

**NUCLEAR SCIENCE ADVISORY COMMITTEE
to the
U.S. DEPARTMENT OF ENERGY AND
NATIONAL SCIENCE FOUNDATION**

PUBLIC MEETING MINUTES

**North Bethesda Marriott Hotel and Conference Center
5701 Marinelli Road, Rockville, MD 20852**

January 28 and 29, 2013

**DOE / NSF NUCLEAR SCIENCE ADVISORY COMMITTEE
SUMMARY OF MEETING**

The U.S. Department of Energy (DOE) and National Science Foundation (NSF) Nuclear Science Advisory Committee (NSAC) was convened at 9:00 a.m. EST on Monday, January 28, 2013, at the North Bethesda Marriott Hotel and Conference Center by NSAC Chair Donald Geesaman.

Committee members present:

Donald Geesaman, Chair	David Kaplan	Allena Opper
Robert Atcher	Joshua Klein	Jorge Piekarewicz
Jeffrey Binder	Karlheinz Langanke	Robert Rundberg
Jeffery Blackmon	Zheng-Tian Lu	Julia Velkovska
Alexandra Gade	Robert McKeown	Raju Venugopalan
Susan Gardner	Curtis Meyer	
Peter Jacobs	Jamie Nagle	

Committee members absent:

None

NSAC Designated Federal Officer:

Tim Hallman, DOE Office of Science (SC), Associate Director, Office of Nuclear Physics

Others present for all or part of the meeting:

Gerald Blazey, White House Office of Science and Technology Policy
 William Brinkman, DOE SC Director of Science
 Pepin Carolan, DOE SC, Fermi Site Office
 Julie Carruthers, DOE SC
 Adrian Cho, Science magazine
 David Dean, Oak Ridge National Laboratory
 Gail Dodge, National Science Foundation
 Paul Doucette, Battelle
 Rolf Ent, Jefferson Laboratory
 George Fai, DOE SC, Office of Nuclear Physics (NP), Program Manager, Nuclear Theory
 Marc Garland, DOE SC, NP, Program Manager, Isotope Facilities
 Konrad Gelbke, Michigan State University NSCL and FRIB Laboratory Director
 Doon Gibbs, Brookhaven National Laboratory
 Jehanne Gillo, DOE SC, NP, Division Director, Facilities and Project Management Division
 Maureen Grade, Gannett
 James Hawkins, DOE SC, NP, Program Manager, Major Initiatives
 Marcos Huerta, DOE SC
 Robert Janssens, Argonne National Laboratory
 Bradley Keister, National Science Foundation, Program Director, Nuclear Physics
 Richard Kouzes, Pacific Northwest National Laboratory
 Thomas Ludlam, Brookhaven National Laboratory
 Reinhold Mann, Brookhaven National Laboratory
 Helmut Marsiske, DOE SC, NP, Program Manager, Nuclear Physics Instrumentation

Hugh Montgomery, Jefferson Laboratory
 Erich Ormand, Lawrence Livermore National Laboratory
 Jerry Draayer, SURA
 Robert Redwine, Massachusetts Institute of Technology
 Hamish Robertson, University of Washington
 Thomas Roser, Lawrence Berkeley National Laboratory
 Lee Schroeder, Lawrence Berkeley National Laboratory / TechSource Inc.
 Susan Seestrom, Los Alamos National Laboratory
 Bradley Sherrill, Michigan State University
 James Sowinski, DOE SC, NP, Acting Program Manager, Heavy Ion Nuclear Physics
 James Symons, Lawrence Berkeley National Laboratory
 Steve Vigdor, Indiana University
 Scott Wilburn, Los Alamos National Laboratory
 John Wilkerson, University of North Carolina

JANUARY 28, 2013

OPENING REMARKS

The Nuclear Science Advisory Committee (NSAC) was convened at 9:00 a.m. EST on Monday, January 28, 2013, at the North Bethesda Marriott Hotel and Conference Center, in Bethesda, MD, by NSAC Chair Donald Geesaman. The meeting was open to the public and conducted in accordance with the requirements of the Federal Advisory Committee Act. Attendees can visit <http://science.energy.gov/np/nsac> for more information about NSAC.

PRESENTATION OF NEWS FROM THE DOE OFFICE OF NUCLEAR PHYSICS

Tim Hallman, DOE Office of Science (SC), Associate Director, Office of Nuclear Physics (NP), shared an update on the activities of the DOE NP.

At this time of year, there is usually an upcoming Presidential Request and DOE would know the FY 2013 budget. The budget is currently unknown, yet NP knows the actions it must pursue.

NP addresses the existence and properties of nuclear matter under extreme conditions, the exotic and excited bound states of quarks and gluons, the ultimate limits of the existence of bound systems of protons and neutrons, nuclear processes that power stars and supernovae and synthesizes the elements, and the nature and fundamental properties of neutrinos and neutrons and their role in the matter-antimatter asymmetry of the universe.

Amidst a continuing resolution, DOE is continuing its support of research at the Brookhaven National Laboratory (BNL) Relativistic Heavy Ion Collider (RHIC), the Thomas Jefferson National Accelerator Laboratory (JLab or TJNAF) Continuous Electron Beam Accelerator Facility (CEBAF), and the Argonne National Laboratory (ANL) Argonne Tandem Linac Accelerator System (ATLAS). FY 2013 highlights also include the 12 GeV Upgrade at CEBAF, preparation for construction of the Facility for Rare Isotope Beams (FRIB); and the research, development and production of stable and radioactive isotopes.

NP facilities are running below optimum use in FY 2013 and at historic lows due to reduced funding and planned outages. The budget will support nine to 11 weeks of use at RHIC. Other news includes lengthening a planned shutdown at CEBAF for the 12 GeV installation, ATLAS will run at most 5,000 hours due to an intensity upgrade, and the Holifield Radioactive Ion Beam Facility (HRIBF) ended operation as a national user facility in April 2012.

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The FY 2013 Congressional Request is \$527M and 3.7 percent less than FY 2012. Budget challenges require NSAC guidance on important spending questions. By category, the percentages of funding in facility operations and research have changed very little since 2009. In research, cuts of five percent in FY 2012 and eight percent in FY2013 present major challenges. NSAC advice is needed. Investments in Major Items of Equipment (MIE) went from four to one percent as NP managed just two MIEs in FY 2012.

There is a charge to the NSAC seeking advice on implementing the priorities and recommendations of the 2007 Long Range Plan (LRP), in light of projected constrained budgets. The charge calls for addressing scientific opportunities, needed facility and instrumentation capabilities, and two funding scenarios.

On January 7 – 9, 2013, NP held a Committee of Visitors (COV) chaired by John Harris of Yale University. The COV assessed NP processes for the solicitation, review, recommending and documentation of proposals, and monitoring of active projects and programs. The evaluation considered the efficacy and quality of these processes, and the quality of the resulting portfolio judged by its breadth and depth, and its national and international standing. The COV was well done and thorough. Some recommendations are awaiting a factual check. Hallman expects the findings to be shared by the Chair at the NSAC meeting in March 2013.

Among other NP news, the permanent appointment of a Medium Energy Program Manager was unsuccessful, but another vacancy announcement will be posted after the mandatory 90-day waiting period. The appointment of a Director of the Physics Research Division is ongoing, and NP must complete its tasks related to the selection certificate this week.

NP is planning for a comparative review of laboratory and university research in spring 2013 or sometime thereafter. Five panels with overlapping membership will comparatively rank research in those areas. They will not fold-in scientific priorities but will look at productivity and promise in those research areas. This will inform later difficult choices, if those need to be made.

The NP Isotope Program may have a second all-Federal isotope workshop in spring 2013, similar to a workshop held in early 2012. That meeting drew input from all agencies to inform isotope demand and supply. A review will explore operations processes in the Physics Research Division to enhance efficiencies and impacts, and explore the creation of a separate portfolio for Neutrons / Neutrinos and Fundamental Symmetries.

NP is anticipating an FY 2014 OMB “passback” on January 28, 2013.

The NP Office annual retreat is March 13 - 14, 2013. NP will also invite laboratory managers to share ideas on budget formulation prior to the NP retreat. The NP retreat will identify portfolio options and formulate a budget for FY 2015.

The NP Office of Program Assessment (OPA) will review RHIC operations summer 2013. OPA will verify an independent assessment on the resources needed for effective operation of the facility.

The 12 GeV CEBAF Upgrade will be reviewed on May 7 – 9, 2013. It will address the impacts of funding changes in FY 2012 (\$50M and not \$66M as in the project baseline), and project challenges such as a magnet manufacturer not completing its contract.

A one-day user facility review for TJNAF, and a Science and Technology review for ATLAS will occur in FY13.

NP and the FRIB project team are examining options for long-lead activities, construction and continuance to determine how to keep it moving forward consistent with status.

The Early Career Award process is in progress.

A nomination has been made by NP for a candidate to attend the 63rd Nobel Laureates meeting from June 30 through July 5, 2013. The topic in 2013 is chemistry.

NP has been discussing with the Office of High-Energy Physics (HEP) how to conduct a down-select process if the science demands a ton-scale $0\nu\beta\beta$ experiment. The reinstatement of the Neutrino Scientific Assessment Group (NuSAG) is one approach. It would include NP and HEP members and look at DBD R&D and down-select criteria. This is purely formative for planning purposes and NP welcomes input from the community.

There is a new charge from SC that asks for a scientific user facility prioritization to ensure optimal benefit from Federal investments. Reports are due to SC by March 22, 2013. This is like an exercise conducted by former SC Director Ray Orbach that aimed to stay at the forefront of scientific capabilities and tools. The charge will support a 10-year outlook and help prioritize the tools that are needed.

The FY 2013 National Defense Authorization Act (NDAA) passed. The bill reflects concern about the supply of molybdenum-99 to produce technetium-99. NSAC is asked to conduct annual reviews of the progress being made to achieve the goals of this section of the bill (Sec. 3173). NP is considering how to most effectively ask various stakeholders to address this direction from Congress and carry out the assessment. Hallman welcomed feedback from the community.

NP management priorities include establishing program priorities despite fiscal uncertainty, continued scientific productivity despite reduced facility operations, managing funding and any changes around the 12 GeV Upgrade, optimizing core research at labs and in academia, continuing the planning for the disassembly and distribution of equipment from HRIBF and transitioning essential staff, nurturing the nuclear structure and astrophysics community prior to FRIB, and meeting stable and radioisotope needs amidst possible reduced production capability.

Hallman shared that the future of U.S. nuclear science may not include the all activities articulated in the 2007 LRP but that scientific opportunities remain rich and important, and support U.S. security and competitiveness.

In closing, Hallman recognized Steve Vigdor for his role as the Associate Director for Nuclear Particle Physics at BNL. Vigdor recently retired. Hallman presented him with a plaque from SC Director William Brinkman.

Roundtable discussion

Hallman clarified for Geesaman that the language in the NDAA came specifically from the bill sent to the House of Representatives. Gillo confirmed this, as well. Geesaman shared that this puts the NSAC in a difficult position as the activities are not done in the Office of Science. Hallman noted that SC conveyed that this was an unusual and perhaps ineffective way to use the NSAC, yet the language prevailed. Gillo clarified for Blackmon that the annual review will likely require setting-up a standing committee. A new committee could be formed and there are other activities that the committee could do, too. She agreed that this poses challenges but it must be addressed. Hallman added that the Director of SC is the only person who can charge the NSAC and other offices have to work through him to give direction.

Venugopalan asked about the 10-year plan for future facilities and if the previous plan covered 20 years. Hallman shared that this is a 10-year outlook. There is momentous activity with the NSAC implementation subpanel but the new charge commissions an independent activity not connected with that. It does connect somewhat with SC's charge to prioritize facilities. Future facilities may be needed to carry out SC's mission. Orbach's plan had a 20-

year outlook with some fuzzy timelines. Some activities have come to fruition and the exercise was useful.

Hallman confirmed for Meyer that plans for the comparative review will go out to the community hopefully by the end of February, and he anticipates the review dates beginning around mid-May running into June. Information requested from university research groups would be about 10 pages and include data about groups and personnel with the physics narrative. NP wants to get information out quickly.

Blackmon asked if there were things that could be done to help the appointment of a Medium Energy Program Manager. Hallman asked for the community's assistance in developing candidates. NP has a specific process with only a 10-day window for applications to be submitted. He asked that the community pre-warn candidates. NP has commented to DOE. Human Resources is aware that this is a short window.

Hallman told McKeown that he is unaware of the timeframe allowed for appointing someone to the Director of the Physics Research Division position as it is a Senior Executive Service position and involves two other boards. It could take several months and has taken as many as eight months in the past.

Public comment

None

PRESENTATION OF NSF NEWS

Denise Caldwell, Acting Division Director, Division of Physics (PHY) at NSF shared an update. Caldwell is an AMO physicist and has done studies in photo-ionization. She came to NSF in 1995 as a program director in AMO and later developed the Physics Frontiers Centers program. There are currently 10 Physics Frontiers Centers (PFC). Caldwell is serving in her role after the departure of Joe Dehmer in September 2012. There is a search to find a new division director.

NSF's structure consists of seven directorates. Six are scientific research directorates. There is considerable turnover at present. PHY is under the Directorate for Mathematical and Physical Sciences (MPS). Fleming Crim from the University of Wisconsin is the newly appointed MPS Assistant Director.

NSF's budget is separated into four lines: operations, education, major construction, and research and related activities (R&RA). The R&RA funding is the major portion of the NSF budget overall. The MPS FY13 R&RA request is 22.5 percent of the R&RA budget and pays for all research, and funds graduate students, postdocs, and the operation of facilities. MPS' budget has increased slightly since FY11 and the FY13 budget is an ongoing discussion.

The overall NSF R&RA request of \$5.98B is an increase of \$294M or 5.2 percent over the FY 12 estimate. This broad and flexible portfolio highlights the Administration's priorities for science and innovation.

The FY13 NSF priorities and portfolio focus on interdisciplinary science and research in specific areas. These are reflected in its budget requests. NSF's Director calls these his OneNSF Framework priorities. One priority is the Cyber infrastructure Framework for 21st Century Science and Engineering (CIF21). It includes data transmission and new approaches to computation. In FY13, MPS, OCI, and ENG built a program on computational and data-enabled science in engineering as an outgrowth of its core discovery programs. It is currently evaluating proposals submitted to the program.

The Physics Division provides younger career awards for research. It also participates in the Integrated NSF Support Promoting Interdisciplinary Research and Education (INSPIRE) for interdisciplinary research. In FY12, partners from two distinct scientific areas could submit a letter-of-intent to two program managers, followed by a proposal, and the program directors could give an award without review. Additional funding was given to support this program and the Physics Division has given four awards. There will be new awards in 2013 and an upcoming webinar to promote this activity. Caldwell encouraged NSAC members to look to NSF for funding opportunities with intellectual overlap with other areas. All of these opportunities still only represent 13.5 percent of the total MPS R&RA budget. The remainder is invested in open discovery projects and proposals evaluated by review panels. These priority areas are not to replace existing programs but to augment those programs and extend them to other programs when it makes intellectual and scientific sense to do so.

The FY13 PHY budget request totals \$280M. About two percent is for administration including Intergovernmental Personnel Act (IPA) Assignments from academia. Operations and maintenance at NSF facilities such as ATLAS at the European Organization for Nuclear Research (CERN), the IceCube Neutrino Observatory at the South Pole, the Laser Interferometer Gravitational-wave Observatory (LIGO) and the National Superconducting Cyclotron Laboratory (NSCL) make up 26 percent of the request. About seven percent of FY13 funds would go to the NSF's 10 PFCs, and three percent would support education and broadening participation at Research Experiences for Undergraduates (REU) sites and specific education programs. The remaining 62 percent (\$173.6M) would cover six major areas of physics, both experimental and theoretical. Investments primarily support undergraduate and graduate research, the human resources needed for the advanced high-technology workforce. PHY recognizes that its awards fund those who will be the researchers of the future.

PHY consists of three work areas – experimental, theoretical and cross-cutting – and some groups therein collaborate. PHY also invests in forming connections such as Physics at the Information Frontier and the PFCs. There is also overlap with the CIF21 priority area.

PHY's Nuclear Physics and Nuclear Astrophysics group consists of Nuclear Physics, Nuclear Theory, and the National Superconducting Cyclotron Laboratory (NSCL). It connects with Physics at the Information Frontier and the PFCs. Total funding was about 17 percent of the FY12 budget.

The NP program within Nuclear Physics and Nuclear Astrophysics is strong and vibrant. It funds productive researchers generating cutting-edge results, and has a broad portfolio representing many subfields. The group tries to leverage additional resources. It has done so through proposals to the Major Research Infrastructure Program (MRI) to get about \$1.5M in FY12 and over \$30M since 1998. NP is closely connected to many areas in PHY and there have been many co-funded awards.

PHY received a positive review from its COV in February 2012.

PHY has close collaboration with DOE for projects that are of mutual interest.

Caldwell does not know what will happen with the FY13 budget but believes that PHY will remain strong. It is in the community's interest that PHY do well due to the research being produced and support for the field's next generation of scientists.

Roundtable discussion

Caldwell informed McKeown of construction activities that have been on the books for four to five years. NSF has lacked sufficient funding for large-scale applications. Community input tagged the desired funding level for construction activities at about \$100M due to the need for new instrumentation, detectors and tools even in areas such as Atomic, Molecular, and Optical Physics. Caldwell estimates that an ultra-fast laser with a frequency comb is about \$1M. Instruments are at the heart of what PHY does. It tries to use a small amount of funds to assist programs with strong proposals that need equipment that is beyond what they can afford. These proposals go into a regular program and the science produced must be first-rate. All programs in the Division can ask for funds and NSF evaluates each proposal to select funding support levels. With a funding increase, Caldwell hopes that the instrumentation program can be broader.

Jacobs pointed out that maintenance and operations budget seems high and asked if research is occurring. Caldwell shared that this includes support of NSCL at around \$21.5M per year; LIGO and two detectors at about \$30M per year; IceCube at about \$3.5M; and ATLAS and the Compact Muon Solenoid (CMS) detectors at Large Hadron Collider (LHC) at under \$20M.

Blackmon noted a Washington Post article on January 28th that described the burden faced by agencies in preparing multiple budget scenarios. Caldwell sees every year in the past 11 as being abnormal. She talked about continuing resolutions, potential shutdowns, and agencies needing to be prepared for anything. PHY continues scenario planning and divisions try to keep programs informed. NSF continues to review proposals and operate as if it knows the budget. Division directors and program managers have less interaction with the Office of Management and Budget (OMB) and the plans that are being made.

PRESENTATION ON CONFERENCE MANAGEMENT

Karen Talamini was unable to join the NSAC meeting.

PRESENTATION OF THE CHARGE ON SCIENTIFIC FACILITIES

Tim Hallman, DOE Office of Science (SC), Associate Director, NP, shared an update on the charge from SC Director Brinkman to the NSAC. It asks that all SC Federal Advisory Committees (FAC) give a report on the prioritization of proposed scientific user facilities to SC by March 22, 2013. The goal is to prioritize facilities to ensure optimal benefit from Federal investments. This will lead to a 10-year prioritization by September 30, 2013.

The SC Associate Directors have proposed a list of new facilities/initiatives or major upgrades to existing facilities that would contribute to science in their respective programs. This list has been provided to SC management and to NSAC Chair Geesaman for NSAC consideration, and as a starting basis for discussion between the Office of Science Management and NSAC.

NSAC needs to create a subpanel to address the broad multidisciplinary community that would benefit from facilities. The threshold on things to be considered starts at \$100M.

SC Director Brinkman will prioritize the proposed new facilities and upgrades and consider resource needs and investments for research needs and operation of existing facilities. He will engage leaders at other agencies and the Administration to ensure priorities are coordinated with other agencies' investments and that they reflect cross-agency needs.

The justification from the NSAC must be categorized in two areas:

- The ability for a facility to contribute to science in the next decade. Facilities should be characterized as absolutely central, important, lower priority, or don't know enough yet.

- The readiness of the facility for major construction, and if it is ready for construction to be initiated, the significant scientific or engineering challenges need to be resolved before construction, or if the mission and technical requirements have not been fully defined.

An NSAC sub-panel should look at what is needed to carry out the NP mission. The subpanel should not engage in detailed reviews of cost estimates or similar data. It should look at what exists and is available, but the review is not intended to be a bottoms-up, Lehman type of review.

Hallman referenced the August 2007 report “Four Years Later: An Interim Report on Facilities for the Future of Science: A Twenty Year Outlook.”¹ He noted a quotation from former DOE Secretary Spencer Abraham in November, 2003, underscoring the importance at the time of DOE’s examination of future needs and that facilities and upgrades be planned for and identified to carry-out future science.

Roundtable Discussion

Geesaman shared that the subcommittee will be chaired by Bob Redwine of the Massachusetts Institute of Technology (MIT). It will consist of the following members:

- Doug Beck – University of Illinois at Urbana-Champaign
- James Beene – Oak Ridge National Laboratory
- Brian Cole – Columbia University
- Carl Gagliardi – Texas A&M University
- Donald Geesaman (ex officio) – Argonne National Laboratory
- Rod Gerig – Argonne National Laboratory
- Keith Griffioen – William and Mary University
- Kim Lister – University of Massachusetts – Lowell
- Zein-Eddine Meziani – Temple University
- Don Rej – Los Alamos National Laboratory
- Hamish Robertson – University of Washington
- James Symons – Lawrence Berkeley National Laboratory

The subcommittee will have its primary meeting in Washington D.C. on February 15 – 16, 2013, and will give a report to the NSAC by February 28 for consideration at the NSAC meeting on March 8 – 9. A draft charge from NSAC to the subcommittee was discussed that Geesaman will send out to NSAC members by email on January 28.

Redwine said that work has begun on characterizing the cost of physics and reach. A message will go out via the American Physical Society’s Division of Nuclear Physics to build awareness and solicit input. It is vital to include projects not on the list and that meet the threshold. Examples are FRIB, the neutrino-less double beta decay experiment, and the electron ion collider (EIC).

Hallman confirmed for Klein that NP is focused on an experiment that could occur at an underground laboratory but is not focused on the stewardship of the facility. That is NP’s input for the NSAC to consider. Geesaman added that the SURF underground laboratory is being addressed by the HEP and NSAC should consider how to interact with the HEP Advisory Panel (HEPAP) on this charge. Hallman shared that several facilities could host this experiment in the

¹ http://science.energy.gov/~media/bes/pdf/archives/plans/ffs_interim_report_11oct07.pdf
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future. Klein expressed concern that the facility for the experiment is not owned by anyone and he is concerned about addressing the facility and the experiment, separately.

Hallman clarified for Nagle that NSAC could probably see the HEP's list. Nagle would like to see the HEPAP draft report at the March 2013 NSAC meeting and identify potential problems if there are proposed experiments and no site for them. Geesaman will contact HEPAP Chair Andrew Lankford to get their list and learn what they are doing.

Hallman sees HEP as a steward of the Sanford facility but whether the NP DBD experiment is sited there depends on depth needed and other factors. He clarified that NP is focused on the science rather than the site operations.

Gade added that all FACs will have their own lists. She asked if an underground facility will have further impetus if two different FACs think that a facility is a good idea.

Hallman reminded the NSAC about Director Brinkman's request for prioritization. Brinkman will look at other agency stakeholders' interests, and in doing his collation, how many propose a facility. Brinkman may have to consider comments that all point to a similar need.

Hallman responded to Geesaman's question about the \$100M threshold. This is typical of a multi-year investment with a high level of effort.

Redwine added that Orbach's threshold was \$50M. Hallman confirmed for McKeown that this threshold could include other partners. Lu asked if the items on Orbach's list have been enacted. Hallman commented that one project on the Orbach list was the new facility for rare isotope beams that became FRIB.

Hallman raised with NSAC the ongoing discussion within federal agencies about open access. This is a result of discussion that Federally-funded research should be broadly available without charge to scientific communities. Components of this are open access to published research results and data management planning with an emphasis on preservation and sharing. A memo is expected from the White House Office of Science and Technology Policy (OSTP) and agencies may need to comply with its vision. This is driven by the need to more rapidly enable scientific discovery, facilitate new discoveries, and create new jobs. The timeframe for this is unknown but it could translate into new guidance for grant submissions and requirements for a data management plan.

Hallman responded to Jacobs' interest in community input to the discussion sharing that Laura Biven of SC did an initial round of information gathering to aid the discussion. There may be a forum for public comment and discussion once draft language is established by the agencies.

Klein noted that there was a subcommittee report that defined what data should be made available. Hallman confirmed that that was part of the initial round of data gathering and environment envisioned for data sharing and management plans.

Velkovska was on the committee for research result sharing. The discussions had two parts – preservation and open access. The high-energy community is working hard on the preservation part. Hallman added that there are two working groups in SC – publications and data management. Community input is informing the approach. He sees this as leading to a community-based requirement requiring a natural coordination at the community level.

In response to Geesaman, Hallman shared that he does not know when this will influence grants. It could take place in a few years and there will be guidance to ensure that all agencies are aligned. The discussion among agencies is that there may be a coordinated response but that implementation will differ among agencies.

Caldwell added that NSF has required that all proposals in the past year include a data management plan. Those without a plan are rejected. PHY has made it part of its review

process. Larger facilities need a detailed plan that is scrutinized during site visits. NSF is looking at how to implement this and using review panel comments to guide expectations. NSF wants input on data management and what the release of data would mean. Keister added that the submission language stopped short of directing how entities should manage their data as approaches in different fields are diverse. Thus, NSF relies heavily on community input to direct how things are proposed and reviewed. In absence of that, the standards will be dictated to agencies. NSF's approach will hopefully shape that guidance.

Geesaman noted that DOE may not want to be prescriptive but that there should be community input as to the tailoring of the plan, requirements, and effective practices. Keister is not aware of a mechanism but wants to learn what different areas do and the effective practices that exist.

Geesaman commented that it has taken time for reviewers and proposers to understand what is meant by "broader impact criteria". There have been many questions at two prior meetings on this topic. Keister has observed this, particularly with the post-doctoral mentoring program. People wonder what they should do, but he sees a differentiation in how to handle proposals and some convergence of views. Theorists are included in this, for example, if they generate codes.

Langanke shared that the analysis committee has had similar discussions, pointing out that science is universal and there are different rules by country. Hallman shared that the agencies are aware of the developments in Europe. He hopes that best practices will help inform an approach that is not too different from the rest of the world.

Jacobs believes that the ultimate goal of data management is to preserve results for the future and unique qualities. This can be very complex for modern experiments. Thus the goal for future data use needs to be clear. He sees the goal as unclear but that community understanding is important. Hallman and NSF envision a tailored approach dictated by the data type and the community of users, and not an approach driven by agencies. NFS intends to take an informed view to support the laudable goals of increased accessibility to accelerate discovery and scientific results. Commercial partners could also enhance the pace of innovation.

PRESENTATION OF THE DOE OFFICE OF SCIENCE PERSPECTIVE

William Brinkman, DOE SC Director, gave an update on DOE news by video teleconference. SC is working with OSTP on open access to research data and results. Brinkman seeks to move forward but sees that it will take iterations before it is settled.

Brinkman thanked Robert Tribble and the NSAC subcommittee in dealing with the implementation of the 2007 LRP.

Brinkman shared that SC is looking at the potential long-term impacts of sequestration and reestablishment of SC baselines. Roughly \$300M could be sacrificed in the SC budget this year and SC is trying to develop consequences while also preparing for the FY14 budget.

SC is getting a passback from OMB this week for FY14.

None of the budget discussions bode well for science or for the Nation. There is international competition in nearly every sub-field and the U.S. could lose its position in the world.

PRESENTATION ON THE REPORT OF THE IMPLEMENTATION OF THE LONG RANGE PLAN

Robert Tribble shared the subcommittee response to a charge given to the NSAC on April 5, 2012. In May 2012, the subcommittee was initiated and the subcommittee members met three times to assemble the report. He reviewed the agendas for subcommittee meetings.

The second meeting was in September 2012, in which DOE and field representatives identified problems and issues in nuclear science and with projects and other things that are in place. Presentations were made by each of the major facilities as well as representatives for theory and computational programs. The subcommittee benefitted from hearing this all in one sitting. Town hall meetings at American Physical Society (APS) and APS Division of Nuclear Physics meetings provided insight, and a website gathered additional input.

The subcommittee met in November and early December 2012 to build recommendations. It reviewed activities in sectors of the field and asked representatives to revisit arguments about their subsections of fields. The subcommittee also looked at budget spreadsheets, and workforce issues and Ph.D. production from 2006 through 2012. Degree completion data is hard to obtain in an accurate manner, but the subcommittee is working to update it. Theory programs, application and challenges and problems were discussed, along with how to support major initiatives. The final report includes statements about closing and not completing facilities.

Tribble reviewed the report structure with the NSAC and shared an overview of the science covered in the report.

Within hadronic physics, there are major efforts following the 12 GeV CEBAF Upgrade to understand what can be learned about the gluon field and excitations of this field. Generalized parton distributions and transverse momentum-dependent distributions should give a tomographic view of activity inside the proton. Proton spin will also be looked at in hadronic physics and draw on work in the U.S. and other countries. There are gluon and antiquark contributions from RHIC, and the work will examine orbital motion contributions from CEBAF. It is known that intrinsic spin comes from a very complex scenario. Nuclei from quantum chromodynamics (QCD) is another area along with the connection between short-range interactions using QCD-inspired forces to predict nuclear properties. Experiments proposed at CEBAF would carry out this program.

Within heavy ion physics, there is research to understand the role of quantum fluctuations near the expected QCD critical point. Tribble shared a figure of the temperature fluctuations in simulations of heavy-ion collisions. Mapping a phase diagram is a central problem in quark-gluon plasma physics and more information is needed. The electron ion collider help to provide information on the initial state of heavy nuclei in the future. Answers can come from changing parameters and the RHIC can do this by varying the energy of the beam. This can enable mapping and the identification of a critical point.

Within heavy ion physics, there are new indications of parity violating domains in QGP. There is also work to determine the perfection of the 'perfect liquid' QGP. An imperfection index measures the internal friction as liquid flows. The RHIC can do this and this enables understanding through measurements which unravel the effects of fluctuations in the geometry of the collisions taking place. Quasi-particles can also be observed to understand formation or lack thereof. Finally, measurements of heavy quarks may also help with a determination of the level of perfection of the quark-gluon liquid discovered at RHIC.

Within nuclear structure and nuclear astrophysics there is a growing body of data about the conditions required to produce all of the stable nuclei seen on Earth. There is knowledge of some processes that are occurring; two where important nuclear physics knowledge is missing are the rapid proton capture and rapid neutron capture processes. FRIB can provide information

for nuclei production and the measure of reaction rates with secondary beams and isotopes through the process.

Moving out from stability, the limits of proton and neutron stability can be known. Little is currently known on the neutron-rich side, especially how many neutrons can be stacked into an isotope. There are differences between the isotopes available today compared with those we can get data about at FRIB, which will inform the limits of where nuclei can exist. This is an area where we have many predictions but lack accurate data.

From complexity to simplicity, there is little known about shell structures. A big challenge is understanding the shell structures at different neutron and proton ratios and the difference.

Work on neutron-rich matter and the connection to neutron stars is possible through work at FRIB. Tests for fundamental symmetries can be done, including measurements of β - ν correlations.

Tribble summarized work being done on fundamental symmetries and neutrinos. The search for electric dipole moments is a search for time reversal violation. One can use polarization measurements in magnetic field and electric fields to see if time violation occurs in nuclei. Such a violation may explain the matter-antimatter asymmetry in the universe.

Neutrinoless double β -decay searches are another area of work. The mixing angles in the neutrino sector are known but the kind of neutrino, Majorana or Dirac, this involves is not known. Research could also show how neutrinos impact time reversal violation.

The neutrino mass scale is not well known. KATRIN (Karlsruhe Tritium Neutrino Experiment) is being funded by U.S. scientists and this work could push down to a 200 milli-eV limit on the mass for neutrinos.

R&D for ton-scale experiments is ongoing and nuclear scientists will do more in the next decade.

Electron interactions beyond the standard model are an area of work being done at CEBAF. Another place where scientists have a major role is in muon g-2 work is at Fermilab. They will have more muons than was possible to get at BNL and this can improve statistical precision to a five σ deviation from theory and achieve something near a discovery level.

Work in nuclear theory and computational nuclear physics drives a lot of the field and there are many examples that involve interactions. Significant computational resources help carry out the program and computation plays a major role in supporting understanding in areas such as diffusion.

Tribble shared that the science case in the report was assembled by subcommittee members working on these areas in the field. They also looked at work outside of their respective fields. This ensured that the science was clear to all members and those outside of a particular field.

The report states, “The subcommittee is unanimous in reaffirming the LRP vision for the field. Each of the recommendations is supported by an extremely compelling science case. If any one part is excised, it will be a significant loss to the U.S. in terms of scientific accomplishments, scientific leadership, development of important new applications, and education of a technically skilled workforce to support homeland security and economic development.”

The report proposed three budget options based on the FY13 Presidential request: 1) Flat-flat funding, 2) Cost-of-living, and 3) modest growth.

In a flat-flat scenario, there are insufficient funds to run CEBAF and RHIC, and build FRIB. There are three options – do not operate RHIC, do not operate CEBAF or do not build FRIB. In the no FRIB scenario, running at RHIC and CEBAF would be at reduced levels and continue to

decrease. Another option is to operate either CEBAF or RHIC with just enough to build FRIB. No option would cover the loss of research funding due to cuts in FY12 and FY13, and another two to three percent in funding would be lost per year due to inflation. There may also be very little funding for new initiatives in the flat-flat scenario.

With a cost-of-living scenario, NP cannot run CEBAF and RHIC and build FRIB. Options are to fund CEBAF and RHIC at reduced levels with no funds for FRIB, or fund one of the facilities with just enough to build FRIB. No option would cover the loss of research funding due to cuts in FY12 and FY13, and another two to three percent in funding would be lost per year due to inflation. There may also be little funding for new initiatives in this scenario.

In a no-growth scenario, NP will lose a major facility that supports 25 percent of the nuclear science workforce. A significant drop in Ph.D. production would result and many new discoveries would not be made. This might also lead to a reluctance in academia to fill vacancies.

Tribble described the losses that could occur if CEBAF is not funded. These include losing investments made to upgrade to 12 GeV and no studies of the excited gluon field. This could also lead to a closure of the TJNAF laboratory.

If FRIB is not funded, NP would lose the construction investments made by the DOE and Michigan State University (MSU), as well as future contributions from MSU. Tribble added that without FRIB, the NSCL would likely close in the future.

Losses from not funding RHIC include investments made for intensity and detector upgrades. Losses include the stoppage of further research into critical regions of phase diagrams of the quark-gluon plasma, and in particular, there would be no low-energy beam scan to search for the critical point. Tribble shared that there is no other facility which can do this work. He added that this could also lead to the loss of a world-class accelerator division, the NASA space radiation program, and medical isotope production.

The subcommittee considered a modest growth scenario which corresponds in FY2014 to a return to the cost-of-living-adjusted (COLA) FY2012 budget, with an additional increase in FY2015 to the level corresponding to steady growth at 1.6% per year since FY2012; subsequent years then grow annually at 1.6%. It is lower than the LRP but gives a viable path for the near future. It would allow running CEBAF and RHIC at lower levels and FRIB construction. Research budgets would be tight and there would be a small amount of funding for new initiatives during FRIB construction. The subcommittee endorsed this scenario as the minimum level of support that is needed to maintain a viable long-term U.S. nuclear science program that encompasses the vision of the LRP.

With a no growth budget, the subcommittee recommended completing the upgrade at CEBAF and recognized that no growth over the coming four years would fundamentally change the direction of what remained of the field. Tribble read wording directly from the report.

The subcommittee report contains two conclusions for consideration by NSAC:

- 1) With no growth in the budget in the next four years, nuclear science must relinquish a major part of its program. If RHIC is closed now, the U.S. would cede all collider leadership, not just the high-energy frontier, to CERN and would lose the scientific discoveries that are enabled by the recent intensity and detector upgrades at RHIC. If FRIB construction is terminated, future leadership in the cornerstone area of nuclear structure and nuclear astrophysics will be ceded to Europe and Asia.
- 2) The subcommittee shared alternate paths to the two no-growth scenarios. The budget profile presented in the 2007 LRP defines what is needed for a vibrant U.S. program in

nuclear science. The report presents a modest growth budget option for the near term that falls well short of the LRP profile and requires significant sacrifices be made relative to the LRP vision. But the modest growth budget will allow the U.S. to preserve the tools that enable science.

Tribble personally sees no winner or losers if there are no growth budgets through FY18. This would be a disaster for U.S. nuclear science, and it would lead to longer-term declines in the field. The community must work together to prevent this from happening.

Roundtable discussion

In response to Gardner's question about the timetable used to determine relative rankings, Tribble shared that the effort a few years ago informed this review. Decisions made in 2005 pointed out that without fiscal improvements, CEBAF would be closed. The decisions are time-dependent as no facility has yet run its course.

Brinkman described the situation as frightening. The sequestration budget is under development. He asked the community to inform Congress of the consequences and permanent damage that could occur, and the difficulty in recovering from these actions.

Tribble clarified for Piekarewicz that modest growth is defined as a rate of 1.6 percent, after restoration of budgets in FY2014 and FY 2015. He clarified for Opper that this rate was seen as the one that would best accommodate the goals of the LRP, noting that this rate allows for maintaining operations while continuing on a path that includes some growth. Blackmon added that it might not be 1.6 percent every year.

Piekarewicz asked what the modest growth approach might mean for younger generations. Tribble noted that Hallman outlined what NP will do to avoid significant budget impacts but Tribble believes that there could still be fewer people in the field. Geesaman added that the modest growth approach contains some restoration of budgets from FY13 but not all of it when considering peaks in FY11 and FY12.

Opper described the modest growth option as unclear, and it could force doing more with less and not doing anything well. Tribble noted that this is not the ongoing path and that it would have to be rethought at some point. He hopes big cuts can be avoided, and recognized that some things will be less than optimal such as fewer running hours and taking longer to build experiments that have \$20M to \$40M budgets. The subcommittee looked at all of these when writing its conclusions, but also felt it was inappropriate to draft detailed budget scenarios which would have exceeded its expertise.

Blackmon pointed out that a \$60M gap in 2015 would reach \$100M by 2018. He asked if there were smaller increases and if there could be guidance in the report. Tribble responded that if DOE is funded over the cost-of-living or at this rate or lower, either would provide positive guidance. He believes that DOE will have to examine in detail what they would support in various budget scenarios. The subcommittee proposed a plan that it is in keeping with the LRP.

Langanke is concerned about the impact of funding cuts on university research, students, and the rehiring of professors. This would be a disaster for nuclear science not just in the U.S.

Klein pointed out that any SC office could claim needing a workforce for homeland security and economic development. He asked what could be said about the science being done in nuclear physics that would make this particular workforce so important. Keister pointed out that there are comments in the report that address the uniqueness of nuclear physics. The subcommittee wanted to cite arguments about science, technology, engineering and mathematics

(STEM) development and also highlight nuclear science. The subcommittee can add to this section.

Klein sees the workforce as important as there are outstanding people doing outstanding science. He asked that the report note that great people can be attracted because the science is so exciting. Velkovska added that budget failures could result in a significant loss in education and workforce skills in nationally-important areas. The report does not discuss the potential loss of current skilled workers due to facility closures, and how the workforce might otherwise be preserved. Tribble commented that this and impacts on the scientific and technical levels were on the subcommittee's mind. In the event of a shut-down, some technical personnel would be hired elsewhere but others would be unemployed.

Blackmon expected more detail on the EIC if RHIC was closed. He asked about the path for the collider and the impact of budget scenarios. This was discussed by the subcommittee, Tribble responded. The EIC is not an approved project and is still conceptual in the LRP as a future plan. There are multiple phases. He added that the community wants to preserve future pathways. It was not a priority in the LRP so the subcommittee did not recommend it. Blackmon commented that it might be good to point this out as a vision for the future and that closure of the RHIC could jeopardize the creation of the EIC. Jacobs added that the modest growth scenario looks at facilities such as EIC and it is mentioned, but the scenario does not support its creation.

Atcher asked if the report identified how many Ph.D. awardees resulted from work at CEBAF and RHIC. Tribble noted that some understanding can be gained from work areas at each facility. The output is pretty uniform across the board and reflective of Ph.D. production.

Gardner asked about the retention of the RHIC workforce in the event of a closure and having personnel for EIC. Tribble shared that SC would have to work with OMB on this but that SC may not know who to contact at this time. Hallman added that if this circumstance occurred, SC would try to retain essential staff but there would be some unrecoverable loss.

Tribble clarified for Blackmon that in some sense the FY14 request is a done deal. The report may impact that budget but he urged the community to move forward with this information to rally around a budget that would help achieve the recommended path.

Blackmon described the report as a snapshot with conclusions based on current understanding. He asked how long SC has if budgets do not reach the modest growth scenario. Tribble urged that all need to look forward to a new LRP that deals with a different budget climate, if that does occur. Velkovska commented that this snapshot gives the impression that random factors dictate the scenarios. Tribble responded that NP is not in a position where it has a large facility that has run its course. There is a vibrant program ahead with CEBAF. SC's future requires FRIB. This is similar to 2005 when the budget might have been very flat or reduced. That subcommittee decided to continue with RHIC. Now, SC can reap science from the 12 GeV Upgrade. SC is left with a choice between two facilities both of which have a dynamic future.

Opper asked if non-Federal support for FRIB along with scientific merit was a basis for the subcommittee's recommendations. Tribble confirmed that this did have an influence.

Velkovska suggested modifying the last sentence in the report about the expansion of the timetable. In addition, the prior line says that this decision will maintain the overall balance in the field as a whole. If RHIC is closed then the overall balance will not be maintained; one-quarter of the program would be lost along with work that cannot be done elsewhere. Tribble responded that making changes to the report at this time would not be trivial and that the

wording was thoroughly vetted. The subcommittee's point is that if FRIB construction were to cease, then the astrophysics program could be lost and it would become QCD-centric in terms of the facilities and programs that are supported.

Blackmon noted that the biggest changes since the report was drafted involve the underground laboratory. The NSF was to have invested in experiments with underground science. This impact needs to be addressed in the report. Subcommittee member John Wilkerson shared that the wording was carefully measured. He noted that the subcommittee did its best considering the change in funding and were also charged with addressing nuclear science. The report seeks to reflect that there is a laboratory in the U.S. that could host energy experiments.

Klein asked how much of the gap between the LRP cost curve and the modest growth curve is based on Deep Underground Science and Engineering Laboratory (DUSEL). Tribble answered that there was no cost in the LRP for DUSEL. The money was expected to come from elsewhere, hence there was no gap.

Tribble confirmed for Lu that if FRIB were abandoned then MSU would be in a very difficult position with regard to the future of the NSCL.

Audience comments

Richard Kouzes asked if the international context was discussed. Tribble shared that this was discussed relative to CEBAF and RHIC which both have significant global contributions. The heavy ion community is also interested in running experiments at LHC and RHIC and this aspect was looked at carefully. They also discussed which collaborations should be domestic and which should be international.

Scott Wilburn noted that the modest growth path says that both accelerators will be reduced and there will be no new starts until the budget improves. The U.S. is on an upslope from the recession, Tribble answered, and it is possible that funding support will improve. Geesaman added that the leading element is that facilities have made a trade-off to invest in capital projects to enable new physics at the expense of operating hours.

Steve Vigdor expressed that the report wording should reflect how the no-growth scenarios would change the overall balance of the field. The goal of the report should be to provide a basis to lobby Congress and cause concern. Kaplan agreed that the current wording does not express the intent, and Klein and Meyer agreed.

Hugh Montgomery thanked the subcommittee, noting that this task has been difficult and that there is no good solution. The U.S. would lose substantial NP leadership and it has worked hard to get into this position. He is gratified that the report made a case for the whole field and urged that all work together to advance funding for NP.

Doon Gibbs thanked the subcommittee and the NSAC. The value of the report is in illustrating the damage to nuclear science if any of the scenarios are taken, and describing paths forward. BNL will work with TJNAF, DOE, FRIB, the community, and constituencies to move toward preferred paths.

NSAC DISCUSSION OF THE SUBCOMMITTEE REPORT

Geesaman asked each NSAC member to offer comments on the report.

Atcher is concerned about training issues as these cut across many areas of nuclear science. He represents concerns about isotopes and medical isotopes, and the RHIC shutdown would

impact isotope production. FRIB proposed building an isotope production capacity. Either site would impact community needs and commercial users who have no other sources.

Binder seconded Atcher's comments, urging an analysis of the impact of scenarios on isotope production. He noted BNL's work on the cutting-edge of production capabilities. The impact would be a loss of expertise, training, and critical isotope needs to support medical devices.

Blackmon suggested that wording suggestions be provided to the subcommittee for their consideration. He pointed out that there are relatively minor things to change such as the mention of the loss of operating hours due to FY12 funding cuts yet no mention of the loss of HRIBF. Geesaman asked the NSAC how to proceed with changes. Tribble felt that there may be a greater impression if the comments come from the NSAC as a whole.

Geesaman asked for continued comments and also tasked the NSAC members to return on day two with suggested improvements. He noted that representatives from MSU, TJNAF and BNL have to recuse themselves from commenting.

Gardner is surprised at how quickly international competition can develop. China is developing an electron collider and global competition in nuclear science is growing. She asked if the report should comment on how the DOE should respond if sequestration is passed. The community should do all it that it can to remediate any impacts on the workforce and to avoid losses in quality and capacity. Lastly, she felt that the report should mention the physics impact on accelerators, and that it would be important to call attention to particle beams in a broader way and technical or tactical accomplishments.

Jacobs suggested that independent critical readers would be welcome and he is eager to hear NSAC comments. The community should push strongly for a moderate growth scenario.

Kaplan expressed that the modest growth scenario is unclear and that 90 percent of the report is a consensus document with modest growth as the best approach. The way forward is to save all of the field's critical components. Calling this a death spiral is too apocalyptic for this report. He also urged citing impacts on universities and students.

Klein urged more focus on workforce impacts and specifically the context of how cuts can impact this entire field and how Ph.D. awardees in this science matter. Junior scientists can be inspired by the work in this field and explanations lead to a better and more inspired workforce.

Rundberg urged that the impact of budget cuts needs to be clearly in the front of the report and not just later in the application and workforce sections, and emphasizing societal impacts in the executive summary. He suggested leveraging a National Academies of Science report from May 2012 and other workforce and capability reviews.

Nagle endorsed the science case and modest growth path, pointing to things such as a budget surplus in California as evidence that modest growth can work. He does not agree that NP can attract junior scientists when opportunities are reduced. He is concerned about the ability of political jockeying to push away years of sweat equity and hard work. Nagle expressed concern about discontinuing RHIC operations. He shared his respect for Tribble and the subcommittee, but expressed concern about how the subcommittee was assembled, and stated that he was told not to discuss that aspect publicly. He hoped that DOE would look at how the subcommittee was assembled.

Langanke is concerned about the impact on junior scientists but also recognizes that graduate students in nuclear science are able to find work. He believes that education is working well, leading to a fascination with astrophysics. He pointed out that science is done for discovery and that its base is nuclear physics as shown by work at all three facilities. Langanke pointed out that from his perspective, working at a laboratory that will host future hadron physics work, he

believes that it is wrong for the U.S. to send a message that its loss is another country's gain as the better signal is to foster collaboration.

Lu noted that the claim that NSCL will be lost if FRIB goes away is not credible. He also urged the subcommittee to be careful in explaining what will happen with cost savings; it could be perceived that the current draft was carelessly developed or that the community could be squeezed for more savings. Lu urged that the innovation that brought about savings needs to be expressed as unexpected and that future upgrades do not have these same expectations.

Lu continued by pointing out that the explanation of proton spin on page 14 is well-written but may lead a person with a physics background to perceive that this will lead to a better solid state device. The point is that protons are studied for scientific value.

Lu also pointed out that the illustration of proton spin and EDM figures may be incorrect even though the wording is accurate.

Meyer added neither of the bad budget scenarios presented a clear choice.

Opper felt that the report answered the charge and made a good case for NP. The lack of response to the no-growth budgets is understandable as both involve ending a laboratory. Opper agreed that the sentence in the report about balance should be changed. She also expressed concern about the modest growth budget that does not end a facility and is a case for all to advocate for but still could be a death spiral.

Geesaman responded to Opper noting that the suggested path would support the LRP. Modest growth is painful but allows continuation of the major thrusts of LRP. He suggested that this should be clearer in the report.

Piekarewicz complimented the subcommittee. He shared concern about maintaining opportunities for junior scientists. He gave his support for the modest growth path, and stated that guidance is needed on how to push this case and path forward.

Velkovska appreciated the recognition that the sentence on balance needs to be changed. She echoed comments that changes could lead to the closure of NSCL. Velkovska also pointed out that the plan is unclear in the context of the timetable and approximate profile and why this was so crucial in deciding a path.

Geesaman reviewed comments that he heard from the NSAC. These include the statement on balance, isotope production capabilities, the consequence of cuts and the underground laboratory, the challenges of sequestration, management of workforce impacts, adding mention of beams to accelerators, the need for fact-checking to support the modest growth scenario, the importance of PhDs, comments on radio chemistry and a desire to hear from Rundberg and others, the need to clarify the potential loss of NSCL, an explanation of why the RHIC intensity upgrade was done at a lower cost, comments about proton spin and the length of the report narrative, changes to the EDM illustration, a better statement about the timetable in the report conclusion, and defense for the modest growth approach. Geesaman asked NSAC members to add comments on day two.

Geesaman asked that the NSAC eventually vote to accept the report subject to these changes. He urged recognition of the importance of acting rapidly due to the short time between getting the report prepared for review by decision makers or facing what would be done in a worst case scenario. He asked NSAC members to send their comments to him and that NSAC will review all comments on day two. The document is not yet public as it has not yet been approved by the NSAC. The slides from Tribble and the video feed from today's meeting are public.

Nagle pointed out that the report encourages understanding of the science and budget approaches, but he is already seeing public information on Google News about budget scenarios.

Nagle worries about it being used to put the budget before the science. Geesaman offered that suggested changes need to go the subcommittee to act upon quickly, and then the NSAC would need to vote to get the report out. Tribble is concerned that multiple changes and communication with the subcommittee will lead to delays. Geesaman pointed out that the NSAC has to embrace the report based on the subcommittee response to its concerns.

REPORT ON ONP COMMITTEE OF VISITORS

Geesaman reviewed the charge for the NP COV, asking the COV to consider:

- a) The efficacy and quality of the processes used to solicit, review, recommend, monitor, and document application, proposal, and award actions; and
- b) The quality of the resulting portfolio, including its breadth and depth, and its national and international standing

Geesaman reviewed the COV membership. The COV convened on January 7 – 9, 2013, and identified ways to improve NP processes. Each NP Program Manager described how they work and break-out sessions looked at individual grant portfolios and individual early career awards. The COV tried to evaluate if decisions were being made in a reasonable way. The COV drafted a report that includes recommendations.

The draft report will be sent to the NSAC on February 22. It is currently with DOE for fact-checking and then will be presented by John Harris at the NSAC meeting on March 8 – 9, 2013.

Roundtable discussion

None

BOARD DISCUSSION

Blackmon asked if smaller groups of NSAC members could discuss changes to the LRP subcommittee report. Jacobs offered to lead a group on balance. Meyer will lead a group to look at workforce. Atcher and Binder will lead a discussion on isotopes. Velkovska asked about addressing the timeline and how it affects balance, to which Tribble responded that it was intentionally not spelled out and that there is not virtue in doing so. Geesaman asked Velkovska and Tribble to discuss this item.

CLOSING REMARKS AND ADJOURNMENT

NSAC Chair Geesaman adjourned the meeting for day one at 3:17 p.m. EST.

JANUARY 29, 2013

The Nuclear Science Advisory Committee (NSAC) was convened at 9:06 a.m. EST on Tuesday, January 29, 2013, by Committee Chair Donald Geesaman.

CONTINUED DISCUSSION OF THE SUBCOMMITTEE REPORT AND LETTER OF TRANSMITTAL

Comments provided to Geesaman and Tribble from NSAC members on day one were sent to the LRP report subcommittee members and some feedback was received.

NSAC members offered edits to the following specific lines of text and sections of the report:

- Line 82 of the report read, “Just one of the many examples of this in nuclear science is today’s burgeoning accelerator industry for producing particle beams.” Gardner clarified that one could talk about particle beams and neutron beams in general. Tribble explained that this paragraph pointed out the application that is the basis for a multi-billion dollar industry and the economic impact that has occurred. Including particle beams might dilute the paragraph.
- Add the phrase “...and a targeted program in fundamental symmetries and neutrino physics” to line 3341 that ended in “...FRIB construction.” The subcommittee agreed on this change.
- Change line 3348 to read “...some very important projects will have to be delayed or not pursued due to a lack of funding of the equipment needed to carry them out.”
- Change lines 3555 – 3558 to read “...this slight preference is in the context of actual timelines and the approximate profile for FRIB construction, presented as a snapshot of the field. If this budget exercise had occurred in a near future year, this snapshot would have changed and the choice might well have been different.”
- Insert into the caption below the figure that describes the modest growth approach, “...the modest growth budget corresponds in FY14 to a return to the cost-of-living-adjusted FY12 budget with an additional increase in FY15 to the level corresponding to steady growth at 1.6 percent per year since FY12. In subsequent years, the growth annually at 1.6 percent is above the cost-of-living adjustment...”
- In line 3501, add “...in the U.S.” to the sentence now ending in “...fusion would be lost.”
- In line 3508, remove “soon” in the sentence.
- In line 3513, change “...would lead the field.” to “...would be a leader of the field.”
- Nagle pointed to line 3524 and the text “...if the U.S. would abandon this effort it would lead to loss of NSCL.” Konrad Gelbke pointed out that this is the final year of a cooperative agreement between the NSF and MSU, sharing that the NSCL would not be competitive within 10 years without a major upgrade. Keister thinks that the timeframe is closer to five to 10 years. Nagle suggested changing line 3524 to the NSCL no longer being competitive and Tribble agreed that this change would not be an issue.
- In line 3553, delete “...and maintains the overall balance of the field as a whole,” to positively end the paragraph with “...FRIB’s unprecedented scientific capabilities.”

Tribble clarified that all changes agreed to at this point were agreed upon by subcommittee.

NSAC members suggested edits to the following specific lines of text and sections:

- Regarding DIANA, change line 2579 to clarify that a site selection has not been made. Tribble confirmed that the subcommittee agreed with this modification.
- Change line 206 which refers to the Facility for Antiproton and Ion Research (FAIR) from “slowed” to “negatively impacted.” Also change “world-leading.”
- Change line 2647 to read “to explore aspects of quark-gluon plasma whose signals are at too high a rate to be studied at the collider and to search for the critical point in lower energy collisions where the...”. This was approved by the subcommittee along with other similar changes.
- In the facilities section, Tribble will add the National Institute of Standards and Technology (NIST) to the list of facilities.

- In line 1910, add “Although a shallower depth than envisioned for DUSEL...” to the sentence that begins “SURF is hosting...”. It describes the construction of the Sanford Underground Research Facility (SURF) in South Dakota. The subcommittee agreed to this modification.
- Change line 680 from “...will be proposed...” to “...have been proposed...”
- The NSAC discussed replacing line 568 with “here we study the decomposition of the nucleon spin in terms of its fundamental constituents, the quarks and gluon.” The suggestion eliminates taking credit for the work described in the original text. Tribble disagreed with the change, as the subcommittee was asked to show examples of others’ work and how the examples couple with what is done in nuclear physics. He sees this as an example that constituents understand. Lu agreed with this change. Gardner shared that the notion that neutron spin is not connected to topographical insulators and connections is misleading. She urged placing the example elsewhere. Geesaman agreed with Tribble that analogies in these systems are not close analogies and there are ones to be made such as spin dressing. Tribble shared that the importance is that the intrinsic quantity shown in a textbook is a complicated quantity and is unused in many applications. Blackmon viewed this as an introductory paragraph and likes its placement. Klein agreed but felt that the first sentence that addresses the internal structure of the proton and relates it to topographic insulators is odd. Lu is concerned that Congressional staff members might resonate with solid-state physicists and some might not agree with the analogy. Tribble will ask the subcommittee to revise the paragraph and the NSAC agreed with that action.
- Add to line 124 wording about inspiring young people before “...continues to engage some of our Nation’s brightest minds.” Tribble has not sent this to the subcommittee and cannot guarantee that there will not be complaints. Klein noted that this puts working with young people at the forefront. Geesaman asked for comment and there was none.
- Change lines 96 – 98 from “...under any of these options, the losses would reduce the ability to train the next generation of the U.S. nuclear science workforce. The losses would likely be permanent for the Nation...” to “...under any of these options, the losses would erode the ability to train the next generation of the U.S. nuclear science workforce. This, with the concomitant loss of trained research experts in nuclear science would make our Nation poorer, and the losses would likely be permanent.” This suggestion came from Gardner. The NSAC discussed what would be meant by poorer and what the losses would be. There is a significant workforce with NP expertise and that is a precious resource. The report needs to indicate the impact of cuts and the erosion of the workforce of this size. Tribble agreed with the rephrasing.
- NSAC agreed not to incorporate changes in lines 101 – 103 that describe the workforce.
- The subcommittee agreed with changes in line 3306 about HRIFB.
- NSAC and the subcommittee agreed to changes in line 206, 1901 and 3341.
- Line 3348 should include “...delayed and not pursued...”
- Geesaman changed the description about FAIR with comments from Langanke.
- Change 3513 to “...be a leader in the work...”

The NSAC suggested additional areas in the report to be changed or that need clarification.

Nagle pointed out that information about the loss of the RHIC upgrade only costing 10 percent appears twice and this needs to be clear. Langanke pointed out that there is a paragraph that explains this.

Tribble shared that the EDM figure will be modified.

After day one, Gardner shared technical and typographical corrections with Geesaman by email. Tribble received these changes from Geesaman and they were accepted.

Gardner pointed out the need to develop a list of Ph.D. recipients. Tribble shared that Brad Filippone of the California Institute of Technology and Barbara Jacak of Stony Brook University are keeping a list of these students and should receive data from NSAC members.

Nuclear chemistry and radio chemistry comments were discussed. This section in the report describes the direct impact that major facility closures might have on the progress of nuclear science. The section discusses the potential impact on the Brookhaven LINAC Isotope Producer (BLIP) and RHIC, and how isotopes support nuclear science in areas such as nuclear forensics, radioactive waste research, heavy medicine, and other areas. Closures could also impact student learning and research, and doctoral completion. Geesaman suggested that that subcommittee rework these examples to achieve the right tone or determine if this paragraph is out of place. He noted that the BLIP closure is cited in the impacts section. Tribble shared that this could be added in the RHIC description in the facilities section, the discussion of isotope production at FRIB, and in future isotope production at FRIB section. Geesaman pointed out that the loss of isotopes in enabling education and training could be part of the applications section. Binder asked that these thoughts be included in the document, and that the conclusions should address the impacts on training for chemists. Binder added that it would be fine if the subcommittee captured the bulk of the discussion in the applications section. Langanke added that he thinks that other countries would have listed medicine as the first area to be impacted. Binder responded that this discussion pointed out a list and he did not disagree that nuclear medicine would be the area most largely impacted. He also shared that the impacts on nuclear forensics is somewhat lost in the report. Geesaman added that heavy element chemistry is among specific elements that do not directly offset isotopes. Tribble agreed to talk with Geesaman to clarify this aspect.

Binder noted that the nuclear physics of fission or nuclear reaction has a vital role in the nuclear forensics of nuclear explosions and other activities related to the production of nuclear weapons. New methods are being developed to determine the design and origin of a nuclear event, based on an analysis of recovered samples. Tribble agreed with adding this to the applications section and noted that nuclear forensics is also cited in the workforce section. Geesaman noted that this has been included in previous reports. Klein added that design and origin are intended to be separate, and that the first line should be “fission and nuclear reactions”.

Geesaman asked for other comments from the NSAC and heard none.

Geesaman asked for a vote on accepting the document and transmittal letter. The NSAC discussed what this means. Geesaman clarified that the document and letter go together, and that the letter simply says that the NSAC accepts the document and transmits it to agencies. He answered Nagle’s concern about the subcommittee being closely split on the report and a lack of consensus by asking if the NSAC should vote on acceptance or try to wordsmith the transmittal to recognize the lack of consensus.

Nagle noted that he can accept the document but that the letter should be clear that the NSAC does not unanimously endorse the recommendation. He asked for a chance to modify the letter prior to voting on acceptance and to explain what would be lost with each option.

Jacobs pointed to a headline in the January 28, 2013, issue of the American Association for the Advancement of Science newsletter “Science Insider” that describes shuttering the last nuclear collider. He urged that the NSAC say that the modest growth scenario is the only path forward over allowing the media to announce the recommendation.

Geesaman presented a draft of the transmittal letter. It shares the dilemma of closing one of two existing facilities or not continuing with the construction of a new facility. It highlights the subcommittee’s assessment of the potential losses under these scenarios. It also highlights increasing nuclear science research investment by other nations.

Kaplan recommended that the paragraph that presents a modest growth scenario precede the paragraph that describes no-growth scenarios.

Nagle expressed that the letter could imply that NSAC has reached a consensus on what to do to address this dire funding scenario.

Geesaman asked if the NSAC should vote. Nagle asked about other options. Opper noted that some level of trust must be placed in the subcommittee. She was reluctant to take a vote.

Jacobs commented that the modest growth path could sustain vitality in all areas and advance nuclear physics while no growth has no future. He felt that these are the subcommittee’s points and that the language was defined. The subcommittee was unanimous in supporting the modest growth approach to move physics forward. However, this answer is qualified and the vote was closely split. The text does not indicate that the U.S. will shutter its last nuclear collider.

Geesaman asked if the letter should state that the NSAC accepts the report and that the modest growth path is the course that the subcommittee and the NSAC unanimously support. Jacobs suggested adding that modest growth is the only viable path. Klein suggested pointing out that the scenario would encompass the vision of the LRP, meaning that the original plan would not occur but the original vision would be intact. Opper suggested changing “...modest growth budget is presented...” to “...the modest growth budget that was considered...” to imply that the NSAC would have accepted something less modest.

Geesaman called for a break at 10:17 a.m. EST and discussion resumed at 10:35 a.m. EST.

Geesaman proposed that the NSAC vote on accepting the report allowing for some to register a no vote. This could show that some in the community feel that NSAC and the subcommittee have made a wrong choice and they are speaking individually rather than as an NSAC member. Another approach is to say that the NSAC is split and did not reach a unanimous consensus which expresses that there are multiple perspectives in the community. The NSAC could accept the report and add a statement that, like the subcommittee, the NSAC was split.

Hallman expressed that he is unsure how SC Director Brinkman would respond. He is sensitive to the headline about reluctantly shuttering the last collider. Hallman shared that the comments should accurately reflect the NSAC and subcommittee’s thoughts. Hallman recognized that the subcommittee deliberated this deeply and could not reach a consensus based purely on science. Hallman thinks that this captures the broader community’s feelings. He shared concern that a split NSAC vote would convey that the community is divided.

Jacobs expressed that a vote by NSAC would undermine the subcommittee’s work. The report is detailed and was read carefully but the topic is very complex. This should be addressed in the transmittal letter and it should reflect that the subcommittee was split. Nagle offered that the NSAC say it was closely split on the subcommittee’s recommendation and it did not reach a consensus to accept the recommendation. Some NSAC members disagreed with this approach.

Geesaman suggested adding that “...the subcommittee was not able to make a choice based on scientific merit alone. Based on additional considerations, the subcommittee, while closely

split, resulted in a slight preference for a choice.” Kaplan suggested that the wording reflect non-unanimity, and Gardner urged that it would be appropriate to have a minimal transmittal letter and to refer readers to the report.

Nagle suggested that it is preferable to vote against the report itself. Geesaman voiced his unwillingness to accept a statement that the NSAC does not endorse a preferred pathway unless it holds a vote.

Nagle asked how the NSAC can have a consensus without a vote. Geesaman shared that a unanimous consensus means that no person is objecting. The NSAC could accept the report and unanimously accept the modest growth scenario. The report explains that the subcommittee was not able to make a choice but had a slight preference for one choice. He asked if more needed to be said, and considered that this does not say that the NSAC endorsed a choice.

Blackmon and Klein noted that the letter should express that the subcommittee has fulfilled its charge.

Jacobs added that the consensus is probably that the no-growth scenario is negative for the field as a whole. It should also be noted that the subcommittee was split on prioritizing facilities. The letter could describe the negative nature of no-growth and allow readers to explore the report and the subcommittee’s conclusions. Geesaman asked about deleting the text about the vote being split and sharpening the paragraph about a no-growth scenario.

Gardner added that the letter should express that modest growth is the only way to capture the vision of the LRP. The letter should state that the decision of no-growth would result in outcomes that will not fulfill this vision.

Velkovska expressed that there should be a note about not reaching unanimous agreement, and Opper asked if there should be a vote on saying whether or not there should be a consensus.

Klein commented that all NSAC can do is to express that the subcommittee has done its job and note that the NSAC accepts that it has done its job.

Lu moved to take a vote on this and it was seconded by Opper. Jacobs asked about the need to define the word “accept”. Nagle responded that the NSAC could vote to not accept the report but that this has negative implications. Geesaman clarified that accept means that the NSAC was charged with this task and the report is being transmitted to the agencies.

A vote was taken with 12 in favor and two opposed.

The NSAC reviewed the transmittal letter, with a suggestion to express that the report was accepted by a majority vote but that it was not unanimous. Geesaman added to the letter that the NSAC accepts the report.

Geesaman asked about including a sentence to read that the subcommittee was closely split. Nagle recommended that the letter reflect that the subcommittee vote, while closely split, resulted in a slight preference for a choice.

Geesaman asked for a vote.

Two NSAC members voted to include this in the letter and six were opposed with five abstentions.

Geesaman commented that something will be added to the letter about the LRP.

Public comment

Venugopalan offered comment from an individual perspective, sharing his deep dismay that the RHIC could be closed under a no growth scenario. The report described the advances made by RHIC and how it has transformed the field and supported new scientists. He shared that the closure would be a tremendous loss and expressed dismay with the report.

McKeown serves as the *ex officio* chair of the APS Division of Nuclear Physics. He shared that the APS advocates for the whole field of physics and he expressed his gratitude to the subcommittee. Speaking on behalf of the leadership for nuclear physics, McKeown conveyed that all will work to advocate for a modest growth scenario.

Continued Discussion and Board Action on the Subcommittee Report

The NSAC continued its discussion of the LRP subcommittee report.

Geesaman reviewed the final text for the transmittal letter. It will read that the NSAC accepts the report and that a copy of the report is enclosed. The letter expresses that the subcommittee was unanimous in endorsing a modest growth scenario as the minimum level of support needed to maintain a viable long-term nuclear science program to encompass the LRP vision. The letter states that this is the NSAC's unanimous recommendation. The letter also expresses the subcommittee's conclusion that the no-growth scenario would require closing one of the two existing large facilities and abandoning a new accelerator.

Klein moved to accept the transmittal letter and Kaplan seconded.

The NSAC voted with 11 in favor and one opposed.

Geesaman confirmed that editorial changes to the report need to be made and that the re-draft will be sent to NSAC members. He thanked the NSAC and subcommittee for its work.

Blackmon pointed out his dismay in the draft report being made available to the public, resulting in an article in AAAS on January 28, 2013. While the NSAC meeting is public, he asked if it would be better to let the report become public before it is discussed or if there are things that could prevent the information being made public in the way that it was done. Geesaman responded that the conclusions had to be discussed in the meeting by the NSAC. He did not offer an approach to prevent media leaks or how to generate a proactive response to the AAAS article.

Blackmon asked about this being subject to Freedom Of Information Act (FOIA) consideration. Hallman commented that this is not a report until it is accepted by the NSAC. There is a desire to oppress lobbying and he does not see the benefits in releasing the report early. Jehanne Gillo confirmed that pre-decisional information is exempt from FOIA.

PUBLIC COMMENT

Adrian Cho of Science Magazine identified himself as the author of the AAAS article. He perceived the point of the charge as asking about a flat budget scenario. Discussions made it clear that in a flat budget, the subcommittee recommended that one facility be closed and that FRIB should go forward. He expressed that he believes that any scientific community would vote for an increased budget. In the charge, the NSAC was not asked for a budget. He commented that it might have been easier to report if the information had been publicly available. Geesaman commented that the charge asked for two budget scenarios and that the NSAC met this charge.

BOARD BUSINESS

The next NSAC meeting is March 8 – 9, 2013

CLOSING REMARKS AND ADJOURNMENT

NSAC Chair Geesaman adjourned the meeting at 11:45 a.m. EST.

The minutes of the U.S. Department of Energy (DOE) and National Science Foundation (NSF) Nuclear Science Advisory Committee (NSAC) held at the North Bethesda Marriott Hotel and Conference Center on January 28 – 29, 2013, are certified to be an accurate representation of what occurred.

A handwritten signature in blue ink, reading "Donald F. Geesaman", with a long horizontal flourish extending to the right.

Donald Geesaman
Chair, Nuclear Science Advisory Committee