Responses of James J. Duderstadt to the Follow-up Questions from the Committee on Science, Subcommittee on Energy and Environment, U.S. House of Representatives concerning the Hearing on *Nuclear Energy's Role: Improving U.S. Energy Security and Reducing Greenhouse Gas Emissions*, held on July 25, 2000.

Nuclear Energy Research Advisory Committee (NERAC)

Q1. What, if anything, has surprised you about the Nuclear Energy Research Advisory Committee's findings?

Two features: First, despite the fact the members of our Committee are very diverse in experiences and perspectives, they have reached a strong consensus that the nation is seriously under-investing both in research in nuclear technology and in the production of the human resources–the well-trained scientists and engineers–so critical to maintaining the nuclear option for our nation. These two areas are clearly the responsibility of the Department of Energy, yet it is also clear that the Department has not given them adequate priority in recent years.

Q2. In your opinion, how have the committee's recommendations been received at the DOE, both inside and outside the Office of Nuclear Energy?

While I believe that Dr. Magwood, Director of the Office of Nuclear Enegy, has both accepted and strongly supported our recommendations, I cannot say the same for those at higher levels in the Department. This is somewhat surprising, in view of the quite strong support for these recommendations both elsewhere in the administration (OSTP and OMB) and in Congress. I can only conclude that the real bottleneck to restoring our nation's capability in nuclear energy lies primarily within the Department of Energy itself.

Status of Nuclear Engineering and Science Education in the United States

Q3. Nuclear Engineering programs and research reactors have been shut down at colleges and universities around the country and enrollment in nuclear engineering programs and related disciplines continues to decrease. The NERAC—through *workshops with the broad scientific community has recommended increased funding, stating "the tools are useless without the people and ideas to make use of them."*

Q4. Please discuss the broader implications if we do not increase DOE's budget in the recommended areas.

NERAC believes that we are seriously at risk in the area of human resources. The report of the Long Range Planning Subcommittee reflects the views both of the other committees and NERAC membership when it states: "Perhaps the most important role for DOE/NE in the nuclear energy area at the present time is to insure that the education system and its facility infrastructure are in good shape." It is clear that United States nuclear engineering programs and university reactor facilities are at great risk and require immediate and concerted attention in DOE funding priorities. The NERAC Blue Ribbon Panel has made a number of important recommendations concerning the nature of DOE programs and support necessary to preserve and strengthen these important national resources. In particular, the Panel recommends an increase of the Nuclear Engineering Educational Research (NEER) program to $20 M/y, a new competitive research grant aimed at sustaining university research reactors at a level of $15 M/y, and a graduate fellowship/traineeship program at $5 M/y. The Panel believes that the plight of nuclear engineering education in this nation is sufficiently serious that the Department should take substantial steps in its FY2002 budget request to move toward these targets. I have appended copies of this report to this document.

The future of nuclear power today is symbolized by empty college classrooms and discontinued nuclear engineering programs, by decommissioned university reactors, and by students turning away from nuclear science and engineering to major in areas such as software engineering and biotechnology, where they see the real action. The future of this technology will be determined by the next generation of scientists, engineers, and leaders. And yet, as governments, industry, and universities, we simply have not made the necessary investments during the past two decades to create this new generation.

Let me give you two examples. First, consider the R&D budget of the Department of Energy. In FY 2001 the Department will spend:

$3.0 billion on research of its Office of Science

$3.7 billion on defense R&D

$1.3 billion on energy R&D (mostly renewables)

$1.1 billion on higher energy physics and nuclear physics

What will it spend on nuclear science and engineering and on nuclear engineering education? $12 million! About 1% of what it is planning to spend on physicists chasing the Higgs boson!

Beyond that comparison, I would note that while most research budgets of the Department of Energy grew by 10% to 14% this year, for the third year in a row the nuclear science and engineering budget remained frozen at $12 million. Its growth was zero.

Ironically, in the summer of 1999 and again in 2000, NERAC conveyed to the Department its highest priority recommendation that adequate funding be provided to these university programs. And what was the administration's response? Procrastination … and a deaf ear.

Let me offer a second example: Education and research in nuclear science and engineering depend heavily on access to nuclear facilities, e.g., nuclear reactors, hot cells, accelerators, and the like. Over the decades, universities have made very substantial investments in developing and supporting campus-based nuclear reactors to sustain not only nuclear engineering programs but as well to provide support for many other areas of scientific research and training. Although these facilities were initially stimulated, encouraged, and supported by the Department of Energy (and its predecessor, the Atomic Energy Commission), federal support has dropped dramatically over the years, declining to roughly $2.8 million per year for fuel subsidy and another $1.5 million for limited support. Yet both the operating costs carried by universities and the projected costs of modernizing these facilities so that they are adequate for contemporary research and training are forcing universities, one by one, to decide that without adequate Department of Energy support, it is simply not worth the expenditure in the face of other more urgent campus priorities. And one by one, these facilities are being closed down, dropping from 76 in number in the 1970s to 28 today. We have just learned that within the next several months, three of the leading nuclear engineering programs in the nation, MIT, Cornell, and Michigan will likely be forced to close their reactor facilities.

The irony is that for a small investment, amounting to $15 million per year or less, the Department of Energy could keep a significant number of university reactor facilities open as national resources. But instead it chooses to spend $44 million per year to keep sacred cows such as the Fast Flux Test Facility on life support (and perhaps even to resuscitate it at a considerably higher cost), while allowing university reactors, which are far more valuable for training and research purposes, to die, one by one.

Let me be very clear about the urgency of this matter. Unless the Department of Energy reprograms funding in FY 2001 and places a priority in its FY2002 budget to provide support for these university reactor facilities, a domino chain of closures will occur over the next several years eliminating most nuclear facilities on university campuses. Of course, one could argue that it might be better if all of the university reactors were closed, and one or more major national facilities were built for education and research. But, this should be a strategic decision rather than a consequence of benign neglect.

Q5. You have devoted a large part of your academic career to nuclear engineering and science. If you could wave a magic want and create the nuclear world the way you would like it, what would it look like?

I would like to see a more balanced approach to the development and implementation of nuclear power more driven by a consideration of strategic national needs rather than opportunistic politics. We need to acknowledge the very significant contributions and potential of nuclear energy while acknowledging and correcting its current deficiencies. In particular, I would like to see it become politically acceptable once again for our public leaders and government agencies–including in particular the Department of Energy–to not only acknowledge the importance of keeping nuclear energy in our energy technology portfolio, but furthermore stating that it is clearly in the national interest to invest in further development of this energy resource.

<u>Meeting Growing Demand for Electricity</u>

Q6. Dr. Holdren's testimony states that for nuclear energy to meet energy demand and make a meaningful reduction in greenhouse gases over the next 50 to 100 years, nuclear energy must grow seven to eight times over its current share of production.

Q6.1 Can the industry's infrastructure support that kind of growth.

Although the current infrastructure–commercial capability, technology base, and, most significant, the availability of adequate human resources–is clearly incapable of such growth, I believe that if the development of nuclear energy were a clear national or global priority, these resources could be put in place during the early part of this century. However it is also the case that should the critical mass of knowledge and people drop too low, the startup period could become unacceptably long.

Q6.2 Please comment more broadly on the status of the commercial infrastructure–including the fuel cycle–in this country.

I believe others on our panel are more capable of responding to this question.

<u>President's Committee of Advisors on Science and Technology (PCAST), Panel on International Cooperation in Energy Research, Development, Demonstration, and Deployment</u>

Q7. The PCAST report to the President states, "Adequate funds are available in the R[adioactive] W[aste] budget to begin addressing possible alternatives … such action could remove a growing obstacle to continued operation of current plants, as nuclear utilities are running out of capacity to store their spent fuel." The DOE has recently announced an arrangement the Philadelphia Electric Corporation to return fees to the Utility – approximately $80 million dollars – previously paid into the Nuclear Waste Fund for a high level repository. The agreement stipulates that the funds are for on-site spent fuel storage until the DOE can receive spent nuclear fuel at a repository. Could this action remove the spent fuel obstacle, identified in the report, leading to new construction?

Again, others are more capable of addressing this issue that I am.

Q8. The PCAST report to the President recommended that a Nuclear Energy Research Initiative be created and substantially funded. The program was created, although funding has not been as high as the PCAST recommendation, what is your assessment of the effectiveness of this program so far?

It is NERAC's view that the NERI program has already been of great value in catalyzing renewed interest in nuclear energy R&D. The response in terms both of the number and quality of proposals has been outstanding, far exceeding the limited funds provided thus far to the program. We believe it is essential that the federal government fund this program at levels closer to the original PCAST recommendations.

Q9. Do you have any other comments on the PCAST report regarding nuclear energy?

More generally there is an urgent sense that the nation must rapidly restore an adequate investment in basic and applied research in nuclear energy if it is to sustain a viable United States capability in the 21st Century. The Long Range Planning Study has recommended a set of program and funding priorities ramping to a level of $240 million by FY2005, including a growth in funding of the Nuclear Energy Research Initiative (NERI) to achieve the goals set by PCAST. We anticipate that this would scale up to levels more comparable to those characterizing the 1970s and 1980s as experimental facilities are developed and demonstration projects are launched. However NERAC believes it important that during the early years, the focus be on developing a broad-based research project rather than focusing prematurely on the development of specific technologies or projects. It is also recommended that at least a part of this program accommodate investigator-initiated basic research projects, selected on the basis of scientific merit rather than confined to DOE programmatic needs.

Relative Risk of Nuclear Energy

Q10. Has there ever been a death at a commercial nuclear facility due to the nuclear side of the plant? How does this compare with industrial accidents at other power plants or other industrial facilities?

Others on the panel have commented on this comparison with more authority that I am able to provide.

Q11. Has the NERAC compared greenhouse gas emissions from gas and coal fired energy plants and nuclear energy plants?

We have not done so directly, although members of our Committee are associated with organizations (national laboratories and universities) which have made these comparisons.

Q13. This Subcommittee held a hearing on the Linear No-Threshold Model for low dose radiation. In terms of relative risk, what poses a greater risk to the public health: nuclear energy plant's low dose radiation at natural background levels or radioactive releases from coal-fired power plants?

Again, others on the panel in a better position to address this issue.

Q14. How are other nuclear energy countries' attitudes toward the environmental benefits of nuclear energy different or similar to the U.S. attitude? Do we have lessons to learn?

It seems increasingly clear that the United States has fallen behind other nations in our efforts to develop and implement nuclear technology. In my opinion, this places our nation at some risk both in terms of meeting our own energy needs in an environmentally acceptable fashion and influencing the decisions of other nations in critical areas such as proliferation-resistant nuclear fuel cycles.

Appendix A

BLUE RIBBON PANEL ON THE FUTURE of UNVERSITY NUCLEAR ENGINEERING PROGRAMS AND UNIVERSITY RESEARCH AND TRAINING REACTORS

Executive Summary

Nuclear engineering programs and departments with an initial emphasis in fission were formed in the late 1950's and 1960's from interdisciplinary efforts in many of the top research universities, providing the manpower for this technical discipline. In the same time period, for many of these programs, university nuclear reactors were constructed and began their operation, providing some of the facilities needed for research and training of students engaged in this profession. However, over the last decade, the U.S. nuclear science and engineering educational structure has not only stagnated but has reached a state of decline. The number of independent nuclear engineering programs and the number of operating university nuclear reactors have both fallen by about half since the mid-1980s. In contrast, the demand for nuclear-trained personnel is again on the rise. Workforce requirements at operating U.S. nuclear power plants are increasing and will undoubtedly remain high, given the plans for plant-life extension in the vast majority of operating light-water reactors in the U.S. Moreover, new initiatives have begun in applied radiation sciences in collaboration with industrial and medical researchers as well as new biotechnologists. Finally, nuclear science and engineering (NS&E) continues to be needed in national security as well as providing the US Navy with effective, safe nuclear propulsion. Thus, the future of nuclear science and engineering programs must be reevaluated and refocused as the new century begins.

In November 1999, DOE Office of Nuclear Energy, Science and Technology requested that NERAC establish an ad hoc panel to consider educational issues related to the future of nuclear science and engineering; i.e., address the future of nuclear engineering

programs, establish a process toward support of university research and training reactors, and identify appropriate collaborations between DOE national laboratories and university programs. To this end the panel is making a series of recommendations to the NERAC and the DOE.

University Nuclear Engineering Programs: Our vision is have DOE assist universities as they refocus these programs to enhance advances in nuclear science and engineering as applied to security, power and medicine and to maintain the necessary human resource for continuing the discipline through the 21st century. These efforts would be to:

1. Enhance the graduate student pipeline to maintain the health of the discipline by increasing doctoral fellowships (~20) and masters scholarships (~40) with funds of $5 million/yr.
2. Assist universities in recruiting and retaining new faculty in nuclear science and engineering by establishing a Junior Faculty Research Initiation Grant program for peer-reviewed grants in basic research.
3. Expand research discoveries in nuclear science and engineering by increasing the Nuclear Engineering Educational Research program (NEER) to $20 million/yr (includes item 2).
4. Help improve the undergraduate nuclear science and engineering discipline and maintain a core competency in nuclear systems engineering and design.
5. Encourage and support a national activity of communication and outreach in nuclear science and engineering to identify its basic benefits for the country in the next century.

University Research and Training Reactors: University reactors are an important part of the nuclear science and engineering infrastructure that must be maintained, because experimental facilities (particularly facilities involving ionizing radiation and nuclear reactions) must be part of the educational basis of the discipline for undergraduate training and graduate research. To insure that such facilities are properly supported the panel recommends the following actions.

The panel proposes that a competitive peer-reviewed program augment current DOE financial support for these university reactors. This program would have the following elements:

1. Maintain the current base program for university reactor assistance program, which provides funds for reactor refueling, operational instrumentation, and reactor sharing at $4.3million/yr.

2. Institute a competitive peer-reviewed university reactors research and training award program, which would provide for reactor improvements as part of focused effort that emphasizes research, training and/or educational outreach, with the following elements:

- Specific award criteria which qualify university reactors for participation in the competition,
- Peer-reviewed competition for innovative research, training and/or outreach proposals,
- Multi-year grants that could involve multi-university, multi-disciplinary collaborative teams,
- Awards for research, training and/or outreach purposes with the total competitive program funds at a level of $15 million annually.

<u>University - DOE Laboratory Interactions</u>: The panel examined several approaches that could increase collaboration between universities and laboratories. Some of these strategies have the common theme that would require exercising some level of central authority within the DOE.

- Increased Nuclear Engineering and Health Physics Fellowships: These are an excellent means of interacting with top graduate students. The panel believes that for this and other reasons the funding for NE/HP Fellowship Program should be substantially increased.

- Increase personnel exchanges between Laboratories and Universities: Laboratories could create programs such as a “Distinguished Visitor Program,” under which university faculty could spend extended periods (e.g. sabbaticals) at laboratories. Laboratories could encourage its staff to give seminars and/or spend time as visiting faculty at universities.

- Designated University Awards: Universities provide largely untapped resources that could participate more fully in DOE applied and basic research programs. To take more advantage of this resource, DOE could negotiate a certain percentage of the laboratory's budget to be subcontracted to universities. Laboratory management could also require individual programs (or divisions or directorates) to subcontract a certain amount or percentage to universities each year.

Appendix B

DOE Program for University Research & Training Reactors

December 21st, 2000; Final Draft by NERAC Blue Ribbon Panel

Introduction

Since nuclear science and engineering is expected to be an important part of the research and development landscape for this next century, a substantive and lasting federal investment is needed to support this infrastructure at universities. University research and training reactors (URRs) are an important part of this NS&E infrastructure that must be maintained, because experimental facilities (particularly experimental facilities involving ionizing radiation and nuclear reactions) must be part of the educational basis for undergraduate and graduate students. Currently, there are twenty-eight university reactors in the U.S. (more than a 50% decrease in the number of reactors from over a decade ago) with annual support of less than $10 million from their individual university budgets (see Table). These expenditures are specifically for the operational aspects of these nuclear reactors at each university site as well as safety and licensing activities; i.e., staff salaries as well as materials and supplies related to operation. The panel has recommended a competitive peer-reviewed program be instituted to provide the resources that are needed to revitalize this important national resource at university campuses throughout the country (see Panel Report, June 2000). This document outlines the basic principles of a competitive program within a historical context that shows the importance of URRs and the need for revitalization.

Background

DOE Secretary O'Leary submitted a report to Congress on URRs on May 19, 1994 for the Energy Policy Act of 1992, based on data gathered in early 1993. The principal findings were:

- DOE considers university research reactors (URRs) to be an important national asset relative to nuclear science, technology, and manpower development.
- The cost of operating all URRs is lower than that of one DOE research reactor.

- The URRs considered in that study represent an initial investment of $60M with a replacement cost of about $1B today.

The National Research Council performed a comprehensive prior study in 1988. It concluded that URRs serve the national interest in research, education and service, and it made the following recommendations:

- Adopt a goal of meeting URR needs to regain competitiveness with Europe and Japan
- Provide up to $20 million annually for infrastructural support through a designated federal agency that would be used for operation and facility upgrades as needed
- Create a peer-review mechanism to assist the designated agency in making these grants.

This study, which references other related studies, also concluded that these research reactors do not adequately fulfill the national interests in research and education related to the neutron sciences and technologies. These shortcomings are particularly apparent when comparing the U.S. to the foreign situation, especially in Europe and Japan. These deficiencies stem in part from inadequacies in financial support for operating, upgrading and providing state-of-the-art research instrumentation. This study proposed to examine organizational structures in Europe and other advanced countries to gain further insight into improving URR operation and oversight.

Importance of University Research and Training Reactors

After discussions with NEDHO and TRTR representatives the panel believes that URRs:

- Are vital for advancement of knowledge in nuclear science and engineering education at the graduate level and provide powerful research tools for the advancement of many other disciplines;

- Provide undergraduate and graduate students with an otherwise unobtainable ‘hands-on’ educational experience, allowing for discovery of nuclear fission reactor processes, understanding of critical nuclear systems and interaction of radiation with matter, which enriches their general and technical education (as well as providing for professional nuclear reactor operators with advanced certification);

- Give the general public an opportunity through outreach activities to better understand and become familiar with nuclear processes and ionizing radiation as well as nuclear fission power.

The URRs have a major impact on research and development in the neutron sciences and technologies, and also provide necessary facilities for the education of future scientists and engineers who are critical to sustaining the nation's technological base in a diverse spectrum of fields. Research work at existing URRs is responsible for developing new radio-pharmaceuticals for diagnosis and treatment of cancers, for providing structural information on new high-technology materials, for developing critical data on the behavior of metals, ceramics, polymers, and reactor coolants in radiation environments, and for providing critical data from neutron activation analysis to make advances in a variety of diverse fields (e.g., allowing archaeologists to date prehistoric artifacts). Most of these areas of technology are uniquely in the domain of nuclear research reactors and not easily duplicated on accelerator-based radiation sources. The facilities existing or that can be developed at URRs for the study of materials, trace element analysis, and for producing isotopes are complementary rather than competitive to those found at the National Laboratories. This is because these facilities are located in the highly creative and multidisciplinary environment of the university where a diversity of students can take advantage of these unique resources. In their role of providing graduate education and training for radiation scientists, URRs exploit these benefits of the university and provide educational advantages that are generally superior to those afforded by the national user facilities. This is the concept for “feeder research reactors” that has been highly successful in Europe and has been an important factor in propelling these countries into their present dominant leadership roles in the neutron sciences. With adequate support of URRs, this model can also be implemented here and help ensure that these technologies are not permanently lost by the U.S.

The URRs also have a major impact in the realm of undergraduate education, outreach and training. Based on the data collected by the panel for its report to NERAC over 1000 students are enrolled in courses that use these URRs annually, and over 5000 visitors tour a URR or are given demonstrations at a URR annually. Beyond these educational activities, many URRs are used for nuclear reactor operator training with local nuclear utilities. It is the panel's opinion that nuclear science and engineering specifically (and probably the physical sciences in general) suffers from a distinct lack of understanding by the general public. One could contend that this is one of underlying reasons why this technology is viewed with uncertainty and apprehension. The panel feels that these URRs and the university programs that support them are unique and may be in the best position to work with the DOE to develop innovative approaches to outreach and education. Innovations in this area could have a major impact in regard to better public understanding of nuclear science and engineering as well as the needs for future human resources.

Current Resources for University Research and Training Reactors

This panel recognizes that the DOE Office of Nuclear Energy currently has the 'University Reactor Fuel Assistance and Support' as an on-going program for university research and training reactors. As part of this program funds are provided for reactor refueling, reactor instrumentation and reactor sharing for users of these facilities. These current programs serve as the minimum external resource base that helps maintain this educational infrastructure for the operation of these university research and training reactors. Specifically, the DOE budget lines for reactor replacement fuel, reactor instrumentation upgrade and reactor user sharing total $4.3 million for FY2000. Note that the bulk of these funds are for reactor fuel replacement (~ $2.8 million); the remaining $1.5 million represents less than 10% of the total operational costs.

Necessity for this Competitive Program

URRs constructed in the late 1950s and early 1960s and granted 40-year operating licenses are now facing the decision of whether to relicense. University administrators who have been funding research reactor operations from university sources are increasingly reluctant to make the long-term commitment to continue the support required for a positive decision on license renewal, without a clear partnership with the federal government to sustain the level of nuclear energy technology activity nationally. Concurrently, Nuclear Engineering Departments are increasing their emphasis on radiation science to stay viable, and their research reactors are thus becoming increasingly vital facilities for anchoring their experimental research activity in nuclear science and engineering. As these reactor facilities provide a capability otherwise unobtainable (e.g., in neutron level and energy distribution), they complement accelerator-based radiation sources; i.e., in activation studies, imaging science and basic neutron science.

The panel is apprehensive that the closure of one or more key university reactors would trigger a re-evaluation of the commitment of many of these university research and training reactors; e.g., regarding renewal of operating licenses as needed in the near future. This could result in the loss nationally of significant capability for radiation science and engineering education programs.

To expand URR capabilities and the associated research and training opportunities for these reactors, infrastructure improvements are needed that go beyond the minimum needed for reactor operation. The panel believes such infrastructure improvements should involve funds for personnel and equipment that would meet specific research or educational objectives, vetted in a peer-reviewed process. These improvements could be in the form of nuclear instrumentation linked with separate externally funded research initiatives, for example. These improvements could also involve upgrade of facilities or development of materials for reactor operator training. In addition, such improvements could be related to educational outreach programs to the general public. Such activities would enhance the importance of the university nuclear reactor to their respective academic programs and their traditional mission of undergraduate and graduate instruction within the university.

Proposed Competitive Program for University Reactors

The panel proposes that a competitive peer-reviewed program augment current DOE financial support for these university research and training reactors. This program would focus on activities beyond operation and would support infrastructure costs associated with personnel and instrumentation upgrades supporting extramurally funded research efforts as well as facility upgrades and personnel costs that involve innovative training and educational outreach activities. The panel recommends the following elements for this expanded DOE program for university reactor support:

1. Maintain the current university reactor assistance program which provides funds for reactor refueling, the reactor instrumentation base program, and the reactor sharing base program (expanding it to allow for on-campus user participation) at the current funding levels, subject to satisfying current university reactor criteria that have been developed by the DOE staff in consultation with TRTR. The committee recognizes that this current funding level may not be sufficient for all the existing university research and training reactors to continue operation.

2. Institute a competitive peer-reviewed university reactors research and training award program. This program would provide additional multi-year grants for the reactor infrastructure that are part of focused proposals by groups of collaborators that can emphasize research, training and/or educational outreach. The panel believes that such a program can provide the needed financial support for qualified university research and training reactors. These resources are for activities that go beyond what is needed only for base operation and provide a competitive arena where innovative ideas can be nurtured. The total program cost would be $15 million per year, which is consistent with the proposals to DOE by the University Working Group in 1996 and with previous studies dating back to the 1988 study by the National Resource Council. The panel suggests that this program be instituted incrementally in FY02 and FY03 budgets to allow for development of the needed DOE administration that would accompany this new activity.

A. Key Elements of Competitive Program

1) Multi-year funding awarded through competitive, peer-reviewed proposal process.

2) Proposals encouraged for research, for education/training, and for public outreach.

3) Funding levels would range from small outreach efforts to multi-university teams.

4) URR required to “qualify” before its proposal is considered. (Specific qualifying criteria have been proposed by the panel – see Table below).

5) University must provide cost-sharing (auditable using NSF-like procedures).

B. Details to this Competitive Program

- Defined missions: The RFP would include *suggestions* for missions for research, education/training and outreach, with a university or university teams free to propose different missions.
- Base infrastructure funding: The program would allow a specified fraction of the budget to be used for personnel, instrumentation upgrades and materials and supplies related to the specific deliverables in the proposal. If DOE does not wish to directly fund such items, then the cost sharing offered by the universities could be used. Overhead (indirect costs) on the contracts could also help the university with base and infrastructure funding.
- Funding period: One to five years. (5 years would be needed for a ‘center’, but shorter periods should not be discouraged for other projects.)
- Level of cost sharing: This needs to be consistent with other federal agencies; e.g., NSF and NIH require a 33-50% cost share (with a possible maximum instituted, so that universities can afford to submit large proposals).
- Funding level: The panel proposed funding to ramp up to $15M/yr (just for this program, without reducing other NEST programs). This funding level was taken from the URR Center of Excellence proposal (1996). It is similar to what was originally proposed in the NRC study in 1988 and is also consistent with general comments in the DOE 1994 report and the proposal by the University Working Group in 1996. The panel feels this is a minimum level of investment based on the basic principle that annual infrastructure investments of about 5-10% of the initial capital investment is needed to maintain a level of competence; note that the capital investment for these

URRs is well over $250 million. The panel realizes this is a preliminary estimate and may need to be increased as better data becomes available once the competitive program is operating.

Proposed Qualifying Criteria for University Nuclear Reactors

The panel would propose the following criteria to qualify university nuclear reactors for research support from the Department of Energy Office of Nuclear Energy under the proposed competitive peer-reviewed program for research, training and outreach.

1. The university nuclear reactor must demonstrate an acceptable operational and safety record over the last five years.

2. The university nuclear reactor must demonstrate that it contributes to the educational infrastructure of a suitable degree program(s).

3. The university nuclear reactor must demonstrate that substantial financial support comes from the university and will continue through at least the program support period.

4. The university nuclear reactor must have a commitment from the appropriate senior university official for its continued operation through at least the program support period.