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

PUBLIC MEETING MINUTES

March 22-23, 2018

DoubleTree by Hilton Hotel Bethesda-Washington DC
8120 Wisconsin Ave, Bethesda, MD 20814

DEPARTMENT OF ENERGY BASIC ENERGY SCIENCES ADVISORY COMMITTEE
SUMMARY OF MEETING

The U.S. Department of Energy (DOE) Basic Energy Sciences Advisory Committee (BESAC) convened on Thursday and Friday, March 22-23, 2018 at the DoubleTree by Hilton Hotel Bethesda-Washington DC, 8120 Wisconsin Ave, Bethesda, MD. The meeting was open to the public and conducted in accordance with the requirements of the Federal Advisory Committee Act. Information about BESAC and this meeting can be found at http://science.energy.gov/bes/besac/

BESAC Members Present:

Persis Drell, BESAC Chair, Stanford University
Jingguang Chen, Columbia University
Sue Clark, Pacific Northwest National Laboratory (PNNL)
Beatriz Roldan Cuenya, Fritz-Haber Institute of the Max Planck Society
Helmut Dosch, DESY
Cynthia Friend, Harvard University
Marc Kastner, Science Philanthropy Alliance
Bruce Kay, Pacific Northwest Laboratory
Stephen Leone, University of California, Berkeley, Lawrence Berkeley National Laboratory (LBNL)
Despina Louca, University of Virginia
Abbas Ourmazd, University of Wisconsin, Milwaukee
Philippe Piot, Northern Illinois University
Anthony Rollett, Carnegie Mellon University
Frances Ross, IBM
Gary Rubloff, University of Maryland
Maria Santore, University of Massachusetts, Amherst
Esther Takeuchi, Stony Brook University
John Tranquada, Brookhaven National Laboratory
Stephen Wasserman, Independent Consultant

BESAC Members Attending Online:

Dawn Bonnell, University of Pennsylvania
Yan Gao, General Electric Company
Sharon Hammes-Schiffer, Yale University
Ian Robertson, University of Wisconsin, Madison

Designated Federal Officer:
Harriet Kung, Director, Office of Basic Energy Sciences (BES)

Committee Manager:
Katie Runkles, BES Program Analyst

BES Management Participants:
Bruce Garrett, Director, BES Chemical Sciences, Geosciences and Biosciences Division
Linda Horton, Director, BES Materials Sciences and Engineering Division
James Murphy, Director, BES Scientific User Facilities Division

Thursday, March 22, 2018

BESAC Chair, Persis Drell, called the meeting to order at 9:30 a.m. Eastern Time (ET). **Drell** asked BESAC members to introduce themselves and opened the meeting.

NEWS FROM OFFICE OF BASIC ENERGY SCIENCES (BES)

Harriet Kung, Director, Office of Basic Energy Sciences (BES) discussed DOE appointees, budget, and updates on SC and BES. The Deputy Secretary of Energy, Dan Brouillette, was sworn into office August 7, 2017 and the Under Secretary for Science, Paul Dabbar, was sworn into office on November 7, 2017. Dabbar, a Naval Academy graduate and nuclear submarine officer, a former member of the advisory board for the DOE's Environmental Management (EM) Program, is familiar with the operations of the national laboratories (labs), and has served on Science Advisory Boards. He will join the meeting tomorrow morning to discuss priorities and goals for SC.

The FY19 budget request for DOE is $30.6B and includes funding for the science portfolio, energy technologies, and nuclear weapons programs. SC's FY19 Request is equal to the enacted FY17 budget, approximately $5.4B. The FY19 Request reflects adjustments due to passage of the Bipartisan Budget Act of 2018. The BES FY19 Request of $1.85B supports early-stage, fundamental research; core research priorities; Energy Frontier Research Centers (EFRCs) and Energy Innovation Hubs (Hubs); user facilities; and the Advanced Light Source Upgrade (ALS-U) and Linac Coherent Light Source-II High Energy (LCLS-II-HE) upgrade construction projects.

In Quantum Information Science (QIS), SC proposes $105M in the FY19 Request focusing on quantum computing and quantum sensor technology. SC's QIS strategy is to build on community input; leverage existing groundwork; focus on cross-cutting themes; and target impactful contributions, science for next-generation advances, and mission-focused applications. Five of six programs in SC are participating and focusing on different parts of QIS. Kung shared opportunities for BES developed in two roundtables: next generation quantum ~~systens~~systems and quantum computing in chemical and materials sciences. Kung updated BESAC on BES user facilities and international developments in storage rings.

A government-wide Omnibus bill was released on March 21st that included funding at the levels set in the Bipartisan Budget Act of 2018. This is a two-year budget deal for FY18 ($80B increase in defense, $63B increase in non-defense) and FY19 ($85B increase in defense, $68B increase in non-defense).

Discussion

Louca sought clarification about the research portion of the budget. **Kung** stated that 40% of the budget is for research, of that, 40% goes to university research in grants directly to Principal Investigators (PI).

Roldan Cuenya asked about the future of the Hubs, their stability, and whether there could be future budget increases for them. **Kung** said that the track record of the Hubs has been very positive and BES learned how to manage the large scale team-based efforts. The publications and research impact coming from the two Hubs has been exciting and positive, and justifies their restoration in the funding request for FY19, and Congress has agreed.

Chen requested more information on pre-proposal numbers and expected funding for the EFRCs. **Kung** indicated that the number of proposals is procurement sensitive. The pre-proposals received from the November 2017 Funding Opportunity Announcement (FOA) went

through pre-proposal comparative reviews by SC program managers and the PIs were notified in late January/early February 2018. Full proposal submissions are due in April and BES expects to complete a peer review process and make an award announcement in July. The FY18 Omnibus bill restored EFRC funding to $110M, ~$100M of which will be available for recompetition through the EFRC FOA DE-FOA-0001810.

Rollett asked if there have been shifts in users or topics at the facilities. **Kung** was pleasantly surprised by community vibrancy and user facilities value, noting that Marc Kastner has seen this impact in the BES 40th Subcommittee study. **Kastner** added that several stories in the BES 40th Subcommittee report clearly demonstrate the enthusiasm for the user facilities, including ones on the life sciences and on the broader impact of the facilities.

Dosch noted the importance of cross-talk and people working at the boundaries between different research communities, e.g., materials science, life science, and artificial intelligence. He mentioned that neuromorphic computing is a major emphasis in Europe and asked where it sits within different agencies in the U.S. **Kung** explained that different aspects of neuromorphic computing reside in different divisions, and that SC had a joint workshop on it. BES has biology-related activities in both research divisions, with different emphases. With the biomedical community, BER has a closer connection than BES does. BES also participates in a number of interagency bodies, and agrees that these connections become very important as science becomes more interdisciplinary.

Drell adjourned BESAC for a break at 10:25 a.m. and reconvened the meeting at 11:00 a.m.

HIGH ENERGY PHYSICS AND QUANTUM INFORMATION SCIENCES

Jim Siegrist, Director, Office of High Energy Physics (HEP) shared HEP's long-term strategy, gave an overview of HEP and particle physics, and discussed the Particle Physics Project Prioritization Panel (P5) report. P5 identified five science drivers motivating particle physics – Higgs Boson, Neutrino Mass, Dark Matter, Cosmic Acceleration, and Explore the Unknown. The three Research Frontiers (Energy, Intensity, and Cosmic) are complementary to one another.

QIS is relevant to HEP topics such as black hole information paradox, testing of fundamental symmetries, search for dark matter, and emergence of space time. HEP's thrust areas in QIS include field theory/analogue simulations, and entanglement-based experiments. Quantum computing for HEP includes data analysis techniques, and algorithms for HEP computations and modeling. Quantum controls and sensor technology includes controls, qubits, and other technology to advance dark universe and space time sensors. In FY17, HEP supported pilot projects in QIS including the blackhole information paradox and exploring particle scattering off a complex boundary condition. The FOA, Quantum Information Science Enabled Discovery (QuantISED) for High Energy Physics, was released on February 28, 2018, applications are due April 16, 2018. The two topics in the FOA are high energy physics and QIS research, and quantum computing for HEP on current and future computing systems. Three additional FY18 activities included a SC-wide Dear Colleague Letter on Accelerating Development of and Research Impacts from QIS, a Request for Information (RFI) on the impacts from and to QIS in HEP, and a Small Business Innovation Research (SBIR) opportunity on QIS supporting technologies.

Discussion

Dosch asked about the U.S. perspective on the next linear collider. **Siegrist** indicated that the next linear collider remains under heavy discussion in the HEP community, most of the community is waiting for a signal from the Japanese.

BES 40th SUBCOMMITTEE REPORT: OVERVIEW

Marc Kastner discussed the charge to and the process used by the BES 40th Subcommittee to develop their report. The objective of the charge was to highlight outstanding examples of BES research's impact to the nation. The subcommittee sent 1,700 emails requesting recommendations for stories and received 65 submissions. At the October 2017 meeting the 65 submissions were reviewed and combined as appropriate to create nine stories. Advice was sought from 11 Congressional staffers, two administration staff members, and two former Congressional staff members. Interviews were conducted and a first draft was written by Al Hammond. The draft was reviewed by subcommittee members. BES confirmed BES contributions and accurate attribution to other SC offices in the report. Further meetings in early 2018 allowed the subcommittee to collect more stories, discuss improvements, complete further reviews, and determine final recommendations. The goals for the stories are to make BES science exciting and important, to be simple and easy to read, to illustrate the BES mission, and to select topics that are characteristic of BES research without being comprehensive.

Discussion

Rollett asked Kastner for insights he gained from the process. **Kastner** mentioned BES's early support of John Clark's work on Josephson's tunneling, and the effect BES has had on DOE's mission.

Roldan Cuenya was curious if research areas in BES had changed over the 40 years. **Kastner** stated that the early focus of BES was on materials science for nuclear energy. Over time the mission broadened to other areas such as renewable energy, energy efficiency, and environmental management.

Ourmazd commented that an important contributor to the success of BES has been the strategy used to identify and nurture important projects over the years and recommendations could be couched in terms of lessons learned. **Kastner** stated that the Subcommittee thought the best way to describe BES strategy was in the introduction, but said they would look for points in the stories that could be highlighted.

Takeuchi asked if the stories mentioned the time between the fundamental investigation and meaningful implementation. **Kastner** indicated the report attempts to illustrate the risk in investment in basic research and that BES hands off projects to industry, other offices in DOE, and other agencies.

Dosch asked how scientific breakthroughs modified the funding strategy. **Kastner** thought there were probably some examples of this and would give it further consideration. **Drell** noted that BESAC could conditionally accept the report, if they were sufficiently comfortable or could wait until the July meeting to vote on acceptance.

Drell adjourned BESAC for lunch at 12:00 p.m. and reconvened the meeting at 1:32 p.m.

QIS PANEL DISCUSSION

Hans Christen, Oak Ridge National Laboratory (ORNL), **Tom Devereaux**, SLAC National Accelerator Laboratory, and **Amir Yacoby**, Harvard University participated in a panel discussion on QIS.

Yacoby stated that we are at the onset of the 2nd quantum revolution. The 1st quantum revolution was the realization that our world is governed by the laws of quantum mechanics, the 2nd quantum revolution is about control (controlling entanglement, controlling superposition, controlling coherence) in systems with an increasing number of degrees of freedom. Some of the promise behind QIS, particularly quantum computing and communications and sensing, has been articulated many times. A quantum machine that can control the interactions between large numbers of constituents has tremendous promise in describing our universe, describing materials, and therefore tremendous promise for BES. Yacoby highlighted three Grand Challenges in QIS: control, scaling up, and making use of QIS. He cautioned that QIS should not be seen as a roadmap, that there is tremendous space for discovery.

Christen discussed the QIS roundtable, Opportunities for Basic Research for Next-Generation Quantum Systems. QIS was defined as assemblies of materials or arrangements of trapped ions or electrons in which the uniquely quantum interactions between the components are tuned to produce a specific behavior. Within that topic two separate aspects were considered: 1) what to do from a chemistry and materials science perspective to create, control, and interact with the systems and 2) opportunities that advance the instrumentation to understand and to use QIS and quantum interactions as sensor and measurement devices. There are challenges in creating quantum systems and opportunities for using those systems to understand materials science and chemistry.

Devereaux is conducting large numerical simulations of quantum systems on classical computer systems. Quantum computing will not solve all things. While large speed-ups are seen in simulating dynamics of quantum systems, structured databases see hardly any speed-up. The workshop on Quantum Computing in Chemical and Materials Sciences identified four Priority Research Opportunities (PRO): controlling quantum dynamics of non-equilibrium systems, physics and chemistry of strongly correlated electron systems, embedding quantum hardware in classical frameworks, and bridging the classical-quantum computing divide.

Discussion

Drell asked the panelists their view of the most important QIS science gaps and how BES could contribute. **Christen** said creating an entirely new structure requires a profound understanding of what individual defects do to de-coherence and a fundamental understanding of the chemistry and materials science process that lead to material defect formations. **Yacoby** mentioned developing materials that have intrinsic protection, exploring endowed topological protection, and schemes to convert quantum information from one form to another. **Devereaux** added gate depth and number of operations on a qubit, identifying hardware requirements to address a particular problem, benchmarking on classical computers, interfacing with the quantum computer, and writing code.

Roldan Cuenya was curious about the main development (key) that gave rise to the 1st QIS prototypes. **Yacoby** said rather than a single development it appears to be a multi-decade endeavor to make use of and figure out the tools needed to control quantum variables. **Christen** suggested the push from companies who make quantum computing platforms available and the multi-disciplinary nature of the research. The user facilities are poised to bring researchers together.

Drell asked the panelists to expand on user facilities' role in relation to QIS. **Christen** said user facilities allow researchers to conduct their research using tools that will be available for others to be used in different areas. **Devereaux** said ultrafast science is poised to make great strides in quantum computing and is looking at time-evolved quantum dynamics. **Yacoby** said materials is key. Layered materials have provided a new way of creating hybrid and complex matter. Need to build instrumentation that constructs these layered structures. Ideally with pre-designed characteristics and partnering with national labs to do that with fabrication centers would be the right way to go.

Roldan Cuenya asked if companies are working with national labs. **Christen** indicated there are interactions at different levels now and there will be an opportunity to increase those interactions in the future.

Ourmazd asked about algorithms that can be implemented on other machines. **Devereaux** mentioned fractionalized excitations, a potential platform for building a topologically protected quantum computer.

Gao asked about characterizing quantum materials. **Yacoby** said we know how to characterize the relevant attributes for a single qubit and two qubits, however, the relevant attributes of a 50-100 qubit quantum processor is unknown and is an open area of exploration.

Rollett mentioned using high throughput techniques for making quantum devices. **Christen** stated two ideas were discussed in the roundtable: 1) an automated or robotic way to stack materials enabling various stacking with high fidelity and high precision, and 2) measuring and fabrication at the same time and learning what to measure during synthesis.

Kay asked the panelists to comment on degradation of the materials, engineering metastable systems, and projected heat loads. **Yacoby** said temperature does not seem to degrade the layered structures; however, currently the premise of QIS is nearly entirely at low temperatures. Several labs around the world are developing low-temperature electronics for controlling quantum processors and many papers are tackling the question of energy.

Rollett asked if the desire to probe devices as you are making them, is a fundamental conflict or that better sensors or different probes and needed. **Christen** said it depends on the platform and type of material; when you are manipulating individual dopants, the temperature is irrelevant because the energy of the probe manipulating the sample is dominating.

Dosch asked if the roundtables yielded a list of fundamental unknowns, questions, or barriers. **Devereaux** noted that the four PROs tackle different aspects of systems and properties to address a problem of interest successfully.

Drell asked what the panelists were interested in solving by using QIS. **Yacoby** wanted to find new ways to explore materials, which could lead to approaches to endow conventional materials with superconducting properties. **Christen** mentioned learning how to position individual defects within a material and using squeeze light to increase resolution and measurement of deflection of a scanning probe. **Devereaux** answered "trying to solve the Hubbard model"; gladly trading exponential complexity for polynomial complexity.

Tranquada asked about overlap of applications on analog quantum computers. **Devereaux** indicated not much time was spent delineating between digital and analog computer platforms. Instead they focused on applications that would work on both platforms.

Piot asked the panelists to comment on new capabilities needed for electron or x-ray probes. **Yacoby** said the arena for new sensors that include entanglement and multiple sensors both for enhancing sensitivity and improving the signal to noise limits is not experimentally established. Entanglement offers tremendous possibilities for studying correlations and multi-

point correlations can provide additional insight into the behavior of materials. **Christen** said a long-term commitment and bringing the community together to co-design measurement techniques.

Ross asked about gaps exist due to lack of instrumentation or funding. **Christen** said the biggest limiting factor is when the application and the instrumentation development fall in the domain of different funding agencies.

Rubloff asked about the scope of investment for QIS and if user facilities were the right place to expand availability of complicated systems for workforce development. **Yacoby** said synthesis and characterization need to be combined and once the system provides fast turn-around of particular materials a user facility will be the right place.

Gao asked about the landscape of QIS development and maturity globally. **Yacoby** indicated there is tremendous investment in Europe and even greater investment in China.

Drell posed the question of when quantum computers will become a commodity. **Devereaux** defined commodity as a thing that can be used. IBM allows one to program on a small qubit system. **Christen** shifted from computing to sensing and suggested that quantum sensors will be used within 10 years. **Yacoby** estimated the current quantum machines will supersede conventional computer capabilities in a couple of years.

BES 40TH SUBCOMMITTEE REPORT: STORIES AND RECOMMENDATIONS

Eric Isaacs, University of Chicago, shared the mission of the BES 40th Subcommittee report (to tell stories in context of the BES mission), highlighted four of the 12 stories completed, and discussed the subcommittee's recommendations.

Discussion

Kung noted the need to give proper credit to other programs, e.g., the Exascale Computing Project (ECP) is solely supported by ASCR.

Drell pointed out the impact of graphs in understanding complex concepts – the ones presented in the talk affect the audience's perception and will not be in the final report. **Kastner** said the layout and images were discussed and that the committee members have a couple of examples of how the stories will look. He commented on the challenge of getting good images that are accessible for all of the stories.

Clark warned not to miss the opportunity for the report to have a forward look. **Isaacs** said the stories are told in an open/broad sense to engage other agencies. The subcommittee mission was to tell great stories about the current and past impact of BES science. **Kastner** mentioned struggling with the specific wording of the recommendations and the tone of the writing.

Several BESAC members offered suggestions on finessing the recommendations to avoid repetition and express historical importance and future exploration. **Kastner** and **Isaacs** requested concrete suggestions from BESAC members for wordsmithing.

Takeuchi, Wasserman, and **Santori** mentioned an Einstein quote in the report and suggested clarifying the historical significance of the quote.

Kay complimented the report and suggested emphasizing the tools BES develops, their importance to enabling intellectual freedom, and the support of BES funding models.

Dosch suggested including the 23 DOE Nobel Laureates and asked Kung about the impact of recommendations.

Rollett asked about adding return on investment (ROI) discussions. **Kung** thought the current stories addressed the impact of BES science and its translation to other programs or industries well. **Kastner** added that the subcommittee did not feel it had the knowledge for ROI. **Drell** suggested caution and noted ROI is extremely complex.

Ourmazd recommended focusing on the executive summary and recommendations sections and asked if the report could include conclusions or best practices. **Kastner** mentioned that the charge asks for recommendations and stated the subcommittee could examine how to contextualize them better. **Kung** raised the point not to underestimate the recommendations from advisory committees. For example EFRCs and the Early Career awards were established based on BESAC recommendations. **Leone** noted that the charge letter was very forward looking and was asking for a very different style of report. **Kung** said while she was expecting some recommendations, these were different from prior BESAC recommendations.

Drell adjourned BESAC for a break at 3:32 p.m. and reconvened the meeting at 4:01 p.m.

BES 40TH SUBCOMMITTEE REPORT: STORIES AND RECOMMENDATIONS DISCUSSION

Kastner shared a proposal with BESAC to separate out findings and recommendations, summarizing what BES has done well.

Dosch, **Kay**, and **Ourmazd** made suggestions of elements to add to the recommendations. **Robertson** reminded BESAC that one story in particular includes great examples of how basic science has translated to industry commercial products. **Tranquada** suggested making stewardship explicit. **Friend** commented that the stories are meant to capture people's attention and designed for the general public and Congressional staffers.

Drell asked BESAC about the issue of balance noting the importance that the field embraces and sees themselves in the report. **Isaacs** asked BESAC if the balance was right between university and lab research.

Ourmazd asked about steps to roll out the report, especially online and via social media. **Kastner** mentioned working with multiple organizations and using presentations to Congressional staffers and members. **Drell** suggested the labs could help with social media.

Wasserman asked when the stories could be used and shared. **Kung** indicated that prior to any pieces being used, BESAC must approve and post the final report. **Isaacs** suggested a coherent communication strategy be put in place, especially with social media. **Kung** agreed that a communications strategy is important.

Friend asked about logistics and provisional acceptance. **Drell** explained that provisional acceptance means the subcommittee will move forward to finalize, then BESAC will see the final version and sign off via email before it went public. Drell called for a vote on provisional acceptance of the report; BESAC unanimously voted for provisional acceptance.

Public Comment Session

None.

Drell adjourned the meeting for the day at 4:25 p.m.

Friday, March 23, 2018

Drell, BESAC Chair, called the meeting to order at 9:00 a.m.

COMMITTEE OF VISITORS (COV) – MATERIALS SCIENCES AND ENGINEERING (MSE) DIVISION UPDATE

Linda Horton, DOE, provided a history of BES COVs, shared substantive changes made because of recommendations from COVs, and highlighted issues with the Portfolio Analysis and Management System (PAMS) system. The COV charge has to examine the efficacy and quality of the award process, and how that affects the portfolio.

In MSE's $360M annual budget, ~$80M go to the EFRCs and Energy Innovation Hub. Funds are divided for universities (40%) and labs (60%); there are 10 core research areas and DOE's Established Program to Stimulate Competitive Research (EPSCoR) program. MSE has 17 personnel; annually MSE receives 700-800 new and renewal proposals, reviews ~450 annual progress reports, and reviews >500 white papers from the community. The COV will look at FY15-FY17 funding opportunities, lab announcements, and awards management, but will not include the Hub or EFRCs. Horton discussed the EPSCoR program which addresses disparities in competitiveness for Federal research support.

Discussion

Dosch asked if the NSF and DOE EPSCoR states are the same. **Horton** indicated they are the same.

CHEMICAL SCIENCES, GEOSCIENCES AND BIOSCIENCES (CSGB) DIVISION STRATEGIC PLANNING PROCESS

Bruce Garrett, DOE, covered progress made on strategic planning for CSGB which was driven by COV recommendations in 2014 and 2017, as well as the mission, vision, and goals. CSGB's strategic focus is on five synergistic research areas: ultrafast chemistry, chemistry at complex interfaces, charge transport and reactivity, reaction pathways in diverse environments, and chemistry in aqueous environments. There are also opportunities for chemical sciences to advance QIS and opportunities to exploit QIS for chemical sciences.

Discussion

Chen noted that some of these problems require multiple PIs working on a team. **Garrett** indicated that determining the best approach is the important next step in the process. **Chen** suggested aligning the EFRCs with a strategic area being proposed. **Garrett** noted that EFRCs are bigger than just the CSGB Division and they are still in the strategic planning process.

Leone asked about communicating with reviewers and PIs on topics of interest and **Louca** suggested promoting machine learning to PIs. **Garrett** said the FY18 FOA has language about the five topics. Garrett shares the information at all PI meetings and has talked extensively to the labs. Future solicitations will be the vehicle to communicate particulars; CSGB is open to any ideas.

Roldan Cuenya asked about the middle ground between single PIs and EFRC teams. **Garrett** said the first solicitation for computational chemical sciences yielded projects that are both single PI and small teams. The monthly meetings with the projects will help find opportunities for collaboration.

Rubloff asked about biology-related topics and delineating scope for BES research. **Garrett** said CSGB's biological efforts are solidly in solar photosynthesis. In terms of scope, CSGB focuses on the molecular scale using the tools of the physical sciences.

ULTRAFAST ROUNDTABLE UPDATE

Tony Heinz, SLAC National Accelerator Laboratory, updated BESAC on the ultrafast science roundtable, discussed the scientific setting and background, and reviewed the roundtable process. Ultrafast x-rays allow for structural analysis, chemical specificity in x-ray spectroscopy, attosecond time resolution, and the study of light-matter interactions.

The roundtable was charged to identify the research priorities, key science drivers and research strategies for the BES research portfolio that uses the Linac Coherent Light Source, including its prospective upgrades. The input will be used to optimize BES's investment in ultrafast x-ray science and ensure the scientific impact of this research to the broader BES mission. The roundtable was held in October 2017 with four subpanels. The report contains four priority research opportunities. The report focuses on new possibilities that complement earlier planning documents for LCLS-II.

Discussion

None.

NEWS FROM THE OFFICE OF UNDER SECRETARY FOR SCIENCE

Paul Dabbar, DOE Under Secretary for Science, discussed leadership and organizational changes at DOE, shared budget information, and mentioned a new initiative. The NNSA area is still separate and the applied energy offices are broken off from science. Secretary Perry thought it was important to have an Under Secretary focused mainly on applied energies, utilities and renewables and different applied areas, and to place the SC, Environmental Management, and Technology Transitions under Dabbar.

There is great support for BES and the National Lab complex in Congress, in both science and project management. User facilities makes SC unique and BES and the science complex have delivered facilities on time and on budget for over 25 years. In chemistry and materials, SC does a number of things applicable to broader applications. The capacity and opportunity for technology transition is much higher than is currently being utilized.

The 16% increase in the SC budget is an all-time high for funding. BES research topics are all fully funded. In operations there are increases at all facilities, and in construction there are accelerated plans for LCLS-II and APS-U. Funding begins for the Advanced Light Source Upgrade (ALS-U), the LCLS-II High Energy upgrade (LCLS-II-HE), and the SNS Proton Power Upgrade. In terms of 2019, there is great support for DOE leadership to continue the momentum. Particularly interesting are accelerating funding for exascale and QIS.

There are tremendous amounts of research and intellectual property created by the national labs. The lab complex has a portfolio including user facilities, intellectual property and technology, and people. National lab complex has a great history around creating new industries such as commercial nuclear power, nuclear imaging, magnetic imaging, and nuclear medicine.

The national lab innovation initiative, called X-Lab Summits, will communicate what the national labs and research complex does for the nation. A technology will be chosen and

highlights of the lab content applicable to that technology will be shared across multi-lab events. The first X-lab Summit to be held at Stanford University is on a BES area, energy storage.

Discussion

Roldan Cuenya asked about future budgets, momentum, and funding stability. **Dabbar** is sensitive to multi-year budgets in terms of research. The U.S. government challenge lies in the annual appropriations process.

Rollett asked about the industry initiatives, X-Lab Summits. **Dabbar** indicated they are looking at including advanced manufacturing, artificial intelligence, machine learning, and grid resiliency and modeling. The challenge is to narrow down the list.

Public Comment Session

None.

Drell adjourned the BESAC meeting at 11:08 a.m.

Respectfully submitted,
Tiffani R. Conner, PhD, PMP, AHIP
Science Writer
ORISE/ ORAU
April 15, 2018