term impacts of program investments.
7. NSF would appreciate your comments on how to improve the COV review process, format, and report template.

The availability of information from the ejacket prior to the in-person meeting was extremely useful.

*The Committee of Visitors is part of a Federal Advisory Committee. The function of Federal Advisory Committees is advisory only. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the Advisory Committee, and do not necessarily reflect the views of the National Science Foundation.*

## SIGNATURE BLOCK:

For the 2024 COV

The image shows two handwritten signatures in black ink. The signature on the left is written in a cursive style and appears to read "Anne E. Fawcett". The signature on the right is more stylized and less legible, consisting of several loops and a long horizontal stroke.

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Jeanne E. Pemberton  
Co-Chair

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Scott D. Rychnovsky  
Co-Chair

## INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

### Chemical Theory, Models and Computational Methods (CTMC)

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, returns without review, and withdrawals) that were *completed within the review period (generally the prior four 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.

**Table 2 - Quality and Effectiveness of the Merit Review Process**

| <p><b>QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</b></p>   | <p><b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b></p> |
|---|--|
| <p>1. Are the review methods (for example, panel, <i>ad hoc</i>, site visits) appropriate?</p> <p>Comments:</p> <p>Most proposals were peer-reviewed, with the majority discussed by a panel. The COV views favorably this process. The POs did a great job with blending panel and <i>ad-hoc</i> reviews. Out of the proposals examined, several proposals were not peer-reviewed to achieve rapid processing. This is not recommended; the COV suggests adding external <i>ad hoc</i> reviews for RAPID and EAGER proposals. Some members felt it should be at least one external review; others felt it should be a minimum of two external reviews. There are some concerns about the influence of priorities of the research interests in CTMC and the role of broader impacts in overall funding decisions especially for medium priority proposals.</p> <p>For the majority of cases, all proposals reviewed are vetted to the appropriate program. It would be instructive for the PO to inform the panel that all proposals reviewed are considered a “fit” for the program. Therefore, such criticisms should not be brought up in panel discussions. It is noted that all panels for the last three years of the COV review period were done virtually; the COV encourages CTMC to consider hybrid and/or in-person panels. Finally, we are encouraged to see the CAREER proposals are now reviewed in panels and a reduction of submission-to-decision time.</p> <p>Awards from the CTMC program appear to be skewed against women and minorities. However, the COV notes that the funding <i>rates</i> are similar for each group, so the problem is more about number of submissions than award rates.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 6</b></p> | <p>YES</p>   |

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS   | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|---|--|
| <p>2. Are both merit review criteria addressed</p> <ul style="list-style-type: none"> <li>a) In individual reviews?</li> <li>b) In panel summaries?</li> <li>c) In Program Officer review analyses?</li> </ul> <p>Comments:</p> <p>There is consensus among (<i>ad hoc</i> and in-person) reviewers, panelists, and program officers to review and comment on both intellectual merit and broader impacts portions of the proposal. However, there seems to be a much greater emphasis on intellectual merit in overall ranking of proposals and funding decisions. The broader impacts appear to be less valued and only seems to have an impact in borderline cases for funding decisions. More clarity on influence of broader impacts should be available; are the criteria of equal value?</p> <p>More uniformity in awards should be given based on reviewers ranking and evaluation with less consideration of previous PI's accomplishments.</p> <p><b>Data Source: Jackets</b></p> | MOSTLY YES                                     |
| <p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>Comments:</p> <p>Overall, the reviewers provided detailed reviews for each review criteria and detailed justification for their overall review. Specifically, most reviewers provided detailed comments on the strengths/weaknesses of the IM component of each proposal, regarding the hypothesis, innovation, and approach. However, the degree to which the BI activities are assessed varies greatly among individual reviewers. There was some variation among reviewers in terms of the extent of detail and substantive comments to justify overall review assessment. It would be instructive to provide reviewers, especially to early stage investigators, some representative examples of prior "exemplary" reviews to guide these efforts.</p> <p><b>Data Source: Jackets</b></p>  | YES  |

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS   | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|---|--|
| <p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>Comments:</p> <p>Most panel summaries properly captured the panel discussions, weighing the strengths (especially significance and innovation) against, if any, weaknesses. On average, there is clear consensus among panelists on what is considered a “high” priority proposal. In addition, rationale for proposal ranking based on intellectual merit is also well-defined. However, there is less clarity on what constitutes “excellence” in Broader Impact activities and its impact on the overall proposal ranking. To make it clearer: what is a quality broader impact? what is considered the bare minimum of impact required in the Broader Impacts?</p> <p><b>Data Source: Jackets</b></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:</p> <p>For the most part, for high-ranking proposals, the justification for funding is clear. For medium priority proposals, justification for funding is less defined. In this vein, for borderline cases, “programmatically research themes” (e.g., “hot areas of science such as machine learning” or “transformative”) have clearly more weight than educational impact or outreach activities. Nonetheless, the jacket provides very detailed and clear justification for the ultimate funding decision that is consistent with the ranking of the proposal among the subset reviewed/considered by the panel.</p> <p><b>Data Source: Jackets</b></p> | <p>MOSTLY YES</p>                              |

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS   | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|---|--|
| <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 PD 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:</p> <p>In general, the program officer provided a detailed and clear rationale for the award/decline decision. For funded proposals, the rationale for funding is very general and the PI is left to interpret the positive funding decision based on the overall reviews and panel summary discussion. It might be helpful to provide slightly more feedback. This is particularly the case for new PIs with proposals that are not discussed by the panel. In general, the review analysis was more detailed when there were more <i>ad hoc</i> reviews beyond the panel discussion summary.</p> <p>In some cases, the PO has detailed notes as to why a certain border-line proposal was funded based on a range of factors, but these were not communicated to the PI. For not awarded/declined proposals, the PO offered the PI the potential to have a more detailed discussion about the panel's concerns, but it is not clear how many PIs accepted to have a discussion with the PO - is this a problem because the COV did not have access to all of the diary documents? More detailed documentation about communication between PI and PO after funding decision for non-funded/declined proposals is recommended.</p> <p><b>Data Source: Jackets</b></p> | <p>MOSTLY YES</p>                              |
| <p>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</p> <p>The merit review process, in general, is very good; there were a few instances where there was a rapid decision made by the PO. Some members of the COV recommend that there always be a review process beyond the PO. If time is important, as in the case of a COVID call for proposals, <i>ad hoc</i> reviews are recommended. More training of proposal writing would be helpful. That might include sharing of some successful standard and RUI proposals.</p> <p>The COV also recommends that CTMC looks into the possibility of having additional <i>ad hoc</i> reviewers (if any) to join the panel discussion of the proposal via Zoom.</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.

**Table 3 - Selection of Reviewers**

| <b>SELECTION OF REVIEWERS</b>  | <b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b> |
|--|---|
| <p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>Comments:</p> <p>The reviewers have expertise to review the proposals. There are no concerns about the expertise or qualifications of the reviewers with a balance of well-established scientists and new faculty. Nonetheless, we would encourage the POs to explore the possibility of including at least one new or PUI investigator in each review panel as well as the inclusion of minority and women reviewers as stated in Response to question #1. For greater transparency, a suggestion would be to ask the reviewers for their level of expertise to review the specific proposal (1-10) and explore how this more “quantifiable” level of expertise influences the ranking of the proposals.</p> <p>Acknowledging that this is taken into consideration by the PO when the PI suggests reviewers, every attempt should be made to include at least one of the PI’s suggestions, as long as there are no COI issues. This is especially true where reviewers are suggested to not be used; these requests should be honored.</p> <p>Finally, we would also encourage the POs to continue ensuring all voices are heard on the panel.</p> <p><b>Data Source: Jackets</b></p> | <p>YES</p>  |

| SELECTION OF REVIEWERS  | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|---|--|
| <p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>Comments:</p> <p>The POs thoroughly checked the COA form and identified the COIs. If an additional COI was identified, the POs appropriately resolved the conflicts. In addition, the program officer does consider the input by the PI in terms of potential reviewers and potential conflict of interests especially for <i>ad hoc</i> reviews. For the most part, the PO screens proposals for fit to the program. Nonetheless, it will be instructive for PO to remind reviewers that all proposals considered are already vetted for “fitness” of the proposal to the program and therefore “fit” of the proposal to the program is not a review criterion and should not be considered during the review process.</p> <p><b>Data Source: Jackets</b></p>   | <p>YES</p>                                     |
| <p>3. Additional comments on reviewer selection:</p> <p>It is recommended to also list the number of proposals reviewed previously by that reviewer to have a good balance between expert reviewers and new reviewers. For new reviewers, it would be instructive for the Program Officer to provide examples of prior “exemplary” reviews for “awarded” and “declined” proposals to see the level of detail expected/recommended for constructive feedback.</p> <p>Every effort should be made to improve the representation of women and members of historically minoritized communities, geographic locations, and types of institutions in review panels. Low panel participation may be related to the small numbers of submissions for women and minoritized communities. If acceptance rate is low from members of these groups to participate in panels, then <i>ad hoc</i> reviews should be obtained.</p> |  |

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

**Table 4 - Management of the Program Under Review**

| <b>MANAGEMENT OF THE PROGRAM UNDER REVIEW</b>   |
|---|
| <p>1. Management of the program.</p> <p>Comments:</p> <p>Overall, the program is well-managed. Funding decisions largely followed the panel's recommendation based on the two review criteria. In this vein, there is a clear understanding among reviewers, panelists, and program officers that funding decisions will in large part be based on intellectual merit while broader impacts contribute primarily to borderline cases.</p> <p>Although complicated, it would be informative to track proposals with stronger "broader impacts" sections by the PIs from different institutions (R1, PUI, HBCU, HSI, etc.) and academic level (assistant professor, associate, or full etc.)</p>  |
| <p>2. Responsiveness of the program to emerging research and education opportunities.</p> <p>Comments:</p> <p>The program is responsive to research and educational priorities in its efforts to create a competitive scientific workforce in the United States. In particular, there is a balance to create partnerships with industrial partners via GOALI proposals, minority serving institutions, and emerging technologies or needs (semiconductors, data science, sustainable chemistry, etc.). A major development is the creation of opportunities to create the next generation of PIs from underrepresented backgrounds in STEM (i.e., LEADS-MPS, ASCEND, etc.) and more efforts on broadening participation will strengthen all programs. Notably, the CTMC program actively participates in research and education opportunities, such as CSSI, CyberTraining, CDS&amp;E. The COV is encouraged to see that CTMC POs are making use of QIS and ML/AI opportunities. The COV encourages CTMC to continue working closely with MOLSSI and related programs to provide educational opportunities to undergraduate and graduate students. The COV also encourages CTMC and other programs to consider how they can fund CURES (course-based undergraduate research experiences).</p> |
| <p>3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.</p> <p>Comments:</p> <p>In general, CTMC has a comprehensive approach to develop and prioritize new programs and supports emerging areas.</p>   |

## MANAGEMENT OF THE PROGRAM UNDER REVIEW

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

#### Comments:

The COV was encouraged to see that the POs addressed well the previous COV comments/recommendations, especially the holding of two panels each year to review CAREER panels. The previous COV recommended awarding smaller awards to RUI proposals. Not all members of this COV agree with this recommendation, because PUI PIs need enough financial resources to complete the planned research with a more limited pool of talent. Further, there are still persistent issues that have not been addressed before and continue to be problematic. These include budget increases that reflect current salaries, cost-of-living, and inflation, and transparency in the decision process, especially more guidance on the weight of broader impacts in funding decisions.

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

**Table 5 - Resulting Portfolio of Awards**

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</b> |
|--|--|
| <p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>Comments:</p> <p>The program supports a wide range of research activities, with a proper balance between the development of (more traditional) electronic structure, force field, dynamics, spectroscopy methods and (newly emerged) machine learning and quantum information science algorithms.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 8</b></p>   | <p>Appropriate</p>   |
| <p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>Comments:</p> <p>Given that many institutions have raised tuition and fees to better support graduate students, it is promising to see that the size of average award has increased in the last 3 years and, given the current inflation levels, it is expected that this number will continue to increase. However, a typical NSF CTMC award can only support ~1.25 graduate students at a time at most institutions, even if the PI does not take salary. That is not enough to support a research group, ideally with at least 3—5 graduate students, thus severely limiting the outcome of CTMC projects.</p> <p>The COV is concerned about the longer-term impact of this increase in average award size on the number of awards that can be made absent an increase in budget. Nonetheless, creating a more competitive pool but with higher award size is generally viewed as a positive thing as long as other factors are considered (PI's current awards and sources of funding) to avoid creating only a few PIs or institutions with most of the federal funding.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 4</b></p> | <p>Appropriate</p>   |

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</b> |
|--|--|
| <p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>Comments:</p> <p>The CTMC funds projects that are innovative and potentially transformative, ranging from fundamental mechanistic studies of energy transfer within light harvest systems all the way to state-of-the-art computer-aided design of ultrafast logical gates. Further, on average, the funded proposals reflect the level of enthusiasm by the reviewers and panelists, which place a very high mark on innovation and transformative research but to a lesser extent to broader impacts. We encourage the CTMC program to fund more high-risk high-reward projects.</p> <p><b>Data Source: Jackets</b></p>   | <p>Appropriate</p>   |
| <p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>Comments:</p> <p>There are a number of proposals (and it is a common practice) for proposals to be funded via several different initiatives/programs. CTMC has over 30 proposals funded in collaboration with other programs in different directorates to support inter- and multi-disciplinary research. For example, in a traditional review cycle, CTMC co-funds interdisciplinary projects with AMO, CBET, DMR, MCB, OAC, and other NSF programs.</p> <p><b>Data Source: If co-funding is a desired proxy for measuring inter- and multi-disciplinary projects, the Co-Funding from Contributing Orgs and Co-Funding Contributed to Recipient Orgs reports can be obtained using Enterprise Reporting, COV Dashboard, Question 7</b></p> | <p>Appropriate</p>   |

| <b>RESULTING PORTFOLIO OF AWARDS</b>  | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|---|--|
| <p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>Comments:</p> <p>There is a distribution of geographical locations, but it could be improved. Increased outreach in programs to improve participation such as EPSCoR is recommended. Notably, some EPSCoR states seem to receive limited or no funding in the review cycle. Innovative solutions, such as CyberTraining, might be needed to increase funding to these and other EPSCoR states. Perhaps it would be good for the program to devote greater effort in creating a pipeline of PIs that can contribute (i.e., increase funding for postdocs and graduate students for academic careers in computational chemistry, etc.). In addition, concerns persist on the level of funding to different levels of institutions (i.e., PUI, HBCUs, etc.) within non-EPSCoR states.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 2</b></p> | <p>Appropriate but needs growth</p>                                    |
| <p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>Comments:</p> <p>It is unclear how many PUI awards were made, given that PUI was not given as a category. The POs are encouraged to include more PUI faculty in the review panels, and to participate in the MERCURY consortium conference and ACS regional meetings that attract PUI researchers. Creating a greater number of opportunities for partnerships between R1 and minority serving institutions is recommended. The relatively low funding rate of proposals from HBCUs is concerning.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 3</b></p>   | <p>Do not know</p>   |

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|--|--|
| <p>7. Does the program portfolio have an appropriate balance of awards to new and early-career investigators?</p> <p>NOTE: A new investigator is an individual who has not served as the PI or Co-PI on any award from NSF (with the exception of doctoral dissertation awards, graduate or post-doctoral fellowships, research planning grants, or conferences, symposia and workshop grants.) An early-career investigator is defined as someone within ten years of receiving his or her last degree at the time of the award.</p> <p>Comments:</p> <p>Overall, there is a good balance and, as expected, there is a higher percentage of declined proposals for new investigators.</p> <p><b>Data Source: Information on new PIs available via Enterprise Reporting, COV Dashboard, Question 6</b></p> | <p>Appropriate</p>   |
| <p>8. Does the program portfolio include projects that integrate research and education?</p> <p>Comments:</p> <p>Overall, proposals include at least some integration between an educational component and the proposed research. Notably, the CTMC CAREER proposals emphasize integration of research and education to a greater degree than traditional proposals. In the latter, the amount of integration of research and education varies because of unclear BI standards.</p> <p><b>Data Source: Jackets</b></p>   | <p>Appropriate</p>   |

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|--|--|
| <p>9. Does the program portfolio have appropriate participation of underrepresented groups<sup>8</sup>?</p> <p>Comments:</p> <p>This is a major concern for this program. There were dismal numbers for funded PIs from underrepresented backgrounds. The COV recommends that CTMC and CHE consider ways to create a deeper pipeline of talent (support postdocs going to academic careers) and or partnerships with faculty from underrepresented backgrounds. In the future, the COV would hope to see an increasing percentage of applications from female and underrepresented groups.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 5</b></p>                                | Not 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:</p> <p>CTMC is responsive to the mission of NSF and relevant national priorities by supporting efforts including (but not limited to) Big Data, Machine Learning/Artificial Intelligence, Quantum information, Semiconductors, etc.</p> <p>Further, through the support of ML/AI and QISE projects and participating in CSSI, CyberTraining, and POSE programs of OAC, the CTMC program has been at the forefront of serving the national priorities such as QIS and ML/AI.</p> <p><b>Data Source: Jackets</b></p> | Appropriate  |
| <p>11. Additional comments on the quality of the projects or the balance of the portfolio:</p> <p>It would be instructive to have information about funding decisions on collaborative R1-HBCUs etc. In addition, information about follow-up calls between not-funded PI and POs would be informative, particularly how often on average these calls happen to PIs of different institution types (R1, HBCUs, etc.)</p>   |  |

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<sup>8</sup> 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.

We applaud CTMC POs for their outreach to the community (office hours, conference attendance) and their dedicated service to the CTMC community (while staying research-active). We hope this continues in the foreseeable future.

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.

The COV suggests consideration of moving to a strictly numerical rating system, including a rating system for both the intellectual merit and broader impact categories. We recommend the CHE division provides more guidance/training to the PIs on proposal writing. This could include sharing of some successful standard and RUI proposals. For BI sections of proposals, some guidance is especially needed. Specifically, beyond training undergraduate/graduate students (including minorities) in the research group, what other BI activities are commonly involved in the CHE projects? A webinar on BI to the CHE community would be helpful. Also, there should be some kind of standard for BI, not just for the proposal writer but also for the review panel. The eJackets indicate the lack of such a standard, both in favor for those who provide well written BI sections with assessments and against for the same thing depending upon the panel. Regardless of whether a PI is well-established, there should be a clear expectation for what is required by the PI for the BI section, wherein simply stating students will be involved is determined to be less than satisfactory.

4. Please provide comments on any other issues the COV feels are relevant, bearing in mind that COV reviews do not include assessment or evaluation of the outcomes or long-term impacts of program investments.

Overall, the NSF continues to be underfunded. CTMC PIs have fewer equipment concerns than others, but it still remains incredibly hard to continue to support computing infrastructure on these grants, and the NSF resources just don't allow for the science to be successfully completed. Increasing efforts to improve participation from minority individuals in CTMC specifically, but within NSF in general, should be continued.

Not CTMC-specific, but the COV senses some mid-career burnout and lack of opportunity in Chemistry that leaves Associate Professors stuck, and many faculty close their research programs at this stage. This seems like a waste.

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

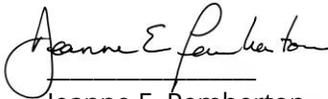
The need to access information for this review from at least three different platforms was very onerous. Improved processes would be appreciated.



*The Committee of Visitors is part of a Federal Advisory Committee. The function of Federal Advisory Committees is advisory only. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the Advisory Committee, and do not necessarily reflect the views of the National Science Foundation.*

**SIGNATURE BLOCK:**

For the 2024 COV



Jeanne E. Pemberton  
Co-Chair



Scott D. Rychnovsky  
Co-Chair

**INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES  
AND MANAGEMENT**

**Environmental Chemical Sciences (ECS)**

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, returns without review, and withdrawals) that were *completed within the review period (generally the prior four 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.

**Table 2 - Quality and Effectiveness of the Merit Review Process**

| <b>QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</b>  | <b>YES, NO,<br/>DATA NOT<br/>AVAILABLE, or<br/>NOT<br/>APPLICABLE</b> |
|---|---|
| <p>1. Are the review methods (for example, panel, <i>ad hoc</i>, site visits) appropriate?</p> <p>Comments:</p> <p>The review methods are appropriate. ECS is a relatively small program, but also covers a broad range of expertise. Therefore, the program uses a combination of panels and <i>ad hoc</i> only reviews. Overall, the reviewers exhibit a solid grasp of the proposals they assess. The program is effective at identifying <i>ad hoc</i> reviewers with the appropriate expertise.</p> <p>All panels since 2020 have been virtual. The COV encourages the program to continue to weigh the pros and cons of virtual versus in-person panels and adjust the panel modes in response. Having at least a hybrid option for those who cannot attend in person is beneficial. Some panels (particularly 2020) have &gt;20 proposals per panel. Consider having more panels with fewer proposals per panel or increasing the number of panelists per proposal. This could also be accomplished by inviting <i>ad hoc</i> reviewers to participate in the panel discussion of individual proposals. This could particularly benefit the review of CAREER proposals, since the number of proposals received is relatively small. Currently, CAREER proposals are mostly reviewed <i>ad hoc</i>, but discussion of these proposals by a group of <i>ad hoc</i> reviewers could be beneficial.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 6</b></p> | <p>Yes</p>  |

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS   | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|---|--|
| <p>2. Are both merit review criteria addressed</p> <p>a) In individual reviews?</p> <p>b) In panel summaries?</p> <p>c) In Program Officer review analyses?</p> <p>Comments:</p> <p>Overall, the review criteria were effectively addressed by the individual reviewers, panel, and Program Officer. However, the Broader Impacts section still requires attention, as it is often not adequately covered in proposals and panel discussions.</p> <p>Although understanding of the Broader Impacts criteria by the community is increasing, there is still a wide range of activities cited under Broader Impacts, making it more difficult to evaluate and to weigh in the overall recommendation.</p> <p><b>Data Source: Jackets</b></p>  | <p>Yes</p>                                     |
| <p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>Comments:</p> <p>For the most part, individual reviewers offered substantive comments. For reviewers from outside the US academy, there appears to be less understanding of the Broader Impacts criteria, and therefore, the assessment of these criteria is more limited. Providing training for reviewers could help them enhance the review process and deliver more effective and constructive feedback. NSF should consider scoring the Intellectual Merit and Broader Impacts criteria separately, in order to facilitate transparency and more consistent evaluation and weighting of these criteria across different proposals.</p> <p><b>Data Source: Jackets</b></p> | <p>Yes</p>                                     |

| <b>QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</b>   | <b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b> |
|--|---|
| <p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>Comments:</p> <p>In general, panel summaries clearly explain the rationale behind the panel consensus. Given the constraints in funding and the decisions that need to be made, encouraging Principal Investigators to contact the Program Officer can provide an opportunity for more effective feedback.</p> <p><b>Data Source: Jackets</b></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:</p> <p>In general, the documentation in the jacket does a good job of explaining the rationale for funding decisions. In particular, the panel summary and the Review Analysis including the ranking, provide the most information for the award/decline decisions.</p> <p><b>Data Source: Jackets</b></p> | <p>Yes</p>  |

| <p><b>QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</b></p>   | <p><b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b></p> |
|---|--|
| <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:</p> <p>In general, the documentation provided to the PI outlines the rationale for decisions. POs should continue to make efforts to clearly communicate the rationale for the award/decline decision in the PO comments to the PI, especially for borderline cases. It is most critical to communicate to the PI what aspects of the proposal can be improved in order to be more competitive. Encouraging or facilitating PIs to contact the Program Officer can also be valuable.</p> <p><b>Data Source: Jackets</b></p> | <p>Yes</p>   |
| <p>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</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.

**Table 3 - Selection of Reviewers**

| <b>SELECTION OF REVIEWERS</b>  | <b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b> |
|--|---|
| <p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>Comments:</p> <p>Overall, the program has been effective at identifying reviewers with a deep comprehension of the topics being reviewed. There is an almost equal breakdown of reviewers by gender, which is laudable, and a good distribution across different institution types.</p> <p><b>Data Source: Jackets</b></p>  | <p>Yes</p>  |
| <p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>Comments:</p> <p>The program uses a variety of different tools to identify and resolve conflicts of interest. The ECS Program Officer is available to clarify any conflict of interest and has been effective at reminding reviewers and panelists about it. In addition, panelists are provided with training to identify conflicts. The methods used to resolve these conflicts are appropriate.</p> <p><b>Data Source: Jackets</b></p> | <p>Yes</p>  |
| <p>3. Additional comments on reviewer selection:</p> <p>The COV commends the program on doing a good job of including reviewers and panelists from a broad range of career stages, including early career scientists.</p>  |   |

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

***Table 4 - Management of the Program Under Review***

| <b>MANAGEMENT OF THE PROGRAM UNDER REVIEW</b>   |
|---|
| <p>1. Management of the program.</p> <p>Comments:</p> <p>The COV commends the ECS program for its support of a wide and diverse range of projects. There has also been a significant improvement in grant size. However, ECS had the lowest average grant size among CHE programs during the 2020-2022 period, despite having a relatively similar funding rate. Given the recent rise in research costs and wages for graduate students and postdocs, and the critical scientific questions addressed by this program, it is crucial for NSF to consider increasing the budget for ECS to ensure its continued effectiveness.</p> <p>Dwell times for proposal decisions were improved across the four-year review period and are now meeting the 6-month NSF target. We encourage ECS to continue this improvement.</p>  |
| <p>2. Responsiveness of the program to emerging research and education opportunities.</p> <p>Comments:</p> <p>The COV is impressed by the balance between emerging topics and fundamental research in the ECS grants. The program does an excellent job of responding to emerging research and education opportunities. It participates in several NSF initiatives, including the Critical Aspects of Sustainability (CAS) and Data Science (D3SC, CDS&amp;E) initiatives. We encourage the program to maintain this balanced portfolio.</p>  |
| <p>3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.</p> <p>Comments:</p> <p>The ECS program has effectively responded to emerging national and global needs while maintaining a focus on fundamental chemical knowledge. In addition to emerging challenges identified by Principal Investigators and the research community, the planning and prioritization processes are often influenced by national and local government priorities that reflect societal needs. In addition, environmental research is supported by many governmental agencies and the existence of Interagency Committees (e.g. Nanoplastics, Contaminants of Emerging Concern) and discussion is a unique advantage of ECS in guiding the development of the portfolio. This is a real strength of the program.</p> |

## MANAGEMENT OF THE PROGRAM UNDER REVIEW

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

#### Comments:

The ECS program has been highly effective in addressing previous COV report comments and recommendations. For example, the program has made an increased effort to clarify the program focus on fundamental molecular processes to proposers, reviewers and panelists and has also included this rationale for funding decisions in the PO comments when appropriate.

However, assessing Broader Impacts remains challenging. This is probably a challenge for the larger scientific community. Emphasizing Broader Impacts in proposal solicitations could help address this issue. Additionally, clarifying the elements of Broader Impacts and how it is evaluated to Principal Investigators, reviewers, and panelists could be beneficial.

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

**Table 5 - Resulting Portfolio of Awards**

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</b> |
|--|--|
| <p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>Comments:</p> <p>The program is by nature multidisciplinary and balances proposals that look at different compartments in the environment and that approach the study of the environment using a broad swath of tools including computational, analytical, and spectroscopic methods.</p> <p>We commend the ECS program for their work in collaboration with other disciplines and programs within NSF-CHE. We believe this is not only needed, given the nature of the program, but it is also a strength.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 8</b></p> | <p>Appropriate</p>   |
| <p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>Comments:</p> <p>The median grant size is one of the lowest at NSF-CHE, and it does not seem sufficient to keep pace with the fast-rising research costs and wages for graduate students and post-doctoral research fellows. It is difficult to imagine how a project could accomplish the amount of work typically required of a single-investigator NSF grant with a budget that does not seem sufficient to support a single full-time researcher for three years.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 4</b></p>   | <p>Not Appropriate</p>                                     |

| RESULTING PORTFOLIO OF AWARDS  | APPROPRIATE,<br>NOT APPROPRIATE,<br>OR DATA NOT<br>AVAILABLE |
|--|--|
| <p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>Comments:</p> <p>The program has identified several emerging and innovative areas. These include: the fate of contaminants of emerging concern in the environment (in all compartments); micro- and nano-plastics interactions with other chemicals in the environment; the use of ML and AI to predict reaction products and develop sustainable chemicals; new insights into cloud and new particle formation in the atmosphere. These areas of targeted innovation are balanced against other goals, including maintaining a diverse portfolio of types of institutions funded, and the merit-based review process that continues to reward high-quality proposals that use traditional techniques that move the field forward.</p> <p>There were also RAPID and GOALI proposals that were evaluated. The resulting award/decline decisions were appropriate.</p> <p><b>Data Source: Jackets</b></p> | <p>Appropriate</p>   |
| <p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>Comments:</p> <p>Yes, the program is by definition inter- and multidisciplinary. In addition, there is co-funding across different programs and divisions in addition to division-wide initiatives. It seems possible that there could be even more co-funding with other divisions within the Directorates of Engineering, Geology, and possibly even Biology.</p> <p><b>Data Source: If co-funding is a desired proxy for measuring inter- and multi-disciplinary projects, the Co-Funding from Contributing Orgs and Co-Funding Contributed to Recipient Orgs reports can be obtained using Enterprise Reporting, COV Dashboard, Question 7</b></p>   | <p>Appropriate</p>   |

| <b>RESULTING PORTFOLIO OF AWARDS</b>  | <b>APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</b> |
|---|--|
| <p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>Comments:</p> <p>Yes, the geographical distribution of PIs is appropriate. However, there are very few funded projects from the upper Midwest, which reflects a fewer number of proposal submissions from this area.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 2</b></p>   | <p>Maybe</p>   |
| <p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>Comments:</p> <p>The program does a good job of balancing awards to different types of institutions. The percentage of proposals awarded is consistent across different institutional types. However, the program should continue to work to increase the overall number of submissions from non-PhD-granting institutions and minority serving institutions.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 3</b></p>  | <p>Appropriate</p>   |
| <p>7. Does the program portfolio have an appropriate balance of awards to new and early-career investigators?</p> <p>NOTE: A new investigator is an individual who has not served as the PI or Co-PI on any award from NSF (with the exception of doctoral dissertation awards, graduate or post-doctoral fellowships, research planning grants, or conferences, symposia and workshop grants.) An early-career investigator is defined as someone within ten years of receiving his or her last degree at the time of the award.</p> <p>Comments:</p> <p>The program is to be commended for the degree to which new investigators are supported. There is no difference in funding rates as a function of prior grant status or as a function of time from Ph.D.</p> <p><b>Data Source: Information on new PIs available via Enterprise Reporting, COV Dashboard, Question 6</b></p> | <p>Appropriate</p>   |

| <b>RESULTING PORTFOLIO OF AWARDS</b>  | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|---|--|
| <p>8. Does the program portfolio include projects that integrate research and education?</p> <p>Comments:</p> <p>Yes, many proposals include educational activities in the Broader Impacts. ECS projects have some educational component, considering that the training of undergraduate and graduate students is an important educational goal</p> <p><b>Data Source: Jackets</b></p>  | <p>Appropriate</p>   |
| <p>9. Does the program portfolio have appropriate participation of underrepresented groups<sup>9</sup>?</p> <p>Comments:</p> <p>The percentage of proposals submitted by male PIs is slightly higher than by female PIs. The funding rate is the same for male and female identifying PIs, suggesting that more submissions from female-identifying PIs should be encouraged. The gender balance for reviewers is closer to equal.</p> <p>For proposals from PIs from underrepresented groups, the number of submissions is small and the funding rate is somewhat lower than the program average, suggesting both could be further improved.</p> <p>The best way to change this is to train and engage in science more people from diverse backgrounds. We don't have the information needed to judge that. Right now, the primary information we have is on the ethnic, gender, and racial breakdown of PIs but that doesn't tell the whole story.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 5</b></p> | <p>Appropriate</p>   |

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<sup>9</sup> 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.

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|--|--|
| <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:</p> <p>The program touches on many areas relevant to national priorities, agency mission, and the needs of constituents, including sustainability, climate science, and resiliency.</p> <p><b>Data Source: Jackets</b></p> | <p>Appropriate</p>   |
| <p>11. Additional comments on the quality of the projects or the balance of the portfolio:</p>   |  |

## OTHER TOPICS

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

The main program area we identified as needing improvement is in the funding levels for individual grants. We also continue to have concerns in how Broader Impacts are defined and evaluated. We recognize that NSF chemistry has done many things to meet the needs of the community in understanding Broader Impacts and yet, we find that many people do not, and that reviewers and review panels treat this merit criterion differently. Suggestions to improve Broader Impacts include increasing the section length to encourage investigators to elaborate their approach and separating the evaluation of Intellectual Merit and Broader Impacts. This would also signal to NSF reviewers that this is an important part of the overall grant.

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.

Agency wide issues include working with Congress to ensure budgets for NSF chemistry that are large enough to cover the costs of graduate students and post-doctoral research fellows. There has been a nation-wide shift in viewing graduate students as full-time employees who should be compensated accordingly, and NSF chemistry grants need to scale to meet these realities. In general, productivity under prior support should reflect the quality of the prior work and its responsiveness to the project goals and should not be simply a measure of total number of papers.

It is also clear that the quality of the review process relies on the training of Program Officers and specifically, their ability to keep abreast of complex and diverse areas of science (not just chemistry). It is important that NSF provide opportunities for Program Officers to attend conferences, including some specialized conferences like Gordon Research Conferences, to stay abreast of new developments in their fields.

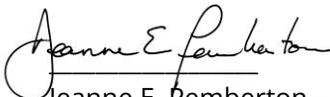
4. Please provide comments on any other issues the COV feels are relevant, bearing in mind that COV reviews do not include assessment or evaluation of the outcomes or long-term impacts of program investments.
5. NSF would appreciate your comments on how to improve the COV review process, format, and report template.

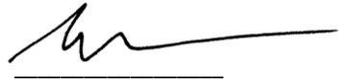
The COV commends NSF for giving us access to the eJackets and to the COV dashboard well in advance of our two-day panel. It was very helpful to have time to review this material and think about it. Touching base with the subgroup members ahead of the meeting also helped to form good working relationships.

*The Committee of Visitors is part of a Federal Advisory Committee. The function of Federal Advisory Committees is advisory only. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the Advisory Committee, and do not necessarily reflect the views of the National Science Foundation.*

**SIGNATURE BLOCK:**

For the 2024 COV

  
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## INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

### Major Research Instrumentation (MRI)

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, returns without review, and withdrawals) that were *completed within the review period (generally the prior four 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.

**Table 2 - Quality and Effectiveness of the Merit Review Process**

| <p><b>QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</b></p>  | <p><b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b></p> |
|--|--|
| <p>1. Are the review methods (for example, panel, <i>ad hoc</i>, site visits) appropriate?</p> <p>Comments:</p> <p>Review methods appear appropriate, well described, and well executed. Panels were used for most proposals that were potentially competitive. The PO made recommendations from panel recommendations based on at least 3 reviews. The <i>ad hoc</i> reviews provided expertise that was useful in informing panel evaluations where panels did not generally have the specific technical expertise.</p> <p>Virtual panels adapted to the unusual situation presented by the COVID pandemic and were highly successful and resulted in operations that appeared as normal as non-COVID years.</p> <p>Ratings (G/V/E) do not always seem to result in the same funding decisions from year to year. A potential tactic is to try for continuity of a small number of reviewers.</p> <p>Regarding virtual panels, discussion is still enabled in the virtual format, allowing for decisions to be reached by a consensus of the panel. This format also allows cost efficiency and a broader selection of panelists. Panel discussions can be vital to clarify strengths and weaknesses, and the return to more in-person panels is supported, while still incorporating some remote participants in a hybrid format to enhance diversity, avoid COI, recruit expert panelists, and consider additional proposals.</p> <p>Recognizing the program’s efforts and commitment to inclusiveness, a better spread of unidentified/female/male panelist ratios is a continuing priority. A portal to recruit reviewers, inviting early career and under-represented colleagues, can help address this gap. A more integral assessment of the PI’s relevant expertise, their recent productivity, and the impact of their past work would likely lead to improved outcomes and more effective distribution of instrument funding. Although some reviewers and some panels considered these criteria to some extent, this was not universally the case.</p> <p>The <i>ad hoc</i> reviewers and panel members cannot be experts in all areas of chemistry, yet descriptions of research to be enabled by instrumentation are multi-disciplinary and often well outside the expertise of reviewers who are experts in instrumentation and individual disciplines. It may be helpful to make PIs focus more on how a particular instrument that is being requested will advance specific projects as opposed to evaluating the importance of various scientific projects.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 6</b></p> | <p>YES</p>   |

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS   | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|---|--|
| <p>2. Are both merit review criteria addressed</p> <p>In individual reviews? Generally, yes</p> <p>In panel summaries? Yes</p> <p>In Program Officer review analyses? Yes</p> <p>Comments:</p> <p>The PO review analysis is thorough in evaluating the merit criteria and is an excellent summary and evaluation of the panel discussion and rankings. Individual reviews tend to evaluate the intellectual merit of a proposal more than the broader impacts. Panel summaries reflect the discussion presented in the individual reviews.</p> <p>The large scope of BI is noticed, and the program has done a good job of valuing broader impacts; some panels and reviewers value diversity or other types of BI more strongly than others; continued vigilance in offering examples, training and workshops to PIs is supported. Clarifying how to address scientific impact and focus on complementary activities related to the proposal would enhance the ability to evaluate BI.</p> <p>The solicitation-specific criteria generally show good reviewer and panel engagement, reflecting that panels recognize that data and instrument management plans are vital to the successful acquisition, oversight and management of instrumentation and its usage.</p> <p>When an initially strongly perceived proposal is declined after panel review, clear explanations were given, but it remains important for the panel and the program to clearly delineate how emerging weaknesses led to the final decision.</p> <p><b>Data Source: Jackets</b></p> | <p>YES</p>                                     |

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS   | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|---|--|
| <p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>Comments:</p> <p>Individual reviews are generally extensive and comprehensive. As noted, intellectual merit discussion is often more expansive, demonstrating an awareness of the strengths and weaknesses of a proposal.</p> <p>Reviewer comments on broader impacts tended to be shorter, and less constructive with generalized statements about how broader impacts can be improved. This is an ongoing challenge for PIs and the NSF.</p> <p>Some reviewers choose to write in short form (i.e. bulleted, incomplete sentences and perhaps some informal writing) when more formal/detailed language would be desired. Reviewer engagement is overall appropriate.</p> <p><b>Data Source: Jackets</b></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:</p> <p>It appeared that consensus among panel members was generally reached, and the panel summaries represented majority and minority opinions of those on the panel.</p> <p>Reviewers and panels may not comment as much on proposals if the IM are sufficiently concerning to reach a negative recommendation. Doing so is a reasonable 'triage' for panels so that more time can be spent on more competitive proposals, but it limits the feedback provided to the PIs. Weaker proposals could merit additional constructive feedback.</p> <p>Both the panels and the POs do an outstanding job of synthesizing a consensus view even when individual review reports vary significantly in their ratings.</p> <p><b>Data Source: Jackets</b></p> | <p>YES</p>                                     |

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS   | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|---|--|
| <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:</p> <p>The Review Analysis was generally excellent in rationalizing funding decisions. It is important for the RA to document decisions in more detail in instances of close decisions, when similarly ranked proposals have different outcomes, especially when the funding decisions are significantly different from the ranking of the panel.</p> <p>The Review Analyses show that the PO is clear about their rationale. Also, the feedback to the PI is very clear including cases when the PO notes that the proposal did not fit scope.</p> <p>It was noticed that proposals that violated the single-instrument rule arose in a small number of the ejackets, where cases ranged from relatively clear depiction of multiple instruments to more ambiguous cases. Providing guidance on this issue in workshops and newsletters may help reduce such issues in the future.</p> <p>Several instances of NDP proposals were provided, and in all cases, the PO analysis was very clear about the reasons for these decisions.</p> <p><b>Data Source: Jackets</b></p> | <p>YES</p>                                     |

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS  | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|--|--|
| <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:</p> <p>In addition to the panel summary and individual reviewer reports, communications from the PO to the PIs were excellent at providing the rational for outcomes. In cases where a proposal was declined, the POs were genuinely interested in providing helpful insights into the decision and advice on how to help the PI be successful in the future. Communications indicated that they were very encouraging for PIs to contact them.</p> <p><b>Data Source: Jackets</b></p> | YES  |
| <p>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</p> <p>The merit review process is effective at allocating resources to worthy projects. NSF is encouraged to seek more female/URG representation on MRI panels. Developing a portal to recruit early career reviewers is suggested, particularly getting diverse reviewers on panels who have not been supported previously.</p> <p>NSF has done an excellent job in diversifying their participant pool in both <i>ad hoc</i> reviews and panels. There remain fewer females than males among reviewers, which may reflect the population of the available pool. The COV recommends that NSF continues to monitor and solicit from a diverse pool of reviewers.</p>   | 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.

**Table 3 - Selection of Reviewers**

| <b>SELECTION OF REVIEWERS</b>   | <b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b> |
|---|---|
| <p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>Comments:</p> <p>This program is unique in chemistry in that different instruments can support all different areas of chemistry and beyond, making it much more challenging to find reviewers who are true experts in all fields covered by a single proposal. Given this challenge, there was significant expertise in chemical instrumentation on the panels and the <i>ad hoc</i> reviewers who commented on whether the instrument capabilities were appropriate.</p> <p>The panel recognized that reviewers cannot have expertise in every subdiscipline. However, having input from people who are not experts in a given discipline is a valuable component of evaluation.</p> <p><b>Data Source: Jackets</b></p> | <p>YES</p>  |
| <p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>Comments:</p> <p>The NSF conflicts of interest assessment is extraordinarily thorough. The higher level of scrutiny is inconsistent with other federal funding agencies, which leads to a high administrative burden on PIs, especially in this program where there are large proposal teams and typically highly collaborative PIs. Adopting a uniform conflict of interest policy among all federal funding agencies is recommended.</p> <p>Requests to not include a reviewer were honored. In a small number of cases, COI was detected later in the process and was handled well, showing a commitment to monitoring for COI throughout the process, not just in initial screening.</p> <p><b>Data Source: Jackets</b></p>      | <p>YES</p>  |

| <b>SELECTION OF REVIEWERS</b>   | <b>YES, NO,<br/>DATA NOT<br/>AVAILABLE,<br/>or NOT<br/>APPLICABLE</b> |
|---|---|
| <p>3. Additional comments on reviewer selection:</p> <p>The number of reviewers from 4-year institutions was very low; however, it appeared that panels that considered proposals from 4-year institutions had more faculty from similar institutions. Consideration to include early career reviewers who have not submitted proposals to introduce them to the overall process and deliberations behind submission could be useful. This might improve proposals submitted down the line or encourage additional submission from URG/female/HBCU.</p> | <p>YES</p>  |

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

***Table 4 - Management of the Program Under Review***

**MANAGEMENT OF THE PROGRAM UNDER REVIEW**

1. Management of the program.

Comments:

The overall management of the program and the contributions of the POs to maintain excellence is outstanding. There is exceptional attention to details, very good interpretation of the panel opinions, and overall assessment by the POs of the proposals in the context of the program portfolio is very good. The POs were also highly compassionate to the PIs whose proposals were declined and genuinely wanted to provide useful feedback and guidance to make each PI more successful.

The recent elimination of cost-sharing reduced the number of awards. Over the five-year time projected for this rule, there would be a loss of ~30 instruments nationally that would impact hundreds of researchers and students if not more. Our understanding is that elimination of cost-sharing did not lead to full cost compensation, and this will lead to a less competitive national infrastructure. Ironically, this is the opposite effect intended.

Steeply increasing instrument costs create a challenging environment to fund instruments at an adequate level. This leads to concerns about how to fund critical infrastructure through the MRI program while balancing diversity of awards. An examination of proposal pressure and funding rates shows that large numbers of highly ranked proposals are not funded.

The program has reduced the gap in the success rate for 4-year institutions, and its continuing efforts are greatly appreciated. As indicated in the prior COV report, such institutions prepare students to advance in STEM at a high rate with emphasis on hands-on instruction and student research.

## MANAGEMENT OF THE PROGRAM UNDER REVIEW

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

#### Comments:

The helium recovery component to the MRI program is outstanding. Helium is a limited resource and recycling this valuable material is critical to continued success of instruments that require it.

Funding for instrument development, which is high risk but can lead to high rewards, is limited. This is due to a limited number of proposals. Although the funding rate for these proposals is competitive, the actual number of proposals in this area that were submitted is shockingly low. If NSF wishes to lead the world in new measurement capabilities that can accelerate all areas of chemistry and related fields, more emphasis on instrument development proposals is necessary. To accomplish this goal, there needs to be more instrument development proposals that are submitted to NSF. This could be achieved with changes to current NSF policy. One method to encourage new high-quality instrument proposals is to eliminate the current limits to the number of proposals submitted for instrument development from individual Universities. Currently, many potential instrumentation development proposals are not submitted because of competing demands for the limited number of applications that can be submitted by a single institution. There should be separate review criteria that would allow up to 5 or 6 years to accomplish a build for complex instruments, with perhaps a noncompetitive review after three years. Successful instrument development programs not only lead to new capabilities that accelerate all areas of chemistry, but also significantly enhance workforce development by giving students at all levels hands-on experience with all aspects of instrumentation that they would not otherwise get by just buying and using commercially available instruments.

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

#### Comments:

It is clear that there was a prioritization process, but it was not always transparent what was being prioritized and why. It seems that there may be unutilized opportunities to link instrument acquisition and instrument development to national research priorities and communicate this information to constituents to encourage more high risk-high reward proposals.

The program is responsive to the listed categories of instrument acquisition and development. Multiple panels, each with an instrument-specific focus, are organized. Track-II proposals are less frequent, though appear supported.

## MANAGEMENT OF THE PROGRAM UNDER REVIEW

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

#### Comments:

The previous COV comments and recommendations have been adequately addressed.

The program's commitment to growing parity is recognized, while successfully narrowing the gap in funding PUIs is commended. These are also areas identified for continued improvement in this review. As noted, more intentional efforts to recruit early career and under-represented reviewers through an online portal could be potent. The PO rationale was deemed very clear in the jackets with detailed and direct comments.

The COV recommends that NSF and CHE consider providing the community with specific examples and better guidance for the Broader Impacts criterion for MRI proposals, as they are distinctive from regular research awards.

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

**Table 5 - Resulting Portfolio of Awards**

| <b>RESULTING PORTFOLIO OF AWARDS</b>  | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|---|--|
| <p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>Comments:</p> <p>Awards were spread among many different instrument types. However, instrument development is under-represented. The program should encourage proposals for instrument development more broadly by not limiting the number of applications for instrument development from any single institution.</p> <p>MRI is primarily supported by the NSF Office of Integrative Activities (OIA) and CHE. This may be a result of the focus, nature, and function of the proposals.</p> <p>Awards cover all facets of instrumentation, e.g. Mass Spectrometry, NMR, Diffraction, and other spectroscopies. An examination of awarded versus declined proposals shows good balance and that coverage of instrument categories is appropriate and is determined mainly by the submissions.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 8</b></p> | <p>APPROPRIATE</p>   |

| <b>RESULTING PORTFOLIO OF AWARDS</b>  | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|---|--|
| <p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>Comments:</p> <p>Developing complex instruments can take longer than three years. NSF should consider allowing longer durations for these types of proposals. The program has done an excellent job given their limited resources. However, the number of instruments funded is surprisingly low given the importance of instrumentation to modern science and the high importance of chemistry to industry and the US economy.</p> <p>Award sizes and duration are appropriate for acquiring new commercial instruments, and dictated by the proposal outline (3-year budget). The small, incremental increase over the four years reported shows meeting increased needs. Further increases to the average award to meet inflation should be considered. The number of Track 2 awards made are small relative to the number of Track 1 awards. The increase in award size in 2023 likely resulted, at least in part, from the elimination of cost-sharing for PhD-granting institutions.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 4</b></p> | APPROPRIATE  |
| <p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>Comments:</p> <p>Because the MRI program supports all areas of chemistry, it is challenging to evaluate the extent to which the awards fit these criteria. Some awards led to a very limited number of publications, whereas the publication records for some others were more robust indicating that some of the proposals did accelerate research progress of multiple groups.</p> <p>Acquisition or development of instruments is typically transformative for the institute. Innovative major research instrumentation can come from vendor advancements, but this outcome is not universally true of all instrument categories.</p> <p>Development proposals provide a direct route to promote innovation and are underfunded and under-proposed.</p> <p><b>Data Source: Jackets</b></p>  | APPROPRIATE  |

| <b>RESULTING PORTFOLIO OF AWARDS</b>  | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|---|--|
| <p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>Comments:</p> <p>Modern instruments are necessary for all areas of chemistry and this program is highly multi-disciplinary.</p> <p>Successful proposals are seen to reflect multiple PIs/co-PIs and senior personnel that cover multiple programs/departments/colleges/entities within their institutions. Co-funding reflects multi-disciplinarity, while room to expand co-funding among more programs is perceived.</p> <p><b>Data Source: If co-funding is a desired proxy for measuring inter- and multi-disciplinary projects, the Co-Funding from Contributing Orgs and Co-Funding Contributed to Recipient Orgs reports can be obtained using Enterprise Reporting, COV Dashboard, Question 7</b></p> | APPROPRIATE  |
| <p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>Comments:</p> <p>Geographic coverage is deemed appropriate including strong participation of EPSCoR to broaden award geography, which is commended. There is a noted asymmetry for submissions depending on location. Some jurisdictions are noted as having no submissions in the 4-year window for the COV, for example. This may reflect the relative population densities in these regions. It is noted that the award rate for many low population density states is at or above the average funding rate, which the panel views positively. Continued tracking of this metric is encouraged.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 2</b></p>   | APPROPRIATE  |

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|--|--|
| <p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>Comments:</p> <p>The success rate for PhD-granting institutions and PUIs differs slightly. The program should remain cognizant of differences between different institutional categories, but there is not a universal expectation that outcomes should be necessarily the same for all types of institutions.</p> <p>It is noted that few proposals were submitted by HBCUs. Soliciting proposals from HBCU/2-yr/4-yr colleges could be pursued through upcoming workshops that are planned by the program. Connecting PIs from underrepresented institutions with mentors could be piloted. Posting deidentified examples of good proposals could be very impactful to institutions with less access to mentors and sample proposals,</p> <p>The program is commended for narrowing the gap in awards to 4-year colleges versus other institutions, but notes the gap still exists. These institutions produce future PhD and STEM professionals at a high rate due in part to close student-faculty mentoring with advanced instrumentation.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 3</b></p> | <p>APPROPRIATE</p>   |

| <b>RESULTING PORTFOLIO OF AWARDS</b>  | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|---|--|
| <p>7. Does the program portfolio have an appropriate balance of awards to new and early-career investigators?</p> <p>NOTE: A new investigator is an individual who has not served as the PI or Co-PI on any award from NSF (with the exception of doctoral dissertation awards, graduate or post-doctoral fellowships, research planning grants, or conferences, symposia and workshop grants.) An early-career investigator is defined as someone within ten years of receiving his or her last degree at the time of the award.</p> <p>Comments:</p> <p>There are a significant number of early career (0-5 year from PhD) awardees, with slightly higher success rates observed for mid-career (10+ year) PIs. The near parity between PIs with no prior support and established PIs suggests that good progress has been made since the prior report, but the small differences that remain support continuing these successful efforts. It should be noted that there is a selection process for more senior investigators in the form of tenure that may contribute to the small unequal outcomes for these two groups.</p> <p><b>Data Source: Information on new PIs available via Enterprise Reporting, COV Dashboard, Question 6</b></p> | <p>APPROPRIATE</p>   |
| <p>8. Does the program portfolio include projects that integrate research and education?</p> <p>Comments:</p> <p>The program is a mechanism supporting research, but eJackets reflect valuing curricular development and educational outreach in broader impacts. Instruments (e.g. NMR, MS, diverse spectroscopies) are also those that are mandated for degree accreditation.</p> <p><b>Data Source: Jackets</b></p>  | <p>APPROPRIATE</p>   |

| <b>RESULTING PORTFOLIO OF AWARDS</b>  | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|---|--|
| <p>9. Does the program portfolio have appropriate participation of underrepresented groups<sup>10</sup>?</p> <p>Comments:</p> <p>We recognize the program works diligently on this but observe that submissions from female PIs remains low.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 5</b></p> | <p>APPROPRIATE</p>   |

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<sup>10</sup> 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.

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|--|--|
| <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:</p> <p>As described above, new state-of-the-art instruments are essential for all areas of research and impact all areas of chemistry and related fields. Promoting access to cutting edge instrumentation is vital to ensure that research maintains an internationally leading presence.</p> <p>Attention is drawn to multiple national initiatives that call out supporting infrastructure for research, for example the National Quantum Initiative and the Nanotechnology Initiative. From the National Strategic Overview for QIS in “Providing Critical Infrastructure Policy” (Pg 8):</p> <ul style="list-style-type: none"> <li>- Encourage agencies to provide the QIS research community with increased access to existing and future facilities and supporting technologies</li> <li>- Establish end-user testbed facilities along with training and engagement, thereby allowing Federal agencies and stakeholders to explore applications relevant to their respective missions</li> </ul> <p>The chemistry MRI program aligns with these goals and furthers these national priorities.</p> <p>The need for an instrumentation infrastructure to support research advances is also reflected in From the National Nanotechnology Initiative Strategic Plan (p. 18), Goal 3. Provide the infrastructure to sustainably support nanotechnology research, development, and deployment.</p> <p><b>Data Source: Jackets</b></p> | <p>APPROPRIATE</p>   |
| <p>11. Additional comments on the quality of the projects or the balance of the portfolio:</p> <p>The new helium Track 3 represents a fast and impactful response to the current helium crisis; increasing funding for this important area is warranted.</p>   | <p>APPROPRIATE</p>   |

## OTHER TOPICS

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

Funding for instrument development, which is high risk but can lead to high rewards, is limited. This is due to a limited number of proposals. Although the funding rate for these proposals is competitive, the actual number of proposals in this area that were submitted is shockingly low. If NSF wishes to lead the world in new measurement capabilities that can accelerate all areas of chemistry and related fields, more emphasis on instrument development proposals is necessary. To accomplish this goal, there needs to be more instrument development proposals that are submitted to NSF. This could be achieved with changes to current NSF policy. One method to encourage new high quality instrument proposals is to eliminate the current limits to the number of proposals submitted for instrument development from individual Universities. Currently, many potential instrumentation development proposals are not submitted because of competing demands for the limited number of applications that can be submitted by a single institution. There should be separate review criteria that would allow up to 5 or 6 years to accomplish a build for complex instruments with perhaps a noncompetitive review after three years. Successful instrument development programs not only lead to new capabilities that accelerate all areas of chemistry, but also significantly enhance workforce development by giving students at all levels hands-on experience with all aspects of instrumentation that they would not otherwise get by just buying and using commercially available instruments.

It was observed that some proposals were difficult to evaluate with respect to how the instrument would be offered for use, particularly it was not always clear whether it would interface strongly with students and provide good training opportunities, or if it would be placed behind a sample-submission wall in which it was administered primarily by staff. As a larger goal of MRI is to enhance training on and access to cutting edge instruments, having PIs and panels address this further in proposals is merited.

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.

The NSF conflicts of interest assessment is thorough. It would be desirable to make this uniform among all federal funding agencies, such as NIH. The different criteria for different agencies vary widely for reasons that are not entirely apparent. It is not clear why this should be so. The lack of uniformity may lead to the perception that some federal organizations allow conflicts whereas others do not.

NSF does not have a mechanism for a single PI to request an instrument over ~\$150K that may be necessary for their NSF-funded research. The MRI is not the appropriate vehicle for this request, because reviewers are asked to evaluate the impact of an instrument to a broad group of researchers. To maintain research excellence in the US, it is imperative that the NSF provides a mechanism for single PIs to purchase cutting-edge instrumentation.

As the MRI program's goal is to improve instrument availability for groundbreaking research, a further understanding of the impact of rising costs and availability of instruments could help improve the published funding opportunity and proposal responses.

There is a dissonance between the BI discussion in the PAPPG and what is found on the NSF website. The website for BI is difficult to find and buried several layers down

(<https://new.nsf.gov/funding/learn/broader-impacts>). This could be easily remedied in the PAPPG and on the NSF website and improve overall awareness of BI activities suggested by the NSF.

4. Please provide comments on any other issues the COV feels are relevant, bearing in mind that COV reviews do not include assessment or evaluation of the outcomes or long-term impacts of program investments.

A more integral assessment of both the PI's relevant expertise, their recent productivity, and the impact of their research would likely lead to improved outcomes and more effective distribution of funding. Although some reviewers and some panels considered these criteria to some extent, this was not universally the case. This should be made a more specific criterion for reviewers and panels to consider.

Reviewer critique was noted of smaller institutions on their helium management plan that does not account for differences in usage, infrastructure and the annual costs of recovery relative to larger sites. In other words, there is an unfavorable cost-benefit analysis for performing helium recovery for the very low helium use of modern long-hold/low-use, lower field instruments in smaller institutions. Examining and clarifying the helium management plan for reviewers with respect to smaller institutions is supported. However, the overall goal of maximizing helium recovery for the least cost balanced nationally should be the primary driving force in these decisions.

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

The communication between NSF staff and POs with the COV was outstanding.

*The Committee of Visitors is part of a Federal Advisory Committee. The function of Federal Advisory Committees is advisory only. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the Advisory Committee, and do not necessarily reflect the views of the National Science Foundation.*

**SIGNATURE BLOCK:**

For the 2024 COV

  
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Co-Chair

  
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## INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

### Macromolecular, Supramolecular and Nanochemistry (MSN)

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, returns without review, and withdrawals) that were *completed within the review period (generally the prior four 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.

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Please answer the following questions about the effectiveness of the merit review process and provide comments or concerns in the space below the question.

**Table 2 - Quality and Effectiveness of the Merit Review Process**

| <p><b>QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</b></p>  | <p><b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b></p> |
|--|--|
| <p>1. Are the review methods (for example, panel, <i>ad hoc</i>, site visits) appropriate?</p> <p>Comments:</p> <p>The COV commends MSN for striving for a high quality and transparent review process. The majority of proposals are reviewed through virtual panels, which provide a thorough balance of topics: Conjugated Pi-systems, Polymer Assemblies, Polymer Synthesis, Supramolecular Chemistry, SAMs/Surface, Nanocarbon, Nanochemistry, Nanoparticle electronic and optical properties, nanoparticle surface and interfacial chemistry, and the Macromolecular Career panel. This breath of topics is commendable.</p> <p>Over this period, only a few proposals solely relied on <i>ad hoc</i> reviews, which were primarily required for topics not matching well with the panels. Since COVID-19 initiated a switch from in-person panels, MSN effectively utilized virtual panels supplemented at times with <i>ad hoc</i> expert reviewers. Individually, virtual panels handled a smaller number of proposals per panel than in-person panels. For those panels that do use <i>ad hoc</i> reviewers, it is suggested, when possible, that the reviewer joins the panel for the discussion of that proposal. In 2023, a single hybrid panel was also held. EAGER and RAPID proposal were internally reviewed.</p> <p>The number of awards and time to send out decisions show improvement over the last 4 years.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 6</b></p> | <p>Yes</p>   |

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS   | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|---|--|
| <p>2. Are both merit review criteria addressed</p> <ul style="list-style-type: none"> <li>a) In individual reviews?</li> <li>b) In panel summaries?</li> <li>c) In Program Officer review analyses?</li> </ul> <p>Comments:</p> <p>With respect to the review criteria, individual reviews almost always have detailed reviews on the intellectual merit part of the proposal. The Broader Impacts section of the individual reviews is more diverse in their response and usefulness. However, this is somewhat mitigated in the panel summaries which tend to do a better job than individual reviews alone. This highlights the usefulness of panels, as evaluating Broader Impacts is certainly a bit more subjective and can be difficult for certain reviewers. A panel discussion helps to highlight key points and educate reviewers. It is acknowledged that NSF has good descriptions of Broader Impacts but not all reviewers are up to date with these definitions.</p> <p>Overall, the panel summaries did a good job summarizing the key points of discussion about the Intellectual Merit and Broader Impacts.</p> <p>The Program Officer Review Analyses were excellent and very representative of the review comments for both Intellectual Merits and Broader Impacts.</p> <p><b>Data Source: Jackets</b></p> | <p>Yes</p>                                     |

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS  | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|--|--|
| <p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>Comments:</p> <p>By far, the majority of the reviews are substantive and provide detailed comments to explain their assessment of the proposals. The quality of the comments either allowed a PI to improve their proposal for resubmission or provided useful feedback for implementation of the research. An average of three to four reviews were provided for each proposal. In the few cases where there was a less detailed review, the other reviews and the panel summary resulted in detailed comments for the PI and PO, again highlighting the advantage of panels.</p> <p>Reviewer training and panel briefings instituted earlier have yielded positive returns in terms of elevating the quality of reviews and assessments.</p> <p><b>Data Source: Jackets</b></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:</p> <p>The COV applauds the program's significant increase in employing panels to evaluate the majority of proposals. The panel process and ensuing discussions provide excellent feedback and can bring out places where individual reviewers, due to their specific expertise, may have missed key points.</p> <p>Overall, the panel summaries were very good and provided good context for evaluation of the proposals. The summary of the reviews was well written and captured the strengths and weaknesses of both review criteria. In the cases where there was a wide variety of opinions from the reviewers the summaries generally explained this well. The COV believes that the Program Officers should be commended on the quality of the panel summaries.</p> <p><b>Data Source: Jackets</b></p> | <p>Yes</p>                                     |

| <b>QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</b>  | <b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b> |
|---|---|
| <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:</p> <p>The jacket contains a transparent overview of the decision process. It includes context statements, individual reviews, panel summary (if applicable), site visit reports (if applicable), Program Officer Review Analysis, and staff diary notes, and provides clear rationale behind each award decision. The Review Analysis was particularly helpful as it gave a very good overall summary of the review process and comments for that proposal. The COV agrees that the Program Officers should be commended on the quality of the panel summaries and Review Analyses.</p> <p>The program also provided overview of the relationship and overlap (if applicable) of current and pending awards. Sometimes, due to overlap, a proposal that was highly rated was not awarded.</p> <p><b>Data Source: Jackets</b></p> | <p>Yes</p>  |

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS   | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|---|--|
| <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:</p> <p>CHE should be commended for clear organization, detailed PO Review Analysis, and detailed PO feedback to the PI. We strongly recommend that MSN continue this practice. In particular, detailed PO comments are especially useful for PIs whose proposals were declined and can emphasize key aspects that need improvement.</p> <p>Overall, individual reviews, panel summaries (when applicable) and the PO comments provided important resources to the PIs in understanding award/decline decisions.</p> <p>Detailed analysis on overlap of current and pending proposals was also included in the jackets. This made clear how the NSF viewed prior funding history and if/when current funding impacted the decision on the proposal.</p> <p><b>Data Source: Jackets</b></p> | <p>Yes</p>                                     |
| <p>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</p> <p>Over the review period, MSN has maintained high standards and transparency in their review processes.</p>   | <p>Yes</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.

**Table 3 - Selection of Reviewers**

| <b>SELECTION OF REVIEWERS</b>  | <b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b> |
|--|---|
| <p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>Comments:</p> <p>The program utilized reviewers from a mix of PhD-level institutions and PUIs from all over the U.S. A few reviewers from international institutions were also used. Some regions were more represented, given the density of institutions in high population states. However, the program was careful to include a mix, geographically, of reviewers. The Program Officers also did a good job in getting reviewers with appropriate expertise. This includes, for example, making sure a review of a PUI proposal has at least one reviewer from a PUI. Notable emphasis was placed on panels over <i>ad hoc</i> only reviews, a laudable development which allows for better discussion of proposals' strengths and weaknesses as well as better insights into the relative ranking of the proposals.</p> <p>Overall, reviewers with appropriate expertise were chosen and returned high quality reviews with an average of 3-4 reviews per proposal. The COV found that the Program Officers made a commendable effort to include representatives from PUI institutions on panels and drew experts from different fields (physics, computations, etc.) to match the topic of the proposals.</p> <p>In all cases, the list of PI suggested reviewers was considered by the PO, although they were not always used for a variety of reasons. When a suggested reviewer is used, there is usually not more than 1 suggested reviewer invited to the panel.</p> <p>There were comments from some COV members that it was hard to specifically determine the expertise of the reviewers given the broad range of topics in MSN.</p> <p><b>Data Source: Jackets</b></p> | <p>Yes</p>  |

| <b>SELECTION OF REVIEWERS</b>  | <b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b> |
|--|---|
| <p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>Comments:</p> <p>Yes, the NSF provides reviewer training both before proposal reviews and prior to the start of panels to minimize conflict of interests (COIs), reduce implicit bias, and stress the importance of evaluating both intellectual merit and broader impacts. In addition, the MSN program officers used several methods to check for COIs, including internal NSF tools and self-reporting, and took appropriate steps when needed. COI panelists that were identified were excused from the panel room and were not involved in the review of that proposal and did not see where it was ranked.</p> <p><b>Data Source: Jackets</b></p> | <p>Yes</p>  |
| <p>3. Additional comments on reviewer selection:</p> <p>The COV recognizes that reviewers are chosen based on their expertise. The program employs a number of strategies to identify potential reviewers including internal NSF reviewer databases, prior awards/submissions, and literature searches.</p> <p>Program Officers made strong efforts to recruit a diverse group of reviewers with panels incorporating diversity in geographic regions, institution type, and gender.</p> <p>Recruitment of diverse experts can be a challenge based on the number of women and URM scientists in the discipline, but it is still important to see a more diverse population of reviewers.</p>  | <p>Yes</p>  |

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

***Table 4 - Management of the Program Under Review***

**MANAGEMENT OF THE PROGRAM UNDER REVIEW**

1. Management of the program.

Comments:

The MSN program is well managed and has a mix of permanent, part time and rotator staff. At any one time, there are 4-6 technical staff. This number is appropriate (maybe a little low) given that MSN is one of the larger programs and has a diverse portfolio. During COVID, the program moved to virtual panels with one hybrid panel (out of 14 panels) occurring in 2023. The processing of proposals is along the GPRA requirements with for example, decisions on 75% of proposals being done within 6 months. The funding rate increased slightly in the last few years primarily due to a slight drop in proposal submissions. Proposal topic areas are broad with the program covering three main research areas Polymers, Supramolecular Chemistry and Nanomaterials and within those areas it covers synthesis, modelling and theory and characterization as well as synergies between them. To deal with this complexity, in 2023, for example, 14 panels were assembled that span the areas of Polymers, Supramolecular Chemistry, and Nanomaterials (covering topics that range from nanoparticles to surfaces to nanocarbon).

## MANAGEMENT OF THE PROGRAM UNDER REVIEW

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

Comments:

The updated program description is detailed and clearly outlines the types of proposals that are funded by MSN. The program targets fundamental questions regarding the making, modeling and measuring of macromolecular, supramolecular and nanoscopic structures. Both internal (Retreats, and PO discussions) and external (national and international meetings in the areas of program interest and workshops) were used to guide the development of the portfolio into rapidly evolving fields including sustainability, climate, national nanotechnology initiative, quantum information sciences, computational / data-enabled science, semi-conductors and electronics and advanced manufacturing. For example, the workshop on Challenges and Prospects for the Next 10 Years of Nanochemistry provided insights into emerging areas of this field. The program encourages GOALI proposals to connect basic research with industrial applications and uses EAGER and RAPID and RAISE to fund high risk/high reward proposals. A majority of research projects are well integrated with education. Outcomes of scientific research discoveries and educational advances are disseminated in high impact journals.

The MSN program also funded new programs and supplements to broaden participation in the mathematical and physical sciences. It promotes inclusion for the scientific enterprise supporting the research of women and underrepresented minority PIs and co-PIs. Program directors participated in NOBCChE Conferences, ACS meetings, CHE Early Career Workshops and Gordon Research conferences to provide helpful information to potential PIs with a special emphasis on junior faculty. However, it was noted that a significant portion of the scientific community may not be able to attend these conferences due to lack of funding. Hence, the COV suggests that there be a survey or some other avenue that would provide input from a broader selection of the chemical scientific community.

It would be an important addition for MSN to support CURES (course-based undergraduate research experiences) which would allow students access to research topics and critical skill applications to which they may not otherwise have access.

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

Comments:

MSN POs use a number of ways to help with planning and guide the development of the portfolio. For example, internally, they use the NSF CHE retreat to ensure MSN aligns with CHE priorities. In addition, team PO discussions are used to constantly revisit program balance and priorities during programmatic recommendation process. Externally, MSN POs attend national meetings and key workshops/round tables to learn about emerging areas.

## MANAGEMENT OF THE PROGRAM UNDER REVIEW

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

#### Comments:

The program thoughtfully responded to prior COV comments and recommendations. The Review Analyses and PO comments were improved to incorporate clear analysis of the review and decision-making processes. Additional detailed feedback was included in the PO comments to the PIs. The program turned to primarily virtual panels and reduced the number of "Mail Review Only" proposals.

The program continues to promote inclusion for the scientific enterprise by supporting the research of women and URG PI/co-PIs, and by encouraging PUI, 2-year institutions and community colleges to get involved in research. The program POs actively participated in events to meet with prospective PIs (especially early-career faculty) and held external office hours to help them understand the program and prepare proposals that fit the program scopes. Program Officers made a conscious effort to engage this community at conferences such as NOBCChE annual meetings, and at HBCUs, HSIs, and MSIs.

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

**Table 5 - Resulting Portfolio of Awards**

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</b> |
|--|--|
| <p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>Comments:</p> <p>The MSN program has a good balance of awards across the disciplines and sub-disciplines as well as interdisciplinary awards co-funded with other divisions. While the panels covered all MSN topic areas, there were comments about the lack of enough data to judge if there was a balance across the sub-disciplines. The program funds 70-80 awards per year typically with a median duration of 36 months. Some 5-year CAREER and 4- year individual investigator awards raise the average duration to ~38 months. The portfolio is well-balanced with innovative projects, which integrate research and education. The projects are relevant to national priorities and NSF's missions.</p> <p>The award sizes have been steady, increasing slightly in 2023, although there were fewer awards that year. It is unclear, if this reflects a rise in an average per year award or an increase in the number of 4- and 5-year awards.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 8</b></p> | <p>Appropriate</p>   |

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|--|--|
| <p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>Comments:</p> <p>The program is to be commended in its excellent stewardship of the funds it receives. It supports innovative research across a range of scientific disciplines. The size and duration of the awards is comparable to other divisions. While the size of awards remained flat over the FY 2020-2022 period from \$450,000 to \$465,000, the award size rose slightly in FY 2023 to \$492,495, a 5.9% increase. This increase is important given the rise in inflation and helps to compensate for the increase in student salary and tuition as well as materials and supplies cost. However, awards need to further increase over the next few years to deal with the increasing costs mentioned above.</p> <p>The median duration is 36 months. A number of NSF divisions are moving to having some selected 48-month proposals. The COV encourages such moves for MSN as this has advantages in allowing the projects to be more fully explored.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 4</b></p> | <p>Appropriate</p>   |
| <p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>Comments:</p> <p>It is clear that the program funds highly innovative awards and is a key driver of innovative research for the MSN community. It has a well-balanced portfolio, including projects that are not only innovative but also train students in rapidly evolving fields. A survey of publications resulting from these awards shows they appear in prestigious, highly-cited journals. The program also supports high risk high reward EAGER, RAPID and RAISE proposals.</p> <p><b>Data Source: Jackets</b></p>   | <p>Appropriate</p>   |

| <b>RESULTING PORTFOLIO OF AWARDS</b>  | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|---|--|
| <p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>Comments:</p> <p>A good number of proposals are interdisciplinary and multidisciplinary projects and are co-funded with other programs in CHE (Chemical Catalysis, Chemical Measurement, Chemical Structure and Dynamics, etc.) and other divisions (CBET, DMR, EES, OSI, OIA, etc.)</p> <p><b>Data Source: If co-funding is a desired proxy for measuring inter- and multi-disciplinary projects, the Co-Funding from Contributing Orgs and Co-Funding Contributed to Recipient Orgs reports can be obtained using Enterprise Reporting, COV Dashboard, Question 7</b></p> | <p>Appropriate</p>   |
| <p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>Comments:</p> <p>Yes, the program has wide geographical distribution with more proposals (awarded and declined) coming from the west coast (CA), northeast (NY, PA, MA) and southern states (TX, FL), which is consistent with other CHE programs.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 2</b></p>   | <p>Appropriate</p>   |

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|--|--|
| <p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>Comments:</p> <p>Most awards go to PhD granting institutions, but this is more related to the fact that it is these institutions that submit the most proposals. As a general rule, the acceptance rate is not too different between different types of institutions (with the exception of those that submit only a small number of proposals). It is important to solicit greater involvement from PUIs, HBCUs, HSIs and MSIs in proposal submission. One key suggestion was to include teaching relief as a key component of grants for such institutions. Most faculty at these institutions have heavy teaching loads and this can inhibit research. If NSF grants can provide teaching relief (as the NIH does), this will attract more proposals from the faculty at these institutions.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 3</b></p>   | <p>Appropriate</p>   |
| <p>7. Does the program portfolio have an appropriate balance of awards to new and early-career investigators?</p> <p>NOTE: A new investigator is an individual who has not served as the PI or Co-PI on any award from NSF (with the exception of doctoral dissertation awards, graduate or post-doctoral fellowships, research planning grants, or conferences, symposia and workshop grants.) An early-career investigator is defined as someone within ten years of receiving his or her last degree at the time of the award.</p> <p>Comments:</p> <p>There is a good balance of proposals for new and early-career investigators. The funding rate is lower for more junior PIs or PIs who have no prior NSF support, but this is to be expected. This success could be enhanced with better mentorship opportunities and white paper submissions. The program also funded a sizeable number of CAREER awards. Over the time period the highest success rate was for those between 10-15 years after PhD.</p> <p><b>Data Source: Information on new PIs available via Enterprise Reporting, COV Dashboard, Question 6</b></p> | <p>Appropriate</p>   |

| <b>RESULTING PORTFOLIO OF AWARDS</b>  | <b>APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</b> |
|---|--|
| <p>8. Does the program portfolio include projects that integrate research and education?</p> <p>Comments:</p> <p>Yes, all CAREER proposals integrate research and education. In addition, the majority of program supported awards contain detailed plans to educate, train and engage students from many educational levels and backgrounds. As reported in their reports and highlights, program-supported investigators publish their science in prestigious journals and disseminate their educational advances in <i>J. Chem. Ed.</i> as well as other online forums.</p> <p><b>Data Source: Jackets</b></p>   | Appropriate  |
| <p>9. Does the program portfolio have appropriate participation of underrepresented groups<sup>11</sup>?</p> <p>Comments:</p> <p>The overall funding rate of MSIs is at a level akin to PhD granting institutions, although certainly the number of proposals submitted is a lot less (ca. 10%). As mentioned, it is recommended that NSF consider including teaching relief in proposals from MSIs and PUIs to encourage more submissions from these institutions. Funding rates for female applicants is higher than for male applicants as is the funding rate for proposals from underrepresented group PIs relative to those PIs not from underrepresented groups. Of course, it should also be noted that a much smaller number of grants are funded for these two groups, because of a lower number of submissions from these groups.</p> <p>The MSN program has made significant efforts to encourage diversity and provided support for Alliances for Graduate Education and the Professorate – Graduate research supplements. The COV recommends continuing and expanding efforts to encourage participation of URM and from HBCUs and MSIs.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 5</b></p> | Appropriate  |

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<sup>11</sup> 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.

| <b>RESULTING PORTFOLIO OF AWARDS</b>  | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|---|--|
| <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:</p> <p>The program supports research projects in rapidly evolving fields important to national priorities, including sustainability, climate, quantum information science, the National Nanotechnology Initiative, semi-conductors and electronics, advanced manufacturing, computation and data-enabled science and engineering. MSN did sponsor a workshop on "Challenges and Prospects for the Next 10 Years of Nanochemistry."</p> <p><b>Data Source: Jackets</b></p> | <p>Appropriate</p>   |
| <p>11. Additional comments on the quality of the projects or the balance of the portfolio:</p> <p>Overall, the MSN program funds a high quality and balanced proposal portfolio. If it can find ways to increase submissions from MSIs then this would be seen as a positive.</p>   | <p>Appropriate</p>   |

## OTHER TOPICS

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

Overall, the MSN program areas are strong and there is a good coverage of topic areas. One possible area that might be interesting to develop are ways to enhance collaborations between experimentalists with AI/ML and data experts in fields relevant to MSN. Improving submissions from HBCU, MSIs, PUIs (e.g., by providing teaching relief) could be a way to help enhance engagement of these programs in MSN. Another suggestion would be to have office hours dedicated to researchers from PUIs, HBCUs, HSIs, MSIs to hear what their challenges are that inhibit them from applying to MSN.

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.

Are there more efficient ways to better capture the significant impact that MSN has on their program fields and education? This information would be helpful to better highlight their role in advancing innovative science, education and training.

The use of virtual panels appears to be working well and is perhaps more inclusive than in-person panels. It is acknowledged that there may be cases where in-person panels can be helpful (e.g., to allow junior PIs to network). Virtual panels are seen as a good avenue for engaging more reviewers, it is noted though that there are challenges when the panel is hybrid.

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

The significant increasing cost of student support and materials/supplies is an increasing challenge to adequately fund the transformative science that MSN currently supports. Moving forward, the COV encourages NSF to seek an increase in budget to help enhance the average award size in order to better deal with these challenges. If there are no budget increases, then there is a discussion to have of about the award size vs award rate.

4. Please provide comments on any other issues the COV feels are relevant, bearing in mind that COV reviews do not include assessment or evaluation of the outcomes or long-term impacts of program investments.

The MSN funds a lot of impactful science and trains a large number of students for the US workforce. This later part is not captured anywhere, e.g., is it possible to capture initial student outcomes post-PhD?

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

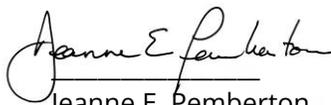
There were a number of different platforms used to provide the COV with the data it needed for evaluation. This was cumbersome and sometimes difficult to navigate.



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**SIGNATURE BLOCK:**

For the 2024 COV

  
\_\_\_\_\_  
Jeanne E. Pemberton  
Co-Chair

  
\_\_\_\_\_  
Scott D. Rychnovsky  
Co-Chair

## **INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT**

### **Research Experiences for Undergraduates Sites (REU) Special Projects and Initiative Investments (combined with REU for the COV) Broadening Participation (combined with REU for the COV)**

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, returns without review, and withdrawals) that were *completed within the review period (generally the prior four 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.

**Table 2 - Quality and Effectiveness of the Merit Review Process**

| <p><b>QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</b></p>  | <p><b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b></p> |
|--|--|
| <p>1. Are the review methods (for example, panel, <i>ad hoc</i>, site visits) appropriate?</p> <p>Comments:</p> <p>REU: The COV agrees with moving from <i>ad hoc</i> to formal panel review.</p> <p>SP: Internally reviewed; here, there appear to be too few reviewers; although it is clear, there are several programs where the documentation of the process could have been improved.</p> <p>BP: LEAPS MPS POs were commended for being able to effectively combine these proposals into panels. ASCEND reviews were managed appropriately.</p> <p>For all three programs, there does not seem to be a standard number of reviewers for these types of programs, with little correlation to the funding amount. This is not necessarily of concern, but the COV notes it.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 6</b></p> | <p>Yes</p>   |

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS  | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|--|--|
| <p>2. Are both merit review criteria addressed</p> <p>a) In individual reviews? Overall, Yes</p> <p>REU: The panelists generally spent equal amounts of time between IM and BI; reviews seemed to be comprehensive but with variation in what a particular reviewer considered an IM or BI, making an overall theme hard to observe. All reviews were strong, but at times significant information/critique emerged in the panel summary that was not present in the individual reviews. As per the 2020 COV report, “there didn’t seem to be consistency in definition, evaluation and weighting of the IM criterion vs the BI. Proper calibration of reviewers and appropriate communication of weighting of these objectives should be improved.”</p> <p>SP: For the special projects it was harder to discern between discussion of these two merit criteria; however, all Review Analyses touched on these. SP: No panel summaries for SP; but often quite detailed RA, which seems appropriate.</p> <p>BP: Individual reviews addressed both IM and BI, but BP specific criteria were not always consistently discussed.</p> <p>b) In panel summaries? Yes</p> <p>c) In Program Officer review analyses ? Yes</p> <p>Comments:</p> <p>More standardized unique templates are needed for programs such as these in order to better assess and discuss the solicitation specific criteria (SSC) of the proposals.</p> <p><b>Data Source: Jackets</b></p> | <p>Yes</p>                                     |

| <b>QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</b>  | <b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b> |
|---|---|
| <p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>Comments:</p> <p>Overall, the majority of individual reviews include substantive comments providing good critique for the proposal's strengths and weaknesses. The PO comments and Review Analyses were consistently excellent.</p> <p>REU: Variable in detail; but overall, the reviews were sufficient. As stated previously, there is not a standardized method of assessing the SSC.</p> <p>SP: It is not clear whether external reviewers understand the assessment of additional criteria used by the program that in some cases lead to funding despite negative or weak external reviews.</p> <p>BP: Yes.</p> <p><b>Data Source: Jackets</b></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>REU: Yes, but emphasis was placed on different criteria depending on the panel.</p> <p>SP: N/A</p> <p>BP: Yes</p> <p>Comments:</p> <p>For proposals that were discussed in panel, the panel summary provides clear rationale for the panel consensus. It was appreciated where individual reviewer comments were included in the panel summaries showing a difference in opinion. The standardization of panel summaries was helpful to provide rationale for panel consensus and took into consideration the panel rankings.</p> <p><b>Data Source: Jackets</b></p>  | <p>Yes</p>  |

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS   | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|---|--|
| <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:</p> <p>Overall: The documentation in the Jacket provides the rationale for award or declination. The PO correspondence and diary notes are helpful in matters where co-funding requests are made to strengthen the portfolios of multiple divisions. The level of documentation included is impressive in the jackets provided. The time stamps and communication series strengthen the rationale for adhering to policies and procedures.</p> <p>REU: yes, funding or declination made sense based on the jacket information. Therefore, we can see the rationale behind final award/decline decisions in all cases including when proposals were closely ranked. In one case, it was noted that the program was flexible recommending a modified budget to fund a program that could run during COVID, which we saw as positive.</p> <p>However, there still appears to be inconsistency between what is being weighted more heavily, and how they are evaluating similar programs, between the different panels. For example, some panels viewed successfully continuing REU proposals favorably, while other panels were looking for something more innovative.</p> <p>SP: no panel summary is created for SPs, so in some instances, the Review Analysis was hard to follow. For example, additional SSC are addressed in the RAs that were not reflected in the individual reviews, and at times conflicted with one another.</p> <p>BP: Yes</p> <p><b>Data Source: Jackets</b></p> | <p>Yes</p>                                     |

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS   | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|---|--|
| <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:</p> <p>Overall: The correspondence to the PI does include rationale for the award or declination. The individual reviews and panel summary (when applicable) give clear input regarding strengths and weaknesses of the proposal. The extra effort from the POs to use language that is positive at the end for resubmissions is commendable.</p> <p>REU: Yes, but while the PI was given access to the individual and summary statements, the additional SSC addressed in the RA would have helped understanding in the event of a competitive declination.</p> <p>SP: All were funded.</p> <p>BP: Mostly, but not always. Since internal reviews are not shared with the PI in cases where there is no panel discussion (e.g., PREC Planning proposals), then it would be helpful for the PO to encourage the PI to get in contact to discuss.</p> <p>In one instance, there were two closely ranked proposals (in different panels) but the RA did not provide the necessary clarity in the rationale for us to understand the justification behind funding of one and declining the other.</p> <p><b>Data Source: Jackets</b></p> | <p>Yes</p>                                     |

| <b>QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</b>   | <b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b> |
|--|---|
| <p>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</p> <p>The RA template was helpful.</p> <p>BP: Problematic and disparate assessment of Broader Impacts in several ASCEND proposals.</p> <p>For the REU program, there were inconsistencies in the interpretation of the merit criteria. NDP is a viable option to streamline panel discussion, although based on the Review Analyses reviewed, it has not been frequently used in the majority of the panels.</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.

**Table 3 - Selection of Reviewers**

| <b>SELECTION OF REVIEWERS</b>   | <b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b> |
|---|---|
| <p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>Comments:</p> <p>Based on the names and institutions, it is difficult to ascertain the expertise and/or qualifications of panelists. Specifically, for REU programs, expertise/qualifications may differ compared to SP and BP.</p> <p><b>Data Source: Jackets</b></p> | <p>Data not available</p>                             |
| <p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>Comments:</p> <p>There is a great deal of effort to resolve COIs. If the PO had a conflict of interest, that was noted in the PO comments , and a different PO was in charge of the review of that particular proposal.</p> <p><b>Data Source: Jackets</b></p>                     | <p>Yes</p>  |
| <p>3. Additional comments on reviewer selection:</p> <p>Possibly having panelists update their resume/areas of interests annually would be helpful. POs collectively could include qualifications for each panel to provide more information (i.e. generating brief selection criteria statement).</p>  |   |

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

***Table 4 - Management of the Program Under Review***

| <b>MANAGEMENT OF THE PROGRAM UNDER REVIEW</b>   |
|---|
| <p>1. Management of the program.</p> <p>Comments:</p> <p>All programs appear to be well managed. Issues where there is not a straightforward answer are answered collaboratively within NSF and there is an effort to reach consensus. There are several areas for improved management of the program, as it would be helpful if the NSF outlined their goal for the management team of each program (number of leads, rotators, how institutional knowledge is maintained). It appears as though there was significant variation in the management of the program during the 2020-23 period, which might explain some of the issues articulated in other parts of this evaluation.</p> |
| <p>2. Responsiveness of the program to emerging research and education opportunities.</p> <p>Comments:</p> <p>The program is proactive at being responsive to emerging research and educational opportunities (i.e. new areas of interest in the field of chemistry, emerging technologies, etc.). Examples included developing new trainee support mechanisms during the COVID-19 pandemic and integrating virtual learning and networking into undergraduate research. Both examples embrace a new opportunity to strengthen program management. Proposals demonstrating innovative techniques being discussed /displayed were reviewed with enthusiasm.</p>                          |

## MANAGEMENT OF THE PROGRAM UNDER REVIEW

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

Comments:

The program planning and prioritization process is dependent on program as reflected below:

Overall, the criteria and/or mission statements for these programs are less clear. These programs are heavily centered upon Broader Impacts; this is commendable. Therefore, these complex programs need to work harder to educate panelists and PIs on the additional SSC.

REU – For the renewal, it may be best to phase out a site as opposed to an abrupt stop of funding, as consequences can be dire when a site is immediately terminated. It appears that the prioritization of ranked proposals targets a diverse group of students (e.g., deaf/hard of hearing, non-traditional, etc.).

SP – It is unclear of the prioritization of this program.

BP - The program planning and prioritization is clear, as the focus leans more strongly on broader impacts and outreach vs. intellectual merit.

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

Comments:

Overall, they have been responsive with concrete actions. It is clear that POs and panelists have been passionate and responsive to suggestions for improvement, but change seems to be slow in coming, likely due to the inherent diversity to each program. Additionally, that complexity places a potentially inordinate focus on the broader impacts that PIs may not be fully able to address without a clearer mission statement and unique, clear solicitation-specific criteria. The PREC was formed after the previous COV report, which is commendable, as it is a concrete step to increase inclusion. The budget has remained static over the past few years, despite a recommendation for an increase. More transparency was recommended, which has been done by POs in reference to panel summaries. Panels have been employed in peer review except in special projects. Clarity of the Broader Impacts review criterion is a long-standing issue. POs have made a concerted effort to discuss this review criterion before the panel begins; however, this may not be sufficient. It would be interesting to review data to quantify success for these new initiatives.

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

**Table 5 - Resulting Portfolio of Awards**

| <b>RESULTING PORTFOLIO OF AWARDS</b>  | <b>APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</b> |
|---|--|
| <p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>Comments:</p> <p>The nature of these programs is CHE-wide and as such, serve the entire community (crossing disciplines and sub-disciplines). Some grants serve communities beyond CHE as well. Many REU proposals are collaborations within a department. Thus, there is appropriate balance across disciplines.</p> <p>BP – All applications were balanced and a mix of LEAP, MPS Ascend, and PREC Planning applications were funded.</p> <p>SP – All applications were funded but the portfolio is balanced.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 8</b></p>  | <p>Appropriate</p>   |
| <p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>Comments:</p> <p>REU - The size and duration are similar except if additional personnel to provide disability accommodations were requested. Median duration is 3 years with an average award size currently of ~\$390K. Generally, there should be greater budget flexibility for the REU program, for example, to allow cohort-building events (e.g. bowling; pizza dinner) that are not generally NSF-allowable expenses. The budget could also be changed to consider the unique needs of a PUI.</p> <p>BP – Appropriate. The median award size has remained ~\$250K over the past three years.</p> <p>SP – Appropriate. BP was included in this program until 2022; before then, the median duration was between 2 – 5 years. This program now has a median duration of 1 year and an award size of &lt;\$96K over the past two years.</p> <p>A few PIs ask for and were granted a no cost extension.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 4</b></p> | <p>Appropriate</p>   |

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</b> |
|--|--|
| <p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>Comments:</p> <p>REU: Yes. The COV appreciates the particular open-mindedness to unique proposals within this program. Many programs in the portfolio serve communities that are often neglected. This could lead to transformative approaches and broadening participation. REUs are more transformative in terms of career trajectory. A comprehensive assessment of transformative impact across the portfolio for students that are differently-abled is harder to assess, likely due to the small numbers of such participants.</p> <p>SP: Yes, but more general in terms of providing support for initiative to bring scientists together to help facilitate research and discussions among different groups.</p> <p>BP: Yes</p> <p><b>Data Source: Jackets</b></p> | <p>Appropriate</p>   |
| <p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>Comments:</p> <p>Co-funding requests were requested and approved if appropriate for REU, BP, and SP. Most funding requests were from EPSCoR (BP), CBET (SP), OMA (REU and SP).</p> <p><b>Data Source: If co-funding is a desired proxy for measuring inter- and multi-disciplinary projects, the Co-Funding from Contributing Orgs and Co-Funding Contributed to Recipient Orgs reports can be obtained using Enterprise Reporting, COV Dashboard, Question 7</b></p>  | <p>Appropriate</p>   |

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</b> |
|--|--|
| <p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>Comments:</p> <p>REU - Well distributed throughout the continental United States. Some missing from EPSCoR states (KY, NV, ME, RI, MO). May need a bigger push for proposals from these regions.</p> <p>For BP and SP, there is a high incidence from CA which could take into consideration the population of the state and the number of institutions.</p> <p>More outreach to middle west US for Special Projects might be useful.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 2</b></p> | <p>Appropriate</p>   |
| <p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>Comments:</p> <p>REU - Most are awarded to PhD granting institutions. A collaborative REU model with partnering PUI and PhD granting institutions could be plausible. Few PUIs submitted proposals and thus, few were awarded; however, it is unclear how an award to a PI from a PhD institution with a co-PI from a PUI is credited in the data provided to the COV.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 3</b></p>  | <p>Data not available</p>                                  |

| <b>RESULTING PORTFOLIO OF AWARDS</b>  | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|---|--|
| <p>7. Does the program portfolio have an appropriate balance of awards to new and early-career investigators?</p> <p>NOTE: A new investigator is an individual who has not served as the PI or Co-PI on any award from NSF (with the exception of doctoral dissertation awards, graduate or post-doctoral fellowships, research planning grants, or conferences, symposia and workshop grants.) An early-career investigator is defined as someone within ten years of receiving his or her last degree at the time of the award.</p> <p>Comments:</p> <p>REU – The award rate for early career investigators is low especially for those &lt;10 years since degree. Might be appropriate for REU grants to have fewer junior faculty PIs.</p> <p>BP – The award rate for early career investigators is high especially for those &lt;10 years since degree. The majority have no prior support, but this is appropriate, as many of these initiatives are for postdocs and early-career PIs.</p> <p>SP – The award rate for early career investigators is high especially for those &lt;10 years since degree.</p> <p><b>Data Source: Information on new PIs available via Enterprise Reporting, COV Dashboard, Question 6</b></p> | <p>Appropriate</p>   |
| <p>8. Does the program portfolio include projects that integrate research and education?</p> <p>Comments:</p> <p>REU - This is intrinsic for this cluster of programs. Many have started a pipeline for students to advance education and research. The educational components and assessment described will strengthen the programs. REU sites that have continuous self-study are more sustainable.</p> <p>SP: n/a</p> <p>BP: Yes, especially LEAPS-MPS</p> <p><b>Data Source: Jackets</b></p>  | <p>Appropriate</p>   |

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|--|--|
| <p>9. Does the program portfolio have appropriate participation of underrepresented groups<sup>12</sup>?</p> <p>REU – The number of URG PIs is low. In terms of student participants, in the future it may be difficult to collect and track demographic data, due to differences in the law from state to state.</p> <p>BP – By nature of the program, this portfolio does have appropriate participation of underrepresented groups (URG).</p> <p>SP – This is dependent on the project.</p> <p>Comments: While the COV understands that submissions from URGs can be limited and that representation cannot be “fixed” by CHE, the low number of submissions from URGs must be addressed by better outreach and a wider net being cast to attract eligible underrepresented minoritized PIs.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 5</b></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:</p> <p>All programs are relevant to national priorities, agency mission, and relevant fields. Specifically, the special projects have supported awards that are more timely to constituent needs.</p> <p>REU: Yes<br/>SP: Yes<br/>BP: Yes</p> <p><b>Data Source: Jackets</b></p>   | <p>Appropriate</p>   |

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<sup>12</sup> 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.

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|--|--|
| <p>11. Additional comments on the quality of the projects or the balance of the portfolio:</p> <p>We were only shown a snapshot of the portfolio, and the limited time for the COV precluded a fuller assessment of the data available in the CHE Dashboard, so it is difficult to determine if the quality of the full portfolio is balanced. Based on the broad spectrum of applications reviewed in this cycle, there appears to be a balance in the portfolio.</p> |  |

## OTHER TOPICS

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

It would be good to know over time the number of REU participants (NSF funded)/NSF site/year - what is the trend? This would be good to know in terms of budgetary costs and whether they are sufficient or not. Most REU sites are at PhD granting institutions. REU sites could involve more PUIs but have a partnering PhD institution to provide additional resources.

Other methods that should be considered as areas for improvement are as follows with more detailed descriptions to follow:

- *Strengthen Intersectional Approaches*
- *Enhance Outreach and Recruitment Efforts*
- *Expand Mentorship and Support Networks*
- *Promote Institutional Change*
- *Leverage Data and Research*
- *Foster International Collaborations*

### *Strengthen Intersectional Approaches*

To effectively address the complex and multifaceted nature of underrepresentation, the NSF must adopt intersectional approaches in its programs. This means recognizing and addressing the overlapping and interdependent systems of discrimination and disadvantage. Programs should be designed to consider the unique experiences of individuals who belong to multiple underrepresented groups, such as women of color or LGBTQ+ individuals with disabilities. Tailoring initiatives to these intersectional identities can lead to more inclusive and impactful outcomes.

### *Enhance Outreach and Recruitment Efforts*

The NSF should invest in comprehensive outreach and recruitment strategies to attract a more diverse pool of applicants for its programs. This includes partnering with minority-serving institutions (MSIs), community colleges, and K-12 schools in underserved areas. NSF could also develop targeted marketing campaigns and informational sessions to raise awareness about its programs and opportunities among underrepresented communities. By actively reaching out to these groups, the NSF can help demystify the application process and encourage more diverse participation.

### *Expand Mentorship and Support Networks*

Mentorship is crucial for the success of underrepresented individuals in STEM fields. The NSF should expand its mentorship programs to provide sustained support for students, researchers, and faculty from diverse backgrounds. This could involve creating mentorship networks that connect early-career researchers with established professionals, offering professional development workshops, and providing resources for mentors to effectively support their mentees. Additionally, the NSF could facilitate peer mentorship programs that allow individuals at similar career stages to share experiences and advice. The NRMN (National Research Mentoring Network) is a mentoring network that could be a resource to fill this gap.

### *Promote Institutional Change*

For broader participation efforts to be successful, institutional change is necessary. The NSF should encourage and support institutions in creating more inclusive environments. This could involve providing grants for institutions to develop and implement diversity, equity, and inclusion (DEI) initiatives, offering training for faculty and staff on inclusive practices, and recognizing institutions that

demonstrate significant progress in promoting diversity. By fostering a culture of inclusion at the institutional level, the NSF can help create a more supportive ecosystem for underrepresented groups.

#### *Leverage Data and Research*

The NSF should leverage data and research to inform its diversity initiatives continuously. This includes collecting and analyzing data on the participation and outcomes of underrepresented groups in NSF programs, identifying trends and gaps, and using this information to refine program design and solicitations. Additionally, the NSF could support research on effective strategies for promoting broader participation and disseminate these findings to the broader STEM community. By grounding its efforts in evidence-based practices, the NSF can enhance the effectiveness of its initiatives.

#### *Foster International Collaborations*

Broadening participation in STEM is a global challenge that requires international cooperation. The NSF should seek to establish and strengthen partnerships with international organizations, universities, and research institutions that are also working towards greater diversity in STEM. Collaborative programs, joint funding opportunities, and exchange initiatives can provide valuable opportunities for underrepresented groups and help build a more inclusive global scientific community.

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

The questions are very comprehensive in regard to program performance in meeting the program specific goals and objectives.

3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.
  - *Increase Funding and Resources*
  - *Improve Communication and Transparency*
  - *Create Incentives for Broader Participation*

Additional information on these issues is described below:

#### *Increase Funding and Resources*

One of the most significant barriers to broader participation is the limited funding available for diversity-focused initiatives. The NSF should advocate for increased federal funding to support these programs. Additionally, NSF should explore partnerships with private sector organizations, philanthropic foundations, and international entities to supplement its resources. Enhanced funding would allow for the expansion of existing programs and the development of new initiatives tailored to the needs of various underrepresented groups.

#### *Improve Communication and Transparency*

Clear and transparent communication is essential for building trust and engagement with underrepresented communities. The NSF should improve its communication strategies to ensure that information about its programs, application processes, and evaluation criteria is easily accessible and understandable. This includes providing materials in multiple languages, offering webinars and informational sessions, and maintaining open lines of communication with applicants and grantees. Transparent communication can help demystify the NSF's processes and encourage broader participation.

*Create Incentives for Broader Participation*

The NSF should consider creating incentives for researchers and institutions to prioritize broader participation in their projects. This could include offering additional funding or recognition for projects that demonstrate a commitment to diversity and inclusion, providing awards for exemplary efforts in promoting broader participation, and integrating broader participation criteria into the merit review process. By incentivizing diversity efforts, the NSF can encourage a more widespread commitment to inclusivity across the STEM community.

Please continue outreach to PIs and reviewers to clarify Broader Impacts. Consider customizing reviewer templates for each program announcement/type of proposal.

4. Please provide comments on any other issues the COV feels are relevant, bearing in mind that COV reviews do not include assessment or evaluation of the outcomes or long-term impacts of program investments.

Transparency of the COV report (as appropriate) may be helpful.

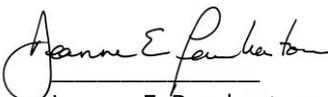
5. NSF would appreciate your comments on how to improve the COV review process, format, and report template.

Different platforms were required for different things (i.e., Sharepoint, Research.gov, etc.). A longer period of time to review materials before the on-site meeting would be appreciated (the COV had ~4-6 weeks to review eJackets.) A live session would be helpful in reviewing information (i.e. eJackets, etc.). Review of the combination of the REU, SP, and BP programs by a single subpanel posed a challenge given the different missions of these programs. This required considerable thought and required separate evaluations for each program. If each had a more comprehensive mission statement/SSC, the evaluation would have been simpler and more streamlined.

*The Committee of Visitors is part of a Federal Advisory Committee. The function of Federal Advisory Committees is advisory only. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the Advisory Committee, and do not necessarily reflect the views of the National Science Foundation.*

**SIGNATURE BLOCK:**

For the 2024 COV

  
\_\_\_\_\_  
Jeanne E. Pemberton  
Co-Chair

  
\_\_\_\_\_  
Scott D. Rychnovsky  
Co-Chair

## INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

### Chemical Synthesis (SYN)

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, returns without review, and withdrawals) that were *completed within the review period (generally the prior four 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.

**Table 2 - Quality and Effectiveness of the Merit Review Process**

| <p><b>QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</b></p>   | <p><b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b></p> |
|---|--|
| <p>1. Are the review methods (for example, panel, <i>ad hoc</i>, site visits) appropriate?</p> <p>Comments:</p> <p>All proposals were reviewed by panels, with requests for <i>ad hoc</i> reviews when appropriate. This is viewed as positive, as the majority of the proposals are being treated in a similar manner. There are pros and cons to straight <i>ad hoc</i> vs panel reviews, but we believe that overall, the panel review process works well and is appropriate.</p> <p>However, the rationale for requesting <i>ad hoc</i> reviews was not consistently addressed in the Review Analysis. This justification would be helpful to understand the motivation and reasoning behind the PO reaching out for a mail-in review. For example, sometimes panel reviews were reviewed as superficial, so <i>ad hoc</i> review was requested after the panel; other times, <i>ad hoc</i> review was requested in advance. In some cases, it appears as if disparate reviews prompted <i>ad hoc</i> review, but the process was not consistent.</p> <p>Some proposals were reviewed by the panel but not discussed in the panel (NDP). The panel discussions are very helpful to PIs, so if all proposals can be discussed, we think they should be. If time is limited and these proposals are not discussed, then it would be helpful for the PO to talk with the PI to help guide the PI moving forward.</p> <p>The panel process was admirable overall. Clear effort was taken to secure a solid slate of reviews.</p> <p>There was one EAGER proposal in the mix, these are internally reviewed. We think that even EAGER proposals would benefit from at least one <i>ad hoc</i> review.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 6</b></p> | <p>Yes</p>   |

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS   | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|---|--|
| <p>2. Are both merit review criteria addressed</p> <p>a) In individual reviews?</p> <p>b) In panel summaries?</p> <p>c) In Program Officer review analyses?</p> <p>Comments:</p> <p>The amount of consideration given to the two criteria varies from individual reviewer to individual reviewer (typically with BI being the criterion that suffers), but both are always addressed in summaries and PO analyses.</p> <p><b>Data Source: Jackets</b></p> | <p>Yes</p>                                     |
| <p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>Comments:</p> <p>In general, yes; there are instances where details are lacking in the individual reviews, but it seems the details get brought up in panel discussion and then are captured by the PO in either their Review Analysis or in the panel summary or both.</p> <p><b>Data Source: Jackets</b></p> | <p>Yes</p>                                     |

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS   | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|---|--|
| <p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>Comments:</p> <p>In comparing the individual reviews with the panel summaries, it is clear to see the rationale behind the discussion. However, sometimes the panel summaries can look quite different from individual rankings, and the decision for award or declination is not always clear. Often the panel summaries highlight the positives and negatives of the proposal (from the individual reviews). However, it is not always clear from the panel summaries which parts are weighed more heavily than others. The consensus among the panelists is what category the proposal is placed in (HP, MP, LP) and is included in the panel summary.</p> <p>Overall, the panel summaries were found to be well balanced in terms of conveying the opinions of all reviewers. It is clear opinions change during the panel discussion; however, these changed opinions are not often reflected in changed rankings from the individual reviews. The committee does not believe the POs should force these changes, but they should ensure that the PIs understand that differences in the panel summary and rankings reflect changes of opinion that occurred.</p> <p>We think the process of prioritizing into HP, MP, LP categories and ranking on day 1 of the panel discussion, and giving panelists time think about the discussion before finalizing the summaries and rankings on day 2 is fantastic and should continue.</p> <p>In was helpful when POs coded which reviewers were making what points (for example, "One reviewer (R1 or E...)".</p> <p><b>Data Source: Jackets</b></p> | <p>For the most part</p>                       |

| QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS  | YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE |
|--|--|
| <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:</p> <p>The documentation in the jacket, most specifically the Review Analysis, was the most informative in providing rationale for award or declination. The POs explain their decisions in a very logical way, and the RA also includes a discussion of other considerations that went into the final funding decision, length of funding, and amount.</p> <p>The review template was viewed as quite helpful in our evaluation of the jacket documentation.</p> <p><b>Data Source: Jackets</b></p> | <p>Yes</p>                                     |

| <b>QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</b>  | <b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b> |
|---|---|
| <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:</p> <p>The panel summaries provide useful insight into the panel's assessment of the proposal. These have the potential to be very helpful to the PI in planning a resubmission when proposals are declined. Therefore, although one can see the rationale in the panel summaries (discussed + and -), it is often difficult to determine the justification for awarding or declining funding simply based on individual reviews and panel summary. The Review Analysis, which the PI does not receive, plays a crucial role in explaining the rationale behind final award decisions; however, the COV understands that there are reasons behind why the RA is not shared with the PI verbatim. There are levels of detail that exceed those found in the panel summary and could be informative to the PI. We do not recommend modifying the process, only making sure that the POs continue to be open and willing to discuss final award decisions with PIs.</p> <p>Along these lines, it is important for the POs to continue to encourage PIs to call to discuss the proposal process and reviews and to encourage site-visits. In addition, some of us have benefitted from POs reaching out to us directly to chat. Therefore, we encourage POs to be more proactive in calling PIs, especially earlier in their careers and especially in cases where the institution does not have a history of receiving SYN funding.</p> <p>There is concern that the proposals that were not discussed in the panel, are not receiving the benefit of the panel summaries. For these proposals, the PI should receive some information that is in the RA (recommend the PI talking with the PO on the phone).</p> <p>(It would be interesting to see data on the success rates of resubmissions.)</p> <p><b>Data Source: Jackets</b></p> | <p>For the most part</p>                              |

| <b>QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</b>   | <b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b> |
|--|---|
| <p>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</p> <ul style="list-style-type: none"> <li>- Overall, the COV believes the multifaceted review process (individual, panel, PO, program) is appropriate and effective. The panel review process, in particular, plays an important role in avoiding systemic biases in some cases.</li> <li>- The pros and cons of in-person vs zoom meetings merit consideration at the CHE level. In-person meetings are often better in terms of enabling everyone on the panel to have their voices heard and to have detailed discussions. Virtual meetings facilitate having the appropriate level of experts participate.</li> <li>- The COV was particularly impressed with the POs' abilities to ensure that each proposal was reviewed by at least three reviews overall with appropriate level of expertise. This expertise was translated to effective panel discussions which are critical and very important to an effective review.</li> <li>- It seems like the evaluation of BIs is highly dependent on the panel. It would help if reviewers had more guidance in how to evaluate BIs.</li> <li>- We encourage the POs to provide additional guidelines or matrices for the panel to review the RUI proposals effectively.</li> <li>- Also, the role of the size of the award in the evaluation process should be clarified.</li> <li>- We noted that the average size of RUI grant awards within SYN increased in 2023 (compared to 2020-2022) and viewed this positively.</li> </ul> |   |

**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.

**Table 3 - Selection of Reviewers**

| <b>SELECTION OF REVIEWERS</b>   | <b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b> |
|---|---|
| <p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>Comments:</p> <p>The expertise of reviewers was viewed as being very relevant to the topic of the proposal. The panels seemed well constructed and tailored to the subject matter of the proposals.</p> <p>We noted that panels rarely included suggested reviewers (which are often experts in the field). However, panelists chosen were knowledgeable in the field and able to appropriately review the proposals.</p> <p>We noted that each RUI proposal did have at least one review from a primarily undergraduate institution.</p> <p><b>Data Source: Jackets</b></p> | <p>Yes</p>  |
| <p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>Comments:</p> <p>The protocols used by the NSF to minimize conflicts of interest seems to be working very well. There were very few, if any, cases where COIs were present, and if they did arise, they were resolved in an appropriate manner.</p> <p><b>Data Source: Jackets</b></p>   | <p>Yes</p>  |

| <b>SELECTION OF REVIEWERS</b>   | <b>YES, NO,<br/>DATA NOT<br/>AVAILABLE,<br/>or NOT<br/>APPLICABLE</b> |
|---|---|
| <p>3. Additional comments on reviewer selection:</p> <p>Gender balance statistics do not seem to be improving over time within the SYN program. CHE should work to rectify this issue. Perhaps direct engagement with the Empowering Women in Organic Chemistry (EWOC) conference would help identify women in industry as reviewers.</p> <p>Many questions arose about the EAGER funding mechanism, so we recommend that CHE develop strategies for educating PIs about the purpose, scope, and process of this underutilized funding opportunity.</p> | No  |

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

***Table 4 - Management of the Program Under Review***

| <b>MANAGEMENT OF THE PROGRAM UNDER REVIEW</b>   |
|---|
| <p>1. Management of the program.</p> <p>Comments:</p> <p>There appears to be a drop in proposal submissions overall. We are not sure if this is pandemic related or caused by other factors.</p> <p>What are the guidelines on how SYN decides on program personnel?</p> <p>The program has benefited from several excellent rotators who have brought current perspectives; however, there are possible benefits that could derive from having one or two more long term scientific staff that would provide a level of institutional memory.</p>                                    |
| <p>2. Responsiveness of the program to emerging research and education opportunities.</p> <p>Comments:</p> <p>On the surface, it appears as though CHE has been responsive to emerging research and educational opportunities, particularly emphasis on sustainable chemistry and international collaboration. The extent to which the SYN program is actively supporting new initiatives (sustainability, DFG interfacing) was unclear to the panel.</p> <p>The COV applauds that the emerging education opportunities and diversity initiatives are a priority for the program.</p> |
| <p>3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.</p> <p>Comments:</p> <p>The program obtains both internal (retreat, foundation and administration priorities) and external (e.g., workshops, conferences, office hours) feedback to guide them in planning and prioritization of the overall portfolio.</p> <p>The COV recommends that POs attend smaller, more focused conferences to keep abreast of advances in the field (GRC, NOS, EWOC).</p>  |

## MANAGEMENT OF THE PROGRAM UNDER REVIEW

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

#### Comments:

- The program has dramatically reduced their reliance on *ad hoc* reviews, as all proposals requiring external reviews that were evaluated by this committee were reviewed in a panel (with some *ad hoc* reviews included when appropriate).
- Regarding the Broader Impacts criterion, the NSF and SYN program undertook several tangible efforts (office hours, workshops, etc.), but ultimately this remains diffuse.
- However, there still appears to be inconsistency in the individual reviews (and panel summaries) in how these are weighted in the review process and the expectations for BIs (sometimes student training is viewed as commendable, other times it is not enough).
- It is clear to the COV that post-panel review, there are multiple rounds of discussion that take place (merging panel rankings and taking into consideration NSF goals) but realize this may not be clear to PIs and panelists. It might serve the NSF well to advertise this more, as it is a strength of their review process.
- The previous COV report expressed concern that prestige and past productivity impacted funding decisions, as opposed to the proposals being evaluated on their merit (IM and BI). We believe that this has been addressed, as the decisions we reviewed were clearly based on the merits of the proposal itself along with how well the proposal met NSF goals.
- How to appropriately weigh different activities within the Broader Impacts merit criterion continues to be the subject of vigorous discussion and debate. The COV recommends that CHE consider asking reviewers to separately score IM and BI criteria.

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

**Table 5 - Resulting Portfolio of Awards**

| <b>RESULTING PORTFOLIO OF AWARDS</b>  | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|---|--|
| <p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>Comments:</p> <p>If we assume the sample that we were assigned to review is representative, then the portfolio seems balanced across organic, inorganic, organometallic, and related sub-fields. There did not appear to be any bias of funding moving to a particular sub-discipline.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 8</b></p>   | <p>Yes</p>   |
| <p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>Comments:</p> <p>Reviewers and panels often address scope which is helpful. The award size is typically modest particularly in a climate where tuition, supplies, and instrumentation costs are increasing. The unionization of graduate students in many institutions is now a reality as are the associated increases in stipends and benefits. In looking to the future, the committee thinks that it will be very important to strive for increased budgets across the board. In the long term, insufficient funding is expected to weaken the competitiveness of the US STEM workforce.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 4</b></p> | <p>No</p>  |

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</b> |
|--|--|
| <p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>Comments:</p> <p>Innovation and transformative projects are clearly among those that are in the portfolio of funded projects. It was also clear the program recognizes that transformation does not occur overnight or within a single funding cycle. Thus, awards are also made to long-standing programs which continue to transform the field. We also noted that projects in which the science was viewed as incremental were in several instances declined based on this consideration.</p> <p><b>Data Source: Jackets</b></p>   | <p>Yes</p>   |
| <p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>Comments:</p> <p>Yes. The program clearly recognizes and funds programs that are at the interface of many sub-disciplines. For example, reaction methods serve as a commonality that bridges efforts in syntheses, catalysis and mechanistic properties. These efforts are supported by the interactions among the SYN, CAT, and CMFP programs.</p> <p>A significant amount of money comes into SYN from OSI, but the mechanism by which this happens is unclear.</p> <p><b>Data Source: If co-funding is a desired proxy for measuring inter- and multi-disciplinary projects, the Co-Funding from Contributing Orgs and Co-Funding Contributed to Recipient Orgs reports can be obtained using Enterprise Reporting, COV Dashboard, Question 7</b></p> | <p>Yes</p>   |

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</b> |
|--|--|
| <p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>Comments:</p> <p>In general, the distribution is appropriate and clearly based on institutions of higher ed per state and the corresponding proposal pressure.</p> <p>However, we note several states (often EPSCOR states) that have no active SYN awards over the 4-year period. Tailored outreach to such schools may be warranted.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 2</b></p>  | <p>No</p>  |
| <p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>Comments:</p> <p>We note the low number of applications and high decline rate from HBCU and 4-year colleges. We encourage SYN program officers to review the process by which those applications are solicited and reviewed and the format of these proposals. For example, these could be reviewed at the beginning of the panel session to avoid the trap of comparing with the standards of PhD-granting institutions. Would it be appropriate to introduce the institution before the proposal is discussed? Would a dedicated block of time within the panel be appropriate? Is a 15-page proposal format optimal in light of the minimal administrative support present at many PUIs?</p> <p>The COV recommends that institution type be identified during reviewer training, during panel review before a proposal is discussed, and during the Review Analysis.</p> <p>We noted that PUIs (MS and 4-year) have lower funding rate compared to PhD granting institutions in the SYN program.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 3</b></p> | <p>No</p>  |

| <b>RESULTING PORTFOLIO OF AWARDS</b>  | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|---|--|
| <p>7. Does the program portfolio have an appropriate balance of awards to new and early-career investigators?</p> <p>NOTE: A new investigator is an individual who has not served as the PI or Co-PI on any award from NSF (with the exception of doctoral dissertation awards, graduate or post-doctoral fellowships, research planning grants, or conferences, symposia and workshop grants.) An early-career investigator is defined as someone within ten years of receiving his or her last degree at the time of the award.</p> <p>Comments:</p> <p>Yes. The CAREER program is working and well received by the research community. There is clearly a higher funding rate for established investigators compared to those who would be receiving funding for the first time. This discrepancy is to be expected given differences in experience, grantsmanship, and having an established research program. Although the expected or appropriate difference is difficult to quantitate, the current differences appear reasonable.</p> <p><b>Data Source: Information on new PIs available via Enterprise Reporting, COV Dashboard, Question 6</b></p> | <p>Yes</p>   |
| <p>8. Does the program portfolio include projects that integrate research and education?</p> <p>Comments:</p> <p>All proposals include training of graduate students, and others are going beyond in terms of Broader Impacts activities.</p> <p><b>Data Source: Jackets</b></p>  | <p>Yes</p>   |

| <b>RESULTING PORTFOLIO OF AWARDS</b>  | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|---|--|
| <p>9. Does the program portfolio have appropriate participation of underrepresented groups<sup>13</sup>?</p> <p>Comments:</p> <p>We appreciate that CHE is making it a priority to diversify the program portfolio in terms of increasing funding to underrepresented groups. The question of what is appropriate is difficult to answer without having national data on the current distribution of faculty in academia today.</p> <p>Analysis of the demographics of the students being supported by NSF awards is absent.</p> <p><b>Data Source: Enterprise Reporting, COV Dashboard, Question 5</b></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:</p> <p>Yes. Within the larger NSF mission of advancing science, the program is working hard and succeeding in addressing sustainability in the context of chemistry and improving diversity in STEM education through several NSF sponsored programs. The program is prioritizing efforts in advanced manufacturing and looking toward the burgeoning areas of Artificial Intelligence (AI) and Machine Learning (ML).</p> <p><b>Data Source: Jackets</b></p> | <p>Yes</p>   |

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<sup>13</sup> 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.

| <b>RESULTING PORTFOLIO OF AWARDS</b>   | <b>APPROPRIATE,<br/>NOT APPROPRIATE,<br/>OR DATA NOT<br/>AVAILABLE</b> |
|--|--|
| <p>11. Additional comments on the quality of the projects or the balance of the portfolio:</p> <p>The COV was impressed with both the quality of the projects and the balance of the portfolio. Achieving this level of balance requires incredible effort in identifying appropriate reviewers, organizing panels, and ensuring fair and appropriate review. Thus, presence of this balance is a clear indication that overall process is functioning well.</p> <p>We note that several unfunded proposals were also deemed to be excellent and worthy of funding, underscoring the need for additional funding in the SYN program.</p> |  |

## OTHER TOPICS

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

Outside reviewers on the EAGER program were identified as a possible area for improvement.

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.

Strive to reduce time from submission to decision. One funding cycle per year is quite difficult on the community. In addition to reducing the time from submission to decision, moving to two submission windows per year would be desirable.

Clarifying the format for the resubmission of declined proposals would be helpful. Since there are no standing review panels, resubmitted proposals would benefit from the inclusion of a statement from the PI regarding the comments from the previous review and the changes that were made to address them.

Increasing cost of performing research.

4. Please provide comments on any other issues the COV feels are relevant, bearing in mind that COV reviews do not include assessment or evaluation of the outcomes or long-term impacts of program investments.
5. NSF would appreciate your comments on how to improve the COV review process, format, and report template.

Clearer instructions and Review Analysis on RUI proposals, particularly those coming from HSI and HBCU institutions, in which the nature of the institution and the responsibilities of the faculty member are weighed appropriately. We suggest the possibility of reviewing these with a dedicated block of time at the beginning of a panel, reminding them of the smaller budget.

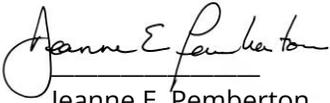
The time involved to review the necessary materials is more than what was outlined during our invitation to participate on the COV committee. Serving on this committee is time consuming but has many benefits, and in order to provide meaningful feedback, having more time to review materials would have been helpful. For example, it would have been preferred to have had our subgroup meetings and email from the COV Committee Chairs by the end of June (instead of mid-July).

Broad feedback from all relevant stakeholders would greatly benefit the COV review process.

*The Committee of Visitors is part of a Federal Advisory Committee. The function of Federal Advisory Committees is advisory only. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the Advisory Committee, and do not necessarily reflect the views of the National Science Foundation.*

**SIGNATURE BLOCK:**

For the 2024 COV

  
\_\_\_\_\_  
Jeanne E. Pemberton  
Co-Chair

  
\_\_\_\_\_  
Scott D. Rychnovsky  
Co-Chair

## V. Appendices

### Appendix A: 2024 Division of Chemistry Committee of Visitors Membership

#### Co-Chairs

**Jeanne E. Pemberton**, Department of Chemistry & Biochemistry, University of Arizona

**Scott D. Rychnovsky**, Department of Chemistry, University of California, Irvine

#### MPSAC Liaison

**Karen I. Goldberg**, Department of Chemistry, University of Pennsylvania

#### Members

**Rachel Narehood Austin**, Department of Chemistry, Barnard College

**Kelly N. Chacón**, Department of Chemistry, Reed College

**Jingyi Chen**, Department of Chemistry & Biochemistry, University of Arkansas

**G. Andrés Cisneros**, Department of Chemistry & Biochemistry, University of Texas at Dallas

**Keary M. Engle**, Department of Chemistry, Scripps Research

**Oswaldo Gutierrez**, Department of Chemistry, Texas A&M University

**Terefe G. Habteyes**, Department of Chemistry & Chemical Biology, University of New Mexico

**Issifu I. Harruna**, Department of Chemistry, Clark Atlanta University

**Elon A. Ison**, Department of Chemistry, North Carolina State University

**Munira Khalil**, Department of Chemistry, University of Washington

**Valeria D. Kleiman**, Department of Chemistry, University of Florida

**Karena A. McKinney**, Department of Chemistry, Colby College

**Mary Ellen McNally**, FMC Corporation

**Amanda Mifflin**, Department of Chemistry & Biochemistry, University of Puget Sound

## **Committee of Visitors Membership (cont'd)**

**Kathleen M. Morgan**, Department of Chemistry, Xavier University of Louisiana

**Juan G. Navea**, Department of Chemistry, Skidmore College

**Allen G. Oliver**, Department of Chemistry & Biochemistry, University of Notre Dame

**Laura Parker**, U.S. Department of Homeland Security

**Tanea Reed**, Department of Chemistry & Forensic Science, Eastern Kentucky University

**Jianhua Ren**, Department of Chemistry, University of the Pacific

**Mario Rivera**, Department of Chemistry, Louisiana State University

**David Rovnyak**, Department of Chemistry, Bucknell University

**Stuart J. Rowan**, Department of Chemistry, University of Chicago

**Brenda Rubenstein**, Department of Chemistry, Brown University

**Yihan Shao**, Department of Chemistry & Biochemistry, University of Oklahoma

**Linda S. Shimizu**, Department of Chemistry & Biochemistry, University of South Carolina

**Blake S. Simpkins**, Chemistry Division, Naval Research Laboratory

**Lisa F. Szczepura**, Department of Chemistry, Illinois State University

**Levi T. Thompson**, Department of Chemical & Biomolecular Engineering, University of Delaware

**Aimee Tomlinson**, Department of Chemistry & Biochemistry, University of North Georgia

**Evan R. Williams**, Department of Chemistry, University of California, Berkeley

**John L. Wood**, Department of Chemistry & Biochemistry, Baylor University

**Jiong Yang**, National Institute of General Medical Sciences, National Institutes of Health

**Rui Zhang**, Department of Chemistry, Western Kentucky University

## **Appendix B: Division of Chemistry – Charge to 2024 Committee of Visitors**



## **Appendix C: Division of Chemistry Committee of Visitors On-Site Meeting Agenda**



## Appendix D: Division of Chemistry Committee of Visitors Subpanel Assignments

| Program            | Specialist Subpanel Assignments |                    |                   |
|--------------------|---------------------------------|--------------------|-------------------|
|                    | Scribe                          |                    |                   |
| CAT                | Rachel Austin                   | Jiong Yang         | Karen Goldberg    |
| Centers/Institutes | Levi Thompson                   | Juan Navea         | Blake Simpkins    |
| CLP                | G. Andrés Cisneros              | Kelly Chacón       | Mario Rivera      |
| CMFP               | Elon Ison                       | Oswaldo Gutierrez  | Kathleen Morgan   |
| CMI                | Jianhua Ren                     | Mary Ellen McNally | Evan Williams     |
| CSD                | Munira Khalil                   | Terefe Habteyes    | Valeria Kleiman   |
| CTMC               | Yihan Shao                      | Aime'e Tomlinson   | Brenda Rubenstein |
| ECS                | Karena McKinney                 | Amanda Mifflin     |                   |
| MRI/Facility       | David Rovnyak                   | Allen Oliver       | Laura Parker      |
| MSN                | Stuart Rowan                    | Linda Shimizu      | Jingyi Chen       |
| REU/BP/SP          | Tanea Reed                      | Keary Engle        | Issifu Harruna    |
| SYN                | Lisa Szczepura                  | Rui Zhang          | John Wood         |

| Program            | Generalist Subpanel Assignments |                    |                    |
|--------------------|---------------------------------|--------------------|--------------------|
|                    | Scribe                          |                    |                    |
| CAT                | Keary Engle                     | Karen Goldberg     | Mario Rivera       |
| Centers/Institutes | Valeria Kleiman                 | David Rovnyak      | Karena McKinney    |
| CLP                | Oswaldo Gutierrez               | G. Andrés Cisneros | Mary Ellen McNally |
| CMFP               | Juan Navea                      | Jingyi Chen        | Rachel Austin      |
| CMI                | Linda Shimizu                   | Jiong Yang         | Tanea Reed         |
| CSD                | Rui Zhang                       | Yihan Shao         | Levi Thompson      |
| CTMC               | Issifu Harruna                  | Terefe Habteyes    | Aime'e Tomlinson   |
| ECS                | Blake Simpkins                  | Amanda Mifflin     | Allen Oliver       |
| MRI/Facility       | Brenda Rubenstein               | John Wood          | Stuart Rowan       |
| MSN                | Laura Parker                    | Jianhua Ren        | Elon Ison          |
| REU/BP/SP          | Evan Williams                   | Munira Khalil      |                    |
| SYN                | Kelly Chacón                    | Lisa Szczepura     | Kathleen Morgan    |