

Minutes of the Meeting of the
Department of Energy and National Science Foundation
Nuclear Science Advisory Committee
Marriott Bethesda North Hotel and Conference Center
Bethesda, Maryland
July 21, 2006

Members Participating:

Robert Tribble, Chairman	June Matthews
Ani Aprahamian	David Robertson
Douglas Bryman	Susan Seestrom
David Dean	Thomas Ullrich
Rolf Ent	Ulbirajara van Kolck
Thomas Glasmacher	William Zajc
Ulrich Heinz	
Roy Lacey	

Members Absent:

Naomi Makins	Guy Savard
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Others Participating:

Peter Bond	Bradley Keister
Lawrence Cardman	Dennis Kovar
Joseph Dehmer	R. G. Hamish Robertson
Stuart Freedman	

Presenters in Order of Appearance:

Joseph Dehmer	Stuart Freedman
Dennis Kovar	Kevin Lesko
Susan Seestrom	Dennis Kovar
R. Bruce Vogelaar	David Dean
William Louis	

About 30 others were in attendance during the course of the two-day meeting.

Chairman Tribble called the meeting to order at 8:03 a.m., made general announcements of convenience, and introduced new members of the Committee. This meeting focuses on neutrinos; future meetings will focus on low-energy physics. He introduced **Joseph Dehmer** to give an update on the Deep Underground Science and Engineering Laboratory (DUSEL).

The history of this project goes back to 2000. It will include geology, engineering, and biology as well as physics. It represents an infrastructure that disciplines can use for decades. Collectively, the discovery potential is very large.

The United States should consider the establishment of a world-leading facility that would enable a broad program of frontier research through generations of technical and scientific advances. We need to look beyond current needs to the needs of future generations. The project is well aligned with the mission of the NSF: it would have a transformational impact on multiple disciplines, it has great education and outreach potential and, [like the Laser Interferometer Gravitational Wave Observatory (LIGO) and IceCube] it does not lie within the missions of other agencies. Investment in R&D of approximately \$6 million is planned for DUSEL and DUSEL-related experiments in FY07 to be prepared to move ahead. Interagency coordination and prioritization is proceeding through the National Science and Technology Council (NSTC) Working Group on Physics of the Universe. It will dovetail with the new facility manual coming out this fall. Engineering is very interested in doing R&D in deep tunneling technology and development of large caverns at great depth. For nuclear physics, DUSEL introduces diversity into the portfolio, complementing the International Linear Collider (ILC). One concept would be to have a Phase I suite of instruments for research on neutrinos and dark matter and a Phase II with a detector for long-baseline neutrino measurements

In June 2006, conceptual design reports were submitted by the Henderson and Homestake teams; these will be evaluated. In September 2006, a solicitation will be issued for proposals to develop a “preliminary” (baseline) design of a DUSEL, including an initial suite of experiments. There is a pending reconsideration request. The documentation was found to be flawed. As a result, the third solicitation will be open to all. Early estimations of the cost are ~\$500 million, including the initial infrastructure development and the initial suite of experiments. The deadline for proposals will be in December 2006 with an award made in April 2007 to design the DUSEL at the selected site. In October 2007, the deadline for the DUSEL Baseline Plan (including the cost, schedule, scope, and management) will occur. The goal is to have a baseline design by December 2007 for an NSF baseline review and to be able to certify a reliable cost then. In March 2008, the DUSEL package will be ready for consideration by the Major Research Equipment and Facilities Construction (MREFC) panel.

Kovar asked if this project had to go to the National Science Board. Dehmer replied, no; that occurs after the Director puts it in the budget.

Ent asked how quickly it might become operational. Dehmer said that the two sites are in different stages of preparation. A big challenge is safety. Certifying the safety side will take some time.

Dennis Kovar was asked to present an update on the Nuclear Physics (NP) program of DOE. The FY07 budget request is much better than the budget for FY06 and is a little above a cost-of-living increase over the FY05 budget. University and national-laboratory

research efforts are restored to approximately FY05 levels. The national user facilities [Relativistic Heavy Ion Collider (RHIC), Continuous Electron Beam Accelerator Facility (CEBAF), Argonne Tandem Linac Accelerator Facility (ATLAS), and Holifield Radioactive Ion Beam Facility (HRIBF)] can operate at near-optimum levels. NP continues to make investments in the Scientific Discovery through Advanced Computing (SciDAC) program with the offices of High Energy Physics (HEP) and Advanced Scientific Computing Research (ASCR). The 12-GeV CEBAF upgrade project has obtained CD-1 [Critical Decision One] approval for a modest start of project engineering and design. R&D is supported in the budget request to address next-generation capabilities in superconducting radiofrequency development at the Thomas Jefferson National Accelerator Facility (TJNAF), electron cooling at RHIC to reach higher beam luminosities, and rare-isotope beam capabilities.

The House appropriations bill provided funding at the level of the President's request. In the Senate appropriations bill, a \$20-million NP request for high-energy density physics (HEDP) R&D (i.e., a heavy-ion program) was removed to fund a new Office of High Energy Density Science. As a result, NP has less than \$30 million for heavy-ion research, terminating support for all NP-supported university and national-laboratory use of RHIC *or* no RHIC running and reductions in force at Brookhaven National Laboratory (BNL). A longer-term impact is the crippling of the use of a large machine and the shifting of research (an integral part of the NP program) to another program. There will be a conference committee meeting in September; it is unclear what will happen after the midterm elections.

There is an existing charge for the Neutrino Scientific Assessment Group (NuSAG) to do an assessment of options for next-generation neutrino beams and detector configurations. There will also be three new charges to NSAC: a committee of visitors (COV) to assess the effectiveness of NP (due in February 2007), a task force to examine the options for a U.S. rare-isotope-beam facility (due in March 2007), and a new long-range plan (LRP) for U.S. nucleus science (due in December 2007).

After the rechartering of NSAC, members were appointed for 1-, 2-, and 3-year terms. Appointments of 1-year terms expire December 5, 2006. Appointments of new members become effective on that same date.

Three outstanding junior investigators were named for NP in FY06. The deadline for nominating candidates for FY07 is in November 2006. The FY05 DOE early-career scientist and engineer awards have yet to be announced. For FY07, there will be a solicitation for rare-isotope-beam R&D; the deadline will be in November 2006; \$4 million has been requested for funding. There will be a workshop on nuclear data and computing R&D relevant to the Advanced Fuel Cycle (AFC) on Aug. 10-11, 2006, in Bethesda, Maryland. It will look at opportunities for the NP program to contribute to the AFC; there will be a solicitation for FY07 with a deadline in November or December of 2006; \$2.4 million has been requested for funding. New grant proposals for FY07 funding that are received by the deadline in November 2006 will be acted upon in the fiscal year. Proposals submitted late in the funding cycle will not be acted on until the next cycle because funds will have been committed.

Two division-director positions have been filled; a new program manager has been named for Advanced Technologies and R&D; two new program-manager vacancies have

opened up; and three detailees are on staff now. There will be a rotation of the detailees, so anyone interested in such a position should contact the Office.

Heinz asked what high-energy-density science (HEDS) included and who was paying for it. There was a 2003 National Academy of Sciences (NAS) report on *Frontiers in High Energy Density Physics*, and HEDS was also mentioned in *Physics of the Universe*. HEDS is a regime that includes stellar explosions with applications to inertial fusion. Astrophysical phenomena, high-energy physics, and nuclear physics are related to it. So far, Fusion Energy Sciences (FES), High Energy Physics (HEP), and Nuclear Physics (NP) were all taxed plus the National Nuclear Security Administration (NNSA). The idea was to put all these together.

Dean asked who would oversee this HEDS effort. Kovar responded that the Energy Policy Act of 2005 created the Under Secretary for Science position to integrate science across the Department, so the Under Secretary has been asked to look at this and to optimize the opportunity. Ent asked how it would work, and Kovar said that it was hard for him to understand that.

Bond asked about the status of the NAS study on rare isotopes. Kovar replied that a report on that topic should be issued in October.

Tribble asked Kovar to address the topic of new charges. Kovar displayed the letters for the three new charges to the Committee. The first was the request for NSAC to set up a COV to look at NP's processes used to solicit, review, recommend, and document proposal actions. The COV has not yet been set up. A report is to be submitted by February 28, 2007. The previous COV (2003) was very favorable to the Office; it had a few suggestions. Those recommendations were responded to, and the responses to the recommendations have been tracked. The report and the documentation of the responses are available.

The second charge is to establish a task force to evaluate the scientific "reach" and technological options for developing a world-class facility in the United States for rare-isotope-beam studies within a given funding envelope. A report is to be submitted by March 2007. Alternatives may be proposed. The options should be looked at systematically. Aprahamian asked how this charge differs from the National Academies of Science's Rare Isotope Science Assessment Committee (RISAC) assessment. Freedman replied that BESAC is looking at the scientific agenda; it is not looking at the facilities. Matthews stated that NSAC should not duplicate RISAC's effort, and the international context should also be considered. The RISAC committee hopes to have a report by October. Glasmacher noted that a lot can change in 4 years and asked how general this assessment was to be. Kovar noted that information for a conceptual design was needed by FY09 or FY10. The concepts put forward for RIA were pretty general. There are resources, capabilities, and configurations that can be considered and evaluated for scientific potential to see if the United States can play a leadership role. The NAS study did not go into that. Glasmacher said that the international context could change by 2007. Kovar noted that this study had already been postponed for 4 years; it cannot be postponed indefinitely. Tribble stated that the Long-Range Plan Subcommittee should not have to evaluate proposals without an overview to guide it. Cardman pointed out that, previously, one committee would consider the scientific reach, and another would consider proposals for specific facilities. That dualism makes a lot of sense. Tribble hoped that they would focus on the important science.

The third charge is the call for a Long-Range Plan. Since the previous Long-Range Plan (2002), there has been more emphasis on international cooperation. Heinz asked if this charge could be modified if the FY07 budget does not go through. Tribble said that that eventuality would be dealt with if it came to pass. The charge calls for two reports, one a subset of the other. One is due October 2007, and the other by the end of 2007. He asked for questions and issues about these charges.

Matthews said that the first two charges are straightforward. The previous Long-Range Plan was undertaken by NSAC as a whole. She asked if that is what will be done for the third charge, or whether there would be a subcommittee.

Von Kolck said that March 2007 sounded like a very tight deadline for the second charge.

Zajc stated that it was unclear how the ongoing town meetings would fit in with the requirements of the charges. Tribble said that the town meetings should consider the potential science. If they make recommendations about facilities, that information could be used as input to the Long-Range Plan.

Heinz suggested that all the committees (Town Meetings and RIB Task Force) should share information efficiently. Input should be sought from the contributors to previous reports. The information is needed by the stated deadlines for budget planning.

Glasmacher said that he believed that it can all be done in time.

Seestrom noted that the town meetings are scheduled in January, which does not leave much time for the Task Force to act on the results. Tribble noted that there will also be a RISAC report in October. Lacey said that some convergence can be expected beforehand.

Tribble said that a smaller subgroup of the Long-Range Plan group will focus on the milestones.

Dean noted that there will be three reports. The science case for a reduced RIA needs to be focused on. That is what the town meetings and the second charge should do.

Bryman asked if the upgrade of CEBAF was a comment on the future of RHIC. Kovar replied, no; it will address the need pointed out by the previous planning reports. RHIC has a long-term plan that identifies a large number of activities and upgrades.

Heinz asked if the funding is compatible with the upgrade. Kovar responded that a funding envelope will be provided, and the question is whether a world-class facility can be built within that envelope. If the Long-Range Plan does not fit with the current plans, those plans will be revisited.

Aprahamian noted that the second and third charges are complementary and have short deadlines. This Committee is waiting for the NAS report on RIA, which should tell what is possible.

Matthews said that the town meetings need to be worked into the mix.

Seestrom said that, if the technical options are looked at by the Task Force and those options are fed into the town meetings, the town meetings could comment on the science that could be done.

Tribble said that there would be more discussion at the Nuclear Structure and Nuclear Astrophysics Physics Town Meeting.

Cardman noted that the Long-Range Plan's review of the milestones is a tedious process and suggested establishing a subcommittee to consider milestones and having that subcommittee report directly to NSAC, not the Long-Range Plan Subcommittee.

Tribble stated that the Committee should consider later if the program is as effective as it can be. He introduced **Susan Seestrom** to present the response of the American Physical Society's (APS's) Division of Nuclear Physics to the LRP charge.

Community input to the LRP was started with a town meeting at the Dallas 2006 APS meeting. A number of executive-committee conference calls have been devoted to planning. It was desirable to do what was important to the community. Theorist/experimentalist co-chairs were set up for each town meeting organizing committee, and executive committee members participate on each organizing committee. The chair ensures that the overall makeup of each organizing committee is broadly representative. There will be 3½ town meetings: one on nuclear structure and astrophysics; one on neutrinos, neutrons, and fundamental symmetries; and "one and a half" on quantum chromodynamics (QCD), with one part focusing on the QCD structure of hadrons and hadronic interactions and the other focusing on understanding the QCD phase diagram. The meeting(s) on QCD will be three days with parallel sessions.

Organizers have been established for the town meeting on nuclear structure and astrophysics. It will be run in parallel with the neutrino town meeting. Both will be held in Chicago, likely in January 2007. Organizers have also been named for the town meeting on neutrinos. The QCD town meetings will have both joint sessions and parallel sessions. The organizers have been invited, and some have accepted. The location will likely be in New Jersey. Education discussions will be held at a workshop. The results of the QCD town meeting will be the subject of a white paper. A competitiveness workshop will be held, but it is unclear how it will be done and how it will fit into the LRP. The white papers from the town meetings will be presented at the April APS meeting.

Matthews suggested that something be done at the APS meeting in Nashville this fall, perhaps holding one of the town meetings then. Seestrom agreed that that will be one opportunity. The workshop chairs can consider that. There are four areas being discussed at the Nashville meeting. Matthews added that a lot of interested people will already be at the Nashville meeting, and additional input could be solicited from those people. Seestrom agreed to look into that possibility.

Tribble noted that one has to put a lot of thought into how to do this. D. Robertson suggested that the Division of Nuclear Chemistry and Technology of the American Chemical Society (ACS) could help draft the information on education and competitiveness. Tribble hoped that other ACS expertise could also be tapped into.

Matthews asked if January would be an appropriate date for the Town meeting? Aprahamian said that it could not be done earlier. Dean pointed out that the NAS report will not be available before that.

Lesko noted that the white papers from the 2000 town meetings are available on the web.

H. Robertson said that it is hoped to have two town meetings on specific topics that will be partly overlapping and partly separate so people can go to parts of both. Schedules and venues have not yet been set. D. Robertson pointed out that the ACS business meeting in San Francisco will be an opportunity to get feedback on the charges from ACS members. Tribble agreed that nuclear chemists need to participate in the town meetings.

Tribble declared a break at 10:09 a.m.

He reconvened the meeting at 10:30 a.m. and called upon **Bruce Vogelaar** to initiate a series of science presentations on neutrino research. Vogelaar's talk on the Borexino experiment can be found at <http://www.sc.doe.gov/np/nsac/agenda072106.html>.

Tribble asked when the first information output would be. Vogelaar said that the first signal will depend on the impurities. If the level is 10^{-16} , the first data would be obtained about 2007. The energy threshold is 400 to 600 KeV.

William Louis was asked to present an update on MiniBooNE [Mini Booster Neutrino Experiment]. Louis's talk on MiniBooNE can be found at <http://www.sc.doe.gov/np/nsac/agenda072106.html>.

Dean asked if the \$12 million was for just the detector [for a proposed OscSNS experiment]. Louis replied that it was for the detector and contingency.

Dean asked, if MiniBooNE does not see anything, would the other two experiments be needed. Louis replied that OscSNS is a fantastic opportunity no matter what.

Heinz asked what was expected from the OscSNS experiment. Louis responded that systematic errors were currently being finalized and are hoped to be less than the statistical errors. In the OscSNS experiment for the 30-MeV neutrino, the systematic error is very, very small. It is a very clean experiment.

Matthews asked what the specificity of the data was. Louis said that he hoped that it will be a definitive result.

Zajc asked what goes into nuanced Monte Carlo. Louis replied that the nuanced Monte Carlo is a work in progress. It is a very good package, but it has some problems to be understood. Many events do not have any effect on the oscillation signal because of cancellation of errors.

Dehmer asked when they planned to open the box. Louis responded that a lot depends on the systematic-error analysis. It is hoped that the release date would be in a couple of months with an announcement of the results a month later.

Stuart Freedman was introduced to speak about the Kamioka Liquid-Scintillator Anti-Neutrino Detector (KamLAND). Freedman's talk on the KamLAND experiment can be found at <http://www.sc.doe.gov/np/nsac/agenda072106.html>.

Kevin Lesko was asked to give an update on the Sudbury Neutrino Observatory (SNO). SNO was developed to study solar neutrinos by comparing charge-current, elastic-scattering, and neutral-current events. Lesko's talk on the SNO experiment can be found at <http://www.sc.doe.gov/np/nsac/agenda072106.html>.

Ullrich asked about geoneutrinos. Lesko replied that one has to have a much lower energy threshold. A proposal is being prepared to do that.

A short break was declared at 12:37 p.m. to obtain food for the working lunch.

At 1:00 p.m., Tribble initiated a discussion of the APS Division of Nuclear Physics town meetings. A letter was drafted providing helpful questions for the town meetings to address. Seestrom was asked to add to, delete from, or change the draft during the following week. Guidance on length of white papers was suggested. The document(s) coming out of the town meetings should contain background information for the portions of the readership who work outside the specific field being described. The subgroups that consider specific areas should prepare *prioritized* lists that can then be integrated in discussions at higher levels. The white papers need summaries and priorities; otherwise someone else (the writing group) will do those tasks. The town meetings should be organized so that parts of the reports are produced before people go home.

The topic of international representation and representatives from nonnuclear-science disciplines in the town meetings was broached. U.S.-scientist participation in rare-isotope-beam experiments elsewhere needs to be looked at, and a survey of opportunities needs to be taken. But where and when? Everything is becoming much more international. This influence must be exerted in the town meetings; it is too late in the resolution phase. The instructions to the town meetings should cite the charge letter and highlight other topics that should also be addressed. All the important aspects of the charge should be included in the instructions.

A number of the topics identified for discussion at the town meetings would be of interest to the broader scientific community. How does one qualify for voting membership, funding from DOE or NSF? You want people with a bigger perspective to contribute from the very beginning of the process.

One does not want to have groups that are so large that they cannot hold discussions. Is there going to be a resolution meeting for the LRP? The implicit charge is the development of a plan that the community will stand behind. Resolution groups have been very effective in producing such plans. Large, detailed white papers will not be very helpful to the writing group. The past two plans had problems in getting the final drafts written. The most important part of the report is the recommendations. Do we want to convey the impression that the facilities should run forever? No, but targets should not be painted on them, either. Transitioning to upgrades is one answer to this problem. To the extent that RIA failed, it was because the recommendation was conditional to begin with and did not have broad buy-in. Never assume that a deal (like DUSEL) is a certainty; if something was a high priority before, the town-meeting organizers should make sure it is in the recommendations if it is still a high priority.

Brad Keister was asked to comment on the Long-Range Plan charge. There are two ways in which the LRP has an impact on NSF. The first is large facilities. For example, the 1996 recommendation to upgrade the NSCL, and the 2002 recommendation to operate the completed facility effectively, are taken seriously by the National Science Board, which must approve construction and operations actions of that scope. LRP recommendations for DUSEL will receive similar attention. The second impact concerns general background within the context of proposals for individuals and groups. The science case for various activities in the LRP serve as valuable input to reviewers and panels. Finally, for any large-scale facility recommendation that will likely take years to implement, the science case must be strong enough that individuals and groups submitting proposals 5-10 years from now to work at those facilities will be able to compete effectively within nuclear physics and within physics more generally at NSF.

Dennis Kovar was asked to review the Long-Range Plan charge. The EPP2010 report said that, in today's world, leadership does not mean singular dominance. Rather, leadership is characterized by taking initiatives on the scientific frontier, accepting risk, and catalyzing partnerships with colleagues both at home and abroad. A leadership position allows a country to exploit scientific and technological developments no matter where they emerge. The U.S. program should not only pursue the most compelling scientific opportunities but also establish a clear path for the United States to reach a leadership position in particle physics. A lot of these assertions reflect how the nuclear science community has been operating all along; it strongly reflects the 1993 COSEPUP report. There have been some successes. The program has been operating under

constrained funding that has resulted in reduction in the number of DOE national user facilities and has limited the ability to pursue identified scientific opportunities.

The recommendations of the 2002 LRP:

- The highest priority of the nuclear-science community is to exploit the extraordinary opportunities for scientific discoveries made possible by the previous investments.
- The Rare Isotope Accelerator (RIA) is the highest priority for major new construction.
- The world's deepest underground science laboratory should be constructed immediately.
- CEBAF should be upgraded to 12 GeV as soon as possible.

A lot of progress has been made since 2002. The highest priorities (RHIC and CEBAF) are now ongoing and successful. Investments have been made in universities and theory. Other investments have also been made in GRETINA [Gamma-Ray Energy Tracking In-Beam Nuclear Array] etc. The funding has made constant effort possible, with a possible 10% increase during the next 7 years. Operations have been made constant, but facilities have been shut down to allow RHIC and CEBAF to operate. Research funding has been essentially flat. Investments in R&D have decreased. In theory, there has been an increase.

Looking to the future, it is uncertain what the funding is going to be next year let alone 5 years from now. It is hoped for a 6.4% increase per year over the next 5 years. The charge to NSAC is to put together a plan for a world-leadership program that fits into this budget and that

- Operates and proceeds with upgrades of RHIC and CEBAF
 - Operating the facilities and supporting the research community
 - Proceeding with the CEBAF and RHIC upgrades
 - Participating in the heavy-ion program at the Large Hadron Collider (LHC)
- Keeps the United States among the leaders in nuclear structure and astrophysics capabilities and trains students to use the facilities provided
 - Operating the facilities and supporting the research community
 - Allowing U.S. researchers to do forefront science by performing the ATLAS and HRIBF accelerator and detector upgrades, completing the GRETINA detector, and providing experimental equipment at facilities with forefront exotic-beam capabilities
 - Starting construction of a U.S. exotic-beam facility at the end of this 5-year period
- Implements the capabilities to address high-priority scientific opportunities by pursuing
 - Fundamental neutron properties (tests of the Standard Model) at the Fundamental Neutron Physics Beamline at the SNS
 - Neutrinoless double-beta decay
 - QCD with lattice-gauge calculations
 - Next-generation nuclear-physics research capabilities with accelerator R&D
 - Nuclear-data measurements and code development for next-generation nuclear reactors

A constant-level budget will not allow one to do all this.

It is timely during this long-range-planning exercise to gauge the progress toward these goals and to recommend revised long-term goals and metrics for the DOE SC Nuclear Physics program (if appropriate). The findings and recommendations of this evaluation should be a separate report.

Dean noted that the charge letter says “constant effort” and “6.4% per year increase” and asked if these terms were in conflict. Kovar replied that the Panel is being asked what is needed to mount a world-class program if all the money in the world were available and, within that, what the priorities are.

Glasmacher asked if the facilities go beyond 5 years. Kovar replied, yes, they do; but Congress asks for 5-year plans.

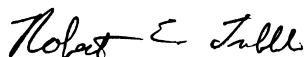
H. Robertson noted that the HEP and NS communities both need a high-intensity linac.

Matthews commented that there are two areas in which there is a large overlap between HEP and NS: general physics and heavy ions. The HEP community should reach out to its colleagues at the town meetings.

David Dean rose to review developments at JUSTIPEN (Japan-U.S. Theory Institute for Physics with Exotic Nuclei). This new center came to be through many discussions. It was opened the previous week in Japan at RIKEN (Rikagaku Kenkyusho), a huge facility. U.S. scientists are traveling there to share theory with the experimentalists. JUSTIPEN’s purpose is to provide an international venue for research on the physics of nuclei during an era of experimental investigations on rare isotopes. It is located at the new Radioactive Ion Beam Factory at RIKEN. Travel and local support is provided for U.S. visits to the Center by NP. The Japanese provide infrastructure and support (offices, computers, computer networking, housing, etc.). Eventually, reciprocal visits of Japan researchers will be made to U.S. sites. A steering committee has been established. It has a web page at www.phys.utk.edu/JUSTIPEN. Individuals can make visits with RIKEN as the base, but including other institutes, as well. Small Japan/U.S. study groups are working on specific topics. JUSTIPEN serves as a clearinghouse for postdoctoral candidates. There is the potential for summer schools or winter schools. It will serve as an interface between theory and experimental efforts on hot topics. A half-dozen U.S. scientists have signed up to visit RIKEN.

Tribble called for public comment. There being none, he went on to new business. It is not clear when the next meeting might be. There being no further new business, the meeting was adjourned at 2:47 p.m.

These minutes of the Nuclear Science Advisory Committee meeting held at the Marriott Bethesda North Hotel & Conference Center, Bethesda, Maryland, July 21, 2006, are certified to be an accurate representation of what occurred.



Robert Tribble
Chair, Nuclear Science Advisory Committee