

**Minutes of the
Biological and Environmental Research Advisory Committee Meeting
May 14-15, 2007
Marriott North Bethesda Hotel and Conference Center
North Bethesda, MD**

BERAC members present:

Michelle S. Broido, Chair	John Pierce (Monday only)
S. James Adelstein	David A. Randall
Eugene W. Bierly (Monday only)	Margaret A. Riley
Robert E. Dickinson	Christopher R. Somerville
Joanna S. Fowler	James M. Tiedje
Keith O. Hodgson	Warren M. Washington
David T. Kingsbury	Raymond E. Wildung
Patricia A. Maurice	John C. Wooley (Monday only)
Joyce E. Penner	

BERAC members absent:

James R. Ehleringer	Melvin I. Simon
Raymond F. Gesteland	Barbara J. Wold
Steven M. Larson	Mavrik Zavarin

Also participating:

Jerry Elwood, Director, Climate Change Research Division, Office of Biological and Environmental Research, Office of Science, Department of Energy

John Ferrell, Office of Energy Efficiency and Renewable Energy, Department of Energy

Michael Himmel, National Renewable Energy 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

Raymond Orbach, Under Secretary for Science, Department of Energy

William Pizer, Resources for the Future

Eddy Rubin, DOE Joint Genome Institute

Rick Stevens, Director, Mathematics and Computer Science Division, Argonne National Laboratory

David Thomassen, Chief Scientist, Office of Biological and Environmental Research, Office of Science, Department of Energy

Paul Vaska, Brookhaven National Laboratory

Michael Viola, Acting Associate Director, Office of Biological and Environmental Research, Office of Science, Department of Energy

Don Wuebbles, University of Illinois

John Zachara, Pacific Northwest National Laboratory

About 70 others attended in the course of the two-day meeting.

Monday, May 14, 2007

Chairwoman Broido called the meeting to order at 9:00 a.m.

Eddy Rubin: Joint Genomic Institute (JGI) – (presentation available)

The JGI is a national DNA sequencing user facility that sequences organisms important for DOE's missions in bioremediation, carbon cycle and bioenergy. The JGI has 107 sequencers, each producing 70,000 base pairs per run, running 24/7. New equipment can provide more than 600 million base pairs per run at reduced cost although the read lengths are much shorter – on the order of 35 nucleotides. The science is focusing on plant genomics, microbes, and metagenomics (probing the biology of an environment). It looks at the role of biology in converting sunlight to alcohol, especially looking at sugars from cellulose, e.g., the well-studied yeast *Pichia stipitis* that converts xylose, a predominant “wood sugar” to ethanol.

Genomic sequences representing most bacteria and archaea have not been determined. There are more than 40 phyla of bacteria, with most bacteria for which we have DNA sequence information being only from 3 phyla. The JGI is creating a reference microbial genome set to support new gene discoveries and to produce functional descriptions. A pilot project is under way to finish about 100 bacterial and archaeal genomes from diverse phyla. Methods are being developed to change the technology landscape. The effort is being linked to an educational project. There are numerous connections and interactions with the biological community.

New capital equipment is needed at the JGI to maintain and increase capacity and to cut costs. The JGI is transferring operating capital (about \$5 million per year) to acquire next-generation equipment.

Rick Stevens: Genomic Encyclopedia of Bacteria and Archaea – (presentation available)

The basic idea of the project being piloted at the JGI (above) is to build an enterprise that can take advantage of the expected exponential improvements of sequencing capabilities; to develop an “industrial” approach to the cultivation, characterization, sequencing, annotation, and analysis of prokaryotic genomes; to build and curate a database of genome sequences, metabolic reconstructions, and standardized phenotype assays associated with each target organism; and to streamline the release of data. Each year, more can be sequenced as sequencing costs decrease and as cultivation efficiencies improve. At all times, the choice of organisms should be optimized to maximize diversity at each stage.

There is a large disparity between the rank-abundance curve and what organisms have been sequenced and deposited in the genome data bank. That gap needs to be closed. A

comprehensive database produced under controlled conditions that includes phenotype data and genotype data will accelerate research in understanding the genotype–phenotype relationship. During the next half-decade, one could sequence vast numbers of genomes, and a strategy is needed for employing this capability.

The project would sequence about 5000 genomes over 5 to 7 years. The biomass/DNA and the libraries would be stored and available for distribution. The project would begin with about 300 taxa per year and increase to 2000 per year with a 24-hour turnaround from assembled sequence to initial availability of the annotation. The genomes would be selected in each cycle to minimize the diversity gaps and prioritized to ensure the project is tracking the community’s interests. It is probably not necessary to “close” the genomes; libraries would be archived for groups that might be interested in closing. The project would provide a comprehensive set of genome sequences for biofuels, the microbial carbon cycle, soil and subsurface microbial ecology, bioremediation and bioconversion of waste streams, evolution and microbial ecological dynamics, environmental sequencing and metagenomics, predictive models of phenotypes, synthetic biology, and cultivability.

Discussion: Automated annotators are now running at Argonne National Laboratory that requires 3 to 4 hours to annotate a sample. For many organisms, no one is involved in annotation, and personnel must be brought in. Closing a genome is an economic and community decision. Manual annotation techniques are needed for about 0.1% of a typical microbial chromosome, doubling the cost for sequencing and annotation. 16s RNA data are needed to minimize the distance between known genomes. A putative set for filling in the blanks was described and is being considered by the biological community now. A good deal of the reference microbes needed to be investigated is unculturable. Taxa that cannot be cultured need mechanisms to extract them from the environment. How fast those techniques can be developed is not currently known. Multiple sequences do not need to be done over time; with various programs, the sequence is produced and overlaid on the reference set over time. Data are made readily available. A registration process for data users tracks requests and where the requests come from; usage is very global. The quality of annotation will dramatically improve because example annotations disambiguate closely related clusters. Novel functions have to be pursued separately. With the genomic data, one cannot see relatively where the genes are; one has to use snippets of base pairs. Having a reference can amplify the meaning of the small-snippet data.

John Ferrell: Energy Efficiency and Renewable Energy (EERE) Biomass Program –
(presentation available)

The Biomass R&D Act of 2000 set up an advisory committee, interagency coordination of biomass efforts, and an annual joint solicitation for DOE and the U.S. Department of Agriculture (USDA). The 2002 Farm Bill and the Energy Policy Act of 2005 also created a number of renewable-energy efforts. The Advanced Energy Initiative was started to reduce foreign-oil dependence, make cellulosic ethanol, and improve vehicle and solar efficiencies. As a result, EERE’s joint efforts with the Office of Science (SC) have

increased. EERE also works closely with industry. The foci of the effort are biomass feedstocks and conversion processes.

The DOE-USDA billion-ton study showed that land resources in the United States can sustainably supply more than 1.3 billion dry tons of plant biomass annually and still continue to meet food, feed, and export demands. Realizing this potential will require R&D, policy change, and stakeholder involvement. The required changes are not unreasonable given current trends. This amount of biomass should be sufficient to replace 30% of current U.S. petroleum requirements for liquid transportation fuel. One question is whether there is sufficient moisture available to support such an alternative-fuels program. A regional feedstock partnership was developed, and regional workshops are being held to move this program forward. One concept being advanced is an integrated biorefinery for corn ethanol, cellulosic residues, and new bioenergy crops (grasses and trees). A number of barriers exist. Solutions are being sought through the expertise of universities, the national laboratories, and cutting-edge industrial partners. There are six winners of the DOE bioenergy-conversion-technology solicitation.

(http://www1.eere.energy.gov/biomass/news_detail.html?news_id=10603) DOE is also funding ethanol development.

(http://www1.eere.energy.gov/biomass/news_detail.html?news_id=10790) Upcoming solicitations include one for an integrated biorefinery demonstration producing 1/10 to 1/5 of the projected scale of a first commercial facility; one to create commercially available, highly effective, and inexpensive enzyme systems for biomass hydrolysis; and (it is hoped) one for thermochemical conversion.

Discussion: The Biomass Program reports to the Assistant Secretary for EERE. It has no climate-change connection. It is believed that the community knows enough about this program to compete; however, it is possible that enough information has not gotten across to universities, although a good response was received from universities at the program's public meetings. A good number of companies have gotten involved, also. In cellulosic-ethanol development, the United States is the world leader. In gasification, it is a step behind.

William Pizer: Review of the Integrated Assessment Research Program – (report available)

Over the past 15 years, the Integrated Assessment Research Program (IARP) has been the principal developer of the science-based tools and intellectual resources in the U.S. for assessing the long term human influences on climate change, the risks from those changes, and the implications of policies and technology options to mitigate those changes. The IARP is a \$3 million per year program primarily funding two integrated modeling programs, one at the Pacific Northwest National Laboratory (PNNL) and one at the Massachusetts Institute of Technology (MIT), funding for smaller, competitive grants for individual projects, and support for the Energy Modeling Forum (EMF) headquartered at Stanford University. The IARP has been scientifically rigorous, producing some of the best research done on modeling. It also produced a method for comparing the costs/benefits of different mitigation strategies in one spreadsheet. The

figures produced by the MIT model were used to inform congressional aides and administration figures to show how stabilization could be achieved.

The Subcommittee suggests improved integration with Earth-system models on high-performance computing platforms; improved representation of impacts; use of near-term objectives and metrics and assessment of whether the Program is achieving them; increased attention to validation, evaluation, and uncertainty; and near-term priority on capacity for practical policy implementation. The Subcommittee found that no change in scope, goals, and objectives of the IARP is needed. Greater interaction with the climate-modeling community and representation of impacts (indicators) are needed. Near-term objectives should have greater specificity and formality. Regional and local scales are beyond the IARP scope; contact between IARP researchers and modelers in this area should be ensured. There should be improved and continued emphasis on validation, model comparison, and uncertainty. The breakdown between the two models and the PI efforts is correct for now. In general, decision-support tools should be developed. The Subcommittee also noted that funding has declined in real terms and needs to be restored and possibly increased. This effort is currently in SC and should stay there.

Discussion: This is a good report on an impressive program. Enhanced directions that could be reflected in this report include (1) the need to map the big climate models on the little climate models and (2) the multi-decadal timescale needed to guide near-term water-resource management and program directions. The Energy Information Administration (EIA) model does, however, cover the multi-decadal scale. The MIT and PPNL models are different and difficult to reconcile because they use different assumptions; the community would be better served by a half-dozen or so models. Hodgson moved and Wooley seconded a motion to accept the report. The motion passed unanimously.

A break was declared at 11:00 a.m. The meeting was reconvened at 11:18 a.m.

Science Talk - Paul Vaska: Advances in Instrumentation for Small-Animal PET Imaging, BER Presidential Young Investigator Awardee – (presentation available)

Positron emission tomography (PET) is a method of imaging functional capabilities in clinical (cancer, cardiac, and brain) and research (brain-function and animals-study) applications. With PET, a radiotracer is synthesized and injected into the subject; ^{18}F -FDG (fluorodeoxyglucose) is the most commonly used tracer. Radiation from the tracer is measured in three dimensions, and the data are reconstructed computationally. The tracer emits a positron and an antineutrino; the positron is detectable because it annihilates upon encountering an electron, giving off a pair of 511-MeV gamma rays that go in opposite directions. A ring of scintillation detectors looks for coincident gammas, defining the line of response. Timing is critical (at nanosecond levels). There are also random data. The raw data are analyzed for parallel lines of response. With spatial frequency filtering, a filtered back-projection can be computed. Real data are corrupted by Poisson noise and biases. Developments at Brookhaven National Laboratory (BNL) include detector design, electronics, and data processing.

It is desirable to look at conscious subjects to study behavior and the effects of stimulation, so BNL started to build the world's smallest PET scanner, the RatCAP, made possible by new gamma-ray-detector technology and microelectronics. It has 12 detector blocks, a time stamp and signal-processing module, data acquisition, and an outside diameter of 72 mm. Full-performance tests have been completed, and it is competitive with state-of-the-art systems.

The next steps are (1) a second-generation design with doubled sensitivity, better timing, and improved electronics; (2) awake-animal studies; and (3) mouse PET imaging for transgenics and the use of mouse models of diseases. A cadmium-zinc telluride detector is being investigated with laboratory-directed R&D (LDRD) funding. Also being investigated is simultaneous PET and magnetic resonance imaging (MRI) multimodal imaging to combine structure with function. Currently, it has only okay contrast, delivers a high radiation dose, and is not truly simultaneous. PET interferes with magnetic resonance, so the RatCAP is being adapted with improvements in the coil. Some simultaneous images have been made; the systems do work together, but shielding needs to be refined, and a bigger, more flexible system needs to be developed.

Discussion: Animal nondestructive imaging is very important with near-term applications in Parkinson's and Alzheimer's diseases. ^{11}C might make a better tracer than ^{18}F because it has a better half-life and can be used to tag any organic material.

The meeting adjourned for lunch at 12:11 p.m.

Monday Afternoon

The meeting was called back into session at 2:02 p.m.

Michael Viola: State of Biological and Environmental Research (BER) –
(presentation available)

Two new staff numbers have been added, an Integrated Assessment Program manager (Bob Vallario) and a Human Subjects Protection Officer for all of DOE (Libby White). A search committee for the Associate Director (AD) for BER is being formed. Selecting the Director of Environmental Remediation should wait until the AD is named. A computational biologist and a microbiologist/geneticist are being recruited.

The FY06 appropriation for BER was \$439.0 million (excluding congressionally directed projects). The FY07 appropriation is \$483.5 million and the FY08 President's request is \$531.9 million. There were no congressionally directed projects this year. The only major increase in the BER budget is for the Bioenergy Research Centers. Once selections have been made in June, these Centers will receive startup funds for this year and will be fully funded next year. Funding for other programs is essentially flat. The science needs of climate change research need to be addressed and are currently poorly funded. Much the same can be said of environmental remediation research. In medical applications, all

tracers used worldwide were developed by BER. The National Institutes of Health has not picked up the gap in funding left by the reduction in the BER program. If BER does not do it, no one will. BER nuclear medicine research now gets only \$5 million per year.

The Climate Change Research Division (CCRD) had a committee of visitors (COV) review two weeks ago. The COV made some excellent suggestions. The new CCRD strategic plan will be presented to BERAC at its next meeting.

In the Life and Medical Sciences Division, the Bioenergy Research Centers selection process is progressing. The applications were received in February, the first review was in April, the second will be at the end of May, and an announcement will be made in mid-June. The proposals are very high-powered and comprehensive.

The National Academy of Sciences report on the state of the science in nuclear medicine is due July 2007.

JGI is funded at >\$50 million per year with seven partners. It is a big operation but operated on a shoestring. It needs more state-of-the-art equipment without a slowdown in operations. It also needs a long-term business plan.

Discussion: The number of applications for Bioenergy Research Centers could not be disclosed. Previously, the Center for Neuroimaging in New Mexico was funded at \$10 million per year for 6 years as a congressionally directed project without peer-review. The new Congress decided that there would be no congressionally directed projects in FY07. An application submitted by the Center for Neuroimaging was exhaustively peer reviewed. To protect DOE's investment in this Center, 1 additional year of research will be funded. Additional work proposals may be submitted and reviewed in the future. In terms of the FY08 budget, the only feedback is on the biology side: the people on the Hill support the request. Beyond the initial bioenergy centers we hope that there will be funding for additional GTL centers for environmental remediation and carbon cycle research in 2010 and 2011.

Joyce Penner: Atmospheric Radiation Measurement (ARM) Facilities Review –
(report and presentation available)

Data collected by ARM facilities is used to quantify cloud and aerosol interactions and convective precipitation for modeling. The ARM national user facilities have a Science Board that reviews requests for field programs at the four fixed sites and the mobile facility. The facilities do not fund research but provide instrumentation, data, and expertise to researchers who “use” the facilities. Of the 1500 users, 931 use the archive, and 69% are not funded by the ARM research program. Several satellite validation exercises have benefited the National Aeronautics and Space Administration and the National Oceanographic and Atmospheric Administration research programs. The ARM user facilities are judged as being highly effective. The cost per product (file) is \$100, which has trended down but has leveled off. The leveraged science cost would show broader impact. The facility's uptime is 98%. It had 883 citations in the scientific

literature from 2002 to 2006. 68% of the user proposals submitted was approved. Only 17% of the requests for deployment of the mobile facility were approved. There is a strong unaccommodated desire to use this facility.

The team has worked to keep the cost factor flat or declining with a savings of \$6 million compared with projections using 3% inflation. They have also trained staff to maintain instruments and derived a cost saving in Internet services through use of higher technology. They feel that they have done almost everything they can to lower costs, and the facility is approaching a period of optimal productivity. However, there is the risk that the ARM infrastructure will not be able to meet the continued growth in requests from the user community under the current funding profile.

The management team established a formal process to address each recommendation from the 2005 review with emphasis given to improvement of data quality, increased documentation and dissemination, and enhancement of communications to the user community. Also, there have been massive improvements to the ARM website and in the organization of its data. The criteria for deployment are certainly better enunciated, and constructive outreach is being pursued. The recommended data quality efforts have been expanded, and management/leadership approaches appear to be evolving.

Discussion: The effectiveness of the facility is enhanced by being part of the ARM Program. Hodgson moved and Kingsbury seconded a motion to accept the Subcommittee's report. The motion passed unanimously.

Christopher Somerville: BP Energy Biosciences Institute at UC Berkeley –
(presentation available)

The Energy Biosciences Institute (EBI) is a partnership among the University of California (UC) at Berkeley, the University of Illinois (UI), Lawrence Berkeley National Laboratory (LBNL), and British Petroleum (BP), which has committed \$500 million over 10 years. The vision from BP is the exploration of biology's reach into energy.

In February 2007, BP and UCB entered into discussions about the terms of agreement. An executive committee is now organizing operational aspects, and a July 1 startup is expected. The key elements of the negotiations were that there be open dissemination of research results and information, a commitment to students, accessibility for research purposes, public benefit, informed participation, legal integrity, fair consideration for university research results, and objective decision making.

At UC, the program is to be co-located in a new building on the Berkeley campus. There is another site at UI making use of UI's farmland. The goals of the EBI are to envision the future; identify and solve the scientific and technical problems required to enable the development of a cellulosic biofuels industry; develop new biotechnologies for enhanced oil recovery, fossil fuel processing, and biosequestration; educate scientists, policymakers, and the public; and train a new generation of students.

BP has established a U.S. subsidiary that will fund both open research and proprietary research. The institute is like a small company with a board of directors. An executive committee will direct the project, and an operations committee will manage activities. Ten faculty appointments will be filled with experts in the requisite fields. All internal and external programs will have EBI-defined goals and milestones. Budgets will be developed annually based on evolving opportunities.

An open call will be issued for preproposals that address broad goals. On the basis of preproposals, PIs will be invited to submit either a project or program proposal. Projects (investigators) will have a defined term; programs (associates) will have rolling 3-year horizons with annual reviews. Proposals will be peer reviewed. The goal is to provide funding by September 28, 2007.

A break was declared at 3:25 p.m. The meeting was called back to order at 3:45 p.m.

Donald Wuebbles: Climate Change Research Division COV Review – (report and presentation available)

The research programs within the Division are well recognized nationally and internationally for the important contributions being made to understanding the climate system and for reducing key uncertainties, helping policymakers to better determine potential responses to concerns about global warming. Several programs are unique, especially ARM, modeling, and ecosystems. There has been significant progress since the previous COV review. Solicitations are more specific and have greater clarity, and there appears to be a modest increase in the number and diversity of reviewers. There is a more balanced treatment of national laboratories and universities.

Project jackets are more complete than they have been. Documentation still varies widely across program elements and is much less substantive for national-laboratory than for university projects. The Division should conduct a self-study to establish a checklist for standard project documentation. An integrated, electronic tracking system should be implemented to ensure that project documentation is complete.

Program managers are doing an excellent job of maintaining project oversight. Program managers are taking a strong and active role in the Climate Change Science Program (CCSP); however, they have insufficient resources to effectively manage and maintain oversight; additional resources should be made available.

Competitive solicitations should be maintained for the national laboratories as well as for universities. Pre-applications should be encouraged for major proposal solicitations. In general, the Division makes effective use of panels and mail reviews. The division should develop an integrated electronic database of reviewers. The role of the chief scientists should be clarified and optimized while eliminating the potential for real or perceived conflict of interest. Tailored instructions to reviewers are essential to ensure useful reviews. Apparently, no formal mechanism exists to document communication with PIs; program managers should include suggestions to address reviewers' comments in the

funding letter or elsewhere. Uncompleted projects may be needed to maintain core competencies at national laboratories and other institutions; such projects should be reviewed and proactively managed. Large projects should ensure consistent periodic reporting and external review. Final reports should be required of all projects. Project managers should prepare an overall program report of accomplishments and proposed future directions as part of the COV-preparation process.

Discussion: Two members of the previous COV were named to this COV, but only one could participate. As presented, the COV report lacked only very minor changes. Adelstein moved and Randall seconded a motion to accept the report as amended. The motion passed unanimously.

John Wooley: Advanced Scientific Computing Research (ASCR) PART (Performance Assessment Rating Tool) Metric for GTL – (presentation available)

Both BER and ASCR have PART metrics for GTL that have been discussed by their respective advisory committees. While BERAC has approved the BER PART metric for GTL, the ASCR Advisory Committee expressed concerns about the reasonableness of the ASCR GTL PART metric. At the last ASCR Advisory Committee meeting, Dr. Orbach charged that Committee to work with BERAC to develop a more appropriate and mutually acceptable metric. The development of the new ASCR PART metric for GTL is due to be completed by August 2007. The charge asked for the status of evaluating computational models, the possibility of accelerating progress, whether ASCR goals are too ambitious, other possible intermediate goals, and the key computational obstacles in developing computer models for biological understanding necessary to characterize and engineer microbes. The Subcommittee will meet in time to provide input to ASCR's advisory committee on August 15. The BERAC portion will bring in outside scientists to advise on the interface between the computer-modeling and biology communities and will interview program managers.

Discussion: The “lack of community guidance” mentioned in the charge refers to the different opinions held by the two communities: the biological community wants desktop-access capability; the computational-science community wants testbed activities for long-term, large-capacity projects. Compromises can be brought about by applying network and other technologies. The lack of buy-in is caused by the timescale projected.

David Thomassen: BER Scientific Focus Areas (SFA) – (presentation available)

About 15 years ago, BER started applying the same rigorous, competitive standards of peer review to the national-laboratory projects as it did for university and private sector research projects. As a result, the BER research portfolio at the national laboratories is principally a collection of excellent, single PI type projects that are little different from the research portfolio funded at universities and private sector institutions. While research at national laboratories should be funded based on rigorous merit review, it should also take advantage of the unique resources, capabilities, and management environment found at the laboratories. Therefore, BER is transitioning its national-laboratory research

portfolio from a single PI approach to one that is more focused on research teams that address questions across broad BER Scientific Focus Areas (SFAs).

SFAs have been established on genomics; ethical, legal, and societal issues; low-dose radiation; climate-change forcing, modeling, response, and mitigation; integrated environmental remediation field studies; subsurface science; medical imaging sciences; advanced medical instrumentation; scientific user facilities; and human subjects. Teams at the national laboratories will address these areas. The ability of these teams to quickly change direction and address critical needs is imperative. This change does not mean that each SFA will only be addressed by a single laboratory or that all laboratories will address all SFAs. Some single PI projects will still be funded at the laboratories when that research addresses a critical BER program need, but these projects will be the exception not the rule. The method of peer review for national laboratories may be different than for the Financial Assistance awards to university and private sector scientists, but it will be no less rigorous. DOE program staff will also have to work in teams. This approach has been presented to the laboratories and their responses are expected this summer. The excellence of science from the national laboratories is expected to continue with the added flexibility and broadened expertise and coordination.

Discussion: The program managers have made a first-cut assessment of each national laboratory and have made their recommendations to the laboratories as to the SFAs that each laboratory should focus on. The national laboratories will have the opportunity to respond. The term “competition” refers to having similar programs at different national laboratories and having scientific competition. One institution may not be able to address all opportunities. There will be recycling of funds and research. In the case where a national laboratory wanted to move in a new research direction, each management and operating contractor would probably respond differently; some might build new competencies, and some might sustain current competencies. Interdisciplinary science sometimes does not map well to the programmatic offices of BER, and a single point of contact may be limiting and inflexible. Human subjects is a focus area because it is a responsibility of the Office. This plan applies to all the non-infrastructure research at the national laboratories. Everyone does not need to be re-reviewed now; the national laboratories are being asked to reorganize their funded research. If new opportunities and needs arise, funding will be realigned. Universities would be expected to continue to partner with national laboratories and vice versa. When a project ends, the national-laboratory portion will not roll over into the national laboratory team portion but will end along with the university’s funding. All the details of having some single PI projects at laboratories have not yet been worked. In general, when a single-PI grant is made to a national laboratory, it will be because the absence of that research would affect the whole portfolio. There has to be a balance, though.

Public comment: Fundamental science is defined as hypothesis-driven or -generating research. The type of research will not change, just how one goes about that research.

The meeting was adjourned for the day at 5:10 p.m.

Tuesday, May 15, 2007

Chairwoman Broido called the meeting to order at 9:00 a.m.

Raymond Orbach: Selection Process for the DOE Bioenergy Research Centers –
(presentation available)

The President has announced a goal of reducing petroleum usage through increased efficiency and the use of alternative fuels. The bioenergy centers are considered by the Secretary to be the most important contribution of his tenure. On August 1, 2006, the funding opportunity announcement (FOA) for those centers was issued in an extremely short time through the heroic effort of Michael Viola and his staff. An FOA is not a request for proposals. A federally funded research and development center was not wanted because it would last forever. Rather, a broad-area announcement was used, a new way of doing business for DOE. The FOA puts universities on an equal footing with the national laboratories. To give the coalitions time to organize, proposals were due on February 1, 2007. The first stage of peer review was completed on April 25 by a distinguished, international team of scientists and administrators from all relevant fields. The FOA elicited some very fine opportunities for our country. The most meritorious applicants have been invited to Washington, D.C., on May 30-31 for a reverse site visit. The Department hopes to announce the successful applicants in mid-June 2007. The President decided to include a third center, and funding for all three centers is included in the FY08 budget request. Everyone wants to get these programs started by September 30. Augmentation of federal funds is expected from other sources; the proposals reflect significant leverage. The President's goal is to be able to replace 20% of today's liquid transportation fuel with alternative, non-petroleum-based fuels in 10 years, i.e., 20 in 10. The enzymes needed for biological conversion are not known, and the necessary genomics has not been done. The genomes of the roughly 200 microbes in the termite's gut are being sequenced to figure out the metabolic pathways for converting cellulose to ethanol.

Discussion: The centers will capture only a portion of the available talent but are not in isolation. DOE will work around them to ensure the robustness of the GTL program. The land-grant institutions, for example, would be a good complement to the centers. Further research will be pursued when the research directions of the centers becomes known. There will be caveats about water use, pesticide use, etc., because otherwise this research would be self-defeating. Water and salinity issues are front and center along with propagation of genetically modified organisms.

Raymond Orbach: Recruiting an Associate Director (AD) of SC for BER –
(presentation available)

The AD for BER will be recruited in a novel way because the normal way is baroque and Byzantine. The normal way was used to try to recruit twice and failed. Now, a recruitment committee will be constituted, the first since 1996. It will employ extensive outreach and will ask for help from BERAC members in identifying potential candidates.

BER is a major program for the country and the world. Among other duties, the AD formulates program goals, strategic directions, priorities, and plans for BER. These responsibilities alone are daunting. Many agencies have a smaller budget and fewer responsibilities. The AD will have excitement and opportunities unmatched in the federal government.

In the climate area, the remarkable IPCC [Intergovernmental Panel on Climate Change] reports will be available for guidance. The content of those reports is terribly important and includes much of BER's own research. These reports lay out what one should worry about. This very important area is in BER.

Computation is being invested in heavily. Currently, the computer in Oak Ridge is at 117 Tflops and will be at 280 Tflops by the end of the year and at 1 Pflop by the end of next year. Advice from BER and BERAC will be relied upon to decide how to invest that computer power.

Discussion: The best way to advance names is to e-mail them to Orbach; the search committee will also contact each BERAC member for suggestions. Generally, candidates may not come in as IPAs [Intergovernmental Personnel Act] to avoid salary loss; there is a limit even on IPAs' salaries and on the length of term they may serve. The person in this position should remain four or five years at least. IPAs will be considered as a last resort, though. The type of person being sought will likely have to take a cut in salary, but these ADs have a profound influence on the future of the nation. The AD does not have to come from any particular discipline but should preferably be a scientist because investments should be science driven. Filling the position of Director of the Environmental Remediation Sciences Division has been awaiting the naming of the AD. The concern was expressed that BER is not funding climate change research aggressively enough. The FY08 budget does not have any earmarks, which leads to an increase in BER's budget. The FY07 budget is a nightmare, and the office has to draw up an FY08 budget before it is known what the FY07 budget is. Guidance is needed on where to put money for climate change research. Investments in climate-change modeling do not show up in this budget. A climate change research roadmap is needed, so a workshop will be held to help formulate a response to the IPCC reports.

Michael Viola: Life and Medical Sciences Division – (presentation available)

The Life and Medical Sciences Division is funding the artificial retina program because the three critical disciplines (microfabrication, microelectronics, and materials science) are all embedded in the national laboratory system. DOE essentially owns artificial-retina science to replace the functionality of retinas degenerated by retinitis pigmentosa and macular degeneration. Seven patients have had implants of 16-electrode devices. The lessons learned include a proof of principle and that patients can perceive light and dark, that low power is sufficient, that patients can learn to use the device, and that the device is biocompatible and functional for years. The next phase is a 60-microelectrode array. It is about a year behind schedule because the device caused some retinal folds in a few of the animal tests. That problem has been solved. It was implanted in two patients in

Mexico. US trials will begin in June with 35 subjects at four centers. The design of the third-generation device (one with 240 microelectrodes) is complete, and all component parts have been constructed. The next step will be joining of four 240-electrode array into a “1000-electrode” array.

Jerry Elwood: Climate Change Research Division (CCRD) – (presentation available)

The CCRD is producing a series of synthesis and assessment products (SAPs) to make sure that scientific research is assessed, synthesized, and communicated to decision makers. These SAPs are designed to perform analyses structured around specific questions, help define future directions and priorities of the CCSP, and satisfy assessment requirements of the Global Change Research Act of 1990. (All the SAPs may be summarized in one document to try to meet that requirement.) The first SAP reviews scenarios of greenhouse-gas emissions and atmospheric concentrations and reviews integrated-scenario development and application. It has been released. The second assesses climate-model strengths and limitations. It is under review. The third considers the effects of climate change on energy production and use in the United States. It is in preparation.

The IPCC reports have been released and are sobering. The CCSP needs decision-support science. The challenges are (1) to provide decision-makers with scientific information and allow informed decisions and (2) to develop possible adaptation and mitigation strategies to deal with future climatic changes and their effects. One therefore needs to know what climates would be produced under different forcing scenarios so one could make informed investments in strategic responses. This program needs to address the questions of what will happen, what would climate change mean, and what can be done about it. Investments in resources and research need to be mapped out.

A strategic plan is needed to map out DOE’s future investment portfolio in climate-change research. The Division’s proposed strategic plan has five overall goals: advancing climate and Earth-systems modeling, improving understanding and model representations of climate processes and Earth-system processes that can affect climate, improving understanding of human impact on and consequences of climate change, improving capabilities and infrastructure for conducting climate-change research, and managing through strategic and problem-driven management approaches. The draft plan is currently under review by BER’s staff and should be publicly available by the fall meeting of BERAC. Options for an independent review of the draft plan include (1) holding a workshop under the BERAC umbrella to review the draft plan, (2) holding a workshop under the BERAC umbrella to develop a plan ab initio, and (3) holding a workshop not under the BERAC umbrella to develop ideas and findings but not recommendations.

Discussion: The debate about the strategic plan should be carried out under the BERAC umbrella but should not have to start from scratch. Rather, it should review the staff-suggested draft. The second and third options did not seem reasonable. Federal Advisory Committee Act requirements would be met by having the workshop conducted by a subcommittee of BERAC and by having its report come back to BERAC for review.

A break was declared at 10:38 a.m. The meeting was called back to order at 10:50 a.m.

Michael Kuperberg: Environmental Remediation Sciences (ERS) Division –
(presentation available)

By 2015, the Environmental Remediation Sciences Division is to provide DOE sufficient scientific understanding to allow a significant fraction of DOE sites to incorporate coupled biological, chemical, and physical processes into decision making for environmental remediation and long-term stewardship, backed up by annual and quarterly measures.

ERS Program (ERSP) investigators received an E.O. Lawrence Award and two IR 100 awards this year for research ranging from fundamental biology to biosensors for uranium.

In October, the Division's Environmental Molecular Sciences Laboratory (EMSL) will celebrate its 10th anniversary of operations. EMSL, a national scientific user facility at PNNL with a \$36 million annual operating budget, has developed an interesting management tool, the EMSL strategy dashboard, to quantify scientific progress.

The Division's portfolio spans a great range of scales. The FY06 research solicitation (Notice 06-12) received more than 180 proposals that were peer reviewed. Processing of awards and declinations are complete, but the funding process was complicated by the FY07 budget delay. Forty awards were made, reflecting a 20% success rate for full proposals. Notably, seven exploratory research projects are being funded; these are high-risk/high-payoff projects conducted by young scientists.

The Integrative Field-Scale Subsurface Research Challenge solicitation received five proposals, of which three were selected for funding.

The FY07 ESRP solicitation was issued in March with a deadline in early May. It received 117 proposals from university leads; reviews will be conducted in July, and awards made in FY08.

In the near future, the Division intends to review and fund proposals to the current solicitation; work with national laboratories to implement the new SFA approach; continue oversight of EMSL; oversee the procurement, delivery, and operation of the next-generation supercomputer; host a COV visit, and review the PNNL-contract stretch-goal performance with BERAC.

Discussion: The Division was not thrilled with the response to the first exploratory-research call for the ERSP. People were not interested in taking the risks hoped for.

John Zachara: Biogeochemistry of Technetium – 2007 E.O. Lawrence Awardee –
(presentation available)

At the Hanford site, 400 Ci of ^{99}Tc were disposed of in trenches and cribs. A plume of technetium is now migrating toward the groundwater, which flows to the Columbia River. Fundamental research is being conducted to determine if the technetium can be immobilized in the soil through the action of microorganisms.

Technetium exists in valence states of +7, which is infinitely soluble in water, and +4, which is not as soluble but still produces a concentration above the regulatory standard to which DOE is held. The physical chemistry of the valence-change reactions needs to be understood. Coupled processes are involved that are mediated by microbiologic transformation, advection and diffusion of water, and microbiologic speciation. These processes can vary with pH, concentration, temperature, etc. and can be competitive, sequential, or simultaneous, leading to different products.

A lot of time has been spent looking at kinetic pathways for Tc(VII) reduction and Tc(IV) oxidation with X-ray adsorption spectroscopy, Mössbauer spectroscopy, and combined techniques to determine valence state, local structure, and Tc interactions. Many metal-reducing bacteria (such as *Shewanella*, *Anaeromyxobacter*, and *Geobacter*) like to change the valence of TC(VII) and other metals at different conditions, producing a variety of products. Such biologic processes can be 10 times more effective than chemical processes.

Biotic experiments have shown a marked reduction in Tc concentrations, but not enough. Experiments with simplified systems indicate that the electron donor plays a major role, heterogeneous Tc(VII) reduction predominates in Fe(III) oxide-microbe systems, microbiologic reduction may predominate under some conditions, Tc(VII) speciation varies in octahedral chain length, and Tc(IV) oxidation rates are slowed by mineral association. As a result, given the evolving hydrology at the Hanford site, heterogeneous reactions may be observable and effective. Furthermore, mineral phases shown to capture Tc are present in the Hanford soil. These results are being used in modeling to identify natural attenuation mechanisms, quantify biogeochemical processes that can reduce the concentration of Tc(VII), and bound constraints imposed by natural processes.

Discussion: Surprisingly, the three experimental organisms behaved very similarly; however, there were differences in their rates. This fundamental science seems close to producing constitutive relationships for predicting migration, so models could be applied to different sites. This work also provides insights on initial conditions at various sites.

Administrative Discussion

Broido announced that the Committee had received a charge for a COV to review the Environmental Remediation Sciences Division.

The floor was opened for public comment. There being none, the meeting was adjourned at 12:23 p.m.

Respectfully submitted,
Frederick M. O'Hara, Jr.
Recording Secretary
May 22, 2007