Minutes
Department of Energy and National Science Foundation
Nuclear Science Advisory Committee
Crystal City Marriott Hotel, Arlington, Va.
November 5, 2009

Members Participating:

Susan Seestrom, Chair
Lawrence Cardman
Vince Cianciolo
Charlotte Elster
Richard Furnstahl
Carl Gagliardi
Dmitri Kharzeev
I-Yang Lee
Christopher Lister
Allison Lung
Gail McLaughlin
Hendrik Schatz
Mark Stoyer
John Wilkerson

Members Absent:

Xiangdong Ji
Michael Ramsey-Musolf
Johanna Stachel
Richard Milner

Others Participating:

Donald Geesaman
Jehanne Gillo
Eugene Henry
Bradley Keister
Richard Kouzes

Presenters in Order of Appearance:

Eugene Henry
Bradley Keister
Donald Geesaman

About 12 others were in attendance during the course of the meeting.

Chair **Susan Seestrom** called the meeting to order at 8:34 am, welcomed the members, and called on **Eugene Henry** to give the update on the DOE Office of Nuclear Physics.

Before beginning his update, Henry asked Stephen Merkowitz of the Office of Science and Technology Policy in the Executive Office of the President to stand. He then recognized outgoing members of the Nuclear Science Advisory Committee (NSAC) and presented them with a certificate of thanks. Larry Cardman, Charlotte Elster, Xiangdong Ji (in China), I-Yang Lee, Richard Milner (absent), Michael Ramsey-Musolf (absent), Mark Stoyer, and John Wilkerson are completing their terms. He thanked them for their hard work and years of service.

Henry declared that this has been a busy year. It included the following reviews: completion of science and technology reviews of four national user facilities; construction, major item of equipment (MIE), and other project reviews; more than 200 actions on grants and awards; agency reviews of international projects (including joint projects with Italy and Germany); a joint agency review of the 88-Inch Cyclotron

operations (jointly funded by the DOE, the U.S. Air Force, and the National Reconnaissance Office); and Recovery Act Solicitation Reviews (some completed and some ongoing). The Office's advisory and coordination activities included the National Academy of Science (NAS) Decadal Survey which has now begun ; approval of the NSAC Charter for 2 years (approval of the charter requires information on the members, so they should expect e-mail from Brenda May seeking that information); interagency working groups on The Physics of the Universe, Large-Scale Science, Mo-99, (insuring a reliable supply of commercial and research isotopes is currently a topic of great interest because of near term shortages and current U.S. dependence on foreign sources), supply and demand of He-3 for neutron detection (there is presently a limited supply which is being drawn down by domestic security, research, and commercial needs) (and forensics; OECD Global Science Forum's Working Group on Astroparticle Physics; and the proposed DUSEL [Deep Underground Science and Engineering Laboratory] Joint Oversight Group (JOG) with the National Science Foundation (NSF), High Energy Physics (HEP), and Nuclear Physics (NP). Interactions with Congress included testimony before the House Science and Technology Committee's Subcommittee on Energy and the Environment (Jehanne Gillo testified about the Isotopes Program, and Dennis Kovar on the Nuclear Physics Program). Other work this year included the Annual Workforce Survey that had a 97% response rate. NP has also begun to use The Strategic Integrated Procurement Enterprise System (STRIPES), which is new software that has great promise but has experienced some growing pains. Henry commented, "We are not paperless, yet, but we will begin processing awards through STRIPES this week."

Henry reported on the status of solicitations for proposals. The American Recovery and Reinvestment Act (ARRA) is funding Graduate Fellowships in Science, Mathematics, and Engineering with at least 80 graduate fellowships planned across the Office of Science (SC) for 3 years at $50,500 per year. Applicants must be U.S. citizens and either senior undergraduates or first- or second-year graduate students. The application deadline is November 30, 2009. There were 23 proposals reviewed for the Rare Isotope Beam (RIB) Science Initiatives, and selection and notification are now under way. Approximately 55 applications were received for R&D on Alternative Isotope Production Techniques, and 10 awards are in process funded by ARRA. NP received approximately 200 applications for Nuclear Science and Technology, which has both ARRA and base funding; 22 were selected for funding with notifications in process; the office is holding a small number of others to be ready in case there is additional funding. The Science Early Career Research Program (funded by ARRA in FY10 and to be funded by base funding in the outyears) received 56 applications with five to be supported at universities and three at national laboratories; these are 5-year awards with additional awards each year in the future funded out of the base program. Topical Collaborations in Nuclear Theory received 19 applications, and reviews are beginning. The process will be completed next month. There has been some concern because of the date on the current continuing solicitation related to this program, but solicitations are still open despite the closing date cited on the web.

The 12-GeV Continuous Electron Beam Accelerator Facility (CEBAF) Upgrade Project had a Lehman Review September 22-24, 2009. Overall, the project is going smoothly. There is $65 million in ARRA funding applied to mitigating risk. It will not be used to advance the schedule. Seestrom asked Henry to confirm that the $65 million

does not increase the total project cost (TPC). He confirmed that the TPC remains unchanged. The money is going toward mitigating risk rather than accelerating the schedule.

The Facility for Rare Isotope Beams DOE TPC is $450 to 550 million. The Michigan State University (MSU) cost share is $94.5 million. CD-0 was granted in FY04; the first project Lehman review was held September 1-3, 2009. CD-1 is planned for FY10. The need for this facility has been reaffirmed by recommendations from NSAC three times; it has also been a recommendation of the DOE *20-Year Facilities Plan* and by the National Academies. MSU has been selected for award and funded with operating dollars. R&D, NEPA, and conceptual-design activities were supported in FY09 and FY10; the engineering and design is planned to start in FY11. A public scoping meeting is planned to be held at MSU on November 11, 2009, with public comments open until December 11, 2009.

Henry reported on the status of NP projects. STAR [Solenoidal Tracker at RHIC (Relativistic Heavy Ion Collider) time-of-flight spectrometer has been completed; GRETINA (Gamma Ray Energy Tracking In-Beam Nuclear Array) MIE has CD-2b/3b status; EBIS (Electron Beam Ion Source) (with NASA) has CD-2/3; nEDM (neutron electric dipole moment) MIE (with NSF) has CD-1; CUORE (Cryogenic Underground Observatory for Rare Events) (with NSF) has CD-1; STAR HFT (Heavy Flavor Tracker) has CD-0; and RIB Science Initiatives and the Majorana Demonstrator R&D Project also have CD-0 status. All are reviewed annually, quarterly, or monthly depending on size.

Henry also reported on the ARRA NP projects and said that all of them are on track. One beneficial use of recovery funding is the money put into computer hardware by the Lattice Quantum ChromoDynamics (LQCD) project. NP was able to augment the LQCD project with 16 Tflops or more of computing. The Science Early Career Research Program to support development of individual research programs of outstanding scientists early in their careers is in process; NP is actively working on the first awards to be announced in FY10.

Henry showed a graph of the funding history of the NP Program showing that funding has been roughly constant with a slight increase the last couple of years. The 2010 appropriation is good for the Office. He then showed the FY10 budget request and appropriation that enables a program that is optimized by balancing research workforce, facility operations, and new initiatives through investments in advanced technology and capabilities. All facilities are supported at near-optimal levels of operation, and investments are made in programmatic infrastructure, facility equipment, and accelerator-improvement projects to increase reliability, cost-effectiveness, and productivity and to provide new capabilities to pursue discovery science. RHIC would operate 3,720 hours (91% of optimal), and CEBAF would operate 5,110 hours (85% of optimal). Funding for instrumentation increased according to planned profiles with two new MIEs initiated STAR HFT and RIB Science. Construction continues on the 12-GeV CEBAF upgrade at approximately the planned profile, adjusted for ARRA funding. R&D and conceptual design of FRIB continued as planned under the cooperative agreement covering this activity. The Isotope Program (moved to NP in FY09) is supported at a level not less than the President's request.

NP's appropriations were reduced compared to the President's request by $17 million (from $552 million to $535 million or -3%) with the following impacts:

- The 12-GeV CEBAF Upgrade is reduced by $2 million (from $22 million to $20 million); NP will try to restore funding in FY11;
- FRIB is increased by $3 million (from $9 million to $12 million); and
- The Isotope Program is to be funded at not less than the President's request of $19.2 million.

The net reduction to the remainder of the NP Program is $18 million from the President's request. This impact is currently under evaluation. New initiatives, such as Applications of Nuclear Science and Technology, will be reduced. Facility operations will be reduced somewhat from the requested plan. Planned project profiles are preserved, and we will try to mitigate reductions-in-force. This mitigation will be helped by ARRA funds, FY09 year-end actions, and the commitment of some reserves (resulting in a loss of flexibility).

Henry presented the updated organization chart of the Office of Nuclear Physics and noted that after 2 years, we have a permanent Associate Director of Science for Nuclear Physics, Timothy Hallman. He introduced from the audience Lino Miceli, who is new to the Office this week, a detailee to Advanced Technology R&D. He thanked several detailees who are leaving. He noted that advertisements are out for several positions on the web site. In particular, NP is seeking a motivated and highly qualified physical scientist to serve as a recognized scientific authority and expert in isotope production and processing. This position will close after the first of the year.

Henry asked if there were questions. Furnstahl asked if it had been decided how and whether the nuclear theory and collaborations money would be spent this year. Henry replied that exact details have not yet been worked out. There is about $1.3 million that will support "X" number of centers; we presume there will be at least one center. Furnstahl asked if there would be another solicitation. Henry said that it would be great if there were, but it was funding dependent. Right now, NP has not put that into their plans. When these projects are completed, there *will* be a new solicitation. Furnstahl said that if the money were not yet spent, there was interest in associated faculty positions but commented that more lead time than they had had this summer was needed for establishing a faculty position. Henry replied that he understood that and that the spending had been done on a very fast track.

Lister said that, in regards to money for equipment, what was "soon"? Henry responded, days to a few weeks. Lister then asked if FRIB would have a federal task force similar to that of DUSEL. Henry said yes, but that things were at an early stage. There are things that have to be discussed, coordinated, and worked out between DOE and NSF as they begin to transition the National Superconducting Cyclotron Laboratory (NSCL) from its current NSF support to FRIB.

Hugh Montgomery of Thomas Jefferson National Accelerator Facility (JLab) asked with respect to DUSEL when the nuclear-physics-dominated experiments being proposed would begin. Henry replied that U.S. researchers and collaborators view DUSEL as the primary site for the full Majorana experiment. In the interim, it will begin at the Sanford Laboratory.

Bradley Keister was then asked to present the update on Nuclear Physics at NSF. He noted that Joseph Dehmer and Edward Seidel had prior commitments to a regular meeting of the MPS Directorate Advisory Committee, so he would present the update. He said that the basic information on the FY09 appropriation is the same as at the July

meeting: NP Experiment funding up +0.5 %, NP Theory +1.5%, and Particle and Nuclear Astrophysics +0.5%. ARRA provided $13 million that provided extra support for new and renewal proposals. Additional funding was provided for major research instrumentation (MRI) whose award total for NP-related proposals was $3.7 million. Cyber-enabled Discovery and Innovation (CDI) funded MSU/Duke collaboration for RHIC physics and other multi-scale systems. CDI proposals need to be interdisciplinary to be considered. Petascale Applications (PetaApps) funded a Louisiana State University/Iowa State/Ohio State collaboration for nuclear structure. Reviews for a second FY09 MRI solicitations, along with a new solicitation for Academic Research Infrastructure (ARI), are in process. The success rate of ARI will likely be low.

Keister then showed table of the FY10 NSF Budget Request with the funding for Research and Related Activities (R&RA) highlighted: FY08 actual funding is $4,853.24 million; FY09 current plan is $5183.10 million; FY09 Recovery Act is $2500 million; FY10 request is $5733.24 million; the change from FY09 of the current plan is $550.14 million (10.6%); Full Committee House is $5,642.10 million; Senate is $5,618.10 million. NSF is still under a continuing resolution. The budget has to go to conference and is still unpredictable. He then showed the FY10 R&RA Budget Request with Mathematical & Physical Sciences (MPS) highlighted: FY08 actual is $1,171.13 million; FY09 current plan is $1,255.96 million; FY09 ARRA is $490 million; FY10 Request is $1,380.00 million; Change over FY09 of the current plan is $124.04 million or 9.9%.

The FY10 MPS Budget Request for Physics: FY08 actual of $251.64 million; FY09 current plan of $226.18 million; FY09 ARRA of $96.30 million; FY10 request of $296.08 million; change over FY09 current plan of $21.61 million or 7.9%. This is less of an increase because of a relatively large increase for Physics last year. The FY10 Physics Division Budget request shows a heavy emphasis on research and education grants and a 2.4% increase for NSCL (National Superconducting Cyclotron Laboratory).

Congress provides budget guidance in its appropriation at the level of the MPS Directorate, but not at division and program levels below that.

The National Science Board (NSB) approved a resolution authorizing an award to the University of California at Berkeley for the preliminary design of the Deep Underground Science and Engineering Laboratory (DUSEL) was signed on September 24, 2009, and represents a critical milestone.

DUSEL Solicitation 4 called for proposals to develop designs and pursue targeted R&D for possible inclusion in the initial suite of experiments at DUSEL. This is in preparation to include a suite of initial experiments along with laboratory construction. . Twenty-five proposals were received, representing 300 senior researchers and 91 institutions. Nine proposals were funded in physics (dark matter, neutrino-less double-beta decay, large water Cerenkov detector, underground accelerator, and an assaying sub-facility) with a total of $21 million over 3 years. Seven proposals were funded in biology, geology, and engineering (BGE) (fracture processes, coupled processes, subsurface imaging and sensing, fiber optic strain monitoring, CO_2 sequestration, and eco-hydrology and deep drilling) with a total of $3 million. NSF is committed to a rich, diverse, and multidisciplinary DUSEL research program.

The DUSEL target timeline for major research equipment and facilities construction (MREFC) was presented: January 2009, NSF Project Review #1; February 2010, NSF Project Review #2; December 2010, NSF Preliminary Design Review; Spring 2011,

presentation of the DUSEL MREFC proposal to the National Science Board (NSB) with the goal of making this in time for an FY13 construction start.

Keister then showed a chart of key NSF people: NSF Director Arden Bement; NSF Deputy Director Cora Marrett (acting), MPS Assistant Director interim AD H.E. Seidel (current OCI head; a search is under way), Physics Division Director Joseph Dehmer, Nuclear Physics Bradley Keister for experiment and theory, and Allena Opper for astrophysics and underground laboratory. Opper will be returning to George Washington University, and a search is now under way for her replacement.

No questions followed, so a break was called at 9:30 a.m. The meeting was called back to order at 9:45 a.m. and the Seestrom introduced Dr. Donald Geesaman (Argonne National Laboratory) to present the report of the NSAC Isotopes Subcommittee entitled "*A Strategic Plan for the Isotope Development and Production for Research and Applications Program*". He first said that changes have occurred in needs for isotopes, and that it is a fluid situation. There have been two charges to NSAC. Charge 1 asked the Subcommittee "to consider broad community input regarding how research isotopes are used and to identify compelling research opportunities using isotopes." The first report "*Compelling Research Opportunities using Isotopes*" led by Prof. Ani Aprahamian (Notre Dame) was accepted by NSAC and transmitted to DOE last April.

The second charge asked NSAC to examine how the National Isotope Production and Applications (NIPA) Program "provides the facilities and capabilities for the production of research and commercial stable and radioactive isotopes …to address the needs of the Nation." The Subcommittee was asked to study the opportunities and priorities to ensure a robust national program in isotope production and to recommend a long-term strategic plan. That Plan should

- Define the current status and impact of the NIPA Program on the isotope needs of the Nation
- Identify and prioritize the most compelling opportunities for the U.S. program to pursue over the next decade and articulate their impact
- Create a coordinated strategy for the use of existing and planned capabilities
- Provide the rationale and priority for new investments, both for a constant level of effort budget and an optimal budget
- Identify and prioritize investments in new capabilities for commercial isotope production
- Consider the robustness of the current isotope production operations in terms of technical capabilities and infrastructure, research and development of production techniques of research and commercial isotopes, support for production of research isotopes, and current levels of scientific and technical staff supported by the NIPA Program

An interim report containing the response to DOE was requested by April 1, 2009, and a final report by July 31, 2009. The report made by the Subcommittee in July was returned for more work to be revisited by the full Committee at this November meeting.

The mission of the DOE Isotope Program is to produce and sell radioactive and stable isotopes in short supply, maintain the infrastructure required to supply isotope products, and support R&D for the development and production of isotopes (not for their end use). DOE isotopes are used 60% for medical research, 20% for other research, and 20% for commercial use. In FY08 there were more than 190 customers and more than 560

shipments, with 10 customers constituting more than 85% of sales. The total FY08 sales were $17.2 million. Appropriations for FY08 were $15.0 million, for FY09 $24.9 million (a substantial increase), and for FY10 $19.2 million.

For some isotopes, the federal responsibility has been assigned elsewhere (i.e., weapons-related isotopes, reactor fuels, and molybdenum-99, the isotope most commonly used in medical procedures). These are not the responsibility of the Office of Nuclear Physics.

The sources of isotopes are accelerators [Brookhaven Linac Isotope Producer (BLIP), the Isotope Production Facility (IPF) at Los Alamos National Laboratory (LANL), universities, and commercial], reactors [Oak Ridge National Laboratory (ORNL) High Flux Isotope Reactor (HFIR) the primary reactor for isotopes; Idaho National Laboratory (INL) Advanced Test Reactor *(*ATR); universities like the University of Missouri Research Reactor Center (MURR) and University of California Davis Stable Isotope Facility (SIF)]; and isotope separators (no DOE facilities) and stockpiles of long-lived or stable isotopes (this source provides lots of precious isotopes, but they are costly because of cleanup issues).

Geesaman showed a map of DOE production sites, including the facilities for which the Isotope Development and Production for Research and Applications (IDPRA) Program has stewardship responsibility [BLIP at Brookhaven , the oldest; HFIR at Oak Ridge, now a BES facility, with parasitic isotope production; and the Los Alamos Neutron Science Center (LANSCE)/Isotope Production Facility (IPF) at Los Alamos, an NNSA/BES facility]; past and potential future participants at Pacific Northwest National Laboratory and Idaho National Laboratory (the ATR), and the MURR at the University of Missouri (with a Memorandum of Understanding for potential collaboration); and the Savannah River Site's (SRS) tritium facility.

The challenges of the Isotope Program were discussed a lot at the previous meeting, but Geesaman wanted to emphasize that the program requires a broad and expensive infrastructure, and that there will be significant ongoing and continuing costs to remain mission ready and to deal with ES&H implications. The Program also requires highly skilled teams, and there is currently a shortage of expertise. The Program leverages major investments by other parts of DOE (at RHIC, LANSCE, and HFIR) but is then subject to changing mission priorities affecting operating schedules and even facility closures. Once a commercial supplier is available, DOE must leave the market; this is a very difficult business model, and many commercial suppliers fail. Foreign suppliers can artificially determine prices and in some cases are subsidized by governments.

In July at NSAC, there was general support for the recommendations with some requests. NSAC asked that a priority order be given to the recommendations. A small rewording was suggested to give DOE flexibility to optimize a response. The discussion on workforce development needs to be more targeted to isotope production. A few more sentences of justification should be added to the Executive Summary. Some of the detail in the discussion of program operations could be reduced. All of these have now been addressed in the revised report. The question on foreign producers was not addressed because that information is not available.

There are challenges in radiopharmaceuticals. NIH wants a supply to be available before funding research. Quantities increase for clinical trials. Part of the research is to establish a correct dose. Researchers need a consistent year-round supply; and in many

cases, the supply cannot be stockpiled. New production techniques may be required. If trials succeed, the quantity needed can increase dramatically. Clinical trials can go to second and third stages; but if there is then a failure, the demand can shrink dramatically. This kind of risk is not attractive to commercial suppliers.

The DOE Isotope program developed at BNL has experienced much success. Its isotopes are used in 70 to 80% of all nuclear-medicine procedures with approximately $200 million in commercial technetium sales each year in the United States. But now there are several important issues: reliability of supply (aging reactors are having problems; the Canadian reactor has been shut down) and proliferation (most current production uses highly enriched uranium). NNSA now has responsibility stemming from the proliferation issues. There have been national shortages of molybdenum-99/technetium-99m, the most used radionuclide in diagnostic nuclear medicine; and during the past year, the emphasis has changed from nonproliferation to reliable supply.

The Nuclear Science Advisory Committee Isotopes (NSACI) Subcommittee has indicated that the supply issue is of great concern. "Recent disruptions in international supply demonstrate the vulnerability of the nation's health care system in this area. The nation must address this vulnerability. At the present time, the isotopes program does not produce ^{99}Mo. With the nonproliferation issue associated with the transport and use of highly enriched uranium currently used for ^{99}Mo production, DOE NNSA has the lead responsibility in this area and is actively investigating options for ^{99}Mo commercial production. The Subcommittee chose to refrain from inserting itself into the intense activity under way but reiterates the importance of this issue."

Other techniques have been sought because molybdenum is in short supply. There has been successful use of ^{82}Sr - ^{82}Rb in clinical positron emission tomography (PET) for cardiac perfusion studies. This is currently the isotope with the highest sales. Limited available running time at accelerators requires multiple producers for year-round availability.

There has been a short-term increase in supplies of strontium. As demand increases, more suppliers enter the market.

The path to an effective Isotope Program requires

- Communication (the Isotope Program has to know what to produce, and this requires forecasts from major customers and funding agencies). The NIH-DOE Working Group is an excellent example of successful communication.
- Coordination with outside partners (to recognize potential unused capacity; to coordinate production schedules for required availability; and to avoid major complications).
- R&D to create more efficient processes (R) and ones that can be shared (D).
- Transportation to make it more reliable to ship isotopes.
- Skilled workforce to both make sure that the ones you have are available and to ensure a new generation of isotope-production workers exists.
- Make sure the facilities you have are mission ready in infrastructure and maintenance.
- New investment for needed production capacity where it does not exist (a dedicated flexible accelerator with year-round availability for isotope production and a new isotope separation facility).

The DOE Office of Nuclear Physics (DOE-ONP) has already made important progress on the path to an effective Isotope Program. To promote communication, there has been the August 2008 Isotope Workshop, the NIH-DOE Working Group, the Interagency Working Group on ^{3}He, a restart of ^{252}Cf production and sales, and the search for a National Isotope Data Center (NIDC) Director (a new position). To support coordination, the Virtual Isotope Center includes Los Alamos National Laboratory and Brookhaven National Laboratory supplemented by international collaborations with TRIUMF (Vancouver, Canada), Institute of Nuclear Research (Troitsk, Russia), National Accelerator Centre (Faurve, South Africa), and the Paul Scherrer Institute (Villigen, Switzerland). In R&D, there has been significant ARRA investment in research. To make sure that the facilities are mission-ready and to improve their capabilities, significant investment has been made in FY09 in upgrading the infrastructure with ARRA funding.

Geesaman then presented the Subcommittee's recommendations for the present program (in priority order):

I.1 Maintain a continuous dialogue with all interested federal agencies and commercial isotope customers to forecast and match realistic isotope demand and achievable production capabilities.

Contact with NIH and the National Cancer Institute are especially important. For an efficient and effective isotope program, accurate forecasts of isotope needs are essential. The DOE-NIH interagency working group is an excellent start for this communication.

I.2 Coordinate production capabilities and supporting research to facilitate networking among existing DOE, commercial, and academic facilities.

I.3 Support a sustained research program in the base budget to enhance the capabilities of the isotope program in the production and supply of isotopes generated from reactors, accelerators, and separators.

Retaining the most creative people in the program is also important.

I.4 Devise processes for the isotope program to better communicate with users, researchers, customers, students, and the public and to seek advice from experts.

For example, users group, expert panels, and an interactive web presence.

I.5 Encourage the use of isotopes for research through reliable availability at affordable prices.

I.6 Increase the robustness and agility of isotope transportation both nationally and internationally.

This can be done by identifying and prioritizing transportation needs through establishing a transportation working group and beginning a collaborative effort to develop and resolve the priority issues (i.e., certification of transportation casks).

II. Invest in workforce development in a multi-pronged approach, reaching out to students, post-doctoral fellows, and faculty through professional training, curriculum development, and meeting/workshop participation.

The dwindling population of skilled workers in areas relating to isotope production and applications is a widely documented concern. This recommendation is focused on the needs of the IDPRA program, itself. The relative priority of this recommendation is comparable to that for a sustained R&D program, with which it is closely linked.

III.1 In major new investments: our highest priority is to construct and operate an electromagnetic isotope separator facility for stable and long-lived radioactive isotopes.

III.2 Construct and operate a variable-energy, high-current, multi-particle accelerator and supporting facilities that have that has the primary purpose of isotope production.

A dedicated facility should be constructed so isotopes will be available year-round and not derived from short-term dedicated runs or parasitic operations.

Given the uncertainties in future demand, this facility should be capable of producing the broadest range of interesting isotopes. Based on the research and medical opportunities considered by the subcommittee, a 30- to 40-MeV maximum energy, variable energy, high-current, multi-particle cyclotron seems to be the best choice on which to base such a facility.

The recommended budget requires increases starting from the constant-effort budget of $19.9 million (FY09) which was a $4.9 million increase over the FY08 budget. This includes a base of funds for R&D (~10% of the operating budget), additional funds to maintain infrastructure (~10% of operating budget), stabilized funding for key personnel (~25% increase of manpower on appropriations), and funds for workforce development (~5% of operating budget). ARRA funds allow these recommendations to be phased in to 2012 and correspond to appropriations of about $25 million (FY09). Initiatives include proof of principle for increased production of alpha emitters ($4 million), new accelerator and associated infrastructure ($40 million), electromagnetic separation facility ($25 million), and plan for a major long-term future facility to address a significant increase in demand (about $50 million, starting in 2016).

In summary, the IDPRA program is a major asset for the nation's competitiveness. It plays an essential role for the federal government in its unique capital investments, sensitive technology, and intellectual advances. It also represents considerable economic risk, which is difficult in the current economic environment. It should focus on development and production. It needs to replace lost capabilities (stable isotopes) and be able to provide radioactive isotopes for research year-round. Following the recent significant pulse of investment, the program could operate on a constant-effort budget for a few years. In the long term, this will force the nation to rely heavily on uncertain foreign sources of isotopes. The NSAC subpanel does not believe that constant-effort funding would be a wise choice for the future.

Seestrom thanked Geesaman for his presentation and Geesaman and Ani Aprahamian, Co-Chair, and the members of the NSACI Subcommittee for this work. She suggested that the report be considered over lunch and that a vote be taken after lunch. She then asked for questions.

Gagliardi asked about the prioritization of the recommendations and if there were any subgroups less happy with the order. Geesaman replied that the priorities are not unanimous but most were generally happy with the final list. No one expressed unhappiness with the final prioritization. Industrial representatives have different priorities from the researchers, but there is a clear consensus with the prioritization. There were no serious splits.

Lee asked about operating costs. Geesaman said that the operating costs are included in some of the estimates. Some operating costs are offset by sales, but these experienced wide fluctuations**.** The operating costs also vary widely depending on the use of existing facilities vs building new facilities. The costs are generous estimates.

Cardman asked about ways to establish dialogue to enhance communications. He mentioned that user groups have dialogues that can clarify interests. Geesaman said that the Office is looking for a director of the National Isotope Data Center. One of the primary missions of that job will be to set provisions in place and to ensure that we get this dialogue. A primary focus of the job will be community outreach. At the moment, we just have a bunch of ideas. It will be that person's job to carry them forward and put them into operation. Cardman suggested that we should encourage this communication in the transmittal letter. Geesaman agreed.

Henry said that the Office plans to add an additional member to NSAC from the Office of Nuclear Medicine who will have a role similar to that of the representative from the Division of Nuclear Physics.

Seestrom asked about the disagreement on transportation. Geesaman explained that LANL and BNL both said that they do not have transportation issues. Oak Ridge, however, tends to produce higher-activity isotopes. Our model potentially involved greater shipment from production facilities at universities and chemistry divisions at laboratories. Unifying transportation procedures could have significant benefit. Last week at the Accelerator R&D Workshop in the isotope subgroup there was interesting interaction between groups from labs and those from industry. Geesaman replied that until this year transportation was at the lowest priority, but it is certainly something that needs to be dealt with in planning for the future.

Seestrom asked for clarification to make sure she understood the resolution. Because of the different levels of activity, Oak Ridge does have issues, and the Subcommittee believes that in the future there will be more need to transport more things. Geesaman concurred.

Stoyer asked why they chose to break out the recommendation on workforce development. Geesaman replied that it is sufficiently important that the NSAC subpanel wanted to call it out separately and make it more visible as a separate recommendation.

Elster commented that she was happy with this report as it addresses workforce issues. It is sufficient to highlight that there is division and will be division. There needs to be a forum to focus on how to get students interested in isotopes and to assure them that there will be a career path in the future. She is happy that they made this a priority issue so that people will keep thinking about it.

During the public comment, Richard Kouzes from Pacific Northwest National Laboratory (PNNL) asked for clarification on Recommendation III. Did the Subcommittee leave open that there could be alternative technologies that could come into play and whether there should be distributed facilities versus a large facility?

Geesaman said that the Subcommittee wanted to try to optimize how to respond to this issue and to emphasize the need for year-round availability and give a suggested solution with caveats.

When there were no additional questions, Seestrom asked if there were any issues that needed to be discussed. She then asked for comments from NSAC members. John Wilkerson commented that the Subcommittee had done a very fine job. McLaughlin added it was very educational on a complex challenging topic. Lister added that**, c**learly, in the future this is going to be a bit of a minefield, and the Subcommittee produced a strong document on a complicated topic. Gagliardi said he had learned a lot. Furnstahl added that the report would be a fabulous resource.

Seestrom added her personal thanks for the difficult work and for their willingness to really make it perfect from the viewpoint of this group. NSAC then voted unanimously to accept the response to the second charge and to transmit it to DOE.

Jehanne Gillo also expressed thanks for the work of the Subcommittee saying that it has already had an impact. NP has been implementing the recommendations. It put out a solicitation that was open to universities and to laboratories as well as to industrial entities that invited proposals for alternative production techniques. NP also put out a call for proposals to the broad community and asked them about their interests and capabilities. NP has reached out and is now working with respondents to set up contracts. Next week there will be a meeting with people from an NIH facility. These recommendations are being implemented. This report is going to be very useful and already has been very helpful. The Subcommittee produced a very good product and benefited from NSAC's willingness to critique the report. Gillo thanked NSAC for being willing to delve into a topic they were not very familiar with and for providing a lot of beneficial comments.

Seestrom led a brief discussion on the wording of the letter transmitting the report to DOE.

Seestrom presented a report on the International Union of Pure and Applied Physics (IUPAP) Working Group 9 aimed at international cooperation, led by Anthony Thomas of JLab, with members from various European and Asian laboratories. There was a report from the Organisation for Economic Co-operation and Development (OECD) Working Group, an announcement of the establishment of a new Asian group analogous to IUPAP, and reports from various subgroups aimed at keeping communities aware of what others are doing. In July there will be a 2-day symposium immediately before the International Nuclear Physics Conference 2010 (INPC2010) that will be held July 4-9, 2010, in Vancouver, Canada, to focus on the current and future thrusts in nuclear physics. The meeting next spring will focus on long-range planning, reconciliation, and formalization of membership.

Seestrom reported on the Committee of Visitors (COV), and its membership and meeting times. She said that there is weak representation from heavy ions. She indicated that the COV is on track and will have an agenda by the end of November.

Seestrom asked the members to discuss ideas on setting a calendar for the meetings of NSAC. Would it be good and possible to set a calendar for one year or longer? Meetings are usually held fall, winter, and summer. Could we capture conference schedules that were of interest to the members and avoid conflicts? Is it better to set a general week for the meetings or to set a specific date? Karzeev said that planning a schedule was a great

idea. Elster commented that scheduling would be helpful if it were set a year ahead so one could plan for it. It would be good to set a particular date. It was then asked if meeting on a Friday or Monday were considered family unfriendly, but it was commented that such a schedule was often easier on academics with teaching schedules. Furnstahl commented that scheduling a year ahead was fine, but that 2 years ahead might prove impossible because many conferences do not schedule that far out. Gagliardi commented that even a schedule for summer 2011 was not yet possible. Gillo stated that meetings need to be scheduled around the President's Request in February or early March. Seestrom asked members to present the dates of physics meetings they were aware of. She then asked their opinion on scheduling an NSAC meeting in conjunction with a major meeting like the APS. Gillo said that there is a clear disadvantage to a non-DC meeting place: holding the meeting in the DC area encourages attendance by Office participants and by other interested federal parties. Schatz added that the length of travel time required by attendance at both a conference and NSAC meeting might make it more difficult. Elster agreed, saying that academic scheduling would make being away a long time difficult. Gagliardi said that he would like adjacent scheduling if it meant fewer plane rides! Wilkerson said he would not like adjacent scheduling because of difficulties with teaching. Seestrom said she would also like to place technical talks on the calendar to avoid conflicts in scheduling. Cardman said that there is a conference in Osaka December 8 – 11. Cianciolo suggested a Google poll. Stoyer said that the APS spring and fall meetings are scheduled 10 years ahead and that the schedule is available on the web. Lung asked that certain periods be blocked out in consideration of project schedules. Seestrom ended the discussion saying that she would collect conflicting meeting dates from members in order to produce a proposed calendar, and asked them to think particularly of February and early March.

Seestrom asked if there were any heads up from NSF or DOE. Keister warned that in the business of proposal reviews, PIs and co-PIs will be required to complete a percent-of-effort table. This required element is motivated by PIs and co-PIs who are substantially overcommitted.

Elster asked when the start of the next long-range plan will occur. Henry said that the most recent LRP was published in 2007 and activities started in 2006. NSAC tries try to have a long-range plan every 5 to 6 years, so the next long-range plan will be in 2011–2013. The new members of the Committee will be part of the process because they will be on the Committee in 2010, 11, and 12. Elster asked whether the isotope plan will be part of the LRP or whether there will be two separate plans. Gillo responded that this will require a lot of thought. There are a lot of synergies between the nuclear science and isotope programs that need to be nurtured, but the two programs need to be kept distinct at some level. The people who are involved in the isotope program do not have expertise in the nuclear science program and vice versa. There is a huge learning curve to making decisions and recommendations on each others' programs. What would we gain by combining? Elster said she just wanted to put this on the table. It is good to encourage the synergies, but the two divisions operate in different ways and have different goals. We don't want to harm an effective process for developing a long-range plan by adding a second discipline into the process. Gillo suggested that NSAC not be too prescriptive on this topic.

Cardman said that the community in the isotope program is dramatically more disparate. It would be very difficult to do a combined plan, but a focused long-range plan with a member of the isotope community sitting on NSAC and communicating their interests would be valuable. We need a common approach. It is essential to come together for a strongly informed long-range plan with input from each group.

Gillo said that we need to get these communities educated, informed, and working together. We will benefit from a member from nuclear medicine working with this Committee.

The meeting adjourned for lunch at 11:20 a.m. and reconvened at 1:00 p.m. when Seestrom called the meeting back into order. She brought up the transmittal letter for the NSACI report. In brief, it said Paragraph 1: You gave us this charge. Paragraph 2: We put together a subcommittee. Paragraph 3: Dr. Geesaman presented the work of the Subcommittee. Paragraph 4: The report was discussed, and NSAC embraces the opportunity, applauds the efforts of the Office, appreciates that the community is more of a community with this process (NSACI), and welcomes the opportunity to contribute to this integration.

In discussion, it was suggested that the word "contribute" connotes money and that it be changed to "support." Stoyer suggested that the Committee focus on a common direction. Henry said that the letter was very positive and suggested that we make the approval more prominent, perhaps by moving it to the beginning. Lung added that the recommendations be endorsed as well as the report. Seestrom asked if anybody wanted a second reading; no one did. The letter with the noted changes was then approved.

There being no public comment, the meeting was adjourned at 1:15 pm.

These minutes of the Nuclear Science Advisory Committee held at the Marriott Crystal Gateway Hotel, Arlington, Virginia, on November 5, 2009 are certified to be an accurate representation of what occurred.

Susan J. Seestrom
Chair, Nuclear Science Advisory Committee