Report
to
Basic Energy Sciences Advisory Committee

Committee of Visitors
For
Basic Energy Sciences Scientific User Facilities Division

April 15-17, 2007

I. Introduction

In the last five years, the Office of Science instituted Committees of Visitors (COV) for all of its major program areas to evaluate the efficiency, program quality, and administration. Previous BES COVs have reviewed all of the BES divisions and contributed to the process of BES program management. These reviews were patterned on the Committees of Visitors established for the NSF; although the mission nature of the BES program makes the COV review different in important ways. Energy Sciences reviews have to deal with the complexities of mixed individual investigator grants, laboratory Field Work Proposals, and facility use.

The present review, which deals with the newly established Scientific User Facilities Division (SUFD), has somewhat different review requirements than for the scientific divisions. The individual budgets of facilities are large by comparison with typical program grants, and peer review differs by the size of the reviewed element and the requirement for consideration of the user aspects of such facilities. In addition the Division is a still a relatively new organization, which is in the process of fully defining its methods and procedures. This makes this review more difficult, but also more influential in establishing the policies and procedures for the future.

II. The Charge

The charge to the COV was formulated by the Director of Basic Energy Sciences, Patricia Dehmer, to consider and provide evaluation of the following four major elements:

1. Assess efficacy and quality of processes used to:
    (a) Solicit, review, recommend, and document proposal actions.
    (b) Monitor active projects, programs and facilities.

2. How has the award process affected:
    (a) Breadth and depth of portfolio elements.
    (b) National and international standing of portfolio elements.

Also provide input for OMB evaluation of Basic Energy Sciences progress toward long-term goals. Each of the components of the Scientific User Facilities Division should be evaluated against each of the four-part long-term goals. Note the OMB guideline ratings of (1) excellent, (2) good, (3) fair, (4) poor, (5) not applicable. Also, comment on observed strengths or deficiencies in any component or sub-component of the Division's portfolio, and suggestions for improvement.

III. The Committee Composition

The Committee was comprised of scientists with a broad range of experience as facility users, facility directors, research managers and reviewers. Many of the Committee members

had previously served either on BESAC, or on earlier COVs, or both. The members of the Committee were as listed below in Table 1:

Overall Chair
Richard Osgood, Columbia
BESAC Chair
John Hemminger
Neutrons (4)
John Tranquada, BNL
Sunny Sinha, UC San Diego
Pat Gallagher, NIST
James Rhyne, LANL
Nanoscience (4)
Miquel Salmeron, LBL
Dave Litster, MIT
Reginald Penner, UC Irvine
Franz Himpsel, Wisconsin

X-rays/ Machines (4-5)
Tai-Chang Chiang, UICC
Gabrielle Long, Argonne*
Janos Kirz, LBL, **M**
Z-X Shen, Stanford/LBL
Persis Drell, SLAC, **M**
Don Bilderback, Cornell, **M**
Brent Fultz, Caltech
Sam Krinsky, BNL, **M**
Microscopy (3)
John Silcox, Cornell
Cev Noyan, Columbia
Miquel Salmeron, LBL

*BESAC Member
M - Denotes Machine Focus

Table I: Members of the COV.

IV. Response to Prior Review

The previous COV review was held in 2004 very shortly after the Division of Scientific User Facilities was created. The facilities reviews prior to that time had been performed both by BESAC subpanels (earlier) and by BES-selected individual peer reviewers (later). As a unique format for facilities reviews had not been established, a significant number of this COV's comments and recommendations address the documentation of the reviews, interactions with the reviewers, and review criteria and metrics. Many of the now-established practices are consistent with those recommendations and, where they differ, the responses are generally adequate. The 2004 COV report also made a series of recommendations regarding the Nanoscale Science Research Centers that were, then, in the early stages of development. The current COV felt that the BES responses were generally in-line with the first-COV's recommendations.

There were only two major recommendations where the responses do not appear to have been consistent with the COV recommendations; these are paraphrased below. These recommendations are important and their implementation should be considered:

- "In the letter to the laboratory management of the facility that was reviewed, there should be a succinct and clear Executive Summary of the reviewers comments that accurately reflects the substance and tone of the entire set of comments. Major recommendations and conclusions, both critical and complimentary, should be highlighted in proportion to their appearance in the report. Many readers read only the

Summary and they should not carry away an impression that would change substantially should they read the report in its entirety."

- "If possible, copies of the BES and facility responses should be distributed to the review committee. The purpose of this distribution is to assure members of the committee that their report has been interpreted properly and that their most significant points have been taken into account. …"

The BES response to these recommendations, taken individually, was reasonable. There is now a summary of representative reviewers' comments as part of the debriefing package in each review file, thus satisfying the first point. The second recommendation cannot be fulfilled, because it is not possible, under the current FACA interpretation, to have a "committee" report. Instead, there is a collection of independent reviews, which are not shared among reviewers for reasons of confidentiality.

However, at present there is still no Executive Summary of the reviewers' comments that is transmitted to the *facility management* along with the letter of findings and recommendations. It is appropriate that this letter of findings, which comes from the program manager, may contain a different emphasis than those summarized from the individual reviews; however, readers of the letter, including upper management at the laboratory of a reviewed facility, might misinterpret the letter as giving an exact summary of the reviews, and fail to read through the reviews themselves. Thus, the intent of these two recommendations of the first COV does not appear to have been adequately addressed.

Finally, the original COV report contained a recommendation that a timeline of the review history be provided with the jacket or documentation for each facility. Such a timeline was promised, but has not yet been implemented. The COV notes that such timelines would be useful for the next COV review.

Recommendation: BES should adopt a practice of having a separate document summarizing the reviewers' comments (Executive Summary) and a letter detailing actions requested by BES following the review.

Recommendation: A timeline of actions and reviews of each facility should be attached to the cover of each review jacket.

V. Discussion of Review

A) COV review process

The COV process is very successful, serving as a "review of reviews" that ensures integrity in the procedures that fund projects within the DOE's Office of Science; it brings confidence and rigor to the evaluation of DOE programmatic activities. The Committee had complete and open access to BES files for the review period, as well as ample time for discussions with BES staff and for "executive-session" discussions. Copies of the previous COV report and the BES response were distributed at the COV meeting. However, the Committee feels

strongly that in the future, these latter two documents be distributed in advance of the meeting to enable COV Members to prepare better for the actual visit.

Recommendation: The previous COV report and BES response should be distributed to the next COV prior to their meeting.

B) Facility Review Process

The COV applauds the increased level of rigor, regularity and predictability that has been brought to the review process for established facilities. As new facilities are brought into operation or into the Division, they become beneficiaries of a well organized system. The three-year cycle appears to be optimal in length. It is very helpful that information is solicited from the facilities well in advance of the review, that the requested data changes little from review to review, and that it is made available to the reviewers before they arrive on site.

The selection of reviewers was found to be appropriate and without conflicts of interest; this careful selection was also found to give an adequate range of expertise to ensure a thorough and well informed review. An important and positive feature of each facility review is the meeting with the staff and the meeting with users' representatives, in both cases without facility management present.

Recommendation: The overall basic review system works exceptionally well, do not change it.

While the overall structure of the facility reviews is excellent, the committee noted several cases where improvements to reviews may be considered:

1) Reviews of the largest facilities approach the limit of that possible by human reviewers. Although an overview session is, of course, crucial since operations and science are closely intertwined, it may be beneficial to divide the review process into two steps, such as a review of operations plus a separate review of the science. Perhaps these could be run simultaneously as parallel sessions.

Recommendation: The Facilities Division staff should begin to plan for an improved strategy for the review process for the largest facilities.

2) At present after the review, the SUF Division Director sends a letter to the facility director, with a copy to the Laboratory Director, outlining his assessment of the review, major findings, and actions to be taken. The individual reviewers' reports are enclosed with this letter. While in most cases this process works well, on occasion there is considerable delay before the letter is sent, and in some cases the conclusions in the letter may be different than the reports of the reviewers. To the extent that the laboratory director may read only the letter and not take the time to read the individual reviewers' sometimes-lengthy reports, this may leave a less than accurate impression of the outcome of the peer-review.

Recommendation: To the extent possible, the results of the review should be provided in a timely fashion. In addition, the comments of the reviewers should be summarized separately from the letter containing requested actions by the SUF Division Director. (See similar recommendation at the end of Section IV.)

3) The Committee notes that program managers need to foster informal mechanisms to assess and monitor facility performance, as well as the latest scientific and technological trends affecting the facilities. Presently, there is heavy reliance on the formal review process. Its use may not be adequate because it is infrequent and is directly tied to an actionable review report to the facility by DOE. Given the potential high stakes of this review for the facility, information flow between facility management, users, and the DOE staff will be tightly controlled in such a formal review. Program managers also need access to the kind of information provided through candid feedback from facility managers, staff, users, and leaders in the research community. This type of feedback is best obtained through informal mechanisms including meetings, facility visits, phone calls, and interactions with facility mangers, users, and user organizations. DOE/BES should encourage this type of interaction and ensure that staffing levels and travel budgets are adequate to support this important vehicle for project information. This need for increased staffing is given more urgency by the growth in overall facility numbers as is mentioned elsewhere in this document. The planned increase by 5 in the SUFD staff is thus essential for the future of BES.

Recommendation: The Committee recommends that the planned increase by 5 in the SUFD staff proceed promptly; it is needed for a well managed facilities program. In addition, allowance for increased travel, i.e. funds and time, to facilities to encourage informal evaluation of facilities should be made.

4) Due to the importance of facilities to the core-research efforts at the various laboratories, it is important that facilities and core-research efforts work and coordinate closely. This collaboration should be explicitly included in each facility and core-research review at BES.

Recommendation: The Committee recommends that each SUFD review explicitly discuss collaborations between core-research programs and SUFD operations.

C) Reports on Specific Classes of Facilities

1) Neutron Facilities

Response to previous COV review:

There were no specific recommendations for neutron facilities in the previous report.

Documentation of Facility Review:

The Neutron Subcommittee found that the overall process used to review operations and construction of BES facilities was effective and of high quality. File jackets were complete and well organized. (Note: There were no Executive Summaries or timelines associated with the facility files as recommended in the previous COV review.) It is a particular strength of BES that in the case of facilities, funding decisions are rarely initiated by a single proposal process, but instead are based on a long and continuous process of assessment, roadmapping, and priority setting, which is integrated throughout the BES management, including SUFD staff, and includes input from various advisory processes and the U.S. scientific community. The Subcommittee also reviewed and found the process of regular operations reviews of these facilities to be effective and of high quality. The Subcommittee also discussed other, less formal, mechanisms for monitoring facility performance with the neutron-facility Program Manager. These mechanisms include collection of annual performance metrics, attending user meetings, and direct contact with facility management and facility users. While there was clear evidence of all of these activities, there is room for improvement in this class of informal-feedback mechanisms. The full Committee makes suggestions for improvements in this regard in **Section B** above.

Finally, the Neutron Subcommittee found significant evidence that the formal review process for monitoring facility development projects and operations had a direct and positive impact on the scientific impact of these facilities. Numerous examples could be found in the optimizing of facility development and construction (e.g. SNS) or of correcting facility development or operations problems (e.g. Lujan and HFIR). The outcome of these corrections has been the development of significant new neutron-measurement capabilities and robust operation, as well as expanded access to leadership-class neutron-scattering instruments at these facilities.

Metrics and User definitions:

Performance metrics for U.S. neutron-scattering facilities are standardized and closely coordinated by DOE/BES. There is evidence that improvements in standardizing definitions are achieving consensus on performance metrics (stemming in particular from the 2003 BES Facility Director's Meeting). In this regard, the Committee also notes that the process of developing and optimizing performance metrics used by DOE is a continuous process. The Joint Facility Director Meeting held in 2003 was an excellent approach for making sure that this process is a collaborative one between DOE officials and facility management. The Subcommittee recommends that this type of interaction continue, as needed.

To show the full research impact of a facility, the Subcommittee suggests tracking the total number of investigator names on proposals *in addition* to tracking the number of users by the current BES definition. This may become increasingly relevant as the number of mail-in or remote users increases in the future. In fact, the Subcommittee felt that the trend in the next decade might be one towards increasing numbers of users who simply send samples for characterization via SANS or SAXS, powder diffraction, protein crystallography, etc. but who are not particularly interested in the details or instrumentation associated with the

scattering process. Thus, it will be even more important for the facilities to maintain scientists who are internationally renowned experts in the core scattering and instrumentation sciences. The scientific value and output of a facility is highly correlated with the scientific quality and innovative ability of its scientific staff. In fact, some of the best science results from collaborations between neutron-facility scientists sophisticated in the interpretation and analysis of scattering data, for example, and outstanding scientists from the user community who are experts in the systems being studied. Thus, the metric of how many papers are published without any co-authorship from facility scientists may not always be adequate to probe the successful scientific output from a facility.

Comments on Neutron Facilities

- Central funding of accelerator, detector and other beam delivery technologies is long overdue and essential to realize the full performance of neutron facilities. However, it is too early to see if this approach is properly organized, funded, and implemented to be effective. This area should be a focus area for the next COV review.
- As SUFD grows and matures, it is essential to ensure that organizational boundaries within BES do not become barriers to effective communication and coordination of related activities. This problem is particularly true for neutron facilities due to their large size and stringent operational requirements. Thus, coordination needs to be promoted both within SUFD (e.g. between neutron and other facility types) and across Divisions (e.g. between neutron/X-ray facilities and the Scattering team in DMSE.

2) Accelerator and Detector R&D

BES has traditionally supported a low level of accelerator and neutron-detector R&D. For the past few years, this support has been at the level of $1-2M/year. In addition, resources for modest accelerator R&D aimed at near-term facility improvements are included in the facility-operations budgets and deployed at the discretion of the facility manager.

It is anticipated that facilities will continue to have the flexibility to support near-term R&D from their operations budget. However, in the FY08 President's request for BES, a new program in accelerator and a new program in detector R&D, both with long range goals, is requested with an FY08 budget request of ~$8M and with a plan for significant increases in subsequent years.

Because this is a new program, the Committee chose to make limited comments on the review process for this SUFD area. These brief comments are given below. In addition, more extensive comments on this area are made in the section on **Managing the SUFD Vision** below.

Review Process

The Accelerator and Detectors Subcommittee examined the execution process for the construction of new facilities. The Subcommittee was impressed by the rigor of the oversight and the completeness of the follow through during the construction process. In

particular the 'Lehman' process of oversight should be singled-out for resulting in excellence in facility construction. The oversight process is forward looking and proactive. A notable example of such proactive planning is the use of operations reviews well in advance of the start of operations to plan the operations phase and smooth the transition from construction to operations.

3) Nanocenters

Response to Prior Review

As the nanoscience research program was new at the time of the last COV, there were a number of recommendations specific to the NSRCs in the last COV review of the SUFD. The Subcommittee comments on those recommendations here:

- The centers created so far have all been developed with broad users' input via user workshops, as was recommended by the previous COV.
- The previous COV recommended that collaboration and coordination among the NSRCs should be encouraged (or possibly required). BESAC has encouraged this coordination and a number of meetings have been held. At this stage of the NSRC program this is an evolving activity and it should continue to be facilitated and monitored.
- The previous COV also recommended formalized agreements (i.e., MOUs) between the NSRC and the hosting National Lab that spell out access of NSRC users and staff to resources in the host Lab, and vice versa. For example, a common proposal should be in place for all national facilities at the host Lab for users who want access to them. This procedure too remains an evolving situation and should be monitored.
- Another matter raised by the previous COV was the integration of the NSRCs with the core-research programs of the DOE and of the host National Lab. This has also been discussed at meetings of the NSRC Directors. It is a subject that should form an element of reviews of the internal research at the centers.

Documentation of Facility Review

At the time of the present COV there had been only one operational NSRC review. However the committee examined pre-operational reviews from three other facilities. For all cases and, in particular, for the operational NSRC, the reviewers wrote detailed, constructive and frank reviews that were summarized very well by the program officer.

Users: Definition and Uniqueness for Each Facility

As the previous COV review pointed out, there may be categories of users who are not always physically present when they use the facility resources. With increased operating experience the NSRCs should develop methods to measure appropriately the services they provide to users. Especially in the NSRCs, a high-quality internal-research program is vital to ensure that the center offers state–of-the-art facilities. While this internal program can create some tension between the user demands and the internal program needs of the center, this tension should be treated as a part of the cost of operation and thus managed to optimize

both goals. It is vital to the success of the NSRCs that the reviews should be conducted in a way that recognizes the centers that are able to attract the best staff scientists. In order to enable that, the NSRC staff who have an 100% appointment in the NSRC should be given a generous allocation of instrumentation time to devote 50% of their effort to their individual research programs; center reviews should also review the quality and success of these programs. While a significant commitment of the NSRC staff to the center is important, one should not forget the importance of synergy with other activities at the institution that hosts the NSRC.

From the preoperation-plans review of the whole NSRC Program in July 2005, the COV noted the following comment in the jacket: "No NSRC made a convincing case that the internal shuffling of national lab scientists is a mechanism by which the excellence of the NSRC would be guaranteed. Achieving excellence means hiring the best people. While some NSRCs recognize the need to recruit established, prominent extramural scientists, this is not universally true. The DOE may wish to consider some type of internal review that would assure that thrust leaders and important thrust scientists do not emerge wholly from reallocation of effort of established scientists and hiring of current lab postdoctoral appointees." In this connection, the COV noticed that there is a large range of staffing models, in terms of the number of staff who have joint appointments with non-NSRC programs, already in use among the 5 NSRCs. This complicates the issue of accountability and the review process. DOE should review this policy. It has been suggested in a previous review that a staff appointment in an NSRC be at 50% minimum level of effort; and at least one NSRC has mandated an 100% appointment requirement for all staff (exclusive of principle investigators).

Metrics

The distinctive character of the NSRCs makes careful consideration of their performance metrics essential. First, although NSRCs should have unique world-class facilities, they must also have facilities, which fulfill a regional mission appropriate to the needs of their particular locale. This role is vital to provide support of talented scientists in a region that otherwise lacks the infrastructure they need to explore their ideas; fulfilling this role may contribute to the lion's share of user numbers. Second, Nanoscience Centers are different than synchrotrons and neutron sources and may contribute in important ways that may not be captured by metrics (such as the number of users, etc.) usually applied to storage rings or neutron sources. These include sample preparation and growth and meeting the needs of remote users. The Nanoscience Centers should be judged by metrics that recognize this difference.

4) E-beam microscopy facilities

The E-beam microscopy facilities have only recently been moved from other support into the SUFD. This involves a culture shift from a strongly emphasized user or even service operation mode into a broader mode, which emphasizes users in addition to responsibilities for developing new instrumentation and applications. In addition, staff at the microscopy facilities must be aware of the underlying theoretical basis for understanding micrographs as

well as the high-spatial-resolution electron spectroscopy now possible with the high-intensity sources and monochromators available today.

Response to Prior Review:

The E-beam Subcommittee found that the response of management (headquarters and local) has generally been accurate, receptive, and effective.

Documentation of Facility Review:

In general, the documentation is very good. However, as mentioned elsewhere in this report the 2004 COV did suggest the addition of a "timeline" relating previous actions on facilities, i.e., a brief history of past actions. The present Subcommittee feels that this addition remains an important and useful tool in examining the facilities jackets.

Users of Facilities: Definitions of and Uniqueness for each facility

The "user" definition, which is standard within the system, seems adequate for these facilities and the Subcommittee sees no reason to alter it. Note that because of the need to establish a strong science base for these new facilities, the Subcommittee suggests that acceptance of proposals favor quality in the selection of proposals; this may result in a decrease in the number of proposals.

Metrics:

The metrics for judging the E-beam facilities seemed reasonable to the Subcommittee; however, several of these groups were originally service facilities within their labs and thus, as mentioned above, the transition to DOE-type facilities will require a particularly strong emphasis on facility science. Thus, the Subcommittee suggests that the charge to the reviewers be altered to ensure that the work of the scientific staff in developing and extending the facility capabilities is clearly recognized as well as its work in directly supporting the user program. Since the facilities have to attract the best scientists, it is essential to give them time for independent research. For example, during a review the work of each staff member could be presented in the following format/order:

- Instrument development theory or simulation research
- Individual science done with that staff member's research time and tools.
- Collaboration with users in connection with or because of these projects.
- The users he/she being mentored in the use of these instruments. Note that this mentoring is not necessarily in projects involved in the first line of interest for the staff scientist.

Comments on E-beam Facilities

Because of the recent establishment of these facilities, the Subcommittee makes several additional comments:

- Each facility is now rebuilding its advisory committee. If these facilities are to become true national facilities, each facility will need to be unique in one respect or another. Each facility needs to re-examine and redefine the mission under which it operates, a task that the new advisory committees should be well equipped to review with the facility. This task needs to be revisited periodically for continuing relevance and should be changed as needed.
- The TEAM Project is a very well managed project, with multiple reviews at multiple levels. The Project is on time, within budget, and will deliver excellent new instruments when completed. All the information related to the project is available, but partitioned over many folders. A timeline summary of the project would have been useful here. A description of some "first" experiments, which will be carried out when the instrument is complete, would have been useful.
- An essential aspect of these facilities is the need for development of appropriate simulation codes and ready access to adequate computing power to run the codes (likely to be substantial in character). In this context, the disappearance of the sole image-simulation effort in the E-beam facilities (from NCEM) was viewed by the recent review team as a serious backward step. The Subcommittee agrees with this assessment and considers that an effort needs to be made to ensure that image simulation and spectroscopy analysis, together with suitable computer capabilities, be made available to users throughout the DOE E-beam Center network.

5) X-ray Synchrotron Facilities

The four synchrotron radiation facilities (APS, ALS, NSLS, and SSRL) represent a huge investment by BES in research infrastructures. They provide very broad user support and have had tremendous impact on scientific research, both nationally and internationally. The operations and management policies of these facilities have undergone fine tuning over the years through continued dialogue among BES staff, facility managers, users, and review teams. The present procedures and practices are mature and often serve as guiding models for other newly established BES facilities. The Subcommittee finds that the current operations of the synchrotron facilities to be highly optimized, and there is ample evidence that the facilities have been responsive to the evolving needs of the research community and to the recommendations from periodic reviews. The Subcommittee wishes to thank and congratulate the BES staff for a well run set of facilities. As there are few concerns, the Subcommittee's report is brief.

Response to Prior Review:

The BES response to the earlier COV report regarding synchrotron sources was good.

Documentation of Facility Review:

The documentation of the peer reviews of the synchrotron facilities was excellent. The materials from the facilities were well prioritized and full of supporting detail. The Subcommittee was pleased to see how well that BES staff judiciously assembled the essential

points of the individual reports into a cover letter.

Metrics:

Remote users should be included as an additional metric for facility evaluation. The definition of a remote user as a user who manipulates an instrument parameter from afar during a measurement seems reasonable. It would also be useful to count separately "mail-in" or "correspondence users", i.e., those people who mail samples to the facility for analysis. Keeping these metrics separate, for now, will allow the facility user data to remain useful if "remote users" and "mail in users" are eventually counted together with users who travel to the facility.

General Comments:

At the COV meeting, BES Director, Patricia Dehmer, announced a plan for a BES study of the long-range development of future light sources, including storage rings, energy-recovery LINACs, free-electron lasers, and possibly other types of novel machines. The Subcommittee was very favorably impressed with the outline presented. We encourage BES to seek the broadest possible scientific and technical input into the strategic-planning vision.

6) Comments on Emerging Facilities

BES has two new types of facilities that are now emerging into full-scale operation. These are the NSRCs and EMCs. Because they have important differences from other DOE user facilities, the committee felt that it was important to look more closely at the their overall operation, a point also commented on in the 2004 COV, for the case of the NSRCs.

Considering first the NSRCs alone, the earlier COV recommended that BES institute *the same* highly transparent, integrated, and uniform system for submitting proposals for all five NSRCs. A search engine that accessed the domains of the five NSRCs would be a valuable tool for applicants seeking specific capabilities. The present Committee again recommends adoption of this procedure.

Recommendation: Institute a uniform, integrated, and transparent proposal system for all five NSRCs.

Additional issues pertaining specifically to the NSRCs are the following:

- Research at NSRCs is likely to be extensively collaborative and every effort should be made to encourage this collaboration. Scientific interactions between outside users and the NSRCs are likely to run the gamut from low-level, non-collaborative work (e.g., AFM imaging of X), to high level, highly collaborative interactions (e.g., low-temperature STM and STS of X). There is a place for both types of interactions within NSRCs and both should be encouraged through the review process, even though perhaps only the collaborative interactions may be expected to yield publications with NSRC coauthors.

- At NSRCs, outside users are able to carry out an especially broad range of experiments, often with minimal day-to-day supervision (e.g., AFM investigations of X). Project tracking therefore becomes essential in order to maximize the efficiency and scientific throughput of each NSRC. New projects could and should be tracked to determine when the stated scientific objectives are being achieved or failing to be achieved. Although the need for this is obvious, the logistics for and results of tracking are not discussed in any of the documentation provided to this Committee. Again, a uniform, NSRC-independent algorithm for efficient project review, renewal and/or termination could be implemented.

There are two issues pertaining to *both* NSRCs and the Electron Microscopy Centers (EMCs):

- NSRC and EMC personnel (with 100% appointments) should be afforded significant time (up to 50%) to pursue their own independent research programs, instrumentation development, etc. in alignment with the overall laboratory objectives. This time should be protected even if 100% of the demand for outside use of NSRC/EMC facilities cannot be satisfied. Without this incentive, excellent scientists will pursue jobs in the private sector or academia. NSRCs and EMCs, thus, must in some cases decline the weakest proposals from outside users. The use of this independent research time should be judged on the same criteria that are applied to the evaluation of core-research programs.
- The important corollary to this is that the research and/or instrumentation development programs and activities of each staff person should be subject to academic-level review that encompasses all research activities, an assessment of external visibility, etc. These reviews may not presently be taking place; they were not part of the facility-provided materials made available to the Committee.

Recommendation: Include explicit time for facility research and instrumentation review in each SUFD review.

7) Metrics

Efficiency Metrics

Operational efficiency is an important objective and one that is complex for large and diverse institutions and facilities. The cost for facilities is determined both by cost of operations and management as well as by laboratory-wide policies, e.g. such as personnel policies and health-care costs. A major cost concern for DOE laboratories is the need to balance operational efficiency with the needs for safe operations. Experience has shown that the DOE facility management efficiencies are best realized via a detailed examination of operational procedures on a regular basis. Given these complexities, the Committee strongly feels that the use of a single metric would not be an effective management tool and, at best, would result in cosmetic changes.

Recommendation: The committee does not recommend the adoption of a single cost metric; such a metric would not be an effective management tool and its use would lead to poor management behavior.

Evolving Metrics

The formal review files document a tightly controlled flow of detailed performance data from the facilities to DOE (and the external reviewers) in preparation for a review. This is a normal and important part of the process, but it leads to a process, in which DOE is using a predetermined ruler. The committee suggests that a collaborative process in evolving these metrics may be beneficial as well. In this process, facility managers would describe their views of key performance goals, metrics, and trends facing their facility. The Committee feels that the process of developing useful measures of facility performance and effectiveness are a shared responsibility between DOE and the facility managers, and the review process would benefit by collaboration in determining metrics.

VI. General Comments

- *Involvement with other BES Divisions:* In the 2004 COV report, the COV recommended that close collaborative must be fostered between the Scientific User Facilities Division and the Materials Sciences and Engineering and Chemistry Divisions. The current committee was pleased to hear of the efforts by the SUFD Director in promoting this involvement, including inclusion of the scientific division staff on facilities review teams and specific joint programs. For example, in the past this has resulted in a number of innovative instrument concepts and the development of new areas of research that are of benefit to both the User Facilities and to the Core Programs. Because of the increasingly major role that the SUFD is playing in BES science, this collaboration is even more important than in the past and the Committee recommends that continuing efforts be made to leverage new programs and science off of these collaborative activities.

- *Costs of operation:* Facility costs are always of concern in maximizing the BES budget effectiveness. This topic can be effectively included in the operations phase of the regular, triennial review. Thus, the review team could, for example, be provided with a list of opportunities for optimizing operational efficiency. In addition, during that review facility management could explicitly address the opportunities for increasing efficiencies, along with necessary tradeoffs that would need to be made.

- *Theory:* The COV was enthusiastic about the important decision of the SUFD to include explicit support for theory in the staffing for facility operations. This decision appears to stem from the existing inclusion of theory in the nanoscience facilities, but it is clearly just as important in X-ray, neutron, accelerator, and E-beam facilities. The SUFD should work to “flesh out” this idea more fully and to develop plans for metrics and interfacility collaboration on theory activities.

Recommendation: SUFD should plan to discuss in more detail its strategy for developing theory at the full complement of BES facilities during the next COV.

VII. Managing the SUFD Vision

General

BES has an excellent investment strategy for developing new facility concepts and an excellent track record for successful management and execution of the construction projects to deliver outstanding facilities. The planning process is science and mission driven, with strong input from the user community. The emphasis on strengthening theory and computation connections with facilities, the new line item on Accelerator and Detector R&D, and scientific excellence at the facilities are very welcome developments. More generally, the Committee is delighted that DOE has recognized the importance of research and development for the next generation of accelerators, advanced detectors and their instrumentation, and theory, advanced scientific computation and simulation for advanced instrumentation. These activities are vital for keeping our user facilities at the cutting-edge, and realizing these facilities investments in the full.

In short, the Committee was very favorably impressed with the outlines presented for the development of new facilities that enable new science. It encourages the Office of Science to seek the broadest possible scientific user input into the strategic vision for these new facilities. Specific comments on planning for these new areas in SUFD are presented below:

New Machines and New Detectors and Imaging Arrays

The Committee strongly endorses the move to develop a funding line explicitly for longer-range accelerator and detector R&D within the BES portfolio. With regards to accelerators, the Committee felt that this research is particularly appropriate at this time as BES is emerging as THE major accelerator operator in the US. Similarly, the Committee also felt that it was a particularly important time for advanced-detector research. Imaging detectors are an important commercial technology and play a potentially important role in homeland security area. Thus, the detectors, which are distinctive for BES applications, may leverage off of these areas as well as off the remarkable progress in integrated electronics and new electronic materials. The growth of this new program is in its early stages and it is too early to comment on the outcomes. However, the Committee feels it is appropriate to offer some suggestions on strategic issues that must be faced as this program develops.

- Within the overall BES R&D program for accelerators and detectors, it will be important to get an appropriate balance between:
  - Near and mid-term R&D that is focused on improvements to existing facilities and enabling the next generation of facilities and detectors
  - Long-term R&D that is aimed at transformational new capabilities in accelerator-based sources including fundamental new mechanisms of acceleration and detection or corresponding improvements or even paradigm-shifting advances in detector materials, on-chip electronics, etc.

- It will be important to encourage a healthy partnership between National Labs and Universities. This partnership is strategically important because it will help to engage students and attract talent to the fields of detector development and accelerator science.
- It will be important to encourage broad-based collaborations between different scientific communities within the Office of Science. In this context, The COV applauds the SC-wide planning effort in accelerator R&D that is being coordinated across the Divisions within the Office of Science; similar planning in detector R&D should also occur.
- BES should also take advantage of opportunities to collaborate internationally in areas of accelerator and detector R&D; this collaboration will allow full exploitation of international R&D facilities.
- As this R&D program grows, new groups should be encouraged to engage in these activities, which we see as vital to the long-term health of BES and more generally, the Office of Science. In particular, the committee anticipates that in the future, other fields will learn to leverage off of the BES investments in these areas.

While there are areas of possible overlap, this new program in accelerator and detector R&D should not replace the R&D funding for near-term focused improvements of facilities that is included in facilities operations. BES is also encouraged to ensure that the R&D for near-term improvements of facilities is supported at a healthy level; it is appropriate to continue to provide these improvements as part of the facility operations budgets to be deployed by the facility manager.

Finally, the COV notes that some aspects of long-range accelerator and detector R&D rely critically on technical resources and technical infrastructure that can only be built up over many years. The R&D program needs to be managed in such a way as to recognize the importance of this sustained longer-term research strategy for its overall success.

VIII. PART Evaluation

The Committee considered carefully the PART criteria and evaluated them as follows:

1) Materials Research: BES facilities play a central role in the BES program in materials characterization via, for example, X-ray and neutron probes, TEM imaging, and proximal-probe studies. In the future, they may play, through the NSRC, a major role in materials synthesis. The committee rates the SUFD's role in this work clearly world-class and more formally **"Excellent"**.
2) Chemical Science Research: BES facilities are crucial to the goal of understanding surface and even bulk chemical processes. These include studies of catalysis structure, probing of high-pressure reactions, environmental reactions and species identification, and chemical-dynamics probes. Again the work in this area at SUFD facilities is world class and more formally **"Excellent"**.
3) Energy Research: The committee did not feel prepared to grade work in this area within the SUFD, although clearly it is important. Thus it gave a rating of **N/A**.
4) Instrumentation: The SUFD is central to BES's efforts in developing new and world-class instrumentation. It should be rated as **"Excellent"** in this area.

IX. Conclusions

The COV concludes that the newly constituted Scientific User Facilities Division is well launched and is operating extremely well. The facility reviews are fair and even-handed and have had significant and clear beneficial impact on several facilities, although many of the facilities are just now reaching the point of operational review. Thus, the Committee finds that the review process has served the existing facilities well. In some cases reviews have promoted changes in management and operations that have improved the scientific impact of these facilities. The reviews have added clarity and focus to the wide spectrum of concerns from the user community, facility personnel, and the BES. Throughout the body of this report, the Committee has made recommendations for improvements and changes in the review process, both in general and in terms of specific facility types. The most general of these recommendations are specifically broken out within the report using yellow highlighting.

On the whole, the Committee is satisfied that the Division is operating well and expects further definition and refining of the review process as SUFD matures. Finally the Committee continues to urge very careful attention to the coordination of the two major science-program divisions (Materials Sciences and Engineering and Chemical Sciences, Geosciences and Biosciences) with the Scientific User Facilities Division; healthy growth of the BES organization will necessitate balance between these two organization units.

Finally, the committee has given PART ratings of 1) Excellent, 2) Excellent, 3) N/A, and 4) Excellent.