

**CREST FINAL REPORT
For
FY 2010 NSF COMMITTEE OF VISITOR (COV) REVIEW**

Guidance to NSF Staff: This document includes the FY 2010 Committee of Visitors Final Report of the CREST Program. The COV followed the specific guidance for the COV review process as described in Subchapter 300-Committee of Visitors Reviews (NSF Manual 1, Section VIII) at: www.inside.nsf.gov/od/oia/cov.

The COV report provides a balanced assessment of NSF's performance in two primary areas: (A) the integrity and efficiency of the **processes** related to proposal review; and (B) the quality of the **results** of NSF's investments that appear over time. The COV also explores the relationships between award decisions and program/NSF-wide goals in order to determine the likelihood that the portfolio will lead to the desired results in the future. The COV studied confidential material for Part A of the Core Questions such as declined proposals and reviewer comments. The *COV report does not contain confidential material or specific information about declined proposals*. Discussions leading to answers for Part B of the Core Questions involved the study of non-confidential material such as results of NSF-funded projects. The report is useful in assessing agency progress in order to meet government-wide performance reporting requirements that are available to the public. We understand that material from COV reports may appear in NSF performance reports and may be subject to an audit.

**FY 2010 NSF COMMITTEES OF VISITORS (COV)
PROGRAM REPORT FOR CREST**

The table below has been completed by program staff.

Date of COV: August 31-September 2, 2010
Program/Cluster/Section: Centers of Research Excellence in Science and Technology (CREST)
Division: Human Resource Development
Directorate: Education and Human Resources
Number of actions reviewed: Awards: 25; Declinations: 22 : Other: N/A
Total number of actions within Program/Cluster/Division during period under review: Awards: 82; Declinations: 53:Other: 0
Manner in which reviewed actions were selected: Random sample of award and non-award actions ending in the numerals "3", "5", and "8" at the end or second from the end of award/decline identification number. The sample includes new, incremental and supplemental actions other than this methodology to form a representative sample of the portfolio. <i>Innovation through Institutional Integration (I²) actions may be included in the total number of actions but were not reviewed by this Committee of Visitors.</i>

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

The COV briefly discussed and provided comments for *each* relevant aspect of the program's review process and management, and based comments on a review of proposal actions (awards, declinations, and withdrawals) that were *completed within the past three fiscal years*. We provided comments for *each* program that was reviewed and for those questions that were relevant to the program under review. We used quantitative information to answer some questions, and made constructive comments noting areas in need of improvement.

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

<p>QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</p>	<p>YES, NO, DATA NOT AVAILABLE, Or NOT APPLICABLE¹</p>
<p>1. Are the review methods (for example, panel, ad hoc, site visits) appropriate?</p> <p>Comments:</p> <p>The review methods are appropriate and include mostly panel but also some ad hoc reviews. The COV noted as many as nine reviews in certain panel reviews. In most instances, the reviewers are panelists with the majority from MSIs. We found that outside ad hoc reviewers from R1 universities have been asked to provide expert ad hoc reviews on the intellectual merit and commend this very good practice.</p> <p>Supplementary awards had fewer reviews although the lower number seems appropriate.</p> <p>Review methods look good yet not without challenges in obtaining qualified reviewers. The method for how the program identifies reviewers may be worth revisiting. We found that subprojects have been completed by mail. Is a telecom to go through these reviews also included? The discussion provides a significant element of the value.</p> <p>1. Questions: Why did supplemental requests go up in 09 as indicated on slide 20? Does this support better flexibility than a higher base budget?</p> <p>2. Site visits seem to have peaked in 2008, dropped in 2009, and may be very low in 2010 depending on when development of slide 18 in the COV</p>	<p>YES</p>

¹ If “Not Applicable,” please explain why in the “Comments” section.

<p>presentation occurred. Is value emerging from the site visits?</p>	
<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 reviewing sample proposals the COV found that individual reviews, panel summaries, and program officer review analysis addressed both review criteria. Our review of a declined proposal as well as awarded proposals showed equal attention to both criteria in the reviews, panel summary and program officer review.</p> <p>The quality of panel summaries seems inconsistent. In some cases these summaries appear weak in the renewals and lack specific details that would help the investigator improve the program. We feel it would be worth spending more time assisting the lead investigators; a very good program could become excellent with such support. Initial reviews seem quite effective for recommended programs and include not just strengths but also weaknesses to be addressed. In many cases, the declined proposal received specific advice for how to improve the program. This follow-up step is an example of a useful review.</p>	<p>YES</p>
<p>3. Do the individual reviewers provide substantive comments to explain their assessment of the proposals?</p> <p>Comments:</p> <p>Although the quality of individual reviews varies, the COV discovered a generally high quality of review with substantial comments to explain decisions. In some instances, even a declined proposal that was poorly written and executed, nonetheless received a thorough review by the panel. Also noteworthy are the MSI reviews which are favorable in their quality and detail compared to reviews from panelists or ad hoc reviewers from R1 institutions.</p> <p>Most reviewers did an excellent job. They sometimes included suggestions for how to improve the proposal, even though several proposals lacked this step, including those where the proposal received a funding renewal. In a capability building program, it is particularly important to use the opportunity of proposal feedback to help the individual investigators improve. Feedback that explicitly requires a strong section which explains to investigators how this might be done would significantly benefit the program.</p>	<p>YES</p>
<p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p>	<p>YES</p>

<p>Comments:</p> <p>The panel summaries generally provide rationale for the panel consensus. However, in evaluating panel summaries for a winning proposal compared to a declined proposal, the detail in the rationale provided for the decision was markedly higher for the winning proposal. This difference in specificity does not seem to be systematic when compared to the summary of another declined proposal, which was quite specific.</p> <p>Sometimes the summary review includes diverse opinions without indicating the specific reason for selecting a given perspective. In these cases it is difficult to distinguish between a funded and a non-funded proposal based only on the summary, and we had to examine the reviews. We found an example of diverse opinions in the summary without a resolving rationale. This jacket also highlights a concern that the review analysis included the statement “lacks innovative and original” research while still recommending the funding. The review provided no explanation of why “lacks innovative and original” research was not necessary,(as might be the case in certain situations more focused on capability building.</p>	
<p>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</p> <p>(Note: Documentation in jacket usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.)</p> <p>Comments:</p> <p>The complete jacket documentation is thorough and provides ample rationale for the decision. While the program officer’s review analysis recycles some comments made in the panel summary, the program officer also provides additional information relevant to the decision, such as the downgrading of the E given by a non-expert reviewer. The panel reviews, panel summaries, and program officer review analysis were by far the most important contributors to the rationale used to make the decision. These analyses are thorough, balanced, and address both intellectual merit and broader impacts.</p> <p>Although information in the jacket generally supported the decision, no information appeared to explain divergent panel summary wording or the opinion of a specific reviewer.</p>	YES
<p>6. Does the documentation to 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 or telephoned with diary note in jacket) of the basis for a declination.)</p>	YES

<p>Comments:</p> <p>The PI receives both panel summaries and program officer review analysis, so our previous comments apply -- the rationale provided to the PIs in support of the decision is generally thorough and balanced.</p>	
<p>7. Is the time to decision appropriate?</p> <p>Note: Time to Decision --NSF Annual Performance Goal: For 70 percent of proposals, inform applicants about funding decisions within six months of proposal receipt or deadline or target date, whichever is later. The date of Division Director concurrence is used in determining the time to decision. Once the Division Director concurs, applicants may be informed that their proposals have been declined or recommended for funding. The NSF-wide goal of 70 percent recognizes that the time to decision is appropriately greater than six months for some programs or some individual proposals.</p> <p>Comments:</p> <p>According to data provided to this visiting panel, the time to decision is appropriate, with over 90% of proposals reviewed in the six-month window.</p> <p>CREST dwell time appears to be three months or less in most cases. We found evidence of one proposal taking a long time in 2009, but otherwise reviews are quick. Matters such as the FaST supplement appropriately cleared within a month or less of the request.</p>	<p>YES</p>
<p>8. Additional comments on the quality and effectiveness of the program's use of merit review process:</p> <p>While the process seems to be effective, the COV would like to see evidence of how the reviews actually do assist the investigators in building their own capability to write good proposals. Ideally the process of the review builds better investigators. Has this information been captured anywhere? Would it be possible to provide specific small capability building grants to investigators who seem to have an idea with great scientific merit, but who lack the writing expertise to sell their ideas?</p>	

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

SELECTION OF REVIEWERS	YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE ²
<p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>Comments:</p> <p>Without a doubt the program has made use of a wide set of reviewers with appropriate qualifications and backgrounds to review the CREST program. In addition to assembling panels with diverse backgrounds, the program has also used ad hoc reviewers with specific expertise that may not be represented in the panel.</p> <p>We noted difficulty in determining whether the reviewers truly have the right kinds of expertise for a given proposal. Our suggestion is to add a self-assessment for reviewers that include such elements as scientific expertise or special institutional knowledge depending on the kind of program undergoing analysis. Also, bringing in nonvoting junior members of faculties or graduate schools would provide a mentoring opportunity that would aid in capability building while simultaneously assisting NSF in finding qualified reviewers. Finally, could the CREST program take advantage of the new PhDs graduating from it to assess the programs by providing some form of evaluation one or two years post graduation? That would help us better understand the individual impact.</p>	YES
<p>2. Did the program use reviewers balanced with respect to characteristics such as geography, type of institution, and underrepresented groups?</p> <p>Note: Demographic data is self reported, with only about 25% of reviewers reporting this information.</p> <p>Comments:</p> <p>The number of reviewers from underrepresented groups has been about 20% in 2008 and 2009. This number seems somewhat low to the COV given that the CREST program focuses on MSI's. Every state in the union appears on the reviewer list, with larger states proportionally represented. The types of institutions represented also seem appropriate. About 50% of the reviewers are</p>	YES

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

<p>from peer MS and PhD institutions, and about 20% are from research intensive PhD institutions.</p> <p>The COV would need to see more about the underlying demographics being sought. Is the goal to increase participation in the review panels also? What about increased participation from industry and FFRDCs? We suggest that you include any appropriate tables in your report.</p>	
<p>3. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>Comments:</p> <p>We found no evidence of COIs in the jackets we reviewed. PIs identified conflicts in advance to make it easier to schedule around potential conflicts.</p>	<p>YES</p>
<p>4. Additional comments on reviewer selection:</p> <p>In general it seems hard to mitigate the problem of having ‘the same’ pool of reviewers. We suggest finding a way to balance the quality of reviews with mentoring possible proposal writers. Perhaps periodically holding proposal reviews on the west coast or in the south would help diversify the participant pool. While this has never been NSF policy, it seems like a reasonable thing to consider and might help with reviewer bias. Note that disadvantaged or smaller institutions may also find it a hardship to be without a faculty member for the time invested in traveling to DC to participate. In these cases, we recommend scheduling some reviews ‘off season’ as well as in alternate locations so as not to overlap with the academic year.</p>	

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

<p>RESULTING PORTFOLIO OF AWARDS</p>	<p>APPROPRIATE, NOT APPROPRIATE³, OR DATA NOT AVAILABLE</p>
<p>1. Overall quality of the research and/or education projects supported by the program.</p> <p>Comments:</p>	<p>APPROPRIATE</p>

³ If “Not Appropriate,” please explain why in the “Comments” section.

<p>From what is available, it is hard to determine the quality is of a program, not just CREST but many large programs. Measurement of capability building within an institution works best after the program is over to ensure that the change has been sustained.</p> <p>Evaluation of CREST proposals includes a strong intellectual merit criterion, encompassing both the relevance of the activity to advancing knowledge, and the originality/creativity/transformational nature of the research. The program directors recognize the need for developing the capacity to become leaders as opposed to beginning with leadership class research. The awards within the program reflect the tension between these characteristics and maintain a good balance as institutions move from nascent leadership efforts to nationally competitive results, a very positive aspect of the program. We found evidence that the progression towards leadership exists by comparing statements about early stage awards and later stage awards, which provide clear evidence of national/international caliber work. Note that a supplement involved further discussions with the PI regarding the research lacks in the original proposal. The strength of that proposal was in the international collaborations it supported.</p> <p>A clear goal of the CREST program is to produce high quality results. Evidence of this substantial quality emerges when observing later-stage programs. One key quality indicator is the ability of institutions that have received CREST funding to become competitive in the national/international community of scholars through development of nationally recognized education programs that result in the production of excellent BS/BA, MS, and PhD students; successfully producing nationally/internationally competitive publications; success in competitive research and other awards; and world class facilities. Several programs provide strong examples of success in this area.</p>	
<p>2. Does the program portfolio promote the integration of research and education?</p> <p>Comments:</p> <ul style="list-style-type: none"> This program strongly encourages the integration of research and education. Most proposals show a strong link between research and education. Perhaps integration comes naturally to these institutions because most of them have been traditional undergraduate teaching institutions. Most submissions reflect this integration of research and education from both Accepted and Declined proposals. <p>The awards have helped most of the institutions transition from purely teaching institutions into successful research and education institutions. As an example, North Carolina A&T State University, previously a teaching institution has successfully combined research and teaching and has won the prestigious and very competitive NSF Engineering Research (ERC) Award.</p>	<p>APPROPRIATE</p>

<p>3. Are awards appropriate in size and duration for the scope of the projects?</p> <p>Comments:</p> <p>We like the approach of providing fewer, but more substantive, awards. This action results in a much higher likelihood of long term change within an institution, though the end of the award may result in a more significant slump or hole in the curriculum. The COV thinks it might be useful to consider whether such a 'slump' is occurring.</p> <p>The awards appear to be appropriate for the duration of the projects. In most instances PIs were careful to itemize the cost in relation to the activities of the proposed project and thus request a total amount that is consistent with the proposed project activities. Both multi-year requests would enable the institutions to implement and complete the projects' goals and objectives.</p>	<p>APPROPRIATE</p>
<p>4. Does the program portfolio have an appropriate balance of:</p> <ul style="list-style-type: none"> • Innovative/potentially transformative projects? <p>Comments:</p> <p>Since we are not sure whether a specific target has been set, this determination is hard to make.</p> <p>Most of the program portfolios have an appropriate balance of potentially transformative projects. However, we recommend multiple site visits to determine how the Grant balances resources to align with the existing institutional resources that enable such transformation.</p>	<p>APPROPRIATE</p>
<p>5. Does the program portfolio have an appropriate balance of:</p> <ul style="list-style-type: none"> • Inter- and Multi- disciplinary projects? <p>Comments:</p> <p>Most of the 'awarded' jackets seem to have a multi/interdisciplinary approach.</p> <p>The portfolios have multidisciplinary and interdisciplinary projects exemplified through faculty research projects, campus and field laboratory experiences, undergraduate and graduate research projects, and summer internships. Further, many of the institutions appear to have collaborators outside of the university that can expand their potential for additional but related disciplines.</p>	<p>APPROPRIATE</p>

<p>6. Does the program portfolio have an appropriate balance considering, for example, award size, single and multiple investigator awards, or other characteristics as appropriate for the program?</p> <p>Comments:</p> <p>Most awardees appear to have received an award the first time through and that about ¼ of the awardees are new. Is this true?</p> <p>The data suggest that most of the awardees received their award on their first attempt, and that about 25% of the awardees are new starts, a very positive indicator.</p> <p>Referring to the current portfolio listed in the COV slides, the award size is about \$5M for 5 years for all new CREST sites; in all cases is a multi-investigator award; and in many cases multi-institutional. Smaller supplementary awards appear to be for SBIR/STTR matching. The balance is appropriate for this program.</p>	<p>APPROPRIATE</p>
<p>7. Does the program portfolio have an appropriate balance of:</p> <ul style="list-style-type: none"> • Awards to new investigators? <p>NOTE: A new investigator is an investigator who has not been a PI on a previously funded NSF grant.</p> <p>Comments:</p> <p>See #6 above – CREST appears to have several new investigators.</p> <p>The COV material shows that the success rate for new applicants was very good. Awards went to 7 PIs who received a center based on their first CREST proposal. Approximately ¼ of the awardees are new.</p>	<p>APPROPRIATE</p>
<p>8. Does the program portfolio have an appropriate balance of:</p> <ul style="list-style-type: none"> • Geographical distribution of Principal Investigators? <p>Comments:</p> <p>The geographical distribution appears to match the need distribution except for the western states. It would be useful to see an overlay of principal investigator locale with ‘need’ locale – whether this be by EPSCOR status, average income, or location of target institutions.</p> <p>The COV slides map out the distribution of the current portfolio and in general the distribution of awards is as expected with one exception. We were surprised to note that the state of California has only one award. Is this</p>	<p>APPROPRIATE</p>

<p>consistent with the number of HSIs in the state? It appears not. In general the geographical distribution does match the need distribution in the western states.</p> <p>We suggest that you develop an overlay of principal investigator locale with ‘need’ locale to facilitate evaluation by EPSCOR status, average income, or location of target institutions.</p>	
<p>9. Does the program portfolio have an appropriate balance of:</p> <ul style="list-style-type: none"> • Institutional types? <p>Comments:</p> <p>We found that most of the institutions in the jacket list and those depicted in the slideshow are traditionally structured graduate universities. In what seems to be a missed opportunity, CREST does not appear to have many four- year undergraduate research institutions participating. The earlier an intervention is made, the more likely it is to be a success. Adding incentive to collaborate with researchers in underserved institutions at the four- year level may be worth considering.</p> <p>CREST awards go predominately to MS institutions with small PhD programs and non-research intensive Ph.D. granting institutions. The data indicate that 66 of the 79 PIs are from these classes of institutions, which are appropriate and expected numbers from this program. Most of the institutions appear to be traditionally structured graduate universities.</p>	<p>NOT APPROPRIATE</p>
<p>10. Does the program portfolio have an appropriate balance:</p> <ul style="list-style-type: none"> • Across disciplines and sub disciplines of the activity? <p>Comments:</p> <p>The current CREST portfolio represents general disciplinary areas that follow along the lines of those areas receiving funding from other science and engineering programs. Some issues need attention: First, a disproportionate number of awards go to the nanotechnology area, even though most of these are legacy awards. We did note two 2009 awards that are nano awards. Second, the Bio area has too few awards, a surprising discovery that seems out of balance with national trends in research. Third, the representation of engineering disciplines is not as high as one would expect—what is the underlying reason for this? Fourth, there are no new centers in the energy area. Perhaps this development is to come, and we would encourage it since energy is the fastest growing large research area in the world, not just in the U.S.</p>	<p>NOT APPROPRIATE</p>
<p>11. Does the program portfolio have appropriate participation of underrepresented groups?</p> <p>Comments:</p>	<p>APPROPRIATE</p>

<p>Approximately 40% of the awards have minority participation. This percentage seems consistent with the available pool of potential PIs or co-PIs. It appears that female participation spiked, then dropped, significantly. Is the reason known? Minority involvement picked up over the same period, though not to the same extent. In general the participation of minority and female PIs seems adequate and consistent with the available pool of faculty in these areas.</p> <p>One issue arises here: Are the CREST collaborations taking advantage of the pool of minority and female PIs in non MSI schools? Tapping the MSI schools certainly enlarges the available pool, especially of mentors.</p>	
<p>12. 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>Both NSF's charter as the lead agency for science and engineering research in the U.S. and its greater role as an agent of change in STEM fields through its broader impacts emphasis make the CREST program highly relevant to the agency mission. More importantly, CREST and RISE center efforts lie within MSI's, placing strong emphasis on education of underrepresented students in STEM fields. By resourcing these institutions to encourage competitive, high level research, they receive encouragement to strengthen their graduate level programs. Whether students stay at the MSI or continue into graduate training at a research university, the CREST and RISE programs enhance the numbers of students entering the STEM pipeline, thereby serving a national priority and need.</p>	<p>APPROPRIATE</p>
<p>13. Additional comments on the quality of the projects or the balance of the portfolio:</p> <p>We observed that: CREST funds centers that have been established at an MSI, with sub-projects that can be accomplished at other institutions increase the capabilities of the MSI. We pose an important question: Do we best serve the students and the national need to diversify STEM fields by increasing the capabilities at the MSI, or by increasing their ability to collaborate with research universities? Is this the same goal? Could a center have two homes, one at the MSI and another at a "mentor" R1 school?</p> <p>What other models have been explored that accomplish the CREST objectives?</p> <p>The balance of lead investigators and center topics appears weak related to engineering/computing disciplines with the exception of nanotechnology/materials which make up a high percentage of the CREST portfolio. We noted only six jackets that appeared conducive to a broad engineering/computer science participation (excluding nanotech). Given the importance of Engineering in STEM, this low quantity may be a weakness in the program. Within these jackets, we assessed four awards for whether they appeared to include strong participation of</p>	

engineering/computing disciplines by examining the references and the background of the lead investigator. We looked at the backgrounds of the investigators, subproject leads, advisory boards, and the makeup of the references and (where available) publications to assess degree of participation. We found a high degree of breadth within these Centers as described below:

Jacket **HRD 0833345**, places emphasis on sensors. The lead PI is in Physical Chemistry. The references cited did not include other engineering disciplines to any large extent; the emphasis was on materials and p-chem.

Jacket **HRD 0833093** emphasizes information systems at Florida international. The lead PI is in computing/information sciences. Cited references are primarily in computer science-information systems (data mining) and in medicine/biology, including medical imaging indicating a well-integrated combination of computing/information sciences and an application discipline.

Jacket **HRD 0931756** focuses on resilient systems at Texas. Lead PI is a highly regarded electrical engineer (IEEE Fellow); references cited are primarily in networking, security, communications, and statistics. We found this to be a good example of a strong electrical/communications proposal.

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

1. Management of the program.

Comments:

The 2009 management plan is succinct and seems effective based on the outcomes of CREST. We noted specific concerns.

The mention of generating a constant 1/3 set of 'fresh eyes' for reviewers is appropriate and good. Experienced reviewers and new reviewers are valuable for different reasons. However, the COV did not observe an explicit plan to increase the diversity of the reviewer pool, and that is a concern since it was an issue that was raised by the 2007 COV. Although individual PMs may be engaged in this, the COV would like to see an NSF- wide initiative for supporting the need for diversity and increasing the reviewer pool. Is this a crosscutting issue? Would NSF support a requirement that investigators/ institutions that receive funds participate in the review process?

Our concerns about the proposal development workshops: Are the workshops increasing the caliber of the written proposals and encouraging more successful first time proposal writers? Who attends them – are they the target audience?

We did not see discussion of the staff workload in the 2009 or earlier management plans, although the COV was briefed on the increase in program managers from one to two.

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

Comments:

As previously noted, an apparent lag exists between the research concentrations represented by CREST awards and national funding trends. One example is the large number of nanotechnology based centers, and the absence of centers with bio/nano or energy focus. The program would be able to address this lag if the CREST proposal teams were coupled more effectively with PIs from major R1 institutions that are more likely to be keeping up with the very latest research trends. We temper this comment, of course, with the stage of development of the MSI in research participation. As MSIs grow and mature in their research capabilities, we encourage them to “catch up” with the R1 community with respect to working in the most current research areas, as opposed to doing incremental research in areas that have been exhausted.

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

Comments:

The COV found it difficult to determine from the management plan what process was used to prioritize areas of research supported by CREST centers. Nevertheless, the diversity in the portfolio seems reasonable, and perhaps the institutions deserve credit for keeping up with emerging trends. The COV in general did not see in the management plan an explicit process for deciding on the research areas that are to receive priority, perhaps a useful exercise that would benefit the yearly planning cycle.

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

Comments:

The above noted comments point out a few areas in which the previous COV recommendations received no follow up, yet in general the program was responsive. The program most notably added a second program manager to address the workload issue. This COV notes that the management plan is not detailed and we emphasize its importance in growing the CREST program along a strategic path rather than an evolutionary path. Overall, we find the program well managed and commend the previous sole program manager for keeping the program running smoothly despite a work overload.

5. Additional comments on program management:

None Noted

PART B. RESULTS OF NSF INVESTMENTS

The NSF mission is to:

- promote the progress of science;
- advance national health, prosperity, and welfare; and
- secure the national defense.

To fulfill this mission, NSF has identified four strategic outcome goals: Discovery, Learning, Research Infrastructure, and Stewardship, although the COV does not review accomplishments related to Stewardship.

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

B.1 OUTCOME GOAL for Discovery: “Foster research that will advance the frontier of knowledge, emphasizing areas of greatest opportunity and potential benefit and establishing the nation as a global leader in fundamental and transformational science and engineering.”

Comments:

Many strong developments have evolved, especially in the nanotech centers. The number of PhDs granted is excellent, as is the number of patents sought. These developments show a path from science into the workplace/industry. The number of papers (evidence) is quite respectable particularly when the context is within a university that historically may not have had a strong history of scientific achievement. The case for the importance of the results could be made even stronger if they are used more effectively in communicating the program success.

Although the program encourages breakthrough projects, it may be helpful if the awardees are encouraged to partner with the U.S. National Labs on projects and also use their facilities. Breakthrough projects that will advance the frontiers do not come easily. Their attainment is possible after many years of sustained work which makes a strong case for partnering and working with National or Industrial Labs.

Basic research is not enough in order to be transformative in the modern world. We propose that you more strongly address and encourage the transition from research ideas to useful technology in CREST. Especially encourage minorities to participate in order to create industries in the institutions’ states.

B.2 OUTCOME GOAL for Learning: “Cultivate a world-class, broadly inclusive science and engineering workforce, and expand the scientific literacy of all citizens.”

Comments:

The CREST program could require institutions with a large number of underrepresented students to collaborate with K-12 schools/school districts or even the institutions’ departments of education for the development of workshops for teachers, advanced field/laboratory experiments for

gifted middle and high school students, and to provide opportunities through the CREST funded programs for team teaching between the faculty researcher and the science teacher. As the outcome goal is to cultivate an inclusive science and engineering workforce, opportunities to expose larger numbers of underrepresented K-12 students to a variety of occupations in science and engineering could significantly impact the number of students entering STEM fields as well as encourage university STEM researchers to explore innovative ways to reach this population.

We recommend that you encourage the centers of excellence to develop programs for Middle and High School future Engineers and Scientists. This strategy will help them think about developing new Digital and Arts Science Academy curriculum for K-12.

We did not specifically note an emphasis on the K-12 or undergraduate support based on the awards presented, at least not from the standpoint of partnering institutions. However, CREST has clearly advanced the production of PhDs and MS, and provided the opportunity for them to publish. These advances are of critical importance to our next generation workforce.

Noteworthy examples are:

- **Strong graduate programs:** Jacket **HRD 0932337**, Tuskegee University 1998-2008 is a \$5M program which has resulted in a vibrant research program with a broad variety of partnerships; a new doctoral program; support for numerous graduate students/undergraduate students; and a very high number of publications (154 archival, 198 conference). Most institutions would find this record highly impressive.
- **National competitiveness in research funding:** Jacket **HRD 0833173**, North Carolina A&T, it was indicated during the CREST program overview that this institution received an ERC (NSF Engineering Research Center) in national competition, as a result of the increased institutional capacity from the CREST program. This is a high level of achievement for any institution.
- **World class education:** Jacket **HRD 0833093**, Florida International, received \$2M from NSF for cyberinfrastructure, and is establishing a partnership for the Latin American Grid (LA Grid) (<http://lagrid.fiu.edu>). The CREST PI holds a co-chair for the LA Grid Governing Board. The goal of this partnership is for the development of global shared research and educational grid computing infrastructure, for world class collaborative computing education, research, application, and innovation.

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

Comments:

We believe that the CREST program should strategically enable institutions to build their own capabilities, while weighing the advantages of improving access of institutions to national centers of specialized infrastructure, such as national micro and nano fabrication centers and foundries. Again, we recommend this as a key goal for a well thought out strategic plan in the overall management plan. If one does not already exist, we suggest performing an assessment to create a map of the existing institutional infrastructure at MSIs to help guide the program funding directed at laboratory development.

Most of the proposals do not include ways of sharing infrastructure which the COV encourages. An example we note is the fabrication of MEMS in Brook Haven Labs etc. Every school

does not have to have a large center for infrastructure but if the design of CREST is to increase the number of students, CREST centers must have resources to build infrastructures sufficient to allow the institution to participate in competitive research. In addition, we encourage CREST centers to collaborate with research institutions and organizations such as national laboratories that have unique resources. We recommend that the institutions develop and maintain sustainable infrastructures that in turn will sustain the research.

The CREST program as currently designed tends to favor those institutions that already have significant infrastructure to conduct STEM research. Building research infrastructure at HBCUs in particular is one of the most critical needs for those institutions. However, we found only one proposal that requested funds for a large piece of equipment and it was declined.

Notable examples are:

- Jacket **HRD 0932339** places emphasis on high performance computing at UTSA. The Lead PI is a highly regarded mechanical engineer with strong leadership in his discipline. The project has mechanical, electrical/imaging, and nanotech faculty- led subprojects. References cited are well distributed across nano, mechanical, and imaging publications. The steering committee for this Center includes materials, electrical, and biological scientists, as well as participation from a DOE national laboratory. Publications cited in the first-year report show good breadth, crossing, modeling/simulation, fluid dynamics, and control theory among others.
- **World class facilities: NCCU HRD 0833173** which has the goal of establishing the world's most intense positron source for material characterization is clearly an international caliber target.

PART C. OTHER TOPICS

FINAL CROSS-TALK SUMMARY

SUMMARY OF BUNDLED HRD COV CROSS-TALK REMARKS September 2, 2010

A group of COV review team members came together from 5 separate teams on September 2nd to discuss their differences in program perspectives, to find synergies that exist among the programs, and to identify mutual areas of concern that can help gain leverage and traction in broadening participation and increasing program effectiveness. The team members reviewed and evaluated the AGEP, CREST, HBCU, LSAMP, and TCUP programs before joining forces and sharing their views at the cross-talk session. Members were enthusiastically in alignment with anticipating the changing national education needs, encouraging collaboration and communication, and accelerating participation in global enterprises. The following summary represents major concerns of the assembled group.

- ❖ **Linkages/feedback mechanism across organizational lines:** The COV panel advocates improved linkages among the programs in HRD, and encourages the use and sharing of tracking and feedback mechanisms used by the programs.
 - A recommendation emerged that any awarded proposal should have the approval of the external review panel regarding its proposed broadening participation emphasis.
 - Several participants want to see more successful, collaborative efforts with other NSF programs, other agencies, National Laboratories, private industry, private foundations, and entrepreneurial research from small companies.
 - The group encourages private-public partnerships to facilitate technology transfer.
 - While use of Ad Hoc reviewers is an acceptable practice, the COV found that mainstream reviewers had more experience and seemed to do a better job. One suggestion to NSF is to provide a clear example of what a strong review looks like to facilitate better quality reviews.
 - Tracking of projects is sometimes difficult when the work ends. The team recommends practices that encourage sustainability and support for the projects.

- ❖ **Leadership Transition at the Top:** With new leadership coming in the opportune time exists to propose new methods of doing business. Panelists suggested that it is time to refine/restate NSF's commitment to BP. Some members recommended that NSF assess their structure to see if it promotes or discourages BP.
 - The panelists encourage the new Director of NSF to engage the affected community of institutional leadership and researchers in the first 90 days. Participants felt that by early engagement in the major concerns of the community, the first 90 days would make it possible to at the very least reinforce and/or establish a framework to meet objectives.
 - Considerable discussion revolved around which agency is best qualified to take the lead in managing a national education agenda. Besides NSF, the panel suggested National Institute of Health (NIH) with its very large budget, the Department of Education (DOE) which they did not feel has the needed clout and the Department

of Defense (DOD) as possible candidates. The panel suggested that leadership belongs with NSF which is well-positioned to take advantage of leveraging opportunities between agencies. With a formal leveraging mechanism in place, more opportunities to fund education would be possible. The NSF could consider developing a position called the Director of Integration to coordinate leveraging.

- IGERT represents a successful example of different directorates working together and cutting across the institutions as a flagship of graduate education. Panelists recommend identifying more programs like this that fund not just hard sciences but also social sciences to actually promote interdisciplinary education and thereby broaden participation.
- Encouraging collaborative grants with other institutions/organizations and/or companies may greatly expand and leverage the work across many programs and institutions.
- Developing leadership skills provides not only resources but also the type of leverage that enhances partnerships.

❖ **Broadening Participation:** Put teeth into it in the review process; identify a clear definition in the Strategic Plan that outlines goals and strategies for broadening participation.

- Consider using individuals who participate in programs and panels as mentors. Panels teach others how to do a better job of writing new proposals.
- A number of participants identified a need to increase the presence of minorities on panels.
- Generate increased participation from those who have been excluded from awards, grants, and fellowships over the years, particularly in STEM areas.
- Broader participation could come not only from giving others the opportunity to see what it is to develop an excellent proposal but also from obtaining diverse viewpoints from panelists.
- Develop a stand-alone section in standards that speaks to Broadening Participation so that it is not necessary to dilute what you emphasize in the science section.
- Several COV team members support the model of a separate panel or ad hoc reviewers to ensure that BP receives proper commentary and that PIs understand the need to incorporate it. The significance of the panel input drives the level of funding as determined by the scientific review, and appropriately, funds are not released until the criterion has been met. Be sure that panels have the expertise to deal with broadening participation and speak strongly to it.
- The funding structure should work to broaden participation rather than hinder it; if funding criteria are too bureaucratic, the result is a negative effect. The concern is that NSF does not have a mechanism in place that would allocate funding unless every piece of the proposal was rewritten to reflect a significant number of smaller proposals.
- Broadening Participation as a required criterion would also be appropriately included at the annual review stage and clearly addressed before the release of continuing grant increments.
- The panel asks which broad impacts NSF wants and further suggests setting standards and achievement metrics that NSF will examine yearly.
- Members suggested that NSF include reviewers who can do a critical analysis of broader impact. Most of the focus seems to be on intellectual merit.
- Improve communication between programs/agencies/organizations to strengthen alliances and make use of existing resources.

- ❖ **Structure of NSF – does it help or hinder Broadening Participation:** The consensus of the HRD COV Teams is that NSF should not consolidate these five programs. Other concerns emerged that ask whether NSF had a role in determining what is in the best interest of the country to leverage and improve on education.
 - Objections have been raised over proposed consolidation of the HRD programs. From a financial standpoint, some panelists feel that putting all the grant money in one pot is going to be a detriment especially to HBCU and TCUP and that the funding structure is short-sighted with the possibility of backfiring on the goal of broadening participation.
 - While the group recognized that human capital resources in some programs showed an increase since the time of the last program evaluations, a suggestion emerged to increase staffing to better manage programs and strengthen opportunities to meet goals for BP and BI.
 - A focus of new hires in specialized areas would allow for an increase in site visits by PIs that adds value to assessing programs, hiring individuals with experience in techniques for broadening participation increases the chance for achieving BP goals, and hiring someone at the executive level with expertise in leveraging opportunities among key parties/agencies.
 - Concerns emerged in discussions that smaller institutions don't have the sophistication to compete with larger institutions and if programs merge, the communities with small institutions will "hear" a message that the federal government doesn't care, and they fear loss of identity.
 - Talk to affected parties before making the organizational and funding changes that are going to generate long-term consequences.
 - Even with structure that has to be addressed and realigned, and with internal problems that have to be solved, the NSF is the ideal agency to carry the banner and lead the national initiative to improve the quality of research and higher education.
 - The incentive is there for NSF to emerge as a leader and to get creative to generate and leverage diverse funding pools.
 - The panelists would like to see NSF become an advocate of change – emerge as the federal "Change Agent" in pursuit of advanced education and funding resources.

- ❖ **Allocation of Resources:**

- Look for ways to fund infrastructure development that includes equipment and laboratories or a way to leverage program resources with other NSF opportunities.
- Put funds directly into supporting students and personnel without taking away from the dollars set aside for research-related expenses.
- Find a way to train students to become active members of faculty by learning how to write proposals, develop networks, and engage with people to expand partnerships and innovative research.
- Set aside funding for information technology tools along with the training to work with new software so that emerging science moves into the next generation with quality results and smooth transitions.
- To ensure that programs are sustainable provide increased support so that you can measure outcomes.
- Look for innovative programs that cultivate entrepreneurial students and programs. Students want to know how they can earn a living, make money and enjoy their work. Without the incentive, they may choose other options that have less satisfying results.

- Consider engaging with private industry to forge partnerships that support internships for students within the organization. Identify success stories where these partnerships have worked.
- ❖ **Demonstrate the Effectiveness of the HRD Programs:** A number of participants believe that NSF programs have a weak system for disseminating information on the successes coming out of these programs. Panelists feel that more investment of funds in NSF programs would be possible if a plan to attract other organizations was in place. Members advocate strengthening the information pipeline and generating national publicity for program accomplishments.
- Use simple graphs; convince people on the outside with presentations that are simple and straightforward.
 - Publicize accomplishments of note; even consider putting ads in major media outlets
 - Consider engaging the services of public relations firms to create interest in investors that have the resources to fund programs.
 - Tell other institutions what we do, that NSF looks for opportunities to engage in collaborative grants and are looking for partnerships and new funding sources to advance education globally.
 - Widely disseminate information on best practices to share information at the national level.
 - Get the attention of the internal press, the Office of Legislative and Public Affairs, and ultimately the media to put the spotlight on successful NSF programs.
 - Develop data bases and target groups to share program information.
- ❖ **Role of the National Science Board:** Some discussion came up about how the National Science board can set priorities with respect to addressing BP and hold programs responsible for addressing it or do without funding. Perhaps this is an enforcement role for NSB.
- Revisited the discussion regarding the possibility of weighting the merit review criteria.
 - Members were in passionate agreement that the composition of the National Science Board needs more diversity.
 - Broadening impact has to be evident throughout the structure including the National Science Board.

CREST COV COMMENTS

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

Across the Portfolio

- ❖ CREST offers a ripe opportunity to train students for the professoriate in addition to the AGEP program. It is recommended that there be a closer and more explicit link between these two programs (CREST and AGEP), citing the business of research as a necessary skill for future faculty.

Program-Specific

- ❖ It is important that CREST centers receive sufficient resources to build sustainable infrastructures and participate in competitive research and that they are encouraged to collaborate with research institutions and organizations, such as national laboratories, that have unique resources. The building and sharing of infrastructure and research networks needs to be improved to increase project sustainability and encourage the development of useful innovations for society.
 - A positive example of this is the collaborative work led by BrookHaven National Laboratory that resulted in the fabrication of microelectromechanical systems (MEMS).
- ❖ NSF should recruit and support the participation of new faculty in review panels. “Mock review” opportunities can be offered to give PhD candidates a sense of what can be expected on an NSF review panel and encourage their future participation.

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

Across the Portfolio

- ❖ How robust are the Directorate’s databases that track demographics and other data on the programs’ target populations? Is the Directorate’s use of money and performance evaluated with respect to those numbers?

Program-Specific

- ❖ Strengthen CREST participation in California, Arizona, and New Mexico.
- ❖ Infrastructure sustainability is an important objective of all centers that should be evaluated after CREST participation ceases to measure the need for an “infrastructure renewal” program.
- ❖ Stronger post-award assessment is needed and evaluation plans should reflect both short- and long-term impacts; for example, is the program still around after the funding is gone; what happens when the program ends, were the goals integrated within the institution, and was there lasting change?

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

Across the Portfolio

- ❖ The Foundation should assess the extent to which each directorate is involved in advancing the Broadening Participation (BP) agenda and take corrective steps where appropriate. Preparing a yearly report on the progress in this area to share what strides other programs are making in BP would be informative and useful.
- ❖ The COV recommends that solicitations from other NSF programs encourage collaboration with HRD programs.
- ❖ Electronically-assembled panels should be established to ensure that proposals recommended for funding fulfill BP criteria.
- ❖ BP has an enormous agenda and the majority of the responsibility to carry out this agency-wide initiative is being placed on the smallest directorate with the least amount of resources, the Directorate for Education and Human Resources (EHR). While EHR is well-suited to provide leadership, all of the directorates should participate in fulfilling this directive. NSF policies with respect to BP should reflect that it is an agency-wide commitment and the Foundation needs to be clearer about what is expected from the various directorates.
- ❖ A more rigorous definition of BP is needed. In order to provide leadership on this issue, NSF should have explicit merit review procedures associated with the BP component of proposals.
- ❖ PIs should be provided with more information regarding the BP aspect of the merit review process. Additionally, the BP portion of the merit review process should be addressed separately in some way. For instance, one person from each panel could look specifically at the BP-related award components. Ultimately, a separate review is the best way to proceed.
- ❖ Make BP a more explicit part of future metrics and assessment so that accountability is built into BP goals.

Program-Specific

- ❖ Strengthen and enhance mentoring to increase the competitiveness of PhD students as research leaders and increase their understanding of the business of research (i.e. proposal writing, conference attendance, publication).
- ❖ To take full advantage of their size and established relationships with MSIs, ERC and MSERC Centers should mentor/partner with CREST centers. To encourage these partnerships, NSF could make the mentorship a formal requirement and condition of ERC and MSERC funding. Each center could retain autonomy, but collaboration is expected and assessed as part of a joint review based on shared publications and jointly mentored students.

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

Across the Portfolio

- ❖ Mandate BP within the Broader Impacts criterion and develop associated implications for non-compliance.
- ❖ Identify ways NSF can partner with government and private entities to pool resources to broaden participation.

Program-Specific

- ❖ To better integrate research and education the CREST program could require CREST-sponsored institutions to collaborate with K-12 schools. This could be in the form of teacher professional development, advanced field/laboratory experiments for gifted middle and high school students, team teaching between the faculty researcher and the science teacher, etc.
- ❖ The program might want to consider informal learning organizations such as museums for further interface. To ensure a strong pipeline from K-12 through CREST, a comprehensive outreach effort should also include components designed for home schooling and/or informal learning organizations.
- ❖ Stronger and wider outreach to agencies beyond participating universities is necessary to increase inter-agency and inter-institutional collaboration.

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

Across the Portfolio

- ❖ Provide systematic training in the steps to be used in extracting programmatic data.
- ❖ The off-site processes allowed the COV to concentrate on the specifics of the program and helped the group cover the materials and come to agreement more quickly.
- ❖ The links and PDFs embedded in the PowerPoint presentations increased accessibility to the materials.
- ❖ In a bundled COV, it would have been nice to touch base with the other programs prior to the cross-talk discussion. Being isolated from each group limited the potential benefits of a more diverse pool of ideas.
- ❖ It is difficult to reconcile the concerns put forward by individual sub-panels into a single document. Some recommendations/concerns may be diluted by other sub-panel observations.
- ❖ Sub-panels may have experienced an unequal emphasis in preparation for the COV, which led to logistical problems.

Program-Specific

- ❖ The quality and content of the electronic documents was commendable. Kudos due for all the effort behind the review – the electronic linkage of documents, ease of use, the jacket system – all of it was extremely well done. Having a technical writer was also extremely helpful.
- ❖ The Webinar could have been more useful. We suggest a more systematic explanation of the steps it takes to complete this process (e.g. a COV for Dummies to make this a success). It would be helpful to have two collaborative meetings. One to brief the COV on the steps needed to conduct a successful COV seminar and another to conduct the actual COV review.
- ❖ The schedule for this COV was not convenient for West Coast participants.
- ❖ Provide every reviewer with background information on each program before the cross-talk dialogue because not everyone reviewing had enough background on the other programs.

SIGNATURE BLOCK:

For the CREST COV
James Renick
Chair

Alfonso Ortega
Sub Chair