Minutes of the
Biological and Environmental Research Advisory Committee Meeting
July 10-11, 2006
American Geophysical Union, Washington, D.C.

BERAC members present:

Michelle S. Broido, Chair
S. James Adelstein
Eugene W. Bierly
Robert E. Dickinson
James R. Ehleringer
Joanna S. Fowler
David T. Kingsbury
Steven M. Larson
Patricia A. Maurice
Joyce E. Penner
John Pierce
David A. Randall
Margaret A. Riley
Christopher R. Somerville
James M. Tiedje (Monday only)
Raymond E. Wildung
Barbara J. Wold*
John C. Wooley
Mavrik Zavarin

*Attended meeting but not sworn in as BERAC member at this meeting.

BERAC members absent:

Raymond F. Gesteland
Margaret S. Leinen
Keith O. Hodgson
Melvin I. Simon
Warren M. Washington

Also participating:

James Bristow, Deputy Director of Programs, Joint Genome Initiative
Allison Campbell, Director, Environmental Molecular Sciences Laboratory, Pacific Northwest National Laboratory
Christine Chalk, Office of Budget and Planning, Office of Science, Department of Energy
Jerry Elwood, Director, Climate Change Research Division, Office of Biological and Environmental Research, Office of Science, Department of Energy
Jeffrey Gaffney, Senior Chemist, Argonne National Laboratory
Michael Kuperberg, Acting Director, Environmental Remediation Sciences Division, Office of Biological and Environmental Research, Office of Science, Department of Energy
Frederick M. O'Hara, Jr., BERAC Recording Secretary, Oak Ridge Institute for Science and Education
Michael Riches, Special Assistant to the Director, Office of Biological and Environmental Research, Office of Science, Department of Energy
Stephen Schwartz, Chief Scientist, Atmospheric Science Program, Brookhaven National Laboratory
David Thomassen, Acting Director, Office of Biological and Environmental Research, Office of Science, Department of Energy
Michael Viola, Director, Life and Medical Sciences Division, Office of Biological and Environmental Research, Office of Science, Department of Energy

About 60 others attended in the course of the two-day meeting.

Monday, July 10, 2006
Morning Session

Before the meeting began, each of the attending BERAC members was individually sworn in as a special government employee by a staff member from Human Resources, Office of Science (SC), U.S. Department of Energy (DOE). The Committee was then given an orientation session by DOE General Counsel covering such issues as responsibilities and conflicts of interest. The meeting was called to order by the Chair, Michelle Broido, at 9:56 a.m. She had each member introduce himself or herself and she gave a brief orientation to the Committee. She read a letter of appreciation to Ari Patrinos prepared by her and outgoing BERAC chair Keith Hodgson and asked for a motion to accept the letter for the record. Kingsbury so moved, and Randall seconded; the motion was unanimously adopted.

James Tiedje: BERAC Review of the Joint Genome Institute (JGI)

On Nov. 16-18, 2005, a review was held in Walnut Creek, CA, of the JGI, one of six major international genome sequencing centers and a DOE user facility. About half of the JGI's on site staff at the Production Genomics Facility (PGF) in Walnut Creek come from Lawrence Berkeley National Laboratory (LBNL) and about half from Lawrence Livermore National Laboratory (LLNL). JGI has 105 DNA sequencers that run 24/7 with an annual capacity of 30 billion base pairs and supports more than 100 user projects each year. The Subcommittee found that the JGI was doing very well in implementing its role as a national user facility; focusing on DOE mission objectives; and operating at the state of the art with respect to cost, quality, and quantity of sequences produced. The Subcommittee was highly impressed with the senior management team, operations staff, and middle management.

The Subcommittee recommended that

- A new memorandum of understanding (MOU) should be negotiated between LLNL and LBNL that clarifies procedural roles and responsibilities, especially in safety and cybersecurity at the PGF. The safety responsibilities of the two laboratories also need to be clarified, and unambiguous guidelines be established for PGF employees.
- A system be established to provide timely information on recordable and lost-time injury rates.
- The organizational structure be reviewed to establish clear lines of authority and responsibility.
- Plans be developed to assemble large genomes, reduce the time lag between genome assemblies and annotations, scale up genome annotation, extend the capabilities of the system, and increase the transparency of the annotation process.
- All proposals, especially those currently reviewed separately by the JGI for the Community Sequencing Program and by the Office of Biological and Environmental Research (BER) for its microbe-based sequencing program, be evaluated by the same review committee, and calls for proposals be parallel and coordinated.
- The demographics of the proposal review committee be improved.
- Input on peer review be sought from the users and other advisory groups.

- Users be surveyed at least annually and at the completion of a project.
- The use of project management techniques and systems and appropriate staff training be expanded.
- Routine meetings be held between the JGI Head of Operations and the counterparts from the other JGI member laboratories.
- A plan be developed for covering senior level vacancies while replacement hiring is undertaken.

Discussion:

In response to a question about how the debate about personnel issues has been played out at the PGF in actual practice, Tiedje responded that with respect to personnel issues there are, in effect, two facilities. The goal is to eliminate these differences to simplify management practices and make the working environment uniform for all employees.

Broido asked for a motion to approve the report. Pierce so moved, and Kingsbury seconded. The report was unanimously accepted and approved.

James Bristow: JGI Response

The Subcommittee's recommendations were important, and JGI has responded to all of them. (Note: The JGI Management was given a draft of the report early in 2006 since the time from the review at the end of 2005 and the July 2006 BERAC meeting where the report was scheduled for discussion was so long). The Microbial Genome Program (MGP) and Community Sequencing Program (CSP) both have had explosive growth in the number of proposals received. The requested resources for JGI alone would exceed the capacity of all of the world's sequencing centers. The user distribution is widespread. The first user meeting was held in April 2006, and a user committee has been formed.

A new MOU for EH&S [environment, health, and safety] has been completed with new reporting requirements. Also, a cybersecurity MOU is being created. A new production sequencing lead has been hired, and senior managers have identified "seconds," who contribute to weekly management meetings and could step into vacancies.

JGI partner laboratory tasks are now coordinated with a weekly genome-management conference call and a monthly partner conference call. "Finishing-in-the-future" meetings for DNA sequencing are held at LANL. A Eukaryotic Genome Program Summit was held to plan scaling, sequencing, and annotation. Sequencing scales very easily; peer review, management, and annotation scale less easily. The peer reviews of the MGP and CSP will be merged, broadening the geographic representation. Electronic proposal submission and review have been instituted. A letter-of-intent (LOI) process has been started, and the User Committee is now providing input to the peer-review committees. A project management lead and two project managers have been appointed. A global project tracking system has been launched, and an end-of-project survey is in draft form. To improve throughput, the JAZZ assembly program was overhauled, and two programmers and three more annotaters have been hired.

The Laboratory Science Program (LSP) was created by JGI with an MOU designed to facilitate access, fulfill sequencing needs for DOE laboratory projects, and shape products and services to meet the needs of the national laboratories. A new lead (Gerald Tuskan of Oak Ridge National Laboratory) was approved. The overall focus of the LSP

will be on bioenergy; however, sequencing for other DOE-relevant projects will also be included. Tuskan will report directly to the JGI director for LSP related issues. Laboratory points of contact have been identified, a small-scale sequencing program has been started, and large-scale sequencing white papers have been written. Current energy relevant projects at the JGI include genomic investigations for corn-based ethanol and soy-based diesel. JGI sequencing has also led to the development of a poplar with an increased cross-sectional area trunk and has identified new cellulase genes from the termite hindgut.

Discussion:

Asked how the facility was positioning itself for new developments, Bristow replied that it responds to proposals. It leads by example. When it developed metagenome sequencing, it got a lot of requests for that service. Wold added that importantly there is a fraction of the sequencing done at the JGI that is chosen and carried out at the discretion of the JGI so that the facility has a science agenda of its own to motivate the scientific staff. Also, the selection of proposals that match the DOE mission leads the science.

David Thomassen: National Academy of Sciences (NAS) Review of Genomics:GTL

Genomics:GTL [Genomes to Life] is a systems-biology program to understand microbial systems well enough to develop computational models of those systems so one can develop new biology based energy sources, environmental remediation strategies, or better understand the global carbon cycle. The GTL Roadmap came out last year and included plans for four technology-based user facilities. The associated costs and scientific value raised questions, so the NAS was asked to review the program. The reviewers were thrilled with the science content. The user-facility concept for protein production, proteomics, etc. were seen as not as productive as integrated research centers for developing new technologies. BER is following that advice. The first research-center call for proposals will be out soon for bioenergy research centers; solicitations for two additional research centers, with bioremediation, carbon sequestration, or other relevant themes will be forthcoming in future years. Overall, the science and mission of the GTL program have not changed, just one component of the overall strategy for achieving GTL program goals. The shift is from user facilities to vertically integrated research centers.

Discussion:

Asked how BER was going to keep these centers at the cutting edge, Thomassen said they will have advisory committees and will be funded specifically for advanced science related to the DOE mission.

In response to a question about the need for BERAC involvement, Thomassen replied that a rich science needs to come out of these centers, and a breadth of review and advice would be important. Asked if BERAC members could get copies of the roadmap, Thomassen agreed to make sure that that happened. (Copies were distributed during the break.)

A question was raised about how this organization will affect the program this office funds. Thomassen replied that this development will broaden and increase the support from and for the research community. It was noted that the funds for the microbial genome brought together disparate researchers, and the question was asked whether having a single manager of a bioenergy research center will change the nature of the research output. Thomassen answered that the program will continue to have a broad

array of principal investigators (PIs) across the entire GTL research portfolio, reflecting a breadth of science and techniques developed, performed, and shared. Committee members commented that the communication of results of this program has been outstanding and that the NAS report praised the decentralized, collegial nature of the research done by GTL. One member agreed with the theme-focused goals; but stated that, on the technology side, information should be released widely, not just to the core group. Thomassen pointed out that having these centers does not preclude general developments in other programs, like the Environmental Molecular Sciences Laboratory (EMSL).

A break was declared at 11:27 a.m. The meeting was called back to order at 11:35 a.m.

Jeffrey Gaffney: Atmospheric Science Program (ASP) and 2006 Mexico City Campaign – Science Talk

The largest uncertainties in global climate predictions are associated with aerosols and clouds. The ASP is focusing on enhancing the scientific knowledge needed to represent radiative forcing and other climatic influences of aerosols in climate models. Research is focused on understanding aerosol influences on atmospheric radiation by studying their sources, transformations, local and regional transport, concentrations, and chemical and physical properties. Aerosols influence radiation and climate through shortwave and longwave radiative effects and through hydrologic effects. These aerosols come from combustion, diesel soots, biomass burning, humic-like substances, and oxidized organic compounds.

Population dynamics are producing many megacities with populations >10 million people, mostly along the Equator. These cities produce high concentrations of aerosols and their precursors. Mexico City is a terrific research opportunity with the world's second largest population, a complex terrain, meteorological infrastructure, and extended preliminary field studies.

In March 2006, three agencies carried out four research programs at the same time, and the data were pooled to characterize aerosol size-dependent composition, aerosol optical properties, aerosol cloud-creating properties, secondary aerosol formation, and urban vs. regional vs. global impacts. The DOE MAX-Mex program alone had 63 scientists, 3 field sites, 2 aircraft, and 1 mobile van. Overall, the interagency MILAGRO program had more than 300 scientists, 6 aircraft, multiple field sites, and multiple mobile vans. The field campaign started in March and ran for 28 days.

The campaign found a lot of black soot particles in the Mexico City air. Eastern United States pollution is sulfate dominated; the Mexico City urban aerosol is organic dominated. The spatial distribution of aerosols over Mexico City was complex, with most emissions transported southwest of the city. The western part of the city experienced urban aerosol; the eastern part of the city experienced dust. Lidar measurements provided a vertical context for in situ measurements, confirming earlier DOE modeling studies. New-particle formation was frequently observed; it was found that chemical composition is crucial in droplet formation. A new, particle-formation process was discovered using atomic-force microscopy.

A very rich data set was produced, and the data were gathered in a very cost-effective manner. The preliminary data will have to be assessed by the scientific community and

prepared for publication. The project was carried out safely with no incidents. This is the biggest meteorological experiment carried out in a megacity.

Discussion:

Asked if the National Oceanic and Atmospheric Administration (NOAA) was involved very much, Gaffney replied, no, not very much. Asked what emphasis was placed on new instruments, he said a lot of new instruments and techniques were used in the field and compared.

Concerning the strategy to get those data into the global models, a meeting for the modeling community was held in January 2005. The researchers will continue to reach out to that community with the data and also ask the modelers what should be measured. Schwartz commented that the program participants have to work hand in hand with the user community, not just publish the data in the literature. It was pointed out that there is a scale problem, too, that has to be taken into consideration.

Asked if there had been large-volume sampling, Gaffney answered, yes. Sample amounts should the large enough to share with others. Carbon-14 analysis was done and 12-hour samples were taken.

The team was thanked for a great experiment that fulfilled the plans set forth by the Committee. The comment was made that it was good to see the different agencies and countries work together so well.

A break for lunch was declared at 12:28 p.m. The meeting was called back into session a 1:45 p.m.

David Thomassen: Status of SC and BER

The Office of Science has embraced the committee of visitors (COV) process. BERAC COVs have been very helpful. The Committee's reports have been of help to the Office of Management and Budget (OMB) examiner. A significant challenge is performance assessment of the achievement of the long-range-plan objectives.

In addition to Ari Patrinos, Kent Lohman and Ray Wildung have left the Office. A number of people have joined BER, which will, hopefully, be at its approved staffing level in a year or two.

The President's State of the Union Address and the NAS publication *Rising above the Gathering Storm* had a big influence on BER as well as on the rest of the federal government. In that report, the staffs of the DOE and National Nuclear Security Administration (NNSA) were seen as an untapped resource in training new scientists and engineers. Also, increased research was called for. In the State of the Union Address, the President announced the American Competitiveness Initiative (ACI) and a doubling of the combined budgets of SC, National Institute of Standards and Technology (NIST), and National Science Foundation (NSF) over the next 10 years. There is a concern that earmarking could seriously affect this budget increase. The Advanced Energy Initiative was also mentioned in the address with a call for better batteries, hybrid/electric cars, hydrogen-fueled cars, and cutting-edge methods of making bioethanol.

DOE is in the top five federal funders of physical, environmental, mathematical and computer, and life sciences. The total funding for SC is projected to increase from $3.6 billion in FY06 to $5.3 billion in FY11. BER's funding profile is also projected to grow during that time period, from $451 million in FY06 to $638 million in FY11. In the FY07

budget request, one sees a substantial increase for life sciences, a decrease in climate-change research with the elimination of the oceans program (iron fertilization and impacts of CO_2 deep-water sequestration), and flat budgets for environmental remediation, medical applications, and measurement science.

Discussion:

Asked if FY06 was the only year BER got funding for all of DOE's earmarks, Thomassen replied that BER has usually received funding for most of the earmarks.

Queried about the $40 million increase for GTL and how it fit in with the increase in bioenergy for Basic Energy Sciences (BES), Thomassen answered that most of the $40 million increase was for bioenergy and that the BER staff had sat down with the staff of BES, which no longer has a specific section in their budget request for bioenergy sciences, to discuss this issue. In this area, BER funds research primarily on the genomic side, and BES' principal link will be to bioinspired nanomaterials.

The question arose of who in the government is looking at the effect of bioenergy on the hydrologic cycle. Thomassen said that BER's interest is in bioenergy plants and microbes but not on the hydrologic cycle. Somerville added that the Department of the Interior has talked about effects on hydrology and riparian areas.

In regard to the 20-year facilities plan, the user facilities that were in the facilities plan are no longer in the GTL plan.

It was pointed out that oil imports would be balanced by the export of soil down the Mississippi River from corn production and that someone needs to look at reducing soil erosion. No-till agriculture is always discussed, but practices have unforeseen effects.

Asked how much impact nuclear medicine will have on the budget, Thomassen replied that we had hoped that the NAS report would inform the FY08 budget. It was not in the FY07 budget request because of priorities. It is hoped that the NAS report will give that topic more weight.

Thomassen went on to describe activities within the Office:

- In Life and Medical Sciences, GTL continues as the highest-priority program.
- The *Biomass-to-Biofuels* report is now out. The product of SC and Energy Efficiency and Renewable Energy (EERE), it provides a path forward for research in that area.
- Remarkable progress is being made at the JGI.
- The low-dose radiation research program continues to lead federal agencies. However, it has butted up against the latest version of the Biological Effects of Ionizing Radiation (BEIR) report which did not include as complete an analysis of the new biology being funded by the BER program as we would have liked.
- SciDAC [Scientific Discovery Through Advanced Computing] has previously had climate modeling as BER's only investment but beginning in FY 2007 BER will expand its SciDAC investments to include GTL and subsurface science.
- The artificial retina program continues to make remarkable progress.
- Climate Change ended its investment in deep-sea sequestration research.
- ARM [the Atmospheric Radiation Measurement Program] needs to be better integrated with BER's climate modeling efforts.
- More tools continue to be needed for environmental remediation and long term stewardship
- There were some significant problems at EMSL that have been addressed and

solved with BERAC's help.

A Committee member who was on the NAS Committee that commissioned the BEIR report said that the BEIR report *does* recognize the BER low-dose program.

Michael Kuperberg: Overview of EMSL

EMSL is a collection of scientific user facilities designed to answer fundamental questions in the environmental sciences that include capabilities for high-performance mass spectrometry, interfacial and nanoscale science, molecular science computing chemistry environmental spectroscopy, biogeochemistry, high-field magnetic resonance support, computer and network services, instrument development, and user administration and outreach. It sits within the Pacific Northwest National Laboratory's (PNNL) organization chart on par with the research directorates. DOE manages EMSL with day-to-day oversight by its onsite office and with direction and performance oversight from program managers here in Washington. In May 2005, two groups (one a BERAC subcommittee) conducted parallel and simultaneous reviews of EMSL's mission, science, operations, and future plans. They both said that they liked the science that EMSL is doing. Many important lessons were learned from these reviews. The relationship between Headquarters and the site office has been strengthened. Weekly conference calls, quarterly face-to-face briefings, and site-office briefings are now held. A number of "deep dives" into EMSL were made during monthly visits by BER staff with detailed interviews of EMSL staff. A proactive management plan is now in place rather than a management by review process. There should not be any more surprises. EMSL now sees the value of project management.

In May 2006, BERAC was asked to conduct a follow-on review to address three questions:

- Does the EMSL Action Plan adequately address the findings and recommendations of the May 2005 reviews?
- Is EMSL's implementation of the Action Plan on track for completion by the end of FY06?
- Will implementation of the Action Plan resolve the findings and recommendations?

James Tiedje: Report on BERAC Follow-On EMSL Review

The review committee was extremely impressed by the responses of EMSL and PNNL management and staff and DOE management from BER and the Pacific Northwest Site Office (PNSO) to the very serious concerns raised by the May 2005 review committee. The Action Plan was timely, comprehensive, and on target. The implementation is effective, widely accepted, and appears to be on its way to completion by its target date of September 30, 2006. The report found that:

1. The EMSL and PNNL management roles and responsibilities are effectively carried out and coordinated. Recommendations:
    - Document a detailed accounting of the boundaries, interfaces, and areas of leveraging that can be institutionalized and understood by EMSL, PNNL, PNSO, and DOE Headquarters.
    - Define practices.
    - Ensure a firm, common understanding, at least down to the Scientific

Facility leads, of funding levels, funding sources, staffing levels, leveraging with other EMSL facilities and collaborative partnerships with PNNL directorates at a detailed level.

2. Extensive discussions of committee recommendations have been effective: a shared Mission Statement is essentially completed, staff hires are creative and effective, tracking and reporting systems are deemed effective, and several "best practices" in planning have been captured. Recommendations:
    - A recapitalization plan is deemed to be on the right track and appropriate, but effectiveness could not be reviewed since the plan was not complete at the time of the review.
    - A proposal process has been initiated, but evaluations of its effectiveness are still to come.
    - A vision of a "single" EMSL with coordinated proposal calls to include theme-based, facility-based, and special areas has been developed.
    - Plans for increasing the number of users and monitoring the effectiveness of their experiences are in process.
    - The definition of "user" should be reevaluated.
3. All four parties (EMSL, PNNL, PNSO, BER) now agree on the mission of EMSL. BER acknowledged its ownership responsibilities, including recognition of the need for increased financial support. CATs (Collaborative Access Teams) have been terminated, and the concept of Grand Challenges is being rethought. New processes have been established for prioritizing equipment acquisition and investments through Science Themes. Utilization policies demonstrate good budget stewardship.
4. It is further recommended that EMSL's mission as a user facility should not preclude the pursuit of high-level science by its staff and that EMSL should be engaged at an earlier stage when PNNL scientists acquire non-BER funded equipment for use at EMSL.
5. Extensive benchmarking has taken place since the previous review. A broad review was made by EMSL of other DOE user facilities' operations and processes; this review was used effectively in establishing "best practices" in EMSL procedures, processes, etc. Self-assessment is part of the PNNL culture; extensive evolution has occurred in EMSL's participation in this process. It is recommended that ongoing benchmarking be part of the documented assessment process.

Discussion:

Asked whether EMSL would be a good place to address the issue of education, Tiedje replied that EMSL is really stretched on leadership. A handle is now being gotten on that issue. Taking on more challenges may or may not be possible right now. There is no authorization for funding travel for students, but EMSL has a number of local high school students working there, and the administration tries to leverage what funding it has. There is a teachers' program, also.

Broido asked for a motion to accept and endorse the Subcommittee's report. Larson so moved, and Kingsbury seconded. The motion passed unanimously.

Allison Campbell: EMSL's Response to the BERAC Review

EMSL had to decide if it was a research facility or a user facility: a shared mission was settled on. Two new lead-scientist positions were added; a business manager and a project-control manager were hired; an associate director for the high-performance computing facility is being hired; and new people were moved into positions to strengthen interactions with users. A strategic plan was put in place that focuses on EMSL's mission as a national scientific user facility. It was developed with stakeholder involvement, puts forward a five-year strategy, outlines EMSL's science themes, offers guidelines for setting priorities and making decisions, and establishes a timeline and measures for success. The EMSL Science Advisory Committee was redefined, a new chair was appointed, new members were identified and solicited, and the Chair now sits on PNNL's Laboratory Advisory Committee.

All user proposals now undergo external review. Consistent review criteria are now in place. The review process is now Web-based, and more than 100 potential reviewers have signed up. Formal calls for proposals have been established. The science-theme calls have been instituted. Facility-focused calls are still used. And open calls may be submitted at any time. The first EMSL-wide calls elicited 99 responses, 58 of which were from PIs outside PNNL and 24 of which were new-user PIs.

The term "user" was redefined as an individual not in the EMSL organization who makes use of the facility as part of an active user proposal, either on site, remotely operating equipment, or acting remotely but not operating equipment. Individuals are only counted once each year as a user. A user survey is now sent out every six months. The FY06 survey had a 48.6% response rate with 91.9% satisfied or very satisfied.

EMSL is currently permitted to use small nondispersable radiological sources. EMSL is exploring options for development of a radiochemical annex that would give more flexibility to the use radioactive samples in research. Part of the process to determine the feasibility of such an annex includes a survey of the potential new user community, development of plans to mitigate safety and contamination concerns, and assurance that such an annex would address Environmental Remediation Sciences Program objectives. Such an annex would be an additional use for EMSL equipment not currently housed in the EMSL building and would include sample preparation etc., and the need to accommodate diverse types of samples.

A workshop is being held Aug. 1-2 to develop a recapitalization plan for updating services, plant, and instrumentation. It will define the scientific challenges in EMSL's four science themes and investments appropriate for EMSL as a national user facility.

New users are being attracted to EMSL with broadly distributed user calls, the establishment of relationships with external peer reviewers, increasing EMSL's presence at national professional society meetings, hosting workshops and user meetings, shortening the queue for the facility by reducing sample turnaround times, considering alternative computer configuration strategies, training users, and the availability of travel money from the National Science Foundation (NSF) for NSF-funded investigators to go to EMSL to conduct aspects of their research.

Steps are also being taken to ensure that (1) EMSL's mission not preclude the pursuit of high-level science by its staff and (2) EMSL leadership is involved early in any acquisition of equipment with non-BER funds.

Discussion:

Asked if EMSL staff can seek funds from other agencies, Campbell replied, absolutely.

In regard to how the scientists are reacting to these responses, Campbell responded that most seem to be behind the changes though there are some pockets of resistance. These changes need to be rolled out to the users. The facility leaders themselves have been enthusiastic about the changes; they see the benefits from these changes.

A break was declared at 3:59 p.m. The meeting was reconvened at 4:20 p.m.

Michelle Broido: Subcommittee Assignments

BERAC has three standing subcommittees. James Tiedje has agreed to chair the Environmental Remediation Subcommittee. Joyce Penner has agreed to chair the Climate Change Research Subcommittee. It is hoped that Melvin Simon will chair the Genomics Subcommittee.

Christine Chalk: Program Assessment Rating Tool (PART) Review

It is important for federal agencies and individual programs like BER to master PART since it is supposed to be tied to future funding decisions. There are seven sets of PART tools for each of the seven types of government programs; SC uses the tools for R&D programs with select questions added from the Capital Assets and Grants PART tools. Four PART sections are used for all programs: Program Purpose, Program Planning, Management, and Results (half of the points are in Results). Without meaningful annual and long-term measures in place, programs are automatically rated "Results Not Demonstrated." It is impossible to score above 50% on the PART without measures in place. BER has three long-term measures plus the facilities measure. For R&D programs, PART assessments cover the key elements of the R&D Investment Criteria.

The critical part of PART is the independently validated management processes: For excellence, the management process is peer review (e.g., COVs) at the project, portfolio, and process levels. For relevance, it is planning that is transparent, realistic, and tied to budgets. For performance, it is long-term and annual performance measures that are meaningful, quantitative, and trendable (when possible); tied to budgets and plans; included in performance ratings of senior managers; and applied to project and facility management (e.g., the Lehman process).

For FY03, programs were given red, yellow, or green scores for program performance based on OMB analyst assessment. SC rated green. For FY04, PART was developed to improve consistency in ratings and to help agencies improve; for FY04, all SC programs were rated Results Not Demonstrated because of lack of meaningful performance measures. Measures were devised and analyzed for FY05, and three SC programs (including BER) were rated effective and three were rated moderately effective.

For the FY05 PART, SC developed new long-term and annual performance measures. These measures are the only measures in SC. Most of these annual measures are quantitative and trendable. They are included in the budget, tracked quarterly by the Department, and audited annually by an independent accounting firm. Progress toward the qualitative long-term measures is evaluated by independent scientific advisory committees (e.g., BERAC) every 3 years. Roadmaps have been developed for the

measures, and definitions have been developed for excellent, good, fair, and poor progress.

BERAC reviewed the long-term and annual PART measures developed for FY05 and found the goals generally meaningful, ambitious (but achievable), and measurable with a few suggested changes that have been incorporated. The first review of progress toward the long-term measures is the subject of a current charge. BER will need a complete report before the next PART re-assessment by OMB in spring 2007.

Discussion:

Asked if these are official reports that will have to be approved by the full Committee, Chalk replied that the OMB did not accept BES's COV results until they were accepted by the full BESAC.

David Thomassen: BER's Long-Term Measures

BER has three long-term performance measures in PART, one for each of its three divisions and one that it shares with the Office of Advanced Scientific Computing (ASCR):

- For Life Sciences: (1) By 2015, characterize the multiprotein complexes (or lack thereof) involving a scientifically significant fraction of a microbe's proteins. (2) Develop computational models to direct the use and design of microbial communities to clean up waste, sequester carbon, or produce hydrogen.
- For Climate Change Research: By 2015, deliver improved climate data and models for policymakers to determine safe levels of greenhouse gases. By 2013, reduce differences between observed temperature and model simulations at subcontinental scales for all available, validated data.
- For Environmental Remediation: By 2015, provide sufficient scientific understanding to allow a significant fraction of DOE sites to incorporate coupled biological, chemical, and physical processes for decision making for environmental remediation.
- For ASCR: By 2015, demonstrate progress toward developing, through the GTL partnership, the computational science capability to model a complete microbe and a simple microbial community.

BERAC needs to understand the BER research program/portfolio, decide what process it wants to use to gain sufficient understanding, and organize itself to carry out this task. It also needs to understand BER's long-term measures and annual measures, asking whether these measures are reasonable and representative of the research programs; if not, determining what new measures should be used; and if not, why they are not reasonable and representative.

The BERAC Subcommittee needs to write a report (due to Orbach by February 2007) presenting its findings and evaluating BER progress toward long-term performance measures. This report is to include both actual progress and progress implied by the direction BER is going. The short- and intermediate-term milestones should be used as a guide in assessing progress; and ratings of excellent, good, fair, poor should be specified.

Discussion:

Asked what mechanisms could be used to adopt these assessments, Thomassen replied that the Committee could accept them at the November meeting or subsequently set up an open telephone conference to deliver, deliberate, and accept the assessment.

COVs are a part of the assessment process, but separate from this assessment. Chalk added that the milestones are a parallel assessment method, although they are not as absolute. If one does not meet a milestone, that is not fatal. They are nonbinding and illustrative of progress. They were developed to accompany the long-range plan.

Broido opened the floor to public comment. There being none, she adjourned the meeting for the day at 5:10 p.m.

Tuesday, July 11, 2006
Morning Session

Chairwoman Broido called the meeting to order at 8:59 a.m.

Christopher Somerville: Workshop on Ethanol Production

A good deal of the corn kernel is starch that can be fermented to ethanol. U.S. production can top out at 12 billion gallons; then cellulosic ethanol is expected to kick in. About 1.3 billion tons of excess cellulose is currently available from crop residues, forest thinning, etc. that would exceed the Secretary's goal.

A workshop was held in December 2005 to

- Define how science can enable lignocellulose biorefining
- Define the technical challenges
- Define common sets of science and technology opportunities and barriers
- Develop Barrier Technology Research Packages (BTRP)
- Define program goals and requirements
- Develop roadmaps for new, coordinated research across EERE and SC

The basic steps in cellulosic ethanol production are: grow it, chop it up, detoxify it, ferment the sugars, hydrolyze the cellulose, and ferment the hemicellulosic sugars. Desirable improvements include increasing the biomass yield; improving the biomass characteristics; exploiting biological catalysts; reducing the treatment severity and wastes; raising sugar yields; eliminating separation; combining enzyme production, hydrolysis, and fermentation into one reactor; and integrating the total process.

The properties of optimal feedstocks are high yield (>15 tons/acre-year), high water-use efficiency, low input (fertilizer, tillage, and pesticides), high conversion efficiency, sustainability, and stable quality and quantity from year to year. High capital costs favor dedicated energy crops. One gram of biomass requires 200 grams of water, so water use will be important to maximizing yield, and crop plants will need to be engineered for drought tolerance.

High plant productivity is important and is a function of many aspects of growth and development, so a broad approach to knowledge creation is essential. However, 50% stover removal will lead to yield reductions because of soil-nutrient depletion, so long-term research is needed on the effects of various cropping regimes on soil quality and microbial ecology. Metagenomics needs to be used to understand soil microbial ecology in a range of cropping systems.

Biomass crops will vary across the climatic zones of the country. Perennial C4 grasses have the highest biomass production rates, but there has been little research on the most promising energy crops, so large gains in productivity are possible.

Improved imaging methods are needed to facilitate the understanding of how cellulosic walls are made and decomposed. Cellulose is a tough substrate to break down. Research objectives include: altering cellulose structure, identifying new sources of cellulases, understanding cellulosome structure and function, structural studies, directed-evolution studies, and enzyme-mixture studies (to enhance breakdown).

The discovery of new enzymes has been enabled by genomics, but many opportunities for improvements exist, and some needed enzymes are not yet known. Another way is to engineer plants that do not have hemicellulosic linkages that are difficult to break down (although those linkages may be essential to constructing the cell walls to begin with). Genomics, proteomics, and informatics tools can be used to facilitate rapid progress.

Lignin is another major biomass component. It is made nonenzymatically, and one cannot break out linkages. But it might be possible to put a cleavable linkage into the lignin synthesis. If feedstocks can be modified to require less energy to process, that would change the game. Also, other products (like butanol) may be easier to produce than ethanol.

Fermentation of *all* the sugars is essential to optimize ethanol production. Systems biology and synthetic biology will be used to develop new organisms that can use all the sugars and that are resistant to inhibitors and products. Elucidation of the regulatory circuits for microbial metabolism will enable large improvements in biofuel and bioproduct production (an objective for GTL).

Discussion:

Asked if the cost of water got factored in, Somerville replied, no. The calculations relied on rainfall; irrigation was not considered. Most of the crops considered are C4 plants. In most cases, plant characteristics do not change with the age of the plant, but perennial crops withdraw their mineral nutrients at the end of the season, leaving the carbon above ground. They have to be harvested at the end of the season.

It was noted that the paper industry uses many of the same industrial techniques as would the production of cellulosic ethanol and the pulp and paper industry has a great surplus capacity that could be used for cellulosic ethanol production; however, those plants are very inefficient.

The workshop participants also considered a few alternative fuels besides ethanol, such as oil cane; but most of the discussion was on fermentation.

Michael Viola: Life and Medical Sciences Program

The Life and Medical Sciences Division were joined into one division about three months ago. The program supports biological stations at world-class synchrotron and neutron sources, the JGI, and the Oak Ridge National Laboratory (ORNL) mouse house. The GTL uses systems-biology research in bioenergy, bioremediation, and carbon sequestration. It funds seven large, core programs, a number of smaller projects, and follows the roadmap. Technological development supports these programs and will continue to be important at the new bioenergy research centers. DOE still takes seriously the need to investigate the effects and benefits of ionizing radiation. It does this in the low-dose radiation program. The division also supports research in nuclear medicine and advanced biomedical instrumentation, and has responsibility for the Department's human-subjects protection program.

Examples of some specific research efforts:

The microbe *Shewenella* has great potential for bioremediation, and a federation of scientists is studying it. There are now 13 strains of *Shewenella* whose genomes have been sequenced. Comparative genomic and physiological analysis of *Shewenella* species is being conducted. An enormous database is being compiled about this organism; 41 cytochromes have been verified in it. Studies are being conducted to characterize and model metabolic and regulatory networks. These data are being analyzed in innovative ways.

DOE was responsible for funding the development of positron-emission tomography (PET) scanner, the microPET, and a mobile PET scanner (for mice). Everything has been miniaturized. The mobile unit (the ratcap) gives a resolution comparable to that of the microPET.

In artificial retina research, a miniature camera transmits a signal to a microelectrode array that stimulates the optic nerve. A 60-electrode device is completing preclinical testing in dogs; a human study is scheduled for next December. The goal is to get to 1000 pixels/electrode. Six national laboratories and four universities are working on this effort.

Jerry Elwood: Climate Change Program

This program has four major programmatic areas of research: climate forcing, climate-change modeling, climate-change responses, and climate-change mitigation. All except climate-change mitigation are part of the interagency U.S. Climate Change Science Program. Sequestration research is part of the U.S. Climate Change Technology Program.

Climate forcing includes the (1) ARM Science Program, which studies the effects of clouds and aerosols on radiation and improves cloud parameterizations and cloud-resolving models; (2) ARM Infrastructure Program, which maintains and operates three stationary climate-research facilities and one mobile facility; (3) Atmospheric Science Program, which studies aerosol properties and processes and conducts field campaigns; (4) Terrestrial Carbon Processes Program, which operates CO_2 flux measurement sites (AmeriFlux), conducts soil carbon and terrestrial carbon process studies, and performs carbon-cycle modeling; (5) Ocean Carbon Cycle Research, which has been discontinued; and (6) Information and Integration, which is centered at the Carbon Dioxide Information Analysis Center (CDIAC) and performs archiving and dissemination of data about greenhouse-gas emissions and concentrations.

The Climate Change Prediction Program seeks to incorporate better representations of key climate processes in climate models. It tests and develops global models, produces climate scenarios using a fully coupled Community Climate System Model (CCSM) for international and national assessments of climate change, applies climate models to examine issues of climate change detection and attribution, develops diagnostic tools and methods, and incorporates best practices in climate models on DOE's high-end computing facilities.

The Climate Change Response Program conducts experimental field studies and observational studies along climate gradients. Its scaling initiative seeks to bridge the gap between molecular biology and ecological systems and how they respond to climate change. Another initiative, the Integrated Assessment Research Program, seeks to develop methods and models for use in end-to-end assessments of climate-change causes

and consequences and in the calculation of costs and benefits of different policy options for climate-change mitigation. The Global Change Education Program supports graduate and undergraduate fellowships to train the next generation of scientists needed for climate change research.

The Climate-Change Mitigation Program conducts research on the terrestrial sequestration of carbon. Research on oceanic sequestration (which studied iron fertilization and pumping CO_2 into the deep ocean) has been discontinued.

Other responsibilities of the Division include producing three (of 21) synthesis and assessment products (SAPs) for the Climate Change Science Program.

Between FY06 and FY07, the Climate Change Science Program budget is decreasing from $137.5 million to $131.2 million because of the elimination of ocean research. Other programmatic changes include the reconfiguration and recompeting of the ARM Unmanned Aerial Vehicle (UAV) program; the reorganization and renaming of the National Institute of Global Environmental Change (NIGEC) program as the National Institute for Climate Change Research (NICCR) with its management moved to DOE headquarters, the number of regional centers reduced from six to four, the establishment of a new center in response to congressional direction, and the issuance of a joint request for proposal (RFP) for all the centers.

Two new staff members have joined the division, and two IPA [Intergovernmental Personnel Act] positions are open.

In 2005, BERAC reviewed in the terrestrial carbon processes program and recommended changes in several areas. Recent recompetition of program funding addresses most of those recommendations; the remainder are being addressed in other ways. Additional BERAC reviews have been requested for the Integrated Assessment Research Program, trace-gas-enrichment experiments, the ARM infrastructure, and the entire program (by a COV).

No strategic plan exists for BER's climate-change program, analogous to the U.S. Global Change Research Program (USGCRP) plan. A 10-year plan is needed. A group of scientists will be engaged to work with program staff in developing such a plan.

A break was declared at 10:41 a.m. The meeting was called back into session at 10:50 a.m.

Michael Kuperberg: Activities of the Environmental Remediation Science Division

DOE has a remediation program to deal with the legacy problems from the U.S. nuclear weapons program. The Division conducts research to develop new science based strategies for dealing with all these problems. The Division is funded at approximately $90 to $100 million per year. The science program is funded at approximately $50 million per year, supporting research from the molecular scale to the field scale. Its mission is to advance the fundamental science leading to solutions to currently intractable environmental problems or to break-through strategies for remediation and long-term stewardship of the DOE sites and other DOE environmental and energy missions. Long-term monitoring is critical to the success of the program. The balance of the funds supports user facility operations, principally EMSL that you heard about yesterday.

One staff member is on detail to the Office of Science and Technology Policy (OSTP), and two new staff members have been hired in the past six months.

High-level waste research was terminated because of FY07 budget reductions; these funds had originally come from the Office of Environmental Management. The FY06 budget consolidated two former programs into a single research program. The program still maintains an interest in processes that control contaminants' mobility in the subsurface.

BERAC is responsible for monitoring the performance of this program, assessing progress on achieving the long-term measure, annual targets, and quarterly milestones. BERAC will also be asked to review the science program's Strategic Plan.

Two solicitations are currently open. One is for (1) hypothesis-driven research to define biologically mediated and/or hydrogeochemical processes influencing the form and mobility of DOE contaminants and (2) addressing the applicability of the proposed research to DOE-relevant contaminant-transport processes occurring in the field. Of the 180 proposals received, half have come from national laboratories, and half from universities. The other solicitation is an integrated field-scale subsurface research challenge. Five full proposals are expected. It is hoped that two field sites will be funded. BERAC called for additional field sites in prior reviews and assessments.

BERAC Discussion on Achieving Long-Term Performance Measures (led by Mike Riches)

Once there is funding for a program, there is a window in which to change and set milestones and performance goals. For FY08 and beyond, that window is between now and September. For FY07, there is a brief window after the budget is approved. The Office needs to know the process that BERAC will follow in the next few months to assess performance so that it will know what information BERAC will need. Any changes recommended by BERAC have to be approved by the Secretary and by OMB.

The evaluations are to address the long-term goals and annual steps prepared by BER and progress toward achieving the long term goals. BERAC can also make fundamental changes in the three long-term goals with good justification. All recommendations need to be in the formal BERAC (approved) report.

The three long-term measures that need to be looked at are for climate change, environmental remediation, and life sciences. There should be some assessment of these by the fall meeting. The evaluations will require meetings with the staff in the office. Joyce Penner has agreed to chair a standing subcommittee on climate change. James Tiedje will chair the Environmental Remediation Subcommittee. Chris Somerville will chair the Life Sciences subcommittee for this review. Conversations with the division directors are critical before meetings.

It was suggested that the life sciences could be expanded to include the NAS report recommendations, but just the long-term goals should be talked about and whether progress is being made on them. Somerville assured the Committee that he had managed the review for the NAS and knows the ancillary issues and questions. Riches said that these goals must cover 80% of the program; they also must be broad enough to cover all the clients' needs. Trends are an important characteristic. The SC strategic plan will incorporate some of these goals. It was noted that the Life Sciences Subcommittee should have someone from the medical side. All contrarian views should not be screened out.

Also, biofuels should be reviewed. The subcommittees should also discuss what goals are stated and measures established.

When a subcommittee's meetings are set, someone should check with all the subcommittee members to see when the largest number could attend.

OMB wants to know if progress is being made on the goals and if the Division is on track to essentially meet its goals. A whole infrastructure exists to track these goals and performances.

Asked how much documentation is required, Riches replied that for the annual goals the auditors looked for papers' abstracts or websites that state that the goal was made. BERAC's documentation will be its report that shows the assessments and reasons.

A concern had been expressed about the effects of biomass energy on hydrology. The Office of Project Assessment (OPA) looks at such effects. BERAC can recommend to Orbach that such a concern be addressed. The scientific community should know more about the hydrologic effects: how bioenergy crop cultivation affects water resources, pollution, and soil fertility and erosion. It was stated that nothing special is required because the effects are positive in comparison to traditional agriculture; production would remain stable but that the product would be diverted from feedlots. It was pointed out that a lot of water is being withdrawn for agricultural irrigation. Broido asked if the Committee wanted higher levels of government to raise this question. The point was made that this question is already being addressed by the U.S. Department of Agriculture; this question is important, but BERAC is not the place to raise it.

Broido called for public comment. There was none. She asked for new business. There being none, she adjourned meeting at 11:54 a.m.

Respectfully submitted,
Frederick M. O'Hara, Jr.
Recording Secretary
August 7, 2006