



## Department of Energy

Washington, DC 20585

November 1, 2000

Professor Persis Drell  
Chair, Local Advisory Council  
Cornell University  
118 Newman Laboratory  
Ithaca, New York 14853

Dear Professor Drell:

I recently learned that Professor Robert C. Richardson, Vice Provost for Research, has requested the Local Advisory Council examine the Ward Center for Nuclear Sciences and make a recommendation to him regarding the future of the laboratory. As the Director of the U.S. Department of Energy's Office of Nuclear Energy, Science and Technology, I am the government's senior official responsible for providing assistance to the Nation's university nuclear engineering programs and research reactors to ensure the long-term viability of this important element of our education infrastructure. As such, I would like to provide you and the Council my perspective on the future of university nuclear engineering programs and the role of Cornell's Ward Laboratory.

There is no question about the difficult time the Nation's nuclear engineering programs have had over the past several years. The number of university research reactors has declined from a high of 64 in the late 1960s to just 29 today. The number of students graduating from U.S. universities with nuclear engineering degrees has fallen by about two-thirds over the last two decades. These trends, however, are changing and the outlook for the Nation's university nuclear engineering programs is improving as nuclear energy and related technologies are becoming the focus of renewed interest.

The university community gained access to a new research reactor in the past year as the University of California-Davis took over responsibility for the McClellan research reactor. The number of students graduating with nuclear technology degrees is again on the rise and starting salaries for nuclear engineers are among the highest for any engineering discipline. Moreover, reports from nuclear engineering schools indicate that job offers for nuclear engineering students far



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exceed the number of students available. In fact, a recent study conducted by the Nuclear Engineering Department Heads Organization found that there was a shortage of over 360 nuclear engineers in 1998-99, and this shortage is expected to increase to over 460 by 2002-03.

The Department fully recognizes the important role of the Nation's university nuclear engineering programs in preparing future researchers and practitioners for careers in the critical fields of medicine, environmental science, national security, and power production. The Department continues to work to maintain the Nation's university nuclear engineering programs and improve operations of U.S. university research reactors. We have seen our funding grow from \$3 million to \$12 million over the past three years. It is our hope that this trend will continue.

The increase in federal funding is reflected in the Department's funding to Cornell's Ward Laboratory which has increased from \$3,000 in 1997-1998 to over \$620,000 in 2000-2001. Cornell's most recent award is the three-year commitment of the Electric Power Research Institute's grant of \$180,000 to match the \$180,000 grant provided by the Department. This award, which represents the maximum grant that currently can be awarded under the DOE/Industry Matching Grants Program, is only available to schools with nuclear engineering programs. Cornell also received a DOE Nuclear Engineering Education Research (NEER) grant of almost \$200,000 for the years 2000-01. The NEER awards are very competitive (*e.g.*, for fiscal year 2000, 13 grants were awarded out of 118 proposals) and limited to universities with a nuclear engineering program and/or a research reactor used for the proposed research. Cornell has also been the recipient of DOE funding through our Reactor Sharing Program (\$30,000 for the past two years), Reactor Instrumentation Upgrades Program (over \$67,000 the past two years), and Fuel Assistance Program (\$350,000 in fiscal year 1999).

The recent Nuclear Energy Research Advisory Committee (NERAC) Report, *The Future of University Nuclear Engineering Programs and University Research and Training Reactors*, found that the increase in federal funding has improved the outlook for the Nation's nuclear engineering and university research reactors but that additional help is needed. Among the NERAC findings and recommendations are the following:

- The current base support program, which provides funding for fuel, reactor sharing and reactor upgrades, must be augmented by a new competitive peer-reviewed award program for reactor improvements as part of a focused

effort emphasizing research, training, and educational outreach. This program is recommended at \$15 million per year to supplement the existing program of \$4-5 million per year.

- There is a need to increase university fellowships and scholarships, recruiting and retaining faculty, expanding the current Nuclear Engineering Education Research grant program, and providing for a national outreach program in nuclear science and engineering. This program is recommended at \$25 million over the current funding level of \$7 million.
- There is a need to increase personnel exchanges between universities and national laboratories; institute programs for university faculty to spend extended periods at the laboratories; and negotiate a percentage of the laboratory budgets to be subcontracted to universities.

While we fully support these key NERAC recommendations, it will take time to fund and implement these program enhancements. In the meantime, NERAC is refining the university research reactor qualification criteria and the award process for the university research reactors. In addition, the Department is seeking to establish an emergency fund to assist universities in the immediate need of assistance prior to the time when the competitive peer-reviewed program, noted above, is underway in 2002. These emergency funds are envisioned as near-term assistance to the universities to help further defray the operating costs for the research reactors.

It is our belief that the Ward Center is a valuable university asset benefitting not only the nuclear engineering program but also servicing a very diverse group of users including undergraduate and graduate students in engineering, physics, *geology, archaeology, arts and sciences, agricultural and life sciences*, architecture, veterinary medicine, human ecology, and even the Hotel School. The Ward Center is also utilized by other universities and high schools through the Reactor Sharing Program funds provided by the Department. In addition, several corporations use the Center for research, testing, and development applications.

Far from waning, nuclear technology appears to be on the brink of a renaissance in the United States and worldwide as the international community seeks solutions to increased electricity, environmental, and medical needs. I urge

Cornell University to continue to support the Ward Center and further strengthen its reputation as a world leader in university based research enabling Cornell to assume an even larger role in the advances and uses of nuclear technology.

Sincerely,

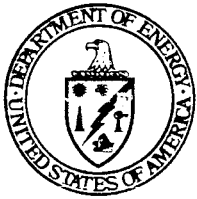
A handwritten signature in black ink, appearing to read 'William D. Magwood, IV', with a long horizontal line extending to the right.

William D. Magwood, IV, Director  
Office of Nuclear Energy, Science  
and Technology

cc: Professor Robert C. Richardson  
Vice Provost for Research  
Cornell University

Professor J. Robert Cooke  
Dean of Faculty  
Cornell University

Dr. Kenan Ünlü  
Director, Ward Center for Nuclear Sciences  
Cornell University



## Department of Energy

Washington, DC 20585

August 31, 2000

Dr. Robert C. Richardson  
Vice Provost for Research  
Cornell University  
529 Clark Hall  
Ithaca, New York 14853

Dear Dr. Richardson:

The Department of Energy has enjoyed a fruitful relationship with Cornell's nuclear engineering and research reactor programs for many years. We understand that the future of these nationally important programs may now be at question. These programs are very important to the Nation's technical infrastructure, and we want to assure that you have complete information about the Department's interest in your nuclear technology activities as your consideration progresses.

There is no question about the difficult time the Nation's nuclear engineering programs have had over the last decade or so. The number of research reactors has declined from a high of 64 in the late 1960s to just 29 today. The number of students graduating from U.S. universities with nuclear engineering degrees has fallen by about two-thirds over the last two decades. It is only because of the foresight and interest of a few robust and academically complete institutions, such as Cornell, that these declines have not been even more precipitous.

As nuclear energy and nuclear technologies in general become the focus of renewed interest, we have found that the situation in nuclear technology education is beginning to improve. U.S. students have gained access to a new research reactor in the past year, McClellan at the University of California-Davis, and no further facilities have closed during this time. The number of students graduating with nuclear technology degrees is again on the rise and starting salaries for nuclear engineers are among the very highest for any engineering discipline. Moreover, reports from nuclear engineering schools indicate that job offers for nuclear engineering students far exceed the number of students available. In fact, a recent study conducted by the Nuclear Engineering Department Heads Organization found that there was a shortage of over 360 nuclear engineers in 1998-99, and this shortage is expected to increase to over 460 by 2002-03. DOE has placed a renewed emphasis on maintaining and improving all U.S. university research reactors. We have seen our funding grow in three years from \$3 million to the present level of \$12 million.

The recent Nuclear Energy Research Advisory Committee Report, "The Future of University Nuclear Engineering Programs and University Research and Training Reactors," recently sent to you under an earlier letter, found that increased Federal funding has improved the outlook for nuclear engineering and university research reactors but that much more needs to be done.



Cornell has been the recipient of some of this increased DOE and private funding over the past two years. Cornell's most recent award is the three-year commitment of the Electric Power Research Institute's matching grant of \$180,000 to match the \$180,000 provided by DOE. It represents the maximum grant that currently can be awarded under the DOE/Industry Matching Grants Program that is only available to schools with nuclear engineering programs. Cornell also received a Nuclear Engineering Education Research (NEER) grant of almost \$200,000 from DOE for the years 2000-01. The NEER awards are very competitive (for fiscal year 2000, 13 grants were awarded out of 118 proposals); and to be eligible for a NEER grant, a university must have an nuclear engineering program and/or a research reactor used for the proposed research. The other DOE programs that have benefitted Cornell are Reactor Sharing (\$30,000 the past two years), Reactor Instrumentation Upgrades (over \$67,000 the past two years), and Fuel Assistance (\$350,000 in fiscal year 1999).

My staff has worked very closely with Dr. Kenan Unlu to ensure that Cornell has a first-tier nuclear engineering program in conjunction with its research reactor. These reactors are vital not only to the health of the nuclear engineering programs but serve to enhance a variety of scientific disciplines within the university.

We are also embarking on new initiatives with minority engineering institutions to establish partnerships to attract minority students to nuclear engineering, and these initiatives are flourishing. An agreement has already been signed between the University of Wisconsin and South Carolina State University. Two others are scheduled to begin soon involving North Carolina State and North Carolina A&T and New Mexico and New Mexico State. Cornell could be part of this rewarding program. We have numerous other programs designed to enhance nuclear engineering and research reactors including offering scholarships and fellowships to outstanding students who enter the discipline.

We hope you will attend the September 18 meeting of university engineering deans. There, you will hear about these and other activities and have an opportunity to discuss how Cornell can achieve greater involvement. It is a dynamic time in the nuclear education area, one that has not been seen in several decades. We are optimistic about the future and hope that Cornell will join us in our education initiatives. A large part of that will be maintaining and improving your research capabilities through the use of the Ward Center Reactor.

I look forward to meeting you on the September 18.

Sincerely,



William D. Magwood, IV, Director  
Office of Nuclear Energy, Science  
and Technology

cc: Prof. H. R. Rawlings, III  
Prof. C. B. Martin  
Dr. K. Unlu



## Department of Energy

Washington, DC 20585

January 18, 2001

Professor Persis Drell  
Chair, Local Advisory Council  
Cornell University  
118 Newman Laboratory  
Ithaca, New York 14853

Dear Dr. Drell:

We were sorry to have missed you on December 20, 2000, when we visited Cornell to discuss the status of the Ward Center research reactor. We had an informative tour of the facility conducted by Dr. Unlu and were privileged to meet many of the faculty using the reactor as well as Dr. Richardson and Dr. Cooke. I hope you enjoyed your visit to Washington on the occasion of your father being honored with the Enrico Fermi Award.

The discussions concerning the future of the reactor were very frank and helpful, enabling us to better understand the issues confronting the university. Through these discussions, we became even more convinced that the Ward Center holds great value to both Cornell as a major university and to the Nation's science and technology infrastructure. While the United States has 29 university research reactors, few are of the quality or have the capabilities of Cornell's.

The decommissioning of university research reactors is a topic of frequent discussion of the Department's Nuclear Energy Research Advisory Committee (NERAC). The NERAC, which is a Federal advisory committee chaired by Dr. James Duderstadt, former President of the University of Michigan, is chartered to advise the Government on matters associated with nuclear science and technology. In its most recent meeting earlier this month, NERAC established a new, three-person panel of experts to collect information on all university reactors including their research and training capabilities, costs to operate, and operating data. The panel will use this information over the next two months to help the Department formulate a strategy to support the maintenance of vital university research reactor facilities in the United States. We hope to announce the details of this strategy in late March or early April. In the interim, we hope that universities with research reactors contemplating decommissioning will delay any decisions until the Department can issue a new strategy.

During the discussions we had during our visit, we found that a significant issue that has concerned Cornell's administration was the assertion that a window of opportunity exists for shipment of fuel to Idaho and that this window may not be



available at a later time. We are confident that this is not the case. In the event Cornell decided to operate the reactor for an unspecified number of years and then decided to decommission, the Department's Idaho National Engineering and Environmental laboratory would be able to schedule the fuel shipments at that time. As a result, we do not believe that fuel shipment windows of opportunity should be a determinative factor in deciding the fate of the Ward Center research reactor.

I hope you find this information helpful to your decision-making process. The Department believes the future will hold growing opportunities in areas related to nuclear science and technology research. As a result, we have dramatically increased our support to university research reactors and expect to see further increases in the future. We look forward to continuing our close working relationship with Cornell as this future unfolds.

If you have any questions or require further information, please do not hesitate to contact me on (202) 586-6630 or have your staff contact John Gutteridge on (301) 903-1632.

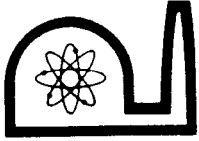
Sincerely,

A handwritten signature in black ink, appearing to read 'William D. Magwood, IV', with a horizontal line underneath.

William D. Magwood, IV, Director  
Office of Nuclear Energy, Science  
and Technology

cc: Dr. R. C. Richardson, Cornell  
Dr. J. R. Cooke, Cornell  
✓ Dr. K. Unlu, Cornell  
Beverly Cook, Manager, ID





**NUCLEAR REACTOR LABORATORY**  
AN INTERDEPARTMENTAL CENTER OF  
MASSACHUSETTS INSTITUTE OF TECHNOLOGY



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253-4202

November 9, 2000

Professor Persis Drell  
Chair, Local Advisory Council  
118 Newman Laboratory  
Cornell University  
Ithaca, NY 14853

Dear Professor Drell:

I am writing in response to Cornell's request for comments on the value of the Ward Center for Nuclear Sciences. I am the Director of the MIT Nuclear Reactor Laboratory and have twice chaired the National Organization of Test, Research and Training Reactors. I have also been very active in urging Federal support for university research reactors. Dave Clark was a good friend (I sponsored him to be an American Nuclear Society Fellow) as is Kenan Ünlü.

University research reactors are in very difficult straits at present. Rather than reiterate my analysis of the underlying causes, I've enclosed a recently published paper that enumerates the reasons for the problems with which these reactors are faced.

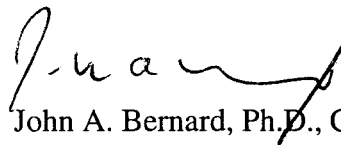
The Ward Center is one of the more productive URRs. Cornell, MIT, Texas, Florida, North Carolina, Michigan, and Penn State have all been very active in presenting research results at American Nuclear Society meetings. Both Dave and Kenan have generated a number of excellent presentations with most being given by their thesis students. Cornell has also done exceptionally well in garnering what support is available from NEER, DOE/Industry Matching Grant, Reactor Sharing, and other Federal programs. Accordingly, I think that you can be confident in the quality of the Ward Center, both the physical resources and the personnel.

The issue that faces Cornell and also all other universities that operate a research reactor is how to increase faculty usage. My recommendation has been for a one-time capital infusion to procure state-of-the-art instruments and a continuing program to fund a technical support staff that would assist faculty in using these instruments. Other solutions such as a "centers of excellence" program and a URR-specific NERI type program have been proposed.

Cornell is not alone in the quandary of what to do. Every university administration that operates a reactor is undergoing an introspective examination such as that which you are undertaking. I would hope that each university does not act alone, look inward, and decide to close its facility based on the lack of faculty usage. Rather I would hope that each administration would look outward and join with its peers to make the case to the U.S. Department of Energy for the potential research value that these university research reactors represent. I think if senior members of each university act in concert it will be possible to convince DOE to provide base support. At present, DOE does recognize the inequity of past funding policies. However, it is unwilling to recommend a remedy unless individuals removed from day-to-day reactor operation make the case that these facilities provide a unique benefit to the nation. That need is very real, although it is not apparent to many of our political leaders. The United States cannot possibly survive over the next several decades without nuclear power as an energy source and it cannot hope to remain at the technical forefront of industry unless it has a neutron scattering capability. Europe and the Pacific Rim nations will soon outstrip us unless we now act to preserve our capability to do research in the nuclear sciences.

My recommendation would be for Cornell to continue operation of the Ward Nuclear Sciences Center and at the same time join with other universities to develop a plan whereby DOE will provide the requisite support to allow URRs to achieve full potential. I can put you in touch with the appropriate people at MIT should you so desire.

Sincerely,



John A. Bernard, Ph.D., CHP, P.E.  
Director

JAB/koc

Cc: Professor J. Robert Cook  
Professor Robert C. Richardson  
Dr. Kenan Ünlü



**Pedro B. Perez, Chairman, TRTR**  
**North Carolina State University**

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**1999-2000 Executive Committee**

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Gary Stimmell, General Electric Co.  
Ray Tsukimura, Aerotest Operations, Inc.  
Bernard W. Wehring, Univ. of Texas-Austin

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7 November 2000

Professor Persis Drell  
Chairperson, Local Advisory Council  
Cornell University  
118 Newman Laboratory  
Ithaca, NY 14853

**Subject: Ward Center for Nuclear Sciences**

Dear Professor Drell,

I am writing this letter on behalf of the National Organization of Test, Research and Training Reactors (TRTR) to share with you and your Council the important contributions of University Research Reactors and in particular to express our support of your Cornell facility.

The Ward Center for Nuclear Sciences (WCNS) has provided safe and reliable analytical and testing facilities supporting the research and education mission of Cornell University and extension services for off-campus users for thirty-eight (38) years. The Cornell TRIGA reactor has been extensively utilized during this time by a diverse group of users within Cornell University, by governmental institutions, and by industrial companies. It is also important to note that your Cornell reactor facility is the only remaining research reactor in the State of New York. TRTR considers the Ward Center to be the **New York Center for Nuclear Sciences**.

TRTR strongly believes that all university research reactors are essential components of the national engineering and scientific infrastructure. These reactors are a safe, efficient and reliable source of neutrons for education, research and services. Neutrons are becoming increasingly more important for studies in the physical and biomedical sciences. Ultra-cold neutrons (UCN) provide some of the most important and beautiful measurements of the fundamental properties of the neutron. Experiments of this kind provide precision tests of the electroweak standard model in particle physics. UCNs also promise to evaluate changes in large biological models. Thermal neutrons have been utilized in semiconductor material doping, production of radiopharmaceuticals, neutron radiography and tomography and neutron activation analysis.

Professor Drell  
Cornell University

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7 November 2000

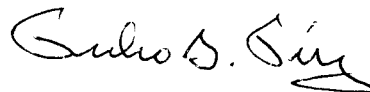
Fast neutrons have been utilized in special applications involving semiconductors. Research reactors provide a full spectrum of neutron energies for diverse applications in science and engineering. The Ward Center has provided neutrons of different energies to a diverse user community. In addition, the Cornell TRIGA reactor was the first university research reactor to construct and operate a cold neutron source. This source provides an outstanding opportunity for developing the first U.S. university ultra cold neutron source.

The Ward Center continues an active research and education role, as it is evident from a recent Department of Energy (DOE) Nuclear Engineering Education Research (NEER) award of almost \$200k. In addition, the Ward Center has received additional funding from the DOE Matching Grant Program to match an Electric Power Research Institute grant. The Ward Center reactor received other funding from DOE including programs including reactor sharing and fuel assistance. These funding levels and sources demonstrate both the industry and DOE recognition of a viable program.

The Nuclear Energy Research Advisory Committee (NERAC) has recommended increased levels of funding for nuclear engineering education and research and for research reactors. The Department of Energy supports the NERAC recommendations and is currently developing new programs and proposing increased funding for existing programs for the FY 2002 federal budget. The Ward Center is expected to be an active participant in these near future programs.

A question often asked is "*What is the Nation missing with research reactor closures?*" However, the important question should be "*What scientific discoveries have we missed by not providing the scientific community with the necessary neutron sources?*" Our Nation, our health and our future cannot afford a missed scientific opportunity. The Cornell University Ward Center for Nuclear Sciences is needed in the 21<sup>st</sup> century, and TRTR urges your Council to continue to support the Center.

Sincerely,



Pedro B. Pérez

cc: Professor J. Robert Cook  
Dean of Faculty  
Cornell University  
Ithaca, NY 14853

Professor Robert C. Richardson  
Vice Provost for Research  
Cornell University  
Ithaca, NY 14853

Dr. Kenan Unlu  
Director, Ward Center for Nuclear Sciences  
Cornell University  
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**Leo M. Bobek**  
*Reactor Director*

**RADIATION LABORATORY**

November 2, 2000

Prof. Peris Drell  
Chair, Local Advisory Council  
118 Newman Laboratory  
Cornell University  
Ithaca, NY 14853

Dear Prof. Drell:

As Chair of the Local Advisory Council for Cornell University, you have been given a task of the utmost importance affecting Cornell, the State of New York, and our Nation. This task is to oversee the decision of whether to continue the operation of the Ward Center for Nuclear Sciences (WSNC).

I do not exaggerate the extensive significance of this decision.

University research reactors (URRs) are a vital component of our Nation's science and technology infrastructure, extending far beyond the interests of nuclear engineering. Laboratories such as the WSNC are indispensable and irreplaceable research facilities used in biomedical, materials, archeological, physics, and various other disciplines.

There has been increasing recognition by the United States Government during the past few years of the regional and national value of URRs. Unfortunately, this recognition results partially from a few universities over the last several years deciding to discontinue the operation of their research reactors.

As Chair of the University Reactor Support Committee (URSC) for the National Organization of Test, Research, and Training Reactors (TRTR), I am familiar with the initiatives now underway within the federal government to support and maintain URRs. In April, a Blue Ribbon Panel of the Nuclear Energy Research Advisory Committee (NERAC) for the Department of Energy Office of Nuclear Energy recommended the establishment of a \$15M research, education, and infrastructure upgrade program for URRs.

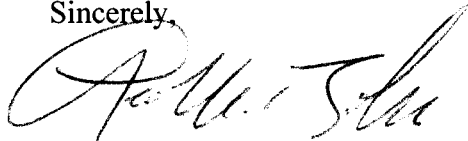
In September, the URSC met with staff of the White House Office of Science and Technology Policy and the Office of Management and Budget to discuss the development of URR funding programs outside of the DOE Office of Nuclear Energy. Specifically discussed was the need to recognize the URRs as multidisciplinary and establish a program for base support of URRs. An OMB budget analyst for the DOE Office of Science recently has requested additional information on the multidisciplinary nature of URRs. Currently, the URSC, in collaboration with the URR at the University of Utah, is

initiating efforts to advance URR initiatives with Senator Bennett of Utah. Senator Bennett is a key member of the Appropriations Subcommittee for Energy and Water Development.

These and other developments will both continue and expand the vital role of URRs. It is my sincere hope that the Ward Center for Nuclear Sciences will continue and grow along with these new initiatives.

If I can provide you any additional information, please do not hesitate to contact me.

Sincerely,



Leo M. Bobek, Director  
UML Research Reactor, and  
Chair, University Reactor Support Committee  
National Organization of Test, Research, and Training Reactors

CC:

Prof. J. Robert Cook  
Dean of Faculty  
315 Day Hall  
Cornell University  
Ithaca, NY 14853

Prof. Robert C. Richardson  
Vice-Provost for Research  
529 Clark Hall  
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Ithaca, NY 14853

Dr. Kenan Ünlü  
Director  
Ward Center for Nuclear Sciences  
Cornell University  
Ithaca, NY 14853



University of Michigan  
College of Engineering  
Nuclear Engineering and Radiological Sciences

*John C. Lee*  
*Professor and Chair*

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November 4, 2000

Professor Persis Drell  
Chair, Local Advisory Council  
118 Newman Laboratory  
Cornell University  
Ithaca, NY 14853

Dear Professor Drell:

It is my pleasure to respond to Dr. Kenan Ünlü's letter of 24 October 2000 regarding the future of the Ward Center for Nuclear Sciences (WCNS). Having reviewed the WCNS activity report of September 2000, I write to provide my strong endorsement for the continued operation and relicensing of the WCNS research reactor when the current license expires in 2003.

In addition to my duties as chair of the Department of Nuclear Engineering and Radiological Sciences at the University of Michigan, I have been serving, for the past two years, as interim director of the Michigan Memorial Phoenix Project, which operates the 2.0-MW Ford Nuclear Reactor on campus. Thus, I am in a position to critically review teaching, research, and service programs at the WCNS reactor and compare them with our own programs at Michigan. Based on the review, I am quite favorably impressed with the overall productivity of the WCNS and with the significant enhancements in scientific programs Dr. Ünlü has accomplished during two short years at Cornell.

As a research reactor with a power output of 500 kW and an annual operating budget of \$500K, the WCNS facility is making significant contributions to teaching and research activities of Cornell University. With 460 operating hours annually, the reactor performs nearly 900 sample irradiations per year and is used in 8 undergraduate and graduate courses. Seventeen faculty members from 12 different departments in four colleges have used the reactor and associated facilities in FY 99/00. I am impressed by the breadth of disciplines and experimental techniques represented in the instructional and research programs. I also note significant scientific collaborations with research scientists from four national laboratories.

It is also significant that a large number of corporate users conduct a variety of research at the WCNS. This is reflected in \$250K of service income for the WCNS, which accounts for a half of its total operating expenditures. I am also impressed by a number of federal grants that the WCNS has been awarded, with a total FY00 budget of approximately \$350K, including the Reactor Instrumentation grant, Nuclear Engineering Education Research (NEER) grant, and DOE/Industry Matching grant. Thus, it appears that the WCNS defrays a substantial fraction of its \$200K central administration support through its indirect cost returns on federal grants. This rate of return on the university support is much higher than that attained typically at university research reactors (URRs), including our own facility at Michigan.

The NEER grant for the development of time-of-flight neutron depth profiling is a particularly significant recognition of Dr. Ünlü's expertise in this important area of neutron physics research, since the success rate for NEER proposals is barely 10%. With the grant, Dr. Ünlü is building a unique research facility, which will improve the depth resolution of light element deposition in surface physics studies. This state-of-the-art facility offers a significant potential as an important nondestructive diagnosis tool in materials science and nanotechnology.

The significant contributions and importance of the university nuclear engineering programs and URRs are amply discussed in the report of the Corradini Subcommittee of the Nuclear Energy Research Advisory Committee, included as Appendix E to the WCNS report. URRs play a crucial role in educating scientists and engineers for further development of nuclear energy and for numerous industrial and medical applications of radiation science and technology. In this role, as the only URR in the state of New York, the WCNS research reactor is expected to play a unique role as a regional facility. Once the nuclear engineering community, with the support of the U. S. Department of Energy and Congress, acquires a larger funding for URRs and university nuclear engineering programs, it is highly likely that the WCNS will receive a substantially increased level of federal funding for its research and service programs.

The WCNS research reactor and associated facilities have made significant contributions to the instructional and research programs of Cornell University. The WCNS facilities have provided significant services to corporate users. Financially, the WCNS has earned a high rate of return on university support over the past few years. Its research program is visible and active under the leadership of Dr. Kenan Ünlü. Thus, there is a high likelihood that the WCNS will be selected as a regional URR with increased DOE funding. I provide my strongest recommendation for the continued operation and relicensing of the WCNS research reactor.

Sincerely,



John C. Lee  
Professor and Chair  
Interim Director of the  
Michigan Memorial Phoenix Project

xc: Professor Robert C. Richardson  
Professor J. Robert Cooke  
Dr. Kenan Ünlü





Nuclear Reactor Facility  
Department of Nuclear and Radiological Engineering

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November 9, 2000

Professor Persis Drell  
Chair, Local Advisory Council  
118 Newman Laboratory  
Cornell University  
Ithaca, NY 14853

Dear Prof. Drell:

This letter is written to provide input for Cornell's review of the Ward Center for Nuclear Sciences and to assist in Cornell's decision about whether to continue operation of the center before relicensing in 2003. A copy of the Ward Center annual report dated September 2000 was supplied to me by Dr. Kenan Ünlü. Based on many years of experience and knowledge of the Ward reactor facility, I have known it to be a highly regarded research and education enterprise. Indeed, the cold neutron work done at the Ward Center has been very well regarded. However, I was delighted to see the breadth of usage of the Ward Center, not only by nuclear engineering faculty but more importantly by the many other disciplines served by such reactor facilities. This ability to provide basic support in dozens of disciplines is why such reactors are so important and must be maintained for the scientific infrastructure of our country. Indeed, there is a worldwide shortage of neutron sources. It is clear that Dr. Ünlü has established a solid research and educational base of users with a growing and quite impressive list of funded research projects. Therefore, I urge your review group to make a speedy and positive decision to continue operation of the center and begin planning for relicensing in 2003.

Looking at the annual report it becomes clear that the Ward Center is doing well and has excellent prospects for further growth. The funding numbers are quite impressive for such a 500 kW facility. Nevertheless, it is essential that the facility and its current as well as potential clientele of educators and researchers be able to plan future uses without concern for relicensing. Now is the time to reendorse creation of the center and express support for continuing operation for relicensing in 2003. An early decision will also allow Dr. Ünlü to solicit more service users. This will assure that the growth seen in just the last couple of years can be used synergistically to foster still more usage.

Another important reason to make a positive decision as soon as possible is to provide another example to the Department of Energy. Facilities such as the Ward reactor provide unique support for this country's basic science infrastructure. Many of these facilities have been lost in recent years but the DOE is now actively engaged in review efforts of its own through the NERAC panel and a special subcommittee to see what is needed to prevent losing these unique multidisciplinary facilities. DOE initiatives to increase funds for research and education usage (NERI and NEER) as well as the NERAC panel's report recommending significant base funding support for such university research reactors is reaching a culminating point. Already in the last several years we've seen considerable increases in funding and with base support funding we will finally have the necessary funding to assure these facilities are adequately maintained to support the broad-based science that they facilitate. Even the nuclear power industry is experiencing a renewal with most existing plants planning to relicense. Our students with degrees in the nuclear area are highly sought even receiving signing bonuses in many cases. Before another decade is gone and as the fossil fuel economy receives more critical review, I believe additional new nuclear power plants will be ordered. Research in this area is already growing. Again, the Ward Center is well placed with already increasing funding to participate in this renewal. Once the positive decision is made that I believe is warranted by the data in the center's annual report, then the facility administration will be able to maintain continuity of the growth already experienced.

As a side note, I believe that relicensing a facility such as the Ward reactor is an eminently doable task. Knowing Dr. Ünlü as I do, I am sure he can manage this task while still moving the quality usage of the facility to still higher levels in both the number and the support of the academic and educational user clientele. Especially with DOE support, this relicensing task should not represent a serious budgetary problem.

If you should need further input or clarification on any issue, please feel free to contact me at any of the contact points listed above. I believe strongly that it would be a grave mistake not to make the decision in the Ward Center's favor at this time. Indeed, their budget appears to be in excellent shape last year and for the coming year. With the future of nuclear science and engineering beginning to look so bright on the national level, it would be unwise to remove a leader.

Thank you for your consideration.

Sincerely,



William G. Vernetson  
Director of Nuclear Facilities

cc: Prof. Robert C. Richardson  
Prof. J. Robert Cooke  
Dr. Kenan Ünlü

November 1, 2000

Prof. Robert C. Richardson  
Vice Provost for Research  
529 Clark Hall  
Cornell University  
Ithaca, NY 14853

Dear Prof. Richardson,

I am writing you to support the continued operation of the Triga Mark II Research Reactor in the Ward Center for Nuclear Sciences. I had met you at the DOE meeting on September 18<sup>th</sup>, 2000, and in that meeting I presented the recommendations of the NERAC Blue Ribbon Panel on the important issues in regard to the future of Nuclear Engineering Programs and University Research Reactors. The Ward Center nuclear reactor is one of the more visible and more important facilities at leading research universities. In my view it is crucial that such facilities are maintained and actually better supported by the DOE and the broader user community. Let me provide you with my reasons for these conclusions.

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 as well as graduate research. To insure that such facilities are properly supported our Blue Ribbon Panel recommended the following actions.

The panel proposed that a competitive peer-reviewed program augment the current DOE financial support for these university reactors, such as the Ward Center nuclear reactor. 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 provides for reactor improvements as part of a focused effort that emphasizes research, training and 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 for a total competitive program funds at a level of \$15 million annually.

It is my opinion that the Ward Center nuclear reactor would likely qualify for such a program and could be competitive for such awards.

The Ward Laboratory staff have already a key DOE NEER award in which the Ward Laboratory nuclear reactor is the crucial facility. An experimental investigation of the time-of-flight (TOF) method for Neutron Depth Profiling (NDP) is a nondestructive, near-surface technique, which utilizes a thermal/cold neutron beam to determine the concentration of specific light elements versus the depth in materials. The depth distribution is obtained by measuring the energy loss spectrum of protons, alphas, or recoil atoms in the substrate materials. Because the charged particle energy is obtained using a surface barrier detector in NDP, the depth resolution is highly dependent on the limited ability of the detectors and associated electronics. A depth resolution of hundreds of Angstroms is achieved with current NDP facilities. However, the performance of NDP can be improved to increase the resolution to a few tens of Angstroms. In the proposed TOF-NDP, a timing start signal is obtained from electrons emitted simultaneous with a neutron-induced recoil particle leaving the surface of the sample. The same particle generates the subsequent stop signal, whereby the residual energy of the particle is much more precisely determined from the particle flight time than currently obtained by the use of surface barrier detectors. Consequently, this experimental study could greatly improve the depth resolution of light elements in technologically important materials and further our understanding of dopant behavior in materials.

It is my view that this sort of research activity is key to the continued vitality of nuclear engineering programs at major research universities. It also seems apparent to me that the Ward Laboratory nuclear reactor is unique in its abilities and should be maintained and could be further supported by the new competitive program that our committee has proposed to the DOE. I hope these comments are helpful in your current deliberations. If I can be of any further assistance please contact me.

Sincerely,



MICHAEL CORRADINI, ASSOCIATE DEAN  
Wisconsin Distinguished Professor of Nuclear Engineering