Minutes for the
Nuclear Energy Research Advisory Committee Meeting
July 29-30, 1999, Embassy Suites Hotel, Arlington, Virginia

NERAC members present:

John Ahearne
Thomas Cochran (Friday only)
Joseph Comfort
Jose Luis Cortez
Maureen S. Crandall
Allen Croff
James Duderstadt (Chair)
Marvin Fertel
Dale Klein
Linda Knight
Robert Long
Warren Miller
Sekazi Mtingwa
Richard Reba
Joy Rempe
Miguel Rios (Friday only)
Allen Sessoms
Robert Socolow
Daniel C. Sullivan
Ashok Thadoni (Ad hoc)
Charles E. Till
Neil Todreas

NERAC members absent:

Thomas Boulette
Beverly Hartline
J. Bennett Johnston
William Kastenberg
C. Paul Robinson
John Taylor
Bruce Tarter

Also present:

Kiyoto Aizawa, Executive Director, Japan Nuclear Cycle Development Institute, Naka-Gun, Ibaraki, Japan
Nancy Carder, NERAC Staff
Tom Clements, The Nuclear Control Institute, Washington, D.C.
Stanley Goldsmith, Director, Division of Nuclear Medicine, Weill Medical College of Cornell University, New York
Norton Haberman, Senior Technical Advisor, Office of Nuclear Energy, Science, and Technology (NE), DOE
Larry Haler, Mayor of Richland, Wash.
John Herczeg, Lead Nuclear Engineer, Office of Technology, DOE
Harold Kaufold, Director, Executive MBA Program, The Wharton School, University of Pennsylvania, Philadelphia
Shinichi Kawarada, Director, Nuclear Research and Technology Division, Science and Technology Agency of Japan, Tokyo
William J. Kinsella, Lewis and Clark College, Portland, Ore.
Alain L'Homme, Deputy Director, Nuclear Reactor Directorate, Commissariat à l'Energie Atomique,

Paris
William Madia, Laboratory Director, Pacific Northwest National Laboratory, Richland, Wash.
William Magwood, Director, Office of Nuclear Energy, Science, and Technology (NE), DOE
Gordon Michaels, Director, Nuclear Technology Programs, Oak Ridge National Laboratory, Oak Ridge, Tenn.
You-Hyun Moon, Science Counsellor, Embassy of the Republic of Korea, Washington, D.C.
Brad Morse, Alliance for Nuclear Accountability, Washington, D.C.
F. M. O'Hara, Jr., NERAC Recording Secretary
Craig Williamson, NERAC Staff
Joan Woodard, Executive Vice President and Deputy Director, Sandia National Laboratories, Albuquerque, N.M.

About 40 others were in attendance during the two-day meeting.

March 30, 1999

Chairman **James Duderstadt** called the meeting to order at 10:40 a.m. and welcomed the members. He asked for changes to the minutes; there being none, he asked for a motion to accept them; they were accepted by consensus. He brought up the question of voting in absentia and adopted the policy to restrict voting to those who are present while encouraging those who are absent to submit comments in writing.

Norton Haberman entered into the record a series of letters and reviews.

William Magwood commented on the FY 2000 budget. The House passed the budget with some changes from the DOE request. Highlights of the budget as it stands pending action by a joint committee include: The NERI Program got small increases in both the House and Senate versions as compared to FY 1999. The NEPO Program was approved by both houses at a funding level of $5 million. A hidden success in the budget is the Isotope Program, which got increases beyond what was asked for in both houses. The Accelerator Transmutation of Waste (ATW) was given $15 million by the Senate but nothing by the House; $5 million was taken out of the Space Power Program by the House. Key developments in the future include four major components (shown here with their current funding status and ultimate target funding):

<	ATW	$15 million from the Senate	$55 million annually
<	Depleted UF_6 Conversion	$30 million (including USEC-transferred funding)	$400 million for plants; $2-3 billion for the total program
<	FFTF	$30-40 million	$200 million for shutdown; $230 million for restart
<	NERI	$20 million in the House; $25 million in the Senate	PCAST envisioned more than $100 million

As can be seen from these figures, a major component of future budgets will be the conversion of depleted UF_6 at plants constructed at Paducah and Portsmouth, spending $100 million per year until the plants are built. The material had been reserved for the use of the U.S. Enrichment Corporation (USEC) until recently, when USEC suspended AVLIS-technology-development activities.

He said that one NERI award was to a highly regarded principal investigator at the University of Illinois

for the study of a low-energy nuclear reaction. That award had been frozen pending review after public comment from the Nuclear Control Institute mistakenly identified the proposed work as "cold fusion." The subject matter of the proposal has elements of both nuclear research and basic science, leading to an ambiguity of how it should be reviewed and by whom. From this experience has come the impetus, in the future, for reviewers to check more closely proposals that cut across disciplinary boundaries.

John Herczeg then spoke about the Nuclear Energy Research Initiative (NERI) Program, the purpose of which is to underwrite long-term research, serve as a birthing place for future programs, and foster international collaboration. The areas of research being funded are proliferation-resistant reactors and fuel technologies, new reactor designs, low-output reactors, new technologies for onsite and surface storage of nuclear waste, advanced nuclear fuels, and fundamental nuclear science. Most projects that are funded run three years at about $350,000 per year.

The applications have been received, peer and relevance reviews have been completed, the award recommendations and award announcements have been made, and the grants and cooperative-agreement awards are currently being processed. The current phase is going very slowly because collaborative agreements mean that agreements have to be worked out with, say, six organizations per award. DOE expects to get all the monies out by Sept. 9, 1999.

A summary of the peer-review final rankings showed that the largest number of applications were received in the fundamental science category; next, with significantly fewer applications, came the advanced reactors and fuel cycles; and the other categories were clustered together with even fewer applicants. Some proposals were rejected because they went against Presidential Directive PDD-13 on plutonium proliferation or because they were in areas funded by other divisions of DOE. Comfort asked if the large number of applications deemed unsatisfactory in the fundamental-science category were largely university proposals. Herczeg said he did not know who the submitters were but knew that many of these applications would have been better funded by other offices of DOE. In the future, the areas that will not be funded will be better identified. This particular class of proposals was reviewed by DOE's Office of Science; in the future, NE will be more involved in the overall process.

Crandall asked how they decided how much to spend on each category, and Herczeg said that the number of proposals in each category was a major determinant. Mtingwa asked why unsuccessful proposers were not told they would not be funded at the preproposal level. Herczeg said there were 510 preproposals, and 200 of them were told they did not meet the criteria, but some of them entered proposals, anyway. Socolow asked why the awards were not made so that one-third of them were one-year grants, allowing the funding of new projects next year. Herczeg said that the objective was to get as many proposals funded as soon as possible with as many of those grants as possible going to universities. Additional funds are hoped for to fund new projects next year; also, it is possible that some projects will not get funded for their second and/or third years.

Till asked if mixed-oxide fuels (MOX) were included in the presidential directive and if there were any MOX proposals. Herczeg answered that there are no MOX proposals funded. Magwood noted that they judged that advanced reprocessing schemes would not be funded and did not want to duplicate work being funded elsewhere in DOE. Ahearne commented that PCAST, when it suggested such an initiative, was trying to rekindle interest in nuclear engineering, particularly at universities, which is consistent with 3-year grants; also, this program is trying to ensure that the work funded is of high quality.

A breakdown of the national laboratories' participation in the successful proposals showed that Argonne National Laboratory (ANL) was involved in 10 successful proposals, Oak Ridge National Laboratory (ORNL) in 5, Sandia National Laboratories (SNL) in 6, Pacific Northwest National Laboratory (PNNL) in 6, Idaho National Engineering and Environmental Laboratory (INEEL) in 5, Brookhaven National Laboratory (BNL) in 2, Los Alamos National Laboratory (LANL) in 2, and Lawrence Livermore National Laboratory (LLNL) in 1. The total funding going to the national laboratories totals $8.4 million (after overhead charges).

A profile of the funding of industries showed that Westinghouse was involved with five successful proposals, General Atomics three, ABB-Combustion Engineering two, and 12 other companies one apiece. Total first-year funding for industry was $4.14 million. Six foreign entities are also participating in the program.

A summary of university funding showed Massachusetts Institute of Technology involved in eight successful proposals; Purdue in four; University of California at Berkeley, Pennsylvania State University, Texas A&M University, University of Florida, and North Carolina State University in three; and 13 other universities participating in 16 other successful proposals. In addition, four foreign universities participated in successful applications. The total first-year funding for universities was $4.99 million.

The 45 awards involve the issuance of 50 grants and 39 interoffice work orders. Six awards have been completed to date. Additional awards are possible after budget reconciliations. One grant (the University of Illinois low-energy nuclear-reaction proposal) has been suspended pending a scientific peer review by the Office of Science (SC).

Duderstadt asked if any effort would be made to track unsuccessful proposals to see if they get funded elsewhere. Herczeg said no, but that NE would go back to the unsuccessful proposers that were identified as being potentially fundable and would encourage them to upgrade their proposals and to resubmit them next year. Klein asked if awards can be backdated to cover the portion of the academic year that precedes the federal fiscal year. Herczeg said that was not possible; they would have to work at risk. Fertel asked whether, given that SC was involved in reviewing some proposals, that would discourage them from funding some research themselves. Herczeg noted that just the reverse was true; SC is now asking what research they could fund. We have made great gains in cooperation with that office. Miller asked if plans had been drawn up for next year's award process, and Herczeg responded that NE has a rough outline for $23 to 25 millions in awards.

A break was declared at 12:07 p.m. At 12:28 p.m., Chairman Duderstadt introduced **Gordon Michaels** to speak about the nuclear R&D capabilities of ORNL. That institution has 1500 scientists and engineers among 5000 staff members. Of its $600 million annual budget, 80% is devoted to DOE work, and 20% is work for others. It sits on 58 mi^2 of land, and the buildings are worth $7 billion. Each year, it hosts 3000 guest researchers, one-quarter of whom come from industry. One-fifth of its funding ($120 million) is for nuclear research on isotope/actinide processing, research reactors, light-water reactors (LWR), advanced reactors, and radioisotope power.

ORNL is DOE's lead laboratory for plutonium-disposition reactor technology and MOX-option integration. Reactor-physics studies are characterizing the impact of weapons-grade plutonium as MOX by validating physics codes, benchmarking against U.S. fuel performance data, and sharing data with OECD countries to cut costs. For the irradiation tests of weapons-grade LWR MOX, ORNL is

responsible for test design and coordination and performing postirradiation examination. In its out-of-pile cladding-fuel compatibility tests, ORNL has found that the main issue is gallium, which attacks the cladding. As they were performing systems analyses, they noted the high costs involved in shipping the sample, so they designed a way to pack more fuel into a shipment. In addition, ORNL is the lead DOE laboratory for the U.S./Russian effort on reactor-based plutonium disposition; some accomplishments are: modifying the blanket of the Russian BN-600 reactor to burn rather than breed plutonium, developing MOX fuels for CANDU reactors to burn both Russian and U.S. weapons plutonium.

The High-Flux Isotope Reactor (HFIR) at ORNL supports both neutron-scattering research and isotope production. It has solid support from SC and more neutron-scattering users than they can satisfy. Socolow asked for a comparison between the HFIR and the FFTF, and Michaels said high flux vs. high fluence. Todreas asked what its lifetime was, and Michaels said 2035. Although ORNL has a decades-long history of developing low-power reactors for the Army, they did not bid on low-power reactors in the NERI competition and are now chagrined that they did not. ORNL is a leader in the design, construction, and operation of research reactors and is now on two industry-led teams bidding to design and build a new Australian research reactor. ORNL has developed and patented a graphite foam manufacturing process that produces a microcellular porous foam that can be impregnated with nuclear fuel or other materials and that has a thermal conductivity that is four times higher than that of copper. The laboratory is developing the materials technology for a high-efficiency radioisotope power system for the conversion of thermal energy to electricity; this effort follows on more than two decades of development and production of radioisotope power systems. It is conducting elevated-temperature and long-term mechanical-properties testing in support of the Japan Atomic Power Company; with 44 creep machines, the laboratory has the most comprehensive creep and fatigue testing facilities in the world. ORNL is the Nuclear Regulatory Commission's (NRC's) lead laboratory for reactor pressure vessel technology; 95% of the nuclear piping and pressure vessel codes and standards come from ORNL. It conducts research to understand how radiation alters the structure and properties of materials; for this, it uses three accelerators (the Triple Ion Facility) that are funded by SC. It also has the Hollifield Radioactive Ion Beam Facility, the Oak Ridge Isochronous Cyclotron, and (under construction) the Spallation Neutron Source (SNS). Two new materials R&D activities are to be funded by the NERI Program: the development of advanced burnable poisons for LWR systems and flow localization in strained irradiated materials.

Under EPRI and Westinghouse sponsorship, ORNL developed an application-specific integrated circuit for reactor protection and control. With it, as the reactor system is upgraded, parallel changes are made in the design of the integrated circuit, and the whole circuit board is swapped out, reducing the testing needed to validate the upgraded control system. ORNL is pioneering equipment-diagnostics technologies; for example, analyses of the current time waveform and the current frequency spectrum of a motor operating a valve allow one to tell where there is wear, if the motor is overheating, or whether the valve packing is too tight. In September, they will deliver to Japan a robotic device for the automatic collection and analysis of radiologic survey data for floors.

In FY-99, the ORNL isotope program received $11.2 million in funding from NE's Isotope Program for radioisotope production in the HFIR; radioisotope processing in the Radioisotope Development Laboratory (RDL); and Cf-252 production in the Radiochemical Engineering Development Center (REDC), the most important of the seven hot-cell facilities at ORNL because of its ability to perform

aqueous processing of irradiated targets. The REDC also produces transuranium elements for SC and DP. The possibility of producing up to 5 kg per year of Pu-238 at the ATR, HFIR, and REDC is attractive because the REDC has clean, empty cells in a modern, operating building. DOE has developed a safe-storage program for DOE's U-233 in response to the Defense Nuclear Facilities Safety Board's recommendation 97-1. In a new activity that is modestly funded, ORNL is the lead laboratory to provide technical support on DUF_6 disposition. The laboratory is in the midst of the Molten-Salt Reactor Remediation Project. This involves an NE thermal breeder reactor that the laboratory was told to shut down within 8 hr; 25 years later, it developed a problem with the fuel. To deal with this problem, the laboratory is setting up a UF_6-processing facility, which is funded by EM. It also has the Health Physics Research Reactor, a pulsed reactor that is capable of restart.

ORNL operates two nuclear centers:

- The Nuclear Operations Analysis Center is supported by the NRC to perform and maintain event analysis, simulation modeling, engineering databases, technical standards, etc.
- The Radiation Safety Information Computational Center has been supported by NE, Naval Reactors, DP, EM, and NRC for more than 20 years to distribute radiation-transport computer codes and radiation-shielding data.

Such infrastructure needs more attention from DOE.

In response to the termination of U.S. nuclear-energy R&D programs between 1990 and 1996, ORNL has diversified its sponsor base, grown new missions while retaining basic capabilities for energy R&D, obtained new leadership roles, and achieved modestly growing funding.

Duderstadt introduced **Dale Klein** to address infrastructure roadmapping. At the previous NERAC meeting, the Infrastructure Roadmapping Subcommittee had discussed whether the FFTF should start an EIS process. The Subcommittee pulled together a number of issues (e.g., the missions of, cost-effectiveness of, and alternatives to the FFTF), and PNNL was given 90 days to come up with a program plan. The document has been produced (and is now available on the World Wide Web at www.fftf.org), and Klein introduced **William Madia** to review its contents. Madia said that PNNL had involved major organizations from around the world and about 500 people to address the questions posed.

Madia noted that, at this juncture, a decision could be made to deactivate (put into safe storage, not decontamination and decommissioning) the facility or undertake a 15-month (minimum) environmental-impact-statement (EIS) process that would result in a record of decision (ROD) to deactivate the facility or to operate it as an international nuclear-science and irradiation-services user facility until the end of its useful lifetime. In the plan, these options were looked at from technical, financial, and management perspectives. Expressions of interest in participating as users were received from Japan, Syncor, Siemens, Iso-Tex, ANMS, Washington State University, and a large number of other institutions. The plan concludes that there is a compelling need and support for the restart of the FFTF and that DOE has the basis to move forward with the EIS process.

This reactor would not be restarted only for industrial interests; rather, it must fulfill core federal purposes or missions, which may be *supplemented* with private-sector interests and involvement. To that end, DOE expects potential private and public sponsors to express serious intentions to financially support the FFTF. He turned the floor over to **William Magwood** to identify the core federal purpose(s), which, he thinks, make the restart of the FFTF a worthwhile endeavor.

Magwood reviewed the status of existing DOE reactors:

- The FFTF has operated for 10 years and has a rated power of 400 MW. Its large core volume (1034 liters) provides unique advantages. It is currently being held on standby at a cost of $40 million per year.
- The ATR (Advanced Test Reactor) has operated for 31 years; it has a rated power of 250 MW and a core volume of 275 liters. It is currently being operated at a cost of $45 million per year. It is a premier test facility for fuels and it makes isotopes. Its high-flux capacity needs to be maintained for naval-reactor testing. It is "okay" for Pu-238 production (for space missions) but does not have much capacity for additional missions.
- The HFIR (High-Flux Isotope Reactor) has operated for 33 years; it has a rated power of 85 MW and a core volume of 51 liters. It is currently being operated at a cost of $28 million per year. It is being used for material-irradiation studies, neutron science, and the production of isotopes. Its high-flux capacity needs to be maintained for conducting neutron science, and it has very limited space for Pu-238 production and offers limited growth possibilities for isotope production.
- The HFBR (High-Flux Beam Reactor) has operated for 33 years; it has a rated power of 60 MW and a core volume of 100 liters. It is currently being held on standby at a cost of $24 million per year. It is designed to be used for neutron science.

He summarized the overall situation with the operating reactors as offering very little high-flux capacity and very little capability for producing Pu-238. The reactivation of the FFTF would offer massively more capability for growth in space-systems testing, ATW experiments, and fusion irradiations. It would also provide unique opportunities to establish an international center for nuclear-technology cooperation and to support long-term growth in the production of medical isotopes under funding provided by the private sector.

The effects of the decision on the NE budget were assessed: If the ROD called for restart, the FY 2000 costs would be $40 million, the transitional costs would be $229 million, and the subsequent annual operating costs would be $55 million (partially offset by user fees). If the record of decision called for shutdown, the FY 2000 costs would be $40 million, the transitional costs would be $199 million, and the subsequent annual operating costs would be $2 million (which would be transferred to the EM budget). If the facility were restarted, a revolving fund modeled after the Isotope Revolving Fund would likely be set up to take in annual appropriations and user fees and to make disbursements for operations and investments in new research. If the reactor were shut down, the nation would be unable to perform several tasks because the United States will never build another reactor with the capabilities of the FFTF.

John Ahearne asked the role of this Committee was given that Magwood has already made up his mind on the restart of the FFTF. Duderstadt said that the Advisory Committee is very independent. The Secretary will have to fight a lot of political battles to get this facility reopened. If his primary advisory group said that it should be shut down, that might well settle the issue.

Socolow asked, if $50 million were put into the FFTF, whether that money would be taken from some other NE or DOE program. Magwood said that the money would not necessarily be taken away from any other DOE office or other federal agency. DOE will have to prioritize its desired funding, but it will not know how the money will be allocated or where it will come from. To do science and technology, you need people and facilities. In the case of reactors, we are reaching the end of the line and will not have the

capability to do a lot of the things that are considered necessary.

Klein commented that NERAC has to decide whether there is enough information in the PNNL plan for the Secretary to make a decision. Madia noted that an agency can "grow" its budget and that this is done all the time.

Madia then returned to his summary of the PNNL plan, calling attention to the fact that the FFTF offers a high power level (100 to 400 MW); a flat flux profile; a large irradiation volume; and a lot of available space, instrumentation, and configurations. It can produce a high flux with the ability to vary widely the energy spectrum from fast through thermal. The needs that the FFTF could fulfill include many with substantial federal purposes:

< basic science research,
< fusion-energy research,
< medical and industrial isotope production,
< transmutation of waste R&D,
< R&D on the life extension and proliferation resistance of nuclear fuels, and
< Pu-238 production for space energy sources.

Other needs to which it could respond include:

< materials research,
< computer-chip hardening,
< space reactor technology development, and
< safety-system testing.

These needs are for existing programs; NASA is talking about going to Mars in the next 20 years, and the fuel could be Pu-238. The question is not *if* the market for isotopes will grow but *how fast* is it going to grow? He showed a table that listed some advantages and disadvantages of the FFTF in meeting each of these needs.

Miller asked if it was fair to say that FFTF would become half production and half user facility. Madia responded that its roles would entail a mix and that it would largely be a user facility to begin with. He then introduced a series of visitors to comment on the international community's interest in and commitment to the FFTF.

Shinichi Kawarada, Director of the Nuclear Research and Technology Division of the Science and Technology Agency of Japan, said that Japan's policy and expectations regarding the FFTF are to continue to pursue an R&D program there. It would be an effective use of human resources. Japan is strongly hopeful that the FFTF will be restarted if it is to be used for peaceful, not military, purposes. It would further advance relations between the United States and Japan. Japanese researchers would use it for testing materials for fusion engineering and many other uses. Japan would provide technical and financial support.

Kiyoto Aizawa, Executive Director of the Japan Nuclear Cycle (JNC) Development Institute, noted that they jointly operate a fast reactor, but the FFTF has several advantages in its higher availability, its ability to irradiate larger targets, and its capability to perform nondestructive testing in short periods. JNC has made a proposal to DOE to perform cooperative research with the FFTF. Two topics have already been identified. If the FFTF cannot be used, the research would be shifted to the Phoenix reactor, but that facility is going to be closed in 2004. The Monju fast breeder reactor has been closed since 1995 when

it experienced a sodium leak from a secondary loop. The DFBR (Demonstration Fast Breeder Reactor), the full scale successor to Monju, currently being designed by the Japan Atomic Power Company (JAPC) will not be available until 2010, so other Japanese organizations will likely consider the FFTF for cooperative ventures.

Alain L'Homme, Deputy Director of the Nuclear Reactor Directorate of the Commissariat à l'Energie Atomique (CEA), said that his organization strongly supports the restart of the FFTF. Fast neutrons are very important for research because of their unique characteristics. One area of research interest is in the transmutation of nuclear waste. His agency is making a strong effort to restart the Phoenix reactor by 2000 and operate it until 2004, when it will reach the end of its design lifetime. They are working on building a new facility in France to produce fast neutrons, but it will not be ready by 2004. The FFTF offers very interesting possibilities for research, and the French government would participate in its operation if it were restarted.

You-Hyun Moon, Science Counsellor for the Embassy of the Republic of Korea, presented his government's position on the FFTF, expressing the opinion that the FFTF is important to all nations with nuclear programs. President Park has written a strong letter of support, proposing Korea's leveraging corporate support by participating in and funding long-term research at the FFTF. It is their view that, in the next decades, many countries, including the United States, will have to increase their production of nuclear energy and that the United States should play a leading role in the support of R&D in that area. Moreover, the United States is not the only country concerned about proliferation. Korea, Japan, and a large number of other countries share those concerns and would like to see the FFTF restarted with safeguards against proliferation in place.

Madia presented information with which to compare the FFTF with alternatives. The facility was designed and operated for 10 years as a materials test and irradiation services facility, its core and conditions are well characterized, and it has been maintained well since shutdown. Restart would require about $84 million in upgrades plus staff and maintenance costs over about 4 years. Deactivation now would take 6 years and cost $199 million. Restart would entail:

Standby/EIS (15 months)	$55 million
Recovery (42 months)	$229 million
Operation (first 20 years)	$55 million per year
Operation (subsequent years)	$61 million per year
Deactivation (7 years)	$295 million

Ahearne asked about the effects of litigation on the EIS. Madia said litigation would likely extend the duration of the EIS period beyond the minimum 12 months. Socolow asked why the operating level was specified as 100 to 400 MW. Madia said the power output would vary with the anticipated needs traded off against waste costs and fuel longevity; if you do not *need* to run it at full power, you do *not* run it at full power.

The key financial assumptions used in the economic assessment were:

- proprietary use of the facility would be on a full-cost-recovery basis plus a 4% assessment to offset recovery costs;
- the facility would operate 34 years at 100 MW with a 75% availability;
- years 1 through 6, an existing, onsite, mixed-oxide fuel would be used;

- years 7 through 20, SNR-300 mixed-oxide fuel would be used;
- years 21 and beyond, a purchased, highly enriched uranium fuel would be used;
- facility use by the private sector would ramp up during the first decade; and
- the missions would stabilize at about 50/50, public and private.

These assumptions allowed the comparison of total annual costs for shutdown vs. restart for the next 6 years, during which the deactivation cost would exceed the standby/EIS cost the first year and then would be significantly less than the restart costs in subsequent years.

Comfort noted that this analysis did not look at how each mission could be accomplished by other means than the FFTF, and Madia replied that the task was overwhelming and acknowledged that this portion of the plan is not developed fully. Ahearne asked Madia to point out the significance of 14-MeV neutrons, and Madia said that fusion reactions produce 14-MeV neutrons, so they are necessary for doing materials investigations for fusion reactors. Furthermore, a reactor with a fast spectrum (which has a higher fluence than a thermal reactor of comparable power density) is much more useful and powerful than an accelerator. Not even the SNS can produce the fluence (the flux over a specific period of time) that is produced in a fast reactor.

Madia went on to point out that a business model had been developed on the basis of the 10 years of previous operations, had been benchmarked against existing user facilities, and had been validated by independent reviews. **Harold Kaufold** of the Wharton School of the University of Pennsylvania was called upon to relate his review of the methods of the business plan and the costs estimated for restart. The basic question addressed by the business plan is: What is the cost to the taxpayers of restarting this facility vs. shutting it down? Those calculations are very sensitive to demand. Under some situations, the restart would produce revenues for the taxpayers, and in other situations it may produce a revenue loss. The finance/science question is whether the outlays are worthwhile for the capabilities that may result. A secondary question is: If we do feel that Congress may take this money from another program, would we want to change our recommendation? He showed a graph of annual estimated revenues based on user forecasts and expert-panel projections with confirmation from agencies and companies. The mix of revenue streams varied greatly between the 2005 to 2010 period and the 2010 to 2020 period, but both periods indicated annual revenues of about $55 million a year. He also showed a restart life-cycle cost profile that indicated the timing and amounts of base-level funding, incremental funding, private-sector user fees, public-sector mission funding, and deactivation costs. It also indicated that the available fuel supply would support operation of the facility for the first 20 years but that an additional fuel supply would have to be tapped for the remainder of the facility's lifetime.

Crandall questioned a large number of the assumptions made in the financial analysis, especially the choice of discount rate. Kaufold responded that the growth rate of the market is based on the estimates of experts in this market and that the 7% growth rate was the conservative value. This is not a mature market, so there is no way of telling what the market may do. Comfort asked if the incremental funding was not already included in the base-level funding, and Kaufold said that it was not. He said that the total cost is $2.5 billion and about half of that is nonproductive costs. Comfort and Socolow contended that in holding the analysis of accrued costs at 2004, the calculated restart costs would be far less than the real costs that could be accrued (extending beyond 2004). Fertel, who had been adding up the numbers presented graphically in the life-cycle cost profile, said that the illustration was correct and that it correctly represented

the numbers that had been cited but that it was visually confusing.

Madia summed up his presentation by saying that NERAC should support going forward with an EIS because

< the FFTF can fulfill a need for nuclear science and irradiation service because of its special attributes,
< sufficient programmatic and financial support had been expressed, and
< plans to manage the reactor are technically and fiscally sound.

Moreover, there is clear international support for a restarted FFTF, the pharmaceutical industry says that demand for radioisotopes will grow significantly, and the five-lab report on climate change relies heavily on nuclear power to control global warming.

A break was declared at 3:58 p.m., and the Committee was called back to order at 4: 14 p.m. The chairman opened the floor to public comment. **Larry Haler**, Mayor of Richland, Wash., said that the city and those around Richland and the county in which it is located strongly support the restart of the FFTF. He had resolutions of support from the state senate and house of representatives. He also had a letter signed by two U.S. senators and five members of Congress to the Sec. of Energy urging the reopening of the facility. The governor supports the EIS process as a first step in restart. The Mayor cited the curtailing of research and clinical treatments because of the unavailability of isotopes. He also noted that the FFTF is the youngest and most sophisticated reactor in the United States. He urged the Committee to vote to proceed with the EIS process for restarting the reactor.

Tom Clements of the Nuclear Control Institute in Washington, D.C., presented a letter to Sec. Richardson, stating that it is a tragedy to have spent so much money on the FFTF program and to have it come to this, that no practical missions had been identified for the FFTF, and that the time to shut it down was now. He asked that the FFTF be made an NRC-regulated facility and that the fuel and targets be licensed. He stated that the German fuel would not be available for export and that it would be a change of U.S. policy to import fuel from Germany's abandoned Kalkar breeder reactor into the United States. Using highly enriched uranium in the reactor would also go against U.S. nonproliferation policy.

Brad Morse of the Alliance for Nuclear Accountability said that the organization opposes the restart of the FFTF and recognizes that the plan put forward is a point of advocacy. He pointed out that the cost for decommissioning and demolition (D&D) was not included in the deactivation costs and that the timeline of the EIS was highly optimistic. He noted that waste generation is a grave situation in Hanford and that one report had the FFTF wastes going to the tank farm.

Charlotte Smith was scheduled to speak but was not present.

Duderstadt called upon Dale Klein to pull together the day's discussions, noting that Moniz has asked for a motion from NERAC. He suggested that a yes vote be for an EIS to be started and a no vote be for the FFTF to be dismantled and decommissioned. Klein made such a motion and Sessoms seconded it.

Ahearne said that isotope production would cover 26 to 57% of the costs of operation after restart. He noted that nuclear-reactor life-extension research drops out as a mission. He wondered if the shutdown of the HFBR might be looked upon as a politically expedient action and the restart of the FFTF as a *quid pro quo*. He offered a series of observations:

< At a meeting of the major nuclear-weapon designers, he had asked if the FFTF was necessary to them, and they said no.
< The directors of the national laboratories have made no mention of breeder reactors in their planned

missions nor has the administration indicated that it wishes to pursue that path of research.

- The plan included no letter from NASA supporting the need for the FFTF.
- The restart of the FFTF would almost certainly compete with other reactors, such as the HFBR, for funding and tasks.
- The federal government's role is not to put competition in place to drive down the cost for nuclear services.
- The commitments to startup include nothing from Materials Disposition; the CEA and Korea frame their responses in terms of their own programs; others come from respondents speaking as *individuals*; fusion experiments might contribute $1 to 3 million per year (not a strong expression of support); one pharmaceutical company expressed disbelief that the government could or would expend the large amount of funds needed to set up a medical-isotope facility; and Duke Power's response (and others' responses) were expressions of interest in *operating* a restarted FFTF.

Fertel said that cost recovery is not required of a government research program. If they are gearing this to *breeder-reactor* requirements, then it is clearly outside PDD-13. Cortez said that he did not see breeder-reactor restart as an issue; the FFTF is a tool that happens to have a liquid fuel, and the restart would be worth the investment if it would significantly contribute to the rejuvenation of nuclear research.

Socolow said that he was troubled by many things going on at this meeting. This meeting is about optimizing the use of resources with an educational component. He was uncomfortable recommending something uncompetitively. Other alternatives should be looked at, such as opportunity costs. To take a recommendation to Sec. Richardson without saying that this is the best choice out of, say, five possibilities, is to shoot the credibility of this committee in the foot. He did not want to create an attractive nuisance; if a new administration wishes to push breeder technology and further discredit nuclear energy, he did not want them to reverse PDD-13 and convert the FFTF to a breeder. In his opinion, that would be a wrong turn.

Duderstadt said a variety of options had not been presented to this committee. The difficult job before this committee is to make a decision about something with few or no alternatives. He took a pragmatic view: You advise on the matters brought to you.

Todreas said that Socolow's issues are interesting but that he was looking at nuclear-energy development on the long term. The timing this committee is put in is difficult, but the key thing is that the technology will never be able to grow into anything practical unless processes and materials can be tested. FFTF offers the opportunity to research fast reactors. Discounting the absolute need for fuel and material testing rules out many advances in nuclear technology.

Klein asked if there was enough information to go forward with the EIS to help obtain enough information to make that final decision. Sessoms said that he had been a skeptic when he went out to visit the reactor. He congratulated the panel for constructing an argument that is helpful. The probability of constructing a new facility for testing fusion-energy materials is zero. The FFTF offers a facility that may be suboptimal for many tasks but is useful for all.

Duderstadt asked Reba about the use of the FFTF for the production of radioisotopes. Reba said that his subcommittee had gone out there six days ago and found that the FFTF would have a limited capability to produce research isotopes but a potentially greater role in producing large quantities of commercial isotopes. he said that, considering the costs involved in upgrading the facility, it might produce an economic

loss. Fertel asked if there were an alternative source to meet the demand. Reba replied that the estimates are all based on simple, linear extrapolations, but markets are chaotic. The need for therapeutic isotopes is real and will grow. Miller put forward the opinion that the NERAC should write a letter to the Secretary saying here are the (e.g.) seven things that still need to be investigated and suggesting how the process should proceed. Klein agreed but noted that that is not what the Committee has been asked to do by Undersecretary Moniz. Miller observed that Moniz does not pay us. Duderstadt suggested that the Committee could rephrase the proposal if it thought that it was inappropriate in its original form. Klein said that he thought Moniz had framed it this way because he thought the EIS is one way to bring out a lot of these concerns.

Till said that if we are serious about developing another generation of reactors, we have to have facilities to build on. Comfort said that this action should not be looked upon as long-range DOE planning, which this Committee was not set up to do. The EIS process, on the other hand, may be an appropriate way to do such planning. University nuclear-engineering departments would like to see a research reactor focused on educational needs. There are costs that could go into the FFTF or could go into a new reactor. One question is whether there is enough research to justify a new reactor. Todreas continued that, to attract new people, you must have hands-on facilities, not just paper studies; you need more of a demonstration than a test reactor. Another reactor may be more accessible and useful to academic researchers than a fast-flux reactor. Comfort asked if the FFTF would fulfill part of that goal, and Todreas said it certainly would.

Duderstadt said that the ultimate role of the FFTF is unknown. A lot of issues have been put before this Committee; it should take some time to consider these issues and commence acting on them early the next day.

Magwood said that he did not think the government would go into the isotope business but would provide facilities for the private sector to use and pay for. Madia said that role was just like the government's role in selling satellite-launch facilities and services. One proposal that has been put forward is from a company that would like to finance and operate such services for the radiopharmaceutical industry.

Magwood pointed out that wastes had not been discussed. If an EIS was pursued, DOE would work out an arrangement with the states on waste disposition as part of the EIS process. He asked Madia to supply more information on the German fuel that Clements had said would not be available for export. Madia said that PNNL had gotten a commitment from the German government in the past few months saying that they would make the fuel available and put up the funds to package it.

Duderstadt adjourned the meeting at 5:37 p.m.

Friday, July 30, 1999

Chairman Duderstadt called the meeting to order at 8:14 a.m. Richard Reba introduced **Stanley Goldsmith** to speak on the therapeutic effects of radionuclides in the treatment of prostate cancer. He reviewed the use of ^{131}I to treat thyroid cancer from which we have learned a lot about organ exposure to radioactivity, allowing the determination of an effective and tolerable dose for the treatment of thyroid cancer with radioiodine.

The diagnosis of prostate cancer has increased because of better detection. One-third of cancer deaths,

40,000 men a year, die of the disease; and one in six develop invasive prostate cancer. The treatment is complex, depending on how the diseased tissue metastasizes. No universal treatment exists. The removal of androgens is effective for a short time, but only for a few years. Other therapeutic strategies are also effective for the short term. This disease often metastasizes to the bones, causing pain and disability. A number of therapies have been used to treat the pain and disability, including bone-seeking radionuclides (^{32}P, ^{89}SR, ^{186}Re, ^{153}Sm, and ^{117m}Sn). But all of these affect the bone marrow, resulting in anemia. Targeted radiotherapy is made possible by the rapid turnover of bone mass in the location of the lesions. Double-blind trials of ^{89}Sr showed a 1 out of 2 improvement in pain. In another study, three-fourths of the patients responded to ^{89}Sr with significant decrease in pain. This treatment is used as a last resort; it may be more effective against micrometastases. Early treatment should be investigated.

How does it work? There appears to be an antitumor effect produced by placement of the radioisotope on the surface of the bone at the point of attachment of the tumor. As a result, high dosages do not lead to larger effects, but they do lead to increased toxicity. This therapy does not produce an extension of life, just an increase in the quality of life.

We have 50 years of experience with radioiodine that could be a model for the treatment of prostate cancer [e.g., using other agents to drag the therapeutic radioisotope to the desired treatment site (e.g., by using ligands, monoclonal antibodies, or peptide ligands)]. So the medical research community needs to have dependable access to the therapeutic radioisotopes at a reasonable cost.

He reviewed current research that indicates therapy strategies that might be effective in treating prostate cancer. It is too soon to have results to report, but the hope is that radiotherapy can be used to treat the disease, not just relieve the pain. Nine radionuclides are now being investigated as potential therapeutic agents. At this point, the research community needs to have a choice of potentially therapeutic nuclides, to determine the optimal energy emitted and half-life, to find out what impurities contribute radiation to the organ without beneficial effect, and to obtain a reliable supply of these agents at a reasonable cost.

Richard Reba, chairman of the Subcommittee on Isotope Research and Production Planning, said this research is an example of what his subcommittee has been examining. The purpose of that subcommittee is to develop a 10-year plan to guide DOE on isotope research and production. DOE has five sites involved in isotope production. The subcommittee addresses such questions as what isotopes are needed, what quantities are needed, and whether privatization should be pursued. A standardized questionnaire was sent to the directors of all the radioisotope-source sites. On the basis of the responses, the subcommittee tried to assess the condition of each site, its relationship to DOE, the priority of radioisotope production, current production, capital investments, etc. Site visits to the five DOE sites and two non-DOE sites are in progress. The preliminary conclusions are that

- isotope programs should focus only on production and purification of research radioisotopes and stable isotopes;
- DOE's budget cannot support five sites;
- the facilities need to be consolidated;
- DOE should support only those that would complement the available supply;
- Isotope Programs, the Office of Science, and the NIH should encourage the medical applications of isotopes;
- phase-1 trials of research radioisotopes should be sponsored at universities; and

< commercial users should pay full production costs.

The subcommittee was assured by DOE that the stable isotope supply was of no concern for the next 5 years, but it should be monitored and the knowledge base preserved. Isotope Programs should privatize as much of the production as possible but not to the degree of placing the supply at risk. Privatization should be proactive, but well-defined, focused, and realistic proposals should be demanded.

An Advanced Nuclear Medicine Initiative should be instituted to foster the exploration of new techniques for the manufacturing of isotopes, the optimization of production and processing techniques, the support of academic institutions, and the production of research radioisotopes. This initiative would be guided by an Isotope Production Panel that would select the isotopes, guide the production and purification, support application development, and perform evaluations of the production process.

The subcommittee made the following specific short-term recommendations:

< Isotope Programs should focus on the production and purification of radioisotopes and stable/enriched isotopes;
< DOE should begin consolidating its existing isotope-production facilities;
< irradiation services should be contracted from the private sector;
< radioisotope production should be put out for competitive bids;
< academic training should be increased before the existing knowledge base is lost;
< the Advanced Nuclear Medicine Initiative should be implemented; and
< a dedicated 70-MeV cyclotron should be planned for radioisotope production.

The subcommittee made the following specific long-term recommendations:

< isotope production and purification should be consolidated in a single facility,
< a 70-MeV cyclotron should be constructed and operated solely for radioisotope production,
< an off-the-shelf-design reactor optimized for isotope production should be built and dedicated to that task,
< stable/enriched isotope production should be limited,
< contingency planning should be carried out to guarantee an uninterrupted radioisotope supply, and
< long-term support should be provided for academic training.

Duderstadt reintroduced **Dale Klein**, summarizing the previous day's discussions of the FFTF restart. Klein circulated a newly crafted Proposed NERAC Resolution Regarding the Fast Flux Test Facility. Todreas asked if the proposal could tie back into the PNNL (90-day) plan. Klein and Duderstadt said that the plan was good, given the constraints under which it was developed, but further points needed to be addressed and clarifications made. Additional wording was introduced for the resolution to indicate that further assessments need to supplement the PNNL plan. Also, a statement on DOE's sustaining of nuclear R&D was inserted. The need to couch this argument in terms of the total DOE budget rather than in just the NE budget was noted. Long pointed out that a number of the community objections (e.g., waste disposition) were not reflected in the proposal or were not stated strongly enough and should be stated explicitly even though they may be treated in the environmental impact statement (EIS). Reba called for an acknowledgment of the unique capabilities of the FFTF to allow comparison to other alternatives in pursuing the mission(s). Also, the Secretary should be alerted to how restart would affect the rest of the Department's budget.

Cochran said that he viewed this document as a compromise, and he complimented the Subcommittee

for producing such a fine document. However, he took a slightly different position; he was disappointed that the Department is considering restarting a reactor with plutonium fuel, which would do considerable damage to efforts to get the Russians out of the reprocessing business and plutonium production.

The amended resolution read as follows:

NERAC Resolution Regarding the Fast Flux Test Facility

Based upon the information provided by the Pacific Northwest National Laboratory (PNNL) on the Fast Flux Test Facility (FFTF) to the Nuclear Energy Research Advisory Committee (NERAC) at its July 29-30 1999 meeting, NERAC recommends that the Secretary proceed toward a record of decision (ROD) concerning the FFTF and that the ROD specifically include the following considerations:

1. Long-term strategy in Nuclear Energy (NE). The restart of FFTF should be considered within the context of a long-term research, development, and education strategy for NE. We are hopeful that over the next few months, NE can take significant first steps toward the development of a long-term strategy. NERAC looks forward to assisting NE in this effort. NERAC believes that the broad objective of NE should be to provide a solid base for implementing the necessary research and development to sustain the important uses of nuclear energy in the United States and worldwide. NERAC believes that if a clear case for FFTF restart emerges from such a long-term strategic planning exercise, it will be more likely to prevail in the Administration, Congress, and the public. A decision to restart FFTF must be made in the larger context of constrained choices.

2. Overall DOE budget: NERAC recognizes that increased Nuclear Research, Development, and Educational programs are essential to support the national nuclear energy programs. Further, NERAC believes that the availability of research reactor facilities is essential to a successful nuclear energy program. However, absent an integrated plan to establish priorities for nuclear energy research, development and education within the nation's overall energy programs, and in light of the currently constrained NE budget, NERAC cannot recommend increased expenditures on FFTF until the plan is available and further clarification of questions identified below is provided as part of an ROD.

FFTF fuel: NERAC understands that there is fuel on hand for six years of operation, at the intended, reduced power level of 100 MW. NERAC further understands that for the follow-on years 7-20 after FFTF restart, MOX fuel from Germany is expected to be made available and that subsequently, enriched uranium fuel would be used. The validity of these assumptions and their consistency with U.S. non-proliferation policy needs to be addressed.

The competitive market for medical isotopes: NERAC is persuaded that the demand for medical isotopes for diagnostic and therapeutic purposes will continue to grow. The role of FFTF in this competitive international market needs to be carefully and accurately assessed as part of the ROD.

Plutonium-238 and NASA missions: The demand for Pu-238 for space programs use represents a potentially critical federal mission for NE. The actual demand and the role of FFTF in satisfying the demand is an important component of the ROD. NASA and PNNL have not yet had the in-depth discussions about NASA's projected needs for Pu-238 power and the alternative routes to Pu-238 production available world-wide.

Missions: The specific missions identified by PNNL for FFTF should be further assessed, including a discussion of alternatives and privatization of some or all of the missions. The risks of not addressing the needs identified in the integrated program plan need to be assessed. An assessment should be performed to ensure that sufficient funding and commitments exist to carry out the FFTF mission plan.

Cost Considerations: A cost and cost-effectiveness comparison of alternatives to FFTF, including restart (upgrade) and decommissioning costs, should be assessed. The ROD should speak to the impact of FFTF restart or shutdown on the generation of waste at FFTF, on other NE programs and on the clean-up of the Hanford site.

It was adopted by a vote of 19 to 2. The two opponents were offered the opportunity to submit written statements, elaborating on why they voted against the resolution, to be included in the record of this meeting. A break was declared at 10:02 a.m.

The Committee was reconvened at 10:21 a.m. to hear a report by **Niel Todreas** on the activities of the Operating Plant Subcommittee. He noted that the budgetary status of NEPO had already been covered by Magwood and that DOE and EPRI were working on a memorandum of understanding (MOU) on how they would cooperate, although the Subcommittee has not yet seen this draft MOU. A major focus of the Subcommittee's effort had been to line up its activities and responsibilities. It reviewed and amended the NEPO Coordinating Committee's charter and named an INPO staff member to the NEPO Coordinating Committee. It clarified the objective of the NEPO Coordinating Committee to ensure that the R&D is in accord with the PCAST recommendations. The NEPO Program is a point of overlap between the Operating Plants Subcommittee and the Strategic Planning Subcommittee; Todreas noted that John Ahearne would present a resolution concerning NEPO from the Strategic Planning Subcommittee. Regarding the policies governing NEPO, the Subcommittee determined the screening and prioritization criteria to be used in project selection, recommended a two-step screening process for establishing priorities among proposed projects, called for clarification of the "national criteria," and plans to further address the issues of national criteria and the appropriateness of DOE research funding.

Magwood asked if the Subcommittee would be coming back with a substantive report on where DOE should be going. Todreas said that there is only one policy issue before us; if other lower-level criteria present themselves, the Subcommittee will comment on them, but it does not see a top-level policy recommendation.

The Committee then backtracked, and the floor was opened to comments and questions about Reba's presentation. Comfort asked if the recommendation to unify isotope-production had ramifications for the FFTF. Reba said that the driving force for that recommendation was that it did not seem to make sense to have production facilities at both Sandia and Los Alamos, 80 miles apart. What was presented lacked the

rationale behind the recommendations; the Subcommittee will provide the whats and whys in the next few months.

Sessoms commented that, if you close down a process line, the money goes away. Magwood noted that the Isotope Program operates through a revolving fund with limited restrictions, so those funds can be invested elsewhere when a facility is shut down (as was done with the calutrons in Oak Ridge).

Duderstadt introduced **John Ahearne** to present the report of the Strategic Planning Subcommittee. Ahearne brought up the question of depleted uranium. Magwood commented that this was the legacy of the uranium-separation process. Ahearne noted that other problems like this have been transferred to EM and questioned why NE has to spend time, effort, and budget dealing with this problem. Where this program really belongs should be considered and perhaps a recommendation made to the Secretary.

Ahearne noted that the draft report of the Strategic Planning Subcommittee has not incorporated Comfort's comments, and two members have not yet made their contributions. This report is the beginning of a process to understand what is going on in U.S. nuclear R&D. The focus of the report is on Moniz's and Magwood's requests for information to back up the FY 2001 budget-development process.

In its discussions, the Subcommittee concluded that NE has four major mission areas:

1. To maintain the necessary national laboratory and university nuclear infrastructure;
2. To support the education system in the areas related to nuclear technology;
3. To serve as the federally responsible agent for nuclear power; and
4. Other nuclear missions, such as medical isotopes and space power.

The Subcommittee supports the FY-2000 programs. It is also thinking through the current *and potential* NE roles in the following topics:

Nuclear energy
Nuclear infrastructure (reactors, hot cells, and accelerators)
Nuclear R&D
Beneficial use of radiation (medical, industrial, agricultural, space, and research)
Civilian low-level waste disposal
Basic nuclear research (physics and chemistry)
DOE nuclear waste cleanup
Nuclear weapons
Nuclear nonproliferation
Fissile material disposition
Naval reactors
Civilian spent nuclear fuel and transuranic waste disposal

It considered, without reaching any conclusions, whether to recommend a redistribution of nuclear-technology-related activities within DOE. At this time, the Subcommittee is not proposing specific roles for NE and will continue to explore this issue. It also discussed three other DOE programs, again without reaching unanimity on a set of recommendations. In regard to the accelerator transmutation of waste (ATW) program, a major effort is coming to completion to develop a roadmap. Two views exist in the Subcommittee: (1) An ATW program does not merit support. (2) Without examining the details of this roadmap, it is not possible to make any recommendations. In regard to the High-Temperature Gas Reactor (HTGR), a congressionally mandated program is funding an effort in Russia, which is overseen by the

Office of Nonproliferation and National Security (NN). While not all Subcommittee members support this program, all members believe that, if the program is continued, it would be more appropriately managed by NE. In regard to radiation effects, another congressionally mandated program funds OS/EM research on the biological effects of low doses and dose rates. Given the possible importance to several DOE programs, credibility would be improved were this program under the auspices of the National Institutes of Health. The Subcommittee will consider some of these issues as it formulates recommendations for the FY-2002 budget process.

Sessoms asked if it was all right to suggest that NIH take on responsibilities. Magwood said that the radiation-effects effort is an SC program. This recommendation can be made, but NE will not have the final say. Ahearne then put forward the recommendations of the Subcommittee in the form of a resolution to be adopted by the Committee:

Resolution of the Strategic Planning Subcommittee

Whereas: As has been pointed out by many studies, including the 1997 PCAST study on federal R&D, the DOE should support a portfolio of energy supplies that must include nuclear energy, as recognized in the 1998 DOE Comprehensive Energy Strategy;

Whereas: NE has the missions of maintaining the necessary national laboratory and university nuclear infrastructure, supporting the education system in the areas related to nuclear technology, serving as the federally responsible agent for nuclear power, and overseeing other nuclear tasks, such as the production of medical isotopes and the development of space power;

Whereas: The best way to ensure the needed future supply of nuclear-technology knowledge is to support university students and faculty and national-laboratory researchers, and the NERI program is an essential element to accomplish this mission;

Whereas: DOE has been directly responsible for many nuclear-related facilities (including hot cells, research reactors, and test facilities) and has had an important role in supporting university facilities, many of which are aging;

Whereas: If nuclear power is going to be retained as an option for future energy supply, if a large number of the current reactors is to continue to operate well into the next century, and if other nuclear technologies are to continue or grow, nuclear science and engineering students must be graduated, graduate students and faculty in nuclear science and engineering must be supported, and appropriate facilities must be maintained;

Whereas: The 1997 PCAST report recommended that "DOE work with its laboratories and the utility industry to develop the specifics of an R&D program to address the problems that may prevent continued operation of current [nuclear power] plants and to fund such a program at $10 million per year, to be matched by industry," for which DOE proposed the Nuclear Energy Plant

Optimization (NEPO) Program;

And whereas: Given the continued reliance on nuclear power and the increasing concern about the use of fossil fuels, it only would be prudent for the U.S. government to support R&D that improves the efficiency and reliability of existing nuclear plants;

It is recommended that

1. The dual-track peer-review process (i.e., review of proposals for scientific merit by qualified researchers followed by review of relevance to NE by DOE personnel) be continued to maintain the integrity of the NERI program;
2. DOE ask and Congress fund the NERI program at the level of $40 million in FY 2001, to support mortgages while continuing to enhance this program and that an *additional* $10 million in FY 2001 be requested for the NERI program specifically focused on international R&D, as recommended in the 1999 PCAST International R&D report;
3. A review be conducted that would consider the needs of all DOE organizations and would (1) determine the condition and capabilities of all hot cells, research reactors, and test facilities supported by the DOE and of those foreign facilities that reasonably could be used to meet U.S. needs and (2) with the strategic plan reach conclusions as to which DOE facilities should be upgraded, what new facilities are needed, and which facilities should be closed;
4. The DOE-NE University Research Support Program in FY 2001 be expanded to an annual funding level of $20 million with the additional funds used to expand the graduate research program;
5. DOE request and Congress fund the PCAST-recommended $10 million per year for the NEPO program;
6. The proposed FY-2000 programs be supported for continuation into FY 2001;
7. A review be conducted of the condition of the university reactors and of their use in teaching and faculty research, reaching conclusions regarding how many need to be upgraded and how many should be supported, following this review with recommendations on the related DOE budget;
8. A review be conducted of (1) the number of people are being funded for nuclear-energy-related work at national laboratories [either by DOE or other sources, including Laboratory-Directed Research and Development Program (LDRD) funds] and (2) what their areas of expertise are and the NE strategic plan be used to reach conclusions about whether any changes should be made, such as increasing funding for the labs, maintaining the current funding and work loads, or consolidating the work at fewer laboratories;
9. NE provide enough support to one or more lead labs to serve as the technical repositories and the critical evaluators of NE-funded work; and
10. A review be conducted to determine the long-term need in the United States for (1) nuclear science and engineering educational infrastructure to serve new graduates and graduate-level degreed people and (2) the number of departments required to support these needs, including whether the current scholarship/fellowship programs are adequate to provide the number and quality of graduates who will be needed by industry, the national laboratories, and government.

Sessoms seconded the motion to adopt these recommendations.

Remke asked if there was any plan to guide the recommendations, and Ahearne responded that producing such a plan is in the Subcommittee's charter and that such a plan will be developed. Duderstadt suggested that DOE might be able to use an expert committee and staff to pull together such a plan. Magwood said that NE expects to have such a plan next year. Duderstadt said he sensed a more urgent need for such a plan because it would undergird any FFTF decision; he thought (1) an amendment was needed to state that such a plan should be developed within a year and (2) something beyond the NERAC structure is needed and should be launched as soon as possible. Comfort asked, if this Subcommittee is expanded with an expert body, what the responsibility of NERAC would be. Duderstadt said that NERAC should be responsible for reviewing and commenting on the plan of the group; the group could report to NE *or* NERAC. Magwood suggested asking the staff to put together a proposal in the next few weeks. Ahearne noted that other fields have large communities that have been working together a long time, but that is not the case in nuclear energy; this group could go a long way to overcome this shortcoming. Magwood conceded that nuclear energy does have a relatively fractured constituency, but there are lines of communication.

Cortez raised the major infrastructure question of university reactors. Duderstadt commented that there may be a more creative way to use DOE monies to support academic needs. Ahearne said that the report noted that DOE has supported reactors at many universities. The number of such reactors has been declining, not totally associated with the closing or merging of nuclear-engineering departments. Many reactors are being maintained by providing commercial services unrelated to their university missions. The report recommended that a review be conducted of (1) the conditions of these university reactors and (2) their use in teaching and faculty research. Furthermore, conclusions should be reached about how many need to be upgraded and how many should be allowed to be closed; the final decision would, of course, be up to the individual university. Recommendations then should be made as to what should be the related DOE budget.

Magwood said that NE has had discussions with universities and will probably go forward with a "blue-ribbon" panel under somebody's [unspecified] auspices to assess the needs, capabilities, and possible disposition of each university reactor. Such an assessment might be done by the National Research Council or NERAC. DOE needs a list of university reactors that the nation *must* maintain. Duderstadt noted that universities do not always want to maintain these reactors, but if DOE gave a stamp of approval (and money) for their continuation, university administrations would appreciate that guidance. Ahearne noted that it is the universities that provide the talent that allows the national laboratories to operate and said that DOE needs to support the universities to support the whole discipline.

Todreas noted that a lot of research programs have been created and asked why these programs have not satisfied the need for support of the academic community. Students need to be primed for 6 to 12 months and then transitioned into the research. To sustain a teaching assistantship, you need enrollment in undergraduate programs. Only $800,000 is available for fellowships across the country. This value is too low.

Rios said that we have forced the national laboratories into a number of things that maybe they should not be doing; and in a broader view, this carries over to DOE. He did not think that the mission has been

properly defined; perhaps it should be limited to the support of nuclear power.

Ahearne said that the Subcommittee disagreed about whether the national laboratories and the universities should be reviewed separately in the grant-review process. Duderstadt noted there is no mechanism for DP or DOD to channel funds into these areas. This broader mission for NE is dictated by the broader mission of DOE. Ahearne summed up that NE has a role because there is not anyone else. Croff said that the national labs and the universities are tightly intertwined, and it may be time to rethink the operation of user facilities and to see if there is a better way to run those facilities in a tightly integrated manner. Duderstadt said that any nuclear-engineering departments that merge with other departments will, in 10 years, have no nuclear-engineering faculty left. Cochran noted that NE grew out of the Advanced Reactor Program, whose purpose was to develop a nuclear industry, and it was very successful in that. Now NE is on the periphery of the nuclear community, caught in a political fight between those who want to get out of nuclear energy and those who want to develop nuclear energy. To go forward, NE needs funding to support that effort. Todreas said that the most important task is to put the mission of supporting education on the agenda; that has not been the case for several years. Industry itself cannot do the job; NE can do it by adopting the mission and debating it.

The vote was called on the resolution of the Subcommittee. Cochran moved to update the recommendations as suggested by the chairman. Cortez seconded. The amendment and the resolution were adopted unanimously.

Haberman asked for public comments. There being none, the meeting was adjourned at 11:56 a.m.

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The following communication was entered into the record by Haberman at the request of the submitter:

Dear Dr. Haberman:

I am writing to express my strong opposition to any restart of Hanford's FFTF reactor. Since moving to Portland, Oregon two years ago, I have followed the numerous issues surrounding the Hanford site with great concern. I believe that the Hanford waste legacy is more than an acute regional problem -- it is national disaster deserving of every possible effort at remediation.

I applaud the Department of Energy's efforts at addressing the problems at Hanford. At the same time, I am concerned that a restart of the FFTF will undermine these efforts substantially. Along with producing a new waste stream, at a site where any new waste burden compounds an already drastic problem, an FFTF restart violates a very important symbolic threshold. By introducing another production mission, this action would undercut the Department's commitment to an undistracted, uncompromised cleanup of Hanford. That cleanup is the stated DOE mission at Hanford, as it should and must be. I urge you not to waver in your support of this commitment to the public interest.

Thank you for your attention to these comments, and best wishes,

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Minutes respectfully submitted by
Frederick M. O'Hara, Jr.
NERAC Recording Secretary
Sept. 1, 1999