MINUTES

Biological and Environmental Research Advisory Committee (BERAC) Meeting
Office of Biological and Environmental Research
Office of science
U.S. Department of Energy

DATE: November 13-14, 2003

LOCATION: American Geophysical Union, Washington, DC. The meeting was announced in the Federal Register on October 28, 2003.

PARTICIPANTS: Approximately 75 people were in attendance for part of all of the meeting. Sixteen BERAC members were present:

Keith Hodgson	Richard Hallgren
James Adelstein	Will Harrison
Eugene Bierly	Steven Larson
Michelle Broido	Roger McClellan
Carlos Bustamante	Lisa Stubbs
Charles DeLisi	James Tiedje
Ray Gesteland	Warren Washington
Jonathan Greer	Barbara Wold

Seven BERAC members were not present:

David Burgess	James Mitchell
Robert Fri	Lou Pitelka
Leroy Hood	Janet Smith
Jill Mesirov	

(Information on the BERAC membership can be found at: http://www.science.doe.gov/ober/berac/members.html)

Thursday, November 13, 2003

Ray Orbach, Director Office of Science

Secretary Abraham announced on Monday the new 20 year facilities outlook for SC. All four Genomes to Life (GTL) facilities recommended by BERAC are included. Two of these are in the first priority group (epoch). The other two GTL facilities are in the second epoch. This is not the case for all advisory committee recommendations. Priorities in near, mid, and long terms. Priorities within each epoch are independent. This is not a funding or budget document. This document will help SC spend money according to priorities when funds become available.

Prioritization across fields was accomplished first within disciplines by advisory committees and Associate Directors and then based on readiness and perceived importance to science. Ended up with 53 recommendations that were cut nearly in half for the final document.

The GTL facilities will revolutionize the next generation of biological research in much the same way that the Production Genomics Facility (and other sequencing centers) did for genomics and biology.

SC programs are still not authorized. Our authorization is still tied up in the energy bill. We haven't been authorized in 15 years. The current version of the authorization bill sets a spending limit for SC of 60% over current funding over the next four years. We remain hopeful that this will pass soon.

Facilities other than the four GTL facilities will benefit biology. The Linac Coherent Light Source (LCLS) will be a remarkable new light source. Its average intensity will be two orders of magnitude greater than any third generation light source. It may enable structure determination of single macromolecules and measurement of chemical reactions of small numbers of molecules in real time. New computational capabilities will enable real time handling of huge amounts of data in real time.

Virtually any facility that has a control room will be controllable remotely by users. This will fundamentally change how scientists can and are able to do experiments.

How will these facilities come to pass? Lehman reviews are famous around the world for their determination of cost and performance. We will be working toward CD-0's over the next few months for the facilities in the first epoch. CD-0 does not mean construction begins or that money is in hand. CD-0 establishes mission need for the facility. Without CD-0 can't do development of conceptual design and can't request funds for Project Engineering and Design (PED). The people who approve CD-0s depend on the size of the facility. The new DOE project management plan has a $400M cutoff at which Deputy Secretary must sign off. If project costs are below $400M the CD-0 goes to the Under Secretary who has delegated authority for sign off to SC-1 for SC projects. In the new 20 year facilities book, the "red" facilities are ready to go. The "blue" and the "green" facilities are not ready yet. Funding profiles and other requirements described in the project management handout are needed to go beyond CD-0.

A word about budget. The conference report between the House and Senate Energy and Water Committees is available on the web. We hope these votes will take place next week. A "record" of nearly $100M for Congressional earmarks is in the BER budget although fortunately most of these are funded. These are grouped in paragraphs by House and Senate Democrats and Republicans. About $8M in earmarks is not covered which is simply a cut for BER. Genomes to Life research did get increased by $5M. Overall, the numbers for SC are up by 5.8% over FY 2003 which was a catastrophic year.

We are working hard on the FY 2005 budget. We will get our passback from OMB about Thanksgiving. Revisions will be made in December and the budget will go to the printer in mid January. The President submits the final budget to Congress at the beginning of February.

Thank you for your efforts. I know and appreciate that BERAC has an extraordinarily broad reach across scientific disciplines.

Questions and Comments

Comment on Secretary of Energy Advisory Board (SEAB) report on the role of science within DOE. Chuck Vest, President of MIT, was the chair of this high profile committee that included members from academia and industry. This report is on the web and accessible through the SC web site. It is an extraordinary document. It talks about the importance of science for all DOE's missions. The basic science must be in place to underpin DOE's responsibilities such as hydrogen and the environment. These are recommendations for the Secretary. Informal comments to Ray are still welcome.

Relationship between SC and NIH? We have plans to continue developing our relationship with NIH both in general and more specifically in areas where there are common goals. NIH and SC already work closely together. The SPEAR 3 upgrade was a joint effort. We are complementary to and different from NIH. NIH is focused on human health. BER develops biological applications for other purposes. We do biology because DOE needs it, not because we are trying to duplicate what NIH does. Ari and I have spent many hours on the Hill trying to explain why NIH shouldn't and can't do all "life sciences" research. We have been contacting each multi purpose lab to put together a plan or consistent strategy for working together with NIH. Our target is to have a plan that can be discussed with NIH by mid December. Interagency collaboration is in everyone's best interests.

Mark Humayun, University of Southern California
The Artificial Retina Project

Several hundred thousand people are blind because of degeneration of their retinas that affects the light receptors in the eye. There has been difficulty in device engineering in the early stages of the project.

Progress in the previous 10-15 years. A camera captures images and sends a signal to a pager sized device that is connected to an electrode behind the ear. Implants of the first prototype device are in three patients. The neurons that remain can be stimulated. A key question is whether you can actually by-pass damaged neurons? (The cochlear prosthesis is an example where this has been shown to work.) The device goes on top of the retina rather than underneath which would cause significant thermal damage. We showed early on that a blind person could "see" simple shapes following retinal stimulation.

There is lots of international interest in the development of an artificial retina. Germany, Japan, Australia, UK, Switzerland, Korea, and India all have projects.

In the laboratory we can interface with the patients through a camera or lap top. We can sequentially stimulate electrodes and the patients can correctly identify the pattern of stimulation ~50% of the time (compared to 25% by chance). Completely blind patients can distinguish light from dark with >90% efficiency.

Unaided mobility will take up to 600 pixels. ~1000 (32x32) pixels will be needed to read large print. ~10,000 pixels will be required for small print.

The initial device is not scaleable to higher resolution. It is hand made with bulky electrodes. The case for the electronics only allows 16 wires/electrodes. The electronics and telemetry circuitry are larger than the eyeball and are relatively inefficient.

There are many challenges to be overcome to build a higher resolution artificial retina. Electrode size – needs to be flexible, electrochemistry constraints, constrained by proximity of stimulators to neurons. Device power – biological thermal limits, smaller electrode size leads to higher impedance. Packaging – hermetic seal. Image processing is needed in real time. Implants need to be stable.

DOE's unique role in this multi institutional project that includes labs, universities, and industry. DOE labs: ORNL, LLNL, SNL, ANL, LANL. Universities: University of Southern California, University of California Santa Cruz, North Carolina State University. Industry: Second Sight.

DOE lab developments/contributions - Silicone rubber conformable electrode array (LLNL). MEMS spring electrode array - SNL. ANL – diamond dust coating for hermetic sealing (provides a protective skin).

Applications for other neural disorders in the future.

Questions and Comments

Voltages? ~10 kohm resistance. ~10 micro amps needed for sight. ~1 volt. This will be a challenge since device resistance goes up with smaller electrodes.

The transfer of DOE technology to medicine has always been an important theme. Don't want this to get lost in discussions about applications of DOE biology to non-human health research.

Will bio-nano research be helpful here or is it too small? Diamond coatings are nanoscale already. Need to make nano-scale "dimples" on the surface of these electrodes to ensure biologically relevant interactions.

Spatial and temporal aspects of vision. Patients have to relearn to see. Takes patients about one month of work with the camera to begin relearning. Patients actually get to the point where they know which electrode is being fired. Why not use recently blind patients? This is a safety trial under the FDA so starting with completely blind patients who are elderly makes more sense.

What about neuro-regeneration strategies? Previously transplanted several patients with fetal neural photo receptor cells. Complete retina was formed but no connections to the host were made. There appears to be a critical time window immediately after birth.

Chris Stubbs, Harvard University
Computational Aspects of Medical Imaging

Joint DOE/NIH (National Institute of Biomedical Imaging and Bioengineering - NIBIB) JASON study this past summer on shortfalls in available computational needs in medical imaging over next 5 years or so.

Impressed with existing efforts. Combination of applied math, computation, and biology. Computational demand of generating, analyzing, and displaying biomedical image data is within current capabilities of high-end systems. Some clear trends that emerge.

What is computationally hard?

- Evolving from qualitative to quantitative analysis
- Using common metrics for algorithm appraisal
- Integrating across modalities and length scales
- Evolving towards an accepted metadata standard
- Database architectures that accommodate image data
- Connectivity across federations of distributed data sets
- Cultural issues – data access, open source, etc.

Domains of medical imaging from molecular to whole body and from basic to clinical. The goal is to move molecular/cellular information to the clinic.

Qualitative versus quantitative image analysis. Different imaging techniques require different image construction algorithms. Raw data and calibration parameters are seldom stored. Algorithm work is still needed.

Storing image data (even up to Tbytes) is not a big deal but moving this data around is a big deal and an impediment to telemedicine.

Why quantitative image analysis is hard

- Uncalibrated data
- Geometrical registration
- Things move over time
- Automated feature recognition

Parameter fitting/extraction
Uncertainties
Quantitative comparison with relevant group or past history

Need for data bases of the above that can be queried.

Data management issues
Databases
Longevity
Confidentiality
Resilience/redundancy
Interoperability

NIH Biomedical Informatics Research Network (BIRN) – some of these things are already happening

Interactive visualization tools. Feature identification and highlighting. Identification of relevant comparison images.

How hard is visualization uncertainty? Value of interactive displays. Heritage of xray films. There is a research community working on multidimensional uncertainties.

Why can't we teach computers the laws that govern biology. This is a major computational challenge but also a real opportunity and benefit.

Recommendations –

- Calibration and linkage with images will enable fusion of imaging methodologies and analyses.
- Develop and distribute standardized sets of test images. Use as a testbed for metadata standards. National Library of Medicine Visible Man project is a good starting point. Include images from all modalities and model systems.
- Cultivate an open source approach and culture
- Promote computer-assisted qualitative analysis in the clinical setting.
- Develop appropriate databases.
- Propose grand challenge problems to the biomedical imaging community

Pat Dehmer, Associate Director for Basic Energy Sciences

Basic Energy Sciences Advisory Committee (BESAC) activities in recent years – basic science drivers, user facilities and advanced tools, science for DOE

~1000 PIs funded – materials properties and transformations at various scales with increased emphasis on understanding complexity at each scale for science and DOE.

Use of electrons, neutrons, and photons to "see" molecules.

Previous top-down construction of materials to the current bottoms up assembly.

Suite of user facilities to see, characterize, and fabricate. We will be able to add a time dimension with the new Linear Coherent Light Source (LCLS). There are currently ~8000 users at the light sources each year. Users represent biology to geosciences to materials sciences. More than half of light source users are not funded by DOE. Neutrons will be one of the next frontiers. Haven't had sufficient, robust neutron sources in the United States. The Spallation Neutron Source (SNS) under construction at ORNL will be the world's leading neutron scattering source. The LCLS will revolutionize the way we do x-ray science.

National Nanotechnology Initiative. Four nanoscale science research facilities. Research for synthesis, processing, fabrication, analysis, and characterization of nanoscale materials plus operation as user facilities. Co-located with other large user facilities. Broad community input during the development of these facilities. NSF, DOD, and DOE are the 3 lead agencies in the US nanoscience initiative. DOE's role will grow as these new centers begin to operate.

President's Hydrogen Initiative. Recent BES report on basic science needs for a hydrogen economy (on the SC and BES web sites). Hydrogen production, storage (probably the current show stopper), and use are the key challenges. Significant research challenges in each area. Not an issue of incremental improvements. Report generated a lot of interest at many levels.

Questions and Comments.

Coordination of nanotechnology with other agencies? Interagency working group that began out of the Office of Science Technology Policy (OSTP) is now part of the National Science and Technology Council (NSTC) process.

Interaction with industry in the nanosciences? We don't formally have a lot of industrial interactions though many BES PIs do have strong industrial interactions.

Jim Mahoney, Department of Commerce
The U.S. Climate Change Science Program: Strategic Planning to Implementation

Encouraged that BER is proposing a new focus on atmospheric aerosols.

A key part of this presentation's title is "Strategic Planning to Implementation."

Total U.S. Climate Change Science Program (CCSP) budget ~$1.75 B per year. 13 agencies have programs, thus there is a great deal of independent activity since the program involves 13 different appropriations. Good progress has been made given all the planning acitivities that have gone on.

A June 2001 National Research Council report identified aerosols as a key area of uncertainty. A key CCSP priority is to increase modeling capacity with a focus on improving model physics, particularly with respect to clouds and aerosols.

June 11, 2001 – Climate Change Research Initiative and Climate Change Technology Initiative (CCRI and CCTI) announced by the President. February 14, 2002 – new cabinet level management responsibility was established for climate science and technology programs. The goal was to provide additional funds to accelerate work that would help the climate change debate. The goal was to define activities and obtain successes in the near term – 2 to 5 years.

CCSP – Principles

- Goal and question oriented strategic plan.
- Integration of US Global Change Research Program (USGCRP) and CCRI.
- Policy neutral standards.
- Combined scientific community and stakeholder review.
- Transparency and comprehensive standards in assessment and decision support.
- Reporting of degree of confidence in findings.

Facilitate the creation and application of knowledge of the Earth's global environment through research, observations, decision support, and communication (not just telling).

The National Academy of Sciences reviewed the original draft of the CCSP strategic plan and is now reviewing a revised strategic plan. Draft reviewed in February 2003. Broad community workshop (~1300 participants) in December 2002. Plan adopts 4 braod approaches reflecting 5 CCSP goals. Responds to President's directives and NRC (Pathways) recommendations for more focus. Commits to continuing long term research.Includes 21 synthesis and assessment products (reports) to be produced over the next 4 years.

5 Goals :

What do we know from the past?
How well can we quantify what we know goes on in air, land, ocean?
Reducing uncertainty?
Ecosystem impacts and feedbacks?
Decision support?

The document overall actually identifies 137 areas of deliverables from all agencies over the next 4 years, plus an additional 74 beyond 4 years.

Questions:

Intent not to duplicate Intergovernmental Panel on Climatge Change (IPCC) activities but where will US focus be that distinguishes it from IPCC? Massive investments in

technology. What are the potential impacts of technology on emission scenarios? Diverse modeling activities.

How is this large program coordinated across agencies? Cabinet officers generally don't get directly involved but the Deputy Secretaries do. This group meets regularly and does push issues on both the science and technology side. Compared to the last decade there is much more direct interagency interaction and accountability.

Dave Conover, DOE
U.S. Climate Change Technology Program

Initial focus on National Climate Change Technology Initiative (NCCTI – often referred to as "neck tie") solicitation (~$40 M) but no funds were provided from Congress in FY 2003 or FY 2004.

Put out request for information/concepts that was reviewed by 6 working groups.
Majority of responses were eligible for agency funding.
Multiagency R&D baseline for FY 2005 (improved climate change criteria and cross-cut).
Technologies compendium.
Current activities report.
Strategic R&D vision and framework.

6 working groups – Energy Production, Energy Efficiency, Other Gases, Sequestration, Measurement and Monitoring, Basic Research (Ari Patrinos chair). Most $ for CCTP in current DOE programs.

Examples of R&D portfolio components –

Energy efficiency and renewable energy
Freedom Car
Hydrogen Fuel Initiative
Fuel cell systems
Future Gen (net zero emission coal fired power plants)
Regional carbon sequestration partnerships
Carbon sequestration leadership forum
Nuclear power Gen IV
Nuclear power 2010
ITER (fusion)

Three scenarios:

- Closing the loop on carbon – i.e., carbon sequestration works
- A new energy backbone – need for carbon sequestration overtaken by other events/options
- Beyond the standard suite – major breakthroughs, new energy options

Questions:

Strategy to help convince people that nuclear power is a viable option? Public perception is an issue. Our role is not as an executor of these programs. These are part of the overall strategies of the Administration initiatives.

As part of the nuclear power program is there part of DOE that is encouraging universities to retain or reinvigorate training programs? Yes, this is critical.

John Zachara, PNNL (with Jim Frederickson)
Report on Biogeochemistry Grand Challenge

Biogeochemistry grand challenge. Year long process. December 2003 report to BER. This is intended to be part of all performance-based contracts with Office of Science laboratories.

General theme – microbe-mineral interactions. Exploring the mineral-microbe interface. This region is dynamic with chemistry and structure determined by interplay and response. Organisms generally using energy stored in the materials to drive their metabolic processes.

Supports multiple DOE missions (environmental and remediation sciences; energy and a sustainable environment) and BER programs (GTL, NABIR, EMSP). It takes advantage of unique DOE resources and capabilities (light sources, computing, and EMSL for example).

November 4-5, 2003 workshop

- State of knowledge on electron transfer at the mineral microbe interface
- Identify and prioritize impactful science topics
- Discuss key science issues that underlie the most exciting topics
- Evaluate computational and experimental capabilities including new ones
- Comment on why the priority topics are broadly impactful

Respiration of insoluble extra cellular materials is a key aspect of several BER programs (NABIR, GTL, EMSP), e.g., conversion of metal or radionuclide valence states.

Two major themes/goals:

Regulation of electron flux between cells and solids – effects of solids on cell metabolism/response.

- Structure/conformation relationships
- Cell surface components and their role in electron transfer and biomineralization

Interplay between microbes and the surface, structural, and electronic properties of minerals.

- Sensing/recognition and response to extra-cellular electron acceptors/donors
- Electron proton coupling

Template effects and biomineralization

Broader impacts – function and chemistry of outer membrane proteins; microbial energy conversion; carbon sequestration; life beyond earth; non-engineered systems; co-evolution of biosphere and geosphere

Questions:

Very important area in the microbial science world. How do microbes sense and interact with their environment – both medically and environmentally?

Does the interface ever get depleted of the electron source? The mineral substrate can be transformed to different structural or transition state changing the profile of available electrons.

Do the microbes form surface colonies? Actually end up forming biofilms. How the electrons can be donated through the biofilm is unknown. Intermicrobe connectivity?

Communities or biofilms in the real world? Don't know but at least a colony of organisms. There are thin and thick biofilms though people usually think only of thick ones.

What are some of the environments where these organisms exist? Many. Sediments, aquifers, fresh water sediments, oceans.

What is the basis for the relative selectivity that microbes have for metal ions in mixed media? Many factors. Redox potential. Concentration. Free energy that can be extracted. One hypothesis is that organisms can sense differences in the surface but that reduced iron sends message that oxidized iron available.

Ari Patrinos, Associate Director for Biology and the Environment

Any questions following Ray Orbach's presentation this morning?

Prioritization of facilities. Four BER facilities in first two priority groups. Question about where they fall within their respective groups and what it means with regard to actually getting funded. Unprecedented for BER to be represented in a list like this. The first two are essentially givens. ITER was a Presidential initiative. Computation was Ray's first priority in coming to SC given its broad applications across all SC (and other) programs. Computing is also the number one priority for BER as well. High performance computing will benefit BER as much or more as others. With regard to Genomes to Life facilities you simply have to believe. Persistence and patience pays off. Will there be money next year? FY 2005 looks pretty grim right now. Should remember that four facilities were approved at the same time under Reagan administration and all were built. All four BER

facilities made the list in contrast to ~50% from other SC offices. There is a rational plan for starting these facilities in a phased plan.

Why does BER get more earmarks than other parts of SC/DOE? Wasn't that common to have earmarks in basic research budgets 10-20 years ago. Initial focus on medical projects – hospitals and hospital wings. Logical link to BER medical program. BER was the last office to join SC and we are the one that sticks out. Perhaps simply an easy target. We are fortunate this year since most of the funds were added and we may in fact nearly break even in the end not counting the anticipated general reduction. "If you're not living on the edge you're taking up too much room." OMB propagating a peer review of all science in the science agencies – this could have a major impact on research-based earmarks.

Reference to Life Science from Homeland Security last year. Additional threats? Opportunities for collaboration? National labs are doing significant amounts of DHS research but BER is not.

Remarks

Some loosening in ability to hire. Looking for geneticist. A few climate change openings. Environmental Remediation division changes – Brendlyn Faison gone; Henry Shaw to return to LLNL at the end of this year; Chris Cooperberg joining as IPA soon from Florida.

FY 2004 conference language.

Additional funds for GTL (+$5M) and EMSL (+$2M). Specified our request levels for SREL and low dose. New molecular imaging probes (+$5M not in request). $87.4M in earmarks. Net of $6.9M below request though did get back about $1.5M for complicated reasons.

Still uncertain fate of Energy Bill depending on who you ask.

FY 2005 picture seems difficult given broad economic issues. OMB will likely have to put the screws on science funding. Anticipating cuts. Have been doing exercises with 5 to 10% reductions internally.

SC reorganization as part of the President's management agenda. Headquarters and field impact. Formation of site offices at all our labs and elimination of some field offices. BER has stewardship responsibility for PNNL so we have a very close relationship with PNNL site office staff and issues. Safety is a high priority for Ray Orbach. We had not been doing as good a job as we should have in the past. Long time laboratory contracts are now being or will likely be competed in the next few years. Much more involvement in developing performance metrics for the labs and the contractors resulting in larger or smaller fees.

Importance of intra and inter agency partnerships. Sorry I couldn't be here when Pat Dehmer spoke about hydrogen and nanoscience. Our path forward with GTL facilities development will benefit from these diverse partnerships. BES and ASCR partnerships in SC are particularly important. Long standing collaboration with many agencies in climate change program. The problem is bigger than any one agency. Environmental Remediation partnerships with EM and Office of Naval Research.

Have had ongoing discussions with Mary Clutter, NSF Biosciences Director. Recognition of value of GTL research and facilities. Quite a bit of integration through NSTC Biotechnology Committee. What we would like to do is create a joint BERAC - NSF Biology Subcommittee to identify opportunities for substantive interaction. Will be calling for volunteers.

High level attention has been paid to interactions with NIH in SC and at DOE. Ongoing partnerships with many NIH institutes. NHGRI, GM, NIBIB, and many more. High level discussions between Elias Zerhouni and Secretary Abraham, Under Secretary Bob Card, and Ray Orbach. We are working on these interaction both at the highest levels and at staff levels across several institutes. There are cultural differences that need to be accommodated. Working with several lab directors to further these interactions. Wil have an update at the next BERAC meeting.

GTL program will be changing its name to Genomics for Energy and the Environment: Genomes to Life or maybe just Genomics Program: GTL. OMB and the White House (the President's science advisor) are insisting that the name be changed. GTL name rang alarm bells that GTL was about human cloning, stem cells, medical research, NIH research, etc. Have developed significant name recognition in the scientific community but we don't have a choice.

In spite of its high profile and success, our Medical Sciences program will continue to be a program that we regularly need to defend and justify. This is one of our toughest sells.

Press conference this morning with the Secretary, Craig Venter, Ham Smith, and Clyde Hutchinson. Announced faster than expected progress in IBEA's (the Institute for Biological Energy Alternatives) ability to accurately and rapidly synthesize a phage genome from scratch. The success in synthesizing this 5,000 base pair genome gives optimism to the hope that a microbe 100 to 1,000 times larger can be synthesized for use to address specific DOE energy and environmental needs. BERAC is being asked to put together a subcommittee chaired by Ray Gesteland to report (by March 12, 2004) on how this accomplishment can be used to accelerate GTL and other DOE-relevant efforts.

Public comment – None

Adjourned at 5:54 PM.

Friday, November 14, 2003

BERAC Charge Reports

Michelle Broido - Two charges.

Additional field research sites? Subcommittee met at Field Research Center meeting at ORNL in the fall of 2003. Additional field research sites are being recommended. Why? Based on analysis of what has been learned so far at NABIR ORNL site and on value of user support provided by existing site to researchers who normally don't do field type studies. The scientific value of field research sites is limited by the field conditions at any given site so sites with conditions different than those at the existing site should be chosen. Need to ensure that new sites have a capacity for long term study essentially requiring that they be located at DOE sites. Draft report to be finalized in the next few weeks.

Review of mesoscale research needs for subsurface science at INEEL. A February 2004 meeting has been scheduled.

Gene Bierly - Two charges

Atmospheric Science Program reconfiguration. Mahoney referred to this yesterday in his remarks. Need for a comprehensive study of aerosols. Need fundamental understanding of aerosols and how to incorporate this new information into climate models. There is aerosol research going on at other agencies but there are still gaps that BER will fill. Transition of atmospheric chemistry and meteorology programs. Goal is to address uncertainties in magnitude of forcing from atmospheric aerosols. A panel has been put together. Will meet Monday – Wednesday November 16-18, 2003 to provide guidance to BER. Only about $12M available so budgetary constraints. Recommendation will include evaluation of ongoing aerosol research programs across the federal government as well as current and planned activities at DOE, e.g., ARM and mobile ARM, UAV, computing capabilities, modeling expertise in atmospheric sciences, etc. Anticipate short report outlining guidance to BER.

Comment. Pleased to see this program go forward. EPA clean air standards includes particulate matter information but not much on aerosols. Impact of aerosols is one of biggest uncertainties in climate modeling. Congratulations of Ari, Jerry, and DOE for taking this on.

Committee of Visitors. NSF has been reviewing their programs using this approach for many years. OMB likes this approach because of it usefulness in addressing Government Performance and Results Act needs. The BES chemistry program was reviewed by a Committee of Visitors about a year ago. Committee did a wonderful job. A tough act to follow. OMB examiner Joel Parriott said that this is the model to follow. BER Climate Change Research Division will be reviewed first. The panel is scheduled to meet February 3-5, 2004. This is ok with OMB. Looking at all projects – lab and university. Close to 300 projects that could be assessed. Efficiency, fairness, and quality of process

from solicitation through review to funding and progress of ongoing projects. Team will go through a sampling of project jackets. Will look at everything that is available. BES panel had subject experts go through jackets the first day followed by a review by nonexperts the second day. Both groups came up with the same findings. The charge is to look at the process but the committee will also look at the science. Will use experts in science and science management.

Is there a way to do this in a proactive versus reactive model? Expectation that all four BER division will need to be reviewed in no less than four years. Should plan as soon as possible to get these scheduled and organized. BES chemistry review was very positive and not antagonistic.

Steve Larson – Medical Imaging Report

At the April 2003 meeting BERAC approved a report on radiopharmaceutical research and development. Orbach had asked how we might best support future radiopharmaceutical development including both research and training and the roles of other agencies. There is an element of urgency to one recommendation in the report in the area of the complementary role of the agencies. The DOE program is under scrutiny for its role in the biomedical arena. The subcommittee would like to flesh out interagency coordination and further define DOE's role. There is an opportunity for communication and interaction with NIH to best take advantage of the expertise and capabilities at the national labs.

Reflections on yesterday's discussions – Keith Hodgson & BERAC

A few issues from late yesterday. Any issues to bring to Ray's attention? GTL? Congratulations for getting GTL facilities where they are in the facilities plan. Any more information on how facilities siting will be done? Primary competitions will be done among the national labs. Criteria for selection, operation, and sustained operation will need to have a strong academic involvement. Details of how this will all happen are still being worked out. Labs will be sole and principle sites? The entities that compete will be the national labs. The DOE system not set up for alternative competitions unless the department is ready to establish new national labs. This is disappointing given BERAC recommendations. Is the optimal environment for each of the facilities going to be achieved by having the facilities on a national lab site? JGI/PGF model is a good example. Value of co-location and synergy with nano science centers and light sources. We are talking about all the GTL facilities not just the first one.

Is GTL being backed up against the ropes resulting in some of the originally discussed key science being squeezed out? Are there ways to reclaim some of the science that has been lost over the past few years? Looking at a strategy for the long view. Secretary spoke of discovery science for the sake of science in his remarks on Monday at the facilities roll out. Why should biology be any different than the other areas of DOE

supported science. BERAC hould convey this message to Orbach and the Secretary in some way. The Secretary has said that nothing that the Department has done for science is as important as what it has done for the Human Genome Project.

Ari is on the hook with the Under Secretary to come up with a DOE-NIH interaction plan by mid December. Need to make sure that this gets attention at the highest levels and support at the working levels of both agencies. Having a subset of BERAC that can help at the appropriate times in our interactions with NIH would be very useful. Greatly encouraged by the mandate to do some of these things. BERAC doesn't want to see a duplication of efforts but there is great value in taking diverse approaches to some key, fundamental areas of science.

There is a vested interest in some quarters (among excellent scientists) in supporting DOE. Most or all around th table probably ha ve a current or past interest. We need to identify some people who can speak for DOE but who have no "contaminating" link to DOE. There was a recent article in The Scientist about systems biology that focused on NIH with no mention of DOE science. Send thoughts or suggestions to Keith.

We should try to engage Ray at the next BERAC meeting to talk about some of these issues.

The DOE web site is all about energy and little if ever about science. Need to remember that this is the Department of Energy after all. Even at Monday's press event most of the questions were about the energy bill not about science.

Andre Syrota – Director of Life Sciences, French Atomic Energy Commission (CEA)

CEA is faced with the same questions as DOE about why there is biology at the CEA. Nuclear Energy (5000 people), Technology Research (~2500 people), Basic Research (~2500 people).

CEA Life Sciences - Radiobiology, Isotopic Labeling, Biomedical Technology. ~1400 staff. About half are from the CEA and remainder are from the French equivalents of NIH and NSF. ~70M Euro from CEA and ~15M Euro from royalties such as the prion test.

Structural biology. European Synchrotron Radiation Facility, neutron facility, and NMR. Biohydrogen program – biomimetic catalysis and hydrogenase modification.

Biochip program. Focus on understanding the biological effects of radiation.

Radiobiology program. DNA damage and repair. Cell cycle check points. Structural radiobiology to determine 3D structures of DNA damage recognition and repair proteins.

Nuclear toxicology. Biological effects of compounds involved in nuclear industry activities.

Nuclear and environmental toxicology programs. Research from biogeochemistry to metal reduction by microbes to treatment of exposed people.

Nuclear medicine and functional imaging. Cognitive processes. Nuclear medicine. Imaging gene expression. Tools for drug development. ImaGene – preclinical imaging facility for gene and cell therapy. New facility under construction. NeuronSpin – a new neuro imaging institute based on very high field MRI (11.7 T magnet). 17T for mice, 11.7 T for human and primates, 3T for humans is currently planned.

Prion diseases. The prion test that was developed by the CEA meets 70% of world market need.

Lab on a chip. Potential for >1 million PCRs per day. Cell sorting chip. Cells are trapped in a dielectrophoretic cage for individual cell analysis.

Potential areas and tools for cooperation.

- Radiobiology
- Environmental toxicology
- Medical imaging
- Depollution, decorporation
- Access to facilities and animal models
- Joint programs, calls for proposals, workshops.

Dan Rokhsar, Director of Infomatics, DOE Joint Genome Institute (JGI)

Microbial pre-finishing and finishing at JGI/LLNL/LANL. Should complete the 100th draft microbe this year. Doing more DNA sequence finishing recently.

Lactic acid bacteria project. Sequence 11 diverse lactic acid bacteria. Consortium of >12 faculty and researchers from across the US. Finishing being done by individual investigators.

Sudden blight and sudden oak death. Two different Phytophthora. With Gordon Moore Foundation for functional genomics. Both genomes nearing completion.

Two different rot fungi. Lignin degrader. Industrial uses. USDA/Fort Detrick (provide DNA) project on soy bean rust fungi of potential bioterrorism concern. No soybean rusts yet found in the U.S.

Chlamydomonas reinhardtii. Principal eukaryotic model for studying photosynthesis and carbon assimilation. Cytoskeleton provides model system for human diseases of interest to NIH. Leveraging NSF projects as well.

Populus tricarpa (cottonwood tree). First woody genome sequenced. Relevant for global climate change, renewable bioenergy supplies, and carbon sequestration. International collaborators – Swedish cDNA, Genome Canada mapping and cDNAs, INRA EST/cDNA. Sequencing phase to be completed this month.

Many animal phyla with no sequence data. Convening a panel to nominate unsampled animal phyla for sequencing.

Current major animal project - Xenopus tropicalis. A true diploid versus X. laevis which is a pseudo tetraploid. Coordinated with Washington University BAC map and with cDNA projects at NIH and Sanger. Done in conjuction with EPA. Aiming to complete in summer 2004.

Proposed/planned organisms
Amphioxus. Invertebrate most closely related to vertebrates. 500-600 Kbp genome
Daphnia pulex (water flea) First crustacean. Commone test organism for EPA ecotoxicology studies.

Sea anemone. Model cnidarian. Invertebrate that branched off the path leading to vertebrates. The simplest animal with a tissue grade of organization, stem cells, gap and tight junctions, and apoptosis. Related to earliest animal fossils.

Phycogenomics – the genomics of algae. Diatom genome project. Aquatic photosynthetic organisms. Phytoplankton – Diverse unicellular photosynthetic eukaryotes. 5000 or so species. Underlie marine food web. Outweigh all marine animals. Ocean carbon fixing potential approximately the same as all terrestrial sources combined. 50 billion metric tons of carbon per year. Rapid dividing, dying, and sinking with incorporated carbon. Thought to be key regulators of atmospheric CO_2.

Diatom being sequenced - Thalassiosira pseudonanna. ~32 Mb genome. Genome initially uncharacterized. Collaborated with David Schwartz and Shigo Zhou to optically map the genome (first JGI collaboration with Schwartz and Zhou). 23 chromosomes. Many genes are equidistant between animal and plant genes. Diatoms proposed as models for microfabrication.

Many broad partnerships both in the US and internationally to leverage JGI capabilities.

Eddy Rubin, Director DOE Joint Genome Institute

Description of JGI's path forward. JGI is as cost effective and efficient at DNA sequencing as any sequencing center in the world. DNA sequence has become part of the vital infrastructure for many areas of science beyond the life sciences.

Community Sequencing Program (CSP) & Microbial Community Genomics.

CSP – New on JGI home page
Peer reviewed process to access JGI sequencing capability
Located and manage by the JGI but outside scientists on the review panels
Will accept a wide range of projects based on scientific merit
Contribution to revolutionary science
Proposal study panel, Advisory Committee, Designated Lab & JGI Directors
Deliverables can range from raw sequence to well annotated assembled genomes
Formalizing a Scientific Support Group at the JGI to work with users
No cost of sequencing to approved users

Other JGI users – GTL, microbial genome program, other agencies (EPA, USDA, NSF)

Need to grow informatics capabilities to deal with the volume of DNA sequence being produced. A cutting edge user facility needs in house users, i.e., a JGI science program.

Sequence based science at the JGI - Gene regulatory vocabulary of animals, studies of body plan evolution, microbial community genomics.

Microbial community genomics. Most microbes unculturable and many of these live in interdependent consortia. Goal is to determine and reassemble the DNA sequences of microbes from communities. What is the structure of natural microbial populations? What is a microbial species? Can we harness their metabolic capabilities? No publications in this area so far.

Initially looking at communities with minimal complexity. Most mature project is with Jill Banfield at the Iron Mountain mine in northern California. Highly contaminated superfund site. Low pH and heavy iron pyrite contamination. Microbes living there are causing the acid drainage. Biofilms on top of the liquid at this site. Evidence so far suggests that individual genomes can be reconstructed from community DNA isolates.

What is the demand for sequencing? Perceived to be great. Don't anticipate having any unused sequencing lanes. First call under the new JGI scientific user facility structure will be in February 2004. Need to get people realizing that they can ask for significant amounts of sequencing that they might have previously have not asked for because of a perceived cost issues, etc. Capacity is already filled for next year. Technology development at the JGI will be focused on issues like sequencing from a single cell/organism.

Public Comment – None

Adjourned 11:55 AM