BASIC ENERGY SCIENCES ADVISORY COMMITTEE
to the
U.S. DEPARTMENT OF ENERGY

MEETING MINUTES

Bethesda North Marriott Hotel & Conference Center

5701 Marinelli Road, North Bethesda, MD 20852

July 25, 2013

PARTICIPANTS

BESAC members present:

Simon Bare	Sharon Hammes-Schiffer
William Barletta	John Hemminger, Chair
Gordon Brown	Bruce Kay
Sylvia Ceyer	William McCurdy, Jr.
Beatriz Roldan Cuenya	Monica Olvera de la Cruz
Frank DiSalvo	Mark Ratner
Persis Drell	Anthony Rollett
Roger French	Maria Santore
Bruce Gates	John Spence
Ernie Hall	

Additional BESAC members:

Yet-Ming Chiang	Matthew Tirrell
Max Lagally	Douglas Tobias
Gary Rubloff	John Tranquada

Also participating:
William Barletta, MIT
Tammy Click, Oak Ridge Institute for Science and Education
Pat Dahmer, Deputy Director, Science Programs
Wolfgang Eberhardt
Wayne Hendrickson
Linda Horton, Director, Division for Material Sciences
Harriet Kung, Director, Office of Science, Basic Energy Sciences
Richard Osgood
Katie Perine, Office of Science, Basic Energy Sciences, Committee Manager
Jim Roberto, Oak Ridge National Laboratory

Approximately 100 others were in attendance.

MEETING MINUTES

Thursday, July 25, 2013

The public meeting was called to order by Basic Energy Sciences Advisory Committee (BESAC) Chair Dr. John Hemminger at 9:00 a.m. BESAC members introduced themselves, and Dr. Hemminger reviewed the agenda and welcomed Dr. Patricia Dehmer, Deputy Director for Science Programs, U.S. Department of Energy (DOE) Office of Science (SC).

Presentation of News from the DOE Office of Science

Dr. Dehmer provided an update on the DOE and its priority goals, and the role of BESAC in the Office of Basic Energy Sciences (BES). The DOE Secretary is Dr. Ernest Moniz, and Mr. Daniel Poneman serves as the DOE Deputy Secretary. The Under Secretary for Science and Office of the Under Secretary positions are vacant. In the past 10 days, seven offices have been consolidated including SC under the newly created Under Secretary of Science and Energy meaning that the management of all scientific offices will fall under one Under Secretary. The Office of the Under Secretary for Management and Performance is a newly created position that will manage seven offices.

The DOE Secretary of Energy Advisory Board is being reactived and will consist of four standing sub-committees. The National Laboratory Operations Board is also being stood up with membership to include national laboratory directors. Dr. Moniz has also established four new Secretarial Councils that will report directly to the Secretary. These changes are substantial and reflect Dr. Moniz's own experience in the DOE and his view on how things have evolved.

The President will announce nominations for the positions of Office of the Under Secretary of Science and the Office of the Under Secretary. Nominations will go before the Senate. When filled, these positions will have an assigned team while the Senate deliberates on the nominees. Nominations could occur in September. Acting representatives are now filling these roles.

Dr. Moniz likes the DOE Energy Frontier Research Centers (EFRC), and his creation of the Under Secretary for Science is a deliberate move to link SC and science programs to one office. Dr. Dehmer shared that this likely will be positive for SC.

SC's priority goal for FY12 – FY13 is to prioritize scientific facilities to ensure optimal benefit from Federal investments. All other SC Federal Advisory Committee Act committees are completing this priority. This will be completed by September 30th and the Director of the Office of Science will make a final decision on facilities. This person is typically a Senate-confirmed appointee, likely to be identified in August. The director will be briefed on the results of the prioritization. Dr. Dehmer added that this type of exercise makes a difference. The first four or five scientific centers that were at the top of SC's priority list ten years ago are now complete, and it is time for DOE to take a new look at facilities.

Dr. Dehmer shared an update on other SC committee activities. Advanced Scientific Computing Research is advised by the Advanced Scientific Computing Advisory Committee (ASCAC) that

deals with data-intensive science and high-performance computing. ASCAC is striving to make a case for HPC and this topic that will be briefed to the new Director of SC.

The Biological and Environmental Research (BER) program is advised by the Biological and Environmental Research Advisory Committee (BERAC). It is forming a vision on genomic science that will direct the course of BER.

The Fusion Energy Sciences (FES) program is advised by the Fusion Energy Sciences Advisory Committee (FESAC). It addresses magnetic and non-magnetic fusion energy priorities, and will inform Federal budget formation discussions being held by the Office of Science and Technology Policy, Office of Management and Budget, and Congress.

The High Energy Physics (HEP) program has recently closed the Tevatron facility. The upcoming Snowmass conference in Minnesota will be attended by members of the High Energy Physics Advisory Panel (HEPAP) to gather input and support long-range planning.

The Nuclear Physics (NP) program is examining the long-term strategic plan for nuclear physics and alternatives if it lacks sufficient funds to meet established goals. NP is advised by the Nuclear Science Advisory Committee (NSAC).

The creation of a next generation light source can be enabled by BES and BESAC's consideration of technical specifications and science. Dr. Dehmer shared that since 1984, funding has grown and several large projects were supported. In the 1990s, construction began on an advanced light source. Efforts were made to roll funding into other construction projects. This timeline shows that funding ramped up for the Spallation Neutron Source, helped nanoscience centers, and funding for the National Synchrotron Light Source (NSLS-II) and Linac Coherent Light Source (LCLS) upgrades began.

Dr. Dehmer believes that SC may return to lower funding levels seen in the 1990s. The next generation light source could be a compelling next step but there is some confusion about what it should be. Direction is needed from BESAC and the committee should converge on its guidance.

Discussion

None

Presentation of News from the Office of Basic Energy Sciences

Dr. Harriet Kung, Director, BES, noted Secretary Moniz's leadership, technical credentials and experience in policy and management. He told the House Committee on Science, Space and Technology on June 18, 2013, that "competing in the new energy economy will require us to harness the expertise of our scientists, engineers and entrepreneurs." Moniz's testimony followed a trip to Oak Ridge National Laboratory where he was impressed by the facilities.

Among staffing changes in SC, Dr. Dehmer returned to the role of Acting Director of SC as of April 1st. Dr. Kung expressed gratitude for Dr. Dehmer's leadership. Dr. Andy Schwartz is

leading the ERFCs as a technical advisor. Dr. Linda Horton had served as the interim lead for the EFRCs and led BES through an important EFRC review process. Dr. Gail McLean is leading the Photosynthetic Systems program in the Chemical Sciences, Geosciences, and Biosciences Division. BES has also welcomed Dr. George Maracas as the program manager overseeing the Nanoscale Science Research Centers and Electron-Beam Microcharacterization Centers, and Dr. Christopher Fecko who is joining the Fuels from Sunlight Energy Innovation Hub management team. There is a vacancy in Experimental Condensed Matter Physics.

The BES FY13 budget appropriation is $1,569M. This is $92M less than in FY12 and reflects a 5.2 percent sequestration cut at the end of the FY13 Continuing Resolution. Energy Innovation Hubs will grow by $4.8M but Core Research will decrease by $5.5M. Most Scientific User Facilities will see a decrease, while the NSLS-II will get $22M more. NSLS-II will see an $87.5M decrease in Construction and Instrumentation funds in FY13 due to a ramp down in projects. LCLS-II funding is $15M more in FY13. It is one of BES' higher priority projects.

BES budget requests and appropriations were steady or grew from FY1997 through FY2012. FY13 is an exception. Each increase along this timeline reflects strategic decisions including construction priorities. Dr. Kung noted that BES should rely on a pipeline of projects being ready to take advantage of increases in funding and that ideas should be mature and have community support. Examples like the initiation of the EFRCs in 2009, the companion single investigator awards, and construction projects reflect this approach. BES will absorb the decrease in FY13 funding through decreases in construction and Major Items of Equipment (MIE) funding. She believes that BES is fortunate to have this roll-off from major construction work to absorb the reduction. Moving to FY14, the buffer will be depleted and BES will have to balance funds between research, user facilities, and construction and instrumentation. Another factor that will drive prioritization is the recognition of international competition.

Dr. Kung praised BESAC for its advice and giving BES direction in recent years. This guidance and the Grand Challenges Report are evident in DOE investments, especially in core research and the EFRCs.

BESAC has had an impact in the Materials Science and Engineering Research Division that is moving toward "Materials by Design." MIT researchers are using neutronscattering to understand self-assembly, how to tune bio-hybrid assembly, and control the final configuration of a new cluster and class of materials. Researchers at Pacific Northwest National Laboratory have designed 3D hierarchical nanoporous structures and examine cathodes for lithium air structure to create better batteries. At the University of Illinois at Urbana-Champaign, there is a way to control space geometry and construct superconducting properties to be deposited on sheets of metal. Ames Laboratory researchers have increased ZT by selecting specific materials and tuning their thermoelectric properties by adding dysprosium atoms. This work reflects control science and new ways of designing materials. The BESAC Grand Challenges Report is the root for this work.

In chemical sciences, research at the Stanford Linear Accelerator Center (SLAC) shows that there are new chemical transformations as researchers are detecting transient states in real time and moving to total absorption. They have confirmed that these states exist in initial and final

states. SLAC is also looking at soot particles and harmful health impacts. LCLS has helped by showing that these particles are very complex. Lawrence Berkeley National Laboratory (LBNL) researchers are examining photosynthesis water splitting to capture simultaneous atomic and electronic structures and decipher the conversion step in the oxygen evolution of these complex enzyme structures.

There are 46 EFRCs in 35 states and Washington D.C. After 3.75 years into five-years of funding, more than 3,800 papers have been published. The EFRCs have had an impressive impact on the Presidential Early Career Award for Scientists and Engineers (PECASE) and Early Career (EC) awards programs. More than 60 companies have benefited from EFRC research, including many start-ups. One is SiNode Systems that is being lead by EFRC student Cary Hayner. Their work is based on the discovery that holey graphene sheets can increase energy capacity when encapsulated with nanoparticles. Silicon has a high energy capacity but cannot stand large volume changes and swelling will cause a change. SiNode combined the best of these to increase energy capacity and the rate of charging. Their work forms a basis for advancing the manufacturing of lithium ion batteries. Hayner and SiNode have won multiple awards including $1M in start-up capital and the 2013 Rice Business Plan Competition.

More than 500 researchers joined the EFRC PI meeting on July 18 – 19, 2013. Restrictions on conference spending limited the number of participants. Former BESAC member George Crabtree and Arun Majumdar gave plenary talks. PIs and students were challenged to attempt to communicate their research using the 1,000 words most commonly used by the public when talking about science. “Energy” was not one of those words, so the list grew to 1,001. Researchers developed posters using these words and submissions from Penn State University and Los Alamos National Laboratory were selected as winners of the 1,001 word challenge.

Presentations were made at the EFRC meeting by 22 finalists of the graduate student and postdoctoral researcher competition, designed to highlight their role in furthering EFRC success. BES staff selected three graduate and three postdoctoral award winners, respectively.

BES facilities are making progress. The NSLS-II used $150M in American Reinvestment and Reduction Act (ARRA) funds to expand its scope and avoid potential risks. The NSLS-II ring and satellite buildings are complete. All five laboratory buildings are within the project scope, and three have been occupied since Spring 2013. The accelerator systems and beamline are progressing, and the magnets have been delivered and seem to work. The completion of these components adds to BES’ credibility and argument for more large projects and new challenges.

The FY14 budget request includes the final year of the EFRCs, and existing and new proposals. The EFRCs fall under the Facilities Operations request of $832M and reflect a one-time $100M funding increase from the Administration. BES is still working on the Funding Opportunity Announcement (FOA). There is not much additional information to share now. The solicitation for FY14 will request both renewals and new EFRC applications, and BESAC reports will guide the FOA and other initiatives that will help shape the technical part. Awards will help maintain the balance of the EFRC portfolio reflective of the Grand Challenges Report and other research.

The FY14 budget request will continue the Energy Innovation Hubs. The Fuels from Sunlight Hub is in its fourth year, and the Joint Center for Energy Storage Research is in its second year. Core Research relies on community reinforcement of the mesoscale science report, and BES is looking forward to community engagement to get more mesoscale proposals. User Facilities will be funded at optimal levels, and Construction and MIE budget requests reflect desired goals.

LCLS-II is a high priority for BES. International competition is growing in this area. The project was stopped due to the Continuing Resolution, and construction on a second tunnel will not be completed until it is moved to a line item in the budget.

The FY14 House Energy and Water Development Subcommittee (HEWD) marks fund BES at $1,583M. This is less than the FY13 budget. This is before sequestration and the President's request. Dr. Kung is encouraged by the HEWD's support of BES, its large suite of user facilities, and the contributions of large-scale and complex projects including the next generation of light source facilities. HEWD supports facility operations and research at the Energy Innovation Hubs, but it does not recommend providing the one-time funding request of $68M for additional EFRCs. The HEWD recommended MIE funding and additional instruments for the Advanced Photon Source (APS) Upgrade and NSLS-II, yet funding will fall five to seven percent below FY13 levels and under operational levels. HEWD recommended $77M less than BES' construction request. It provided language for the LCLS-II tunnel upgrade but only about 50 percent of the total request. The HEWD offered a provision that prevents SC from entering into multi-year user agreements with a value of less than $1.5M with the expectation that SC will fully fund all three years of a project. BES is working with SC on how to implement this, and Dr. Kung noted that this could alter the number of new and renewal projects that BES would support in a given year. She is working with Dr. Dehmer to define an agreeable strategy.

The Senate Energy and Water Development Subcommittee (SEWD) recommended a funding level $57M below BES's FY14 request. The SEWD recommendations are positive other than only providing base funding for the EFRCs. User facilities would be funded at full levels.

There are huge differences between the HEWD and SEWD marks for BES. Dr. Kung shared that the disparity may be hard to reconcile. In comparison, HEWD support for all of SC is larger. The House marks support most of the FY14 request except for a 60 percent reduction for specific areas such as the Energy Innovation Hubs, NSLS-II construction, and user facility operation. The Senate supports the BES FY14 request except for the one-time EFRC funding request.

All other SC program FY14 requests are higher than FY13 appropriation levels. Differences between the HEWD and SEWD marks can be tied to research, which sends a sobering message about the BES program.

Budget uncertainty and constraints are the new normal. This is an opportunity for BES to take stock of its accomplishments and seize opportunities to invest in the future. Dr. Kung sees an increase in community support, and despite a lack of full House and Senate support, BES has a $1.6B budget and must deliver the best science possible. The BESAC is asked to help BES be ready for the next opportunity when it comes along, and to balance grand challenge opportunities with mission-driven science. BES must be well-positioned to stay at the leading edge. Facilities

need full support for operation and to support users. This involves making hard choices about operations. BESAC can help BES make wise choices and balance program components, research modalities, research and facility operations, and construction.

Part of the challenge to BES is selecting the best new U.S. light source. Published reports and workshops held since 2008 set a foundation for prioritization. BESAC can help clarify the vision and path going forward to best maintain U.S. leadership.

Discussion

Dr. DiSalvo shared that BESAC members are getting questions about the EFRCs and the timing of the release of funding recompete. Dr. Kung shared that the BES is working hard to prepare the announcement and obtain final DOE approval. Funding for current EFRCs will end in August. Kung hopes that a budget will be announced by then along with guidance on award selection. The entire process could take five months.

Dr. Kung responded to Dr. Cuenya's concern about the implication of policy changes and HEWD mark language on single investigator PI grants, sharing that Dr. Dehmer is aware of the potential impact on smaller grants and that she has tasked all SC programs to come up with strategies. Dr. Dehmer talked about creating a mechanism to fund the awards that can be conducted on an experimental basis. The House and Senate are aware that their guidance would force a new mechanism and tool for directors to manage awards. The Senate was glad to hear this and does not want any actions that would harm programs. The House seems okay with SC's approach, too. SC has not yet decided what guidance to give associate directors that is a compromise between the Senate and House direction. Dr. Dehmer likes that idea of a mechanism that lets programs manage funds as part of their award portfolio, and one that would be judiciously implemented and not harm programs.

Dr. Gates asked if support levels per PI will be normalized, and what the consequences could be. Dr. Kung noted that the distinctions between BES' investments must be scrutinized. She does not want one investment to erode critical mass or a core program that largely supports individual research. Years of experience inform BES' criteria and funding levels, and future selections.

Dr. Gates asked about the number of graduate students who could be funded per PI in the current approach. Dr. Kung explained that one month's summer salary and one student is about average. EFRC funds depend on the level of support. Dr. Horton added that there was a lot of matching funding in the EFRCs, in particular. Some students get matching funds from universities. Some faculty may not personally accept funding but fund postdoctoral students. Things may seem out of balance compared with other parts of the program, if one does the math. BES can analyze core research and other things, but the EFRCs are more complex. Dr. Horton believes that all modalities are being equally conducted. An analysis of the number of PIs involved with EFRCs and the funding amount each receives has not been done. Dr. Kung added that the Portfolio Analysis and Management System will give better control of personnel and funding data.

Dr. Kung clarified for Dr. Hammes-Schiffer that the House and Senate recommendations are not necessarily reflective of differing levels of enthusiasm about the Energy Innovation Hubs versus

the EFRCs. She noted that the House language recognized that some facilities are in final years and that the EFRCs have had a five-year funding stream. Dr. Horton added that the House had a smaller budget to work with which may be reflected in their recommendations.

Dr. Gates asked if there is a perception that elected officials are attracted to mission over basic research. Dr. Kung shared that both the HEWD and SEWD seem supportive of basic and mission-related science. Some staff members may be concerned about moving too far into technological extremes, and there is a question about the government's role in technological development. She felt that there is overall support for basic research and that the committees understand the value of science, even if they differ in recommended levels of investment. She expressed that SC has been treated well in terms of overall budget reductions.

Dr. Rollett asked about interest in U.S. investments versus the rest of the world. Dr. Kung noted that the data on light source development around the world is sobering and eye-opening. In addition, a number of studies have looked at the percentage of GDP and scientific investment per country, and demonstrate a very competitive environment beset with heavy budget constraints.

Presentation on the Status of International Light Sources

Dr. Persis Drell provided an international view of light sources. The three types of light sources are the storage ring (SR), energy recovery linac (ERL), and the free-electron laser (FEL). The first two are spontaneous emission sources, and the FEL is a simulation emission source.

Light sources are defined by a limited to a finite number of parameters and criteria that include wavelength range, brightness, pulse width, coherence, stability and the number of undulators, beamlines and endstations.

Each type of light source is defined by its pulse structure. The SR has high repetition rates and fast pulses. ERLs have high a repetition rate of around $1/10^{th}$ of a microsecond between pulses. FELs have three separate types of structures. In the burst mode, there is a burst of repetitions with a long pause between the repetitions. The pulsed mode features a single repetition with less than one microsecond between each repetition. The CW mode has high repetition rates that are equally spaced.

Decisions about which technology to use are driven by scientific goals and science delivery. Achieving goals requires a focus on more than just the x-ray source and includes the infrastructure around it and accompanying technologies and tools.

Wavelength range is comparable among SRs, FELs and ERLs. Peak brightness is a feature unique to FELs, but average brightness is about the same for all. Pulse structure and the CW mode are found in SRs and ERLs, and will be common to FELs in the future. A big difference between light sources is the number of beam lines available.

There are many international light source competitors working in soft, medium and hard x-ray SRs and FELs. With direct investments and advances in technology, SRs may reach an ultimate goal of diffracted limited emittance achieving higher peak and average brightness, and enhanced

coherence. FELs are new enough such that there are many options for advancing this technology. Seeding will allow for higher peak and average brightness, better energy stability, and a reduction of temporal and intensity fluctuations. There are also approaches aiming for more undulators per injector, higher repetition rates, shorter pulses, and simultaneous multiple color operation.

Looking at the future and how SRs and FELs might compare, the biggest changes will be increased brightness in SRs, an increase in average brightness in FEL by increasing the repetition rates, decreasing the pulse width in FELs, achieving full coherence in FELs, and progress in getting multiple undulators per facility.

Europe, the U.S. and Asia are actively developing x-ray sources but also taking different approaches to develop more capability and capacity. Each will have to decide between hard versus soft x-ray facilities and the types of investments to make and tools to build.

A comparison of ring horizontal emittance with ring energy offers an understanding of different facilities' capabilities. Many facilities achieve an nm-rad of 1 or more and there are some facilities that will reach a diffraction limit of six and higher GeV.

Five hard x-ray FELs are in operation and under construction. LCLS-I and II are U.S. sources. XFEL will begin operation in Germany in 2015. It has a pulsed super-conducting LINAC and reaches 17.5 GeV. SACLA has been operating in Japan since 2011 and has a somewhat lower energy LINAC. PAL XFEL in South Korea will turn on in 2015, and Switzerland's FEL will begin in 2017. Both of the former are normal operating machines. At question is how to get high energy x-rays from low energy LINAC sources without sacrificing performance.

Asia has moved from high-performing third generation SRs and many regional SRs to an upgraded ultimate storage ring (USR) at 6 GeV, an upgrade to SCALA in Japan with injectors and undulators, and the FEL in South Korea with one beam line. A 3 GeV ERL is planned.

Efforts in Europe are more aggressive as several high-performing soft, medium and hard x-rays and two soft x-ray FELs are in operation. In the near future, the ESRF will be upgraded to a USR and PETRA-3 will be expanded. The FLASH I facility will become FLASH II with two beamlines, and two new hard x-ray FELS are being built. By 2020, Europe will have the most advanced suite of light sources in the world, with an enormous concentration in Hamburg, Germany. The German strategy includes infrastructure investments to exploit light sources and deliver science. DESY is one of the operators and will run FLASH I and II. It has invested about $2B since 2009 with construction on facilities including the Center for Structural System Biology (CSSB), the Center for FEL Science, and the start of construction on PETRA III. These are supported with funding from the Helmholtz Foundation.

The U.S. approach includes four SRs and one hard x-ray FEL. In the near future, the LCLS-II will start and the APS will be upgraded to boost brightness and achieve a higher repetition rate. LCLS-II will have extended capacity and capabilities. Beyond 2020, there is a proposal that achieves higher repetition rates and 10 undulators in soft x-ray FEL.

BES' strategy will be guided by BESAC's report on light sources. The BESAC was charged by the BES "to address the most challenging and important science yet to be done that will require light sources and to determine the best sources we can afford that will allow us to explore those scientific frontiers".

Discussion

Dr. Barlett shared that a second beam line at the Fermi National Accelerator Laboratory is running and a third beam line is under design. He also noted significant optics development work in France and Germany, describing this as a significant hurdle for U.S. efforts.

In response to Dr. Rollett's interest in detector technology, Dr. Drell shared that this is being pursued at DESY and a European network is being developed for detector technology R&D.

Presentation of the BESAC Light Source Subcommittee Findings

Dr. John Hemminger presented the Subcommittee findings. The charge to BESAC was presented on January 2, 2013, and asked for a BESAC Subcommittee to provide advice to SC on future light sources. It asked for an assessment of the grand challenge science issues that should be addressed, to evaluate the effectiveness of current light sources in addressing these challenges, to enumerate the performance specifications should be that would drive the science that is of interest, to prioritize recommendations on future light sources, and to comment on the R&D initiatives needed to accelerate future light source facility development in a cost effective manner. It also asked the Subcommittee to leverage studies carried out by BESAC and BES.

The Subcommittee consisted of 22 members with approximately half from the current BESAC or who were former members. Several members ran earlier workshops that generated reports that were cited in the charge.

BESAC has been involved in the facilities prioritization report that was discussed at the BESAC meeting in February 2013. The report urged DOE to aggressively pursue a new future light source with unprecedented beam characteristics and thus unprecedented opportunities for world-leading science.

A one-day meeting was held on May 23rd. Four talks gave perspective on the charge response, established a common starting point, and set the agenda for a longer meeting held in July. Participants discussed grand challenge issues facing BES and concluded that the reports that the charge speaks to are current thus preventing the need to do additional research. One exception to this are changes to the international landscape. The group also concluded that the U.S. has a significant role in x-ray science due to the work that has been done at U.S. sources. It is understood that the leadership role will no longer be held by the U.S. as others move forward. Recommendations for a new U.S. light source at the level of investment that is being considered have to be science driven and not at the level of capacity.

The U.S. has historically strong leadership in SR facilities with a community of around 10,000 users. As reported in the 1999 "Leone Report" developed by a BESAC subcommittee, exciting

advances are possible in the hard x-ray region. This preceded the development of the LCLS and demonstrated that the DOE recognized the potential opportunity and that there are users from the U.S. and other places doing fundamental science.

The Subcommittee met on July 10 – 12, and heard presentations from Graham Fleming, Phil Bucksbaum, Oleg Shpyrko, Wei Yang, and George Crabtree. The Subcommittee found that there is an increase in international competition in x-ray science. However, there is opportunity to strengthen fundamental science by developing a new light source with a high-repetition rate, and ultrabright and transform limited femtosecond x-ray pulses over a broad photon energy range with full spatial and temporal coherence. The design should include stability and precision timing as critical characteristics of the new light sources.

Dr. Hemminger explained that femtosecond pulses permit electron dynamic experiments that move from just looking at molecules structural information to understanding the dynamics in molecules in materials to understand and control those processes.

The presentations given highlighted the importance of coherence in light sources. Full spatial and temporal coherence are needed for fundamental science, as is real stability for energy in the photons. Some experiments include carrying-out the sort of multidimensional experiments that revolutionize other regions of the energy spectrum. A high repetition rate is needed. Dr. Hemminger called these stretch goals as they require a facility that is doable but, like the LCLS, has never been done before and is not presently planned worldwide.

Presentations by Paul Alivisatos, Chi-Chang Kao, George Hoffstaetter and Joel Brock, and Paul Evans described various approaches to light source facilities. It included a presentation from light source facility directors on diffraction-limited SRs.

The Subcommittee concluded that the best approach for a light source to achieve the desired characteristics is a seeded FEL that has independently tunable undulators, pulse characteristics, and a high repetition rate to conduct a broad span of coherent “pump probe” experiments. The high-end need is driven by the need to look at through materials.

The new light source would be beyond any existing or planned facility worldwide. None of the concepts presented in July fully met all criteria and the Subcommittee acknowledged that not all of the criteria need to be met. Dr. Hemminger believes that the timing now as it relates to the international science is similar to the timing of the launch of the LCLS. The LCLS has generated tremendous science and a huge following, and other countries are now building similar facilities.

The Subcommittee examined the R&D needed to support the proposed light source and support the science that would be conducted there. Europe has detectors that the U.S. would like to use at the LCLS and sometimes is allowed to use. However, this is not a desirable position for the U.S.

In discussing diffraction limited SRs and SR upgrades, the subcommittee found that current plans will leave the U.S. behind the international community. The Subcommittee recommended that SC carefully evaluate present upgrade plans to determine paths that will guarantee that U.S. facilities remain at the cutting edge of x-ray SR science.

For years, researchers have come to the U.S. to use user facilities. If there is a tremendous light source facility abroad, researchers could go there. However, U.S. funding mechanisms limit agency support for student and postdoctoral research and travel.

Discussion

Dr. Gates asked why other countries are not responding to this window of opportunity. Dr. Hemminger's opinion is that the U.S. owns scientific ingenuity in this field but feels that the research possible with a high repetition rate coherent photon source in the soft- and near-hard x-ray regions has not been a focus outside of the U.S. Foreign efforts like those at DESY are in the hard x-ray region. Dr. Drell added that XFEL research might like this resource but have a somewhat awkward source structure. It may be possible that they do not know what is possible with an FEL. She believes that XFEL efforts will go down to the soft x-ray level, and that researchers have learned a lot in the last few years.

Dr. Barletta cited the Subcommittee's notion that the success of the LCLS has led to building hard x-rays and that with the exception of the DESY laboratories, expertise at other laboratories sought more LINAC technology to be competitive. He felt that this might explain why countries have not sought this opportunity. He shared that DESY has a goal to upgrade to capabilities described by the Subcommittee.

Dr. Cuenya asked if there is sufficient training and enough people in the U.S. to operate the facility. Dr. Hemminger feels that success at LCLS has shown that the U.S. has the capacity to build and operate a new facility, but felt that having enough people is an interesting question. Dr. Barletta added that there have been substantial accomplishments at the Continuous Electron Beam Accelerator Facility, Cornell University, Argonne and Fermi national laboratories, and in the development of superconducting undulators. He feels that the U.S. has the technical expertise for the effort proposed by the Subcommittee.

Dr.Hemminger clarified for Dr. DiSalvo that the Subcommittee recommends one facility that is inclusive of the different kinds of instrumentation described on page three of the report. DiSalvo noted that the report seemed to segregate the types.

Dr. Cuenya asked if any current proposals could fit the Subcommittee's requirements, and if presenters would be asked to provide proposals. Dr. Hemminger responded that the proposals all had merit but the community should craft an approach to meet the specified photon criteria. Implementation is a challenge for the BES and the laboratory community. Hemminger shared that the proposal from the Next Generation Light Source at LBNL described a high repetition rate concept. The proposal for upgrades to LCLS has a repetition rate of one kilohertz which is too low to achieve the experiments envisioned. The burst mode achievable with the XFEL is maybe inconvenient. The U.S. should pursue an approach that does not duplicate capabilities.

The Subcommittee report is 14 pages in length and will require proofing to be complete.

The BESAC unanimously accepted the findings presented by Subcommittee.

Presentation of the Scientific User Facilities Division Committee of Visitors Report

Dr. Hemminger introduced Dr. William Barletta and told the BESAC that the Chemistry Division Committee of Visitors (COV) will be conducted in 2014.

The Scientific User Facilities Division (SUFD) COV responded to a charge requesting an assessment of the processes used during FY10, 11 and 12 to solicit, review, recommend and document proposal actions, and to monitor project and programs. Four sub-groups from within the Committee examined construction projects, nano-science and electron beams, light sources, accelerator and detector research, and neutron facilities.

The Division was commended on its ability to effectively use funding to construct and operate a system of facilities to deliver world-leading science. It demonstrates a high level of efficacy in reviewing, recommending, and documenting proposal actions. The COV noted that international competition in scientific user facilities is fierce and maintaining leadership will require increased investments in user facilities and in support of facility users.

The COV presented five SUFD-wide findings and recommendations. It found that the SUFD is effectively addressing recommendations made in the most recent COV report. It was also noted that the travel budget is incommensurate with the effective oversight of the program. It was recommended that SUFD managers be more flexible to interact with facility managers and increase their onsite presence.

The COV found that SUFD is able to provide data on computers to each reviewer, which facilitates a highly responsive and improved COV process. It recommended a move to a fully searchable database and making this available for the next COV.

The facility review process is effective. The COV noted that there is now a definition of high impact publications for light sources and neutron sources that allows for a more effective review. It recommended that SUFD finalize the set of uniform definitions of high impact publications for the nanoscience centers.

In general, the scientists at facilities are a critical asset and the COV recommended a focus on their career development, as well as ensuring the availability of state-of-the-art equipment and software. It also found that facilities serve different scientific communities and are needed and important, and recommended that metrics need to be appropriate for assessing all types of facilities and in line with delivering results that are compelling for those outside of the SUFD.

The COV noted that there is an increase in the number of industrial users, but that facility managers should be informed if a greater increase is required. It recommended that proposal requirements should include criteria that value factors such as economic and technological impacts. User agreements should also be reviewed to remove barriers to industry users.

In the light sources and accelerator and detector research (ADR) area, SUFD used a balanced and fair proposal review process that recognized the value of having people onsite for reviews. The

COV recommended an annual follow-up to address issues and that the next COV should be able to review these recommendations from the outset. The COV noted that resources to this area are too limited to maintain leadership, but that projects are generally excellent. It also recommended that the portfolio should be increased to $20M to $30M per year, and that the concept of a hub would advance ADR technology, among other recommendations. In sum, the number of issues to be examined is broad, funding is tight, and hence there needs to be some coordination of research elements to cover the most important areas.

In the neutron sources area, the COV recommended the tracking of a new, supplementary metric to reflect facility impact. It also recommended that neutron scattering facilities explore partnering with other agencies in a cooperative stewardship model. It noted that it is unreasonable to frontload facilities with understaffed construction or beamlines and recommended that a well-articulated plan be developed when MIE is being considered. It also found that the last study of neutron scattering was completed more than 10 years ago, and recommended that the DOE join other agencies to assess the present status and future directions in neutron science.

The COV found that the Nanoscience Research Centers (NSRC) and E-beam Microcharacterization Centers (EBMC) are in a wrap-up phase, and the centers' facilities and instruments are in high demand. The staff is also oversubscribed. It recommended an expansion of facilities or operating hours. An alternative is to reject a higher number of proposals. The COV observed that SUFD managers have established transparent and thorough processes for project evaluation. It recommended an increase in in-person time between DOE officials and management, scientific staff, and the user community of NSRCs and EBMCs. It also recommended the tailoring of metrics for the centers. The COV recommended addressing career track issues at reviews and in out-year communication between the SUFD and center staff.

The COV recommended merger plans to improve electron beam microscopy centers due to understaffing and underfunding, as these are of great importance. The result could be greater synergy and operational efficiencies. Along with this, different metrics may be needed for these centers to assess the performance of the top-quality staff at the EMBCs to support retention and recruitment efforts. Related recommendations include establishing and socializing clear post-merger expectations, and that planning include the prioritization of laboratory material science programs outside the NSRCs for access in a new merged format.

The COV noted that the TEAM instrumentation program was important for the EBMCs but that the completion of TEAM did not lead to type of next generation instrumentation proposals seen at the light source and neutron projects. DOE should plan for quasi-major investments in EBMCs and NSRCs facilities and in instrumentation, and plan for a vision or roadmap that guides next-generation EM capabilities across EBMCs rather than fostering competition.

High utilization instruments in EBMCs are in high demand but under-utilized. The COV recommended that merger plans include overall staffing expansion plans or at least for highest impact and higher utilization tools.

The COV considered industry use of the centers, recommending that any desired increase in the proportion of industry users should be clearly communicated to the NSRCs. This also applies to nanoscience centers.

Construction projects were evaluated and the COV found that SUFD has stayed within +/- 10 percent of its projected costs and schedules. It was further noted that project management metrics are more visible as indicators of DOE performance to external stakeholders. One area of concern is that CD4 requirements are either too loose or too tight, and the COV recommended all stakeholders understand the requirements and that these are fully achievable in the budget.

The COV commented on the impact of travel fund restrictions. SUFD should define the correct level of field performance of managers to provide oversight, awareness and communication, and onsite presence should be related to program risk and include the use of communication tools.

Dr. Bartlett thanked Jim Murphy, SUFD staff, and Linda Cerrone for enabling the review.

Discussion

Dr. Ceyer asked about industry resource use and at what point after a scientific review that a legal review occurs. She also wondered about the percentage of industry proposals that are turned down. Dr. Hall shared that the issue is not of a legal nature but is signing a user agreement with a facility. His experience with lab-wide user agreements is that they can take several years to craft language that is agreeable to all due to multiple stipulations around user agreements. Dr. Horton added that the liability clause is a challenge that requires input from attorneys on both sides of the discussion, and that this is more of a Federal government matter than a DOE issue.

Dr. Hall clarified for Dr. Hemminger that an agreement signed with one industry partner can normally be used at multiple facilities. Laboratories may periodically revise a user agreement or an agreement renewal may provoke a review. Dr. Barletta shared that his experience is that a blanket agreement is not possible and that legal counsel will require a specific agreement.

Dr. Barletta clarified for Dr. Rollett that tailoring criteria and the consideration of high impact journals refers to each field having 10 to 20 journals. The directors, user groups and others agree on what is important in their field, know the value of publishing in certain journals, and that fields can vary in terms of their processes. The COV recommended that user groups and managers collaboratively determine what is important. He also clarified that these determinations are written down and examined fairly often.

BESAC formally accepted the report from the Scientific User Facilities Division Committee of Visitors Report.

Presentation of the Energy Frontier Research Centers and Joint Center for Artificial Photosynthesis Energy Innovation Hub Committee of Visitors Report

Dr. Persis Drell presented findings and recommendations from the EFRC and Joint Center for Artificial Photosynthesis (JCAP) COV. This was the very first review of the programs of the EFRCs and Hub, and was not a review of the EFRCs and Hubs.

Both are supported by BES. The EFRC funding opportunity was announced in April 2008, and five awards were made in August 2009 at a total of $777M over five years. The Fuels for Sunlight Hub was announced in December 2009 and with a five-year award of $122M to JCAP in September 2010. Both are visible and scrutiny of their management processes was necessary.

The COV assessed the efficacy and quality of the processes used to solicit, review, recommend, and document proposal actions and the monitoring of active projects. It also commented on the award process' impact on the breadth and depth of portfolio elements, and the national and international standing of those elements. The COV consisted of 19 members divided into three subpanels. It conducted an initial review, then a second process to ensure cross-calibration.

The COV found that EFRC and JPAC processes funded research that has been in areas relevant to the BES mission and it has been led by highly recognized scientists, reflecting positively on the judgment of BES staff and program managers. The review of proposals was challenging due to the timing of ARRA funding and the need to allocate this to the EFRCs. Decisions were made in a short amount of time, and the identification of reviewers was challenging as many community members were participants in the process. Still, reviewers were of a high quality. BES did a good job recruiting reviewers but there was a lack of diversity among the panel.

BES management processes for the EFRCs are well implemented and effective, from scientific reviews to other types of reviews, and are set up to make EFRCs as successful as possible. The COV found a high level of integrity in the processes and the active use of different mechanisms to address challenges. The EFRCs are an inspiring story about the value of fundamental research.

The JPAC solicitation and review process is substantial, thorough, and well managed by the BES staff. The review process was through and well documented. The COV also found that both the EFRCs and the JPAC present new management challenges, and the size and unique focus of the JPAC makes a thorough management process very important. The COV report contains more comments related to management strategies and the need for continued BES oversight of the JPAC to achieve its goals.

It was recommended that while the EFRC award documents gave clear rationale for funding a project, feedback on rejected proposals should be more expansive. At present, feedback is limited to reviewers' comments and a total score. This limitation was understood by the COV to be an outcome of reviewing a large number of proposals in a short time.

The COV recommended that the BES take steps to integrate activities in the JPAC to ensure focus the single goal to be achieve over a five-year period.

Dr. Drell thanked the COV for their work and producing complete report within one week of the review, and thanked the BES staff for their support and providing advance information.

Discussion

Dr. Hemminger commended the COV for its work as this COV process was unique compared to typical efforts.

Dr. Drell responded to Dr. Hemminger's question about diversity among EFRC senior staff management, recognizing that the absence of a database prevented the COV from conducting the type of assessment that it would have liked to do. She noted that BES acknowledged this shortcoming. COV members still attempted some analysis using online data finding that representation was around 11 percent and concluded that this should be larger.

Dr. Hemminger has observed that there is a lack of diversity among PIs and low turnover, hence it may take a while for the pipeline to feed more diverse talent into these positions. He noted that this is a new program and hopes that its diversity will eventually match that of the community. Dr. Drell responded that the COV did not know if its findings were truly a snapshot or simply the effect of having insufficient data. She felt that attention should be paid to this area.

The BESAC accepted the Energy Frontier Research Centers and Joint Center for Artificial Photosynthesis Energy Innovation Hub Committee of Visitors Report.

Public comment

None

Other business

Those on BESAC will provide some wordsmithing to help finalize the report from the BESAC Light Source Subcommittee.

The meeting was adjourned by Dr. Hemminger at 2:53 pm.