

**Report of a Workshop on “Nuclear Power Growth: Domestic and International Public Acceptance,” Woodrow Wilson International Center for Scholars, Washington, DC, November 30, 2006**

As a result of rising petroleum prices, increasing energy demand, concerns over energy security, environmental initiatives aimed at reducing greenhouse gas emissions and other emerging issues, nuclear energy will receive growing scrutiny in the coming decades. In the United States, the Bush Administration’s energy policy has been favorable to nuclear power growth, and the Global Nuclear Energy Partnership (GNEP) is designed to expand nuclear power in the United States and abroad. While the U.S. remains the largest producer, other parts of the world have been pursuing nuclear power more aggressively. There is a general sense that the utilization of nuclear energy to generate electricity will grow, perhaps dramatically, resulting in a “renaissance” of nuclear energy.

It is widely viewed that such an expansion of nuclear power would have positive energy, economic and environmental benefits for the world. However, there are concerns about the economic competitiveness, safety and proliferation and terrorism risks of nuclear power. Public acceptance is largely tied to these and other issues, as well as to risk perceptions, perhaps most tellingly, that the growth of nuclear power will inevitably generate increased risks of proliferation and terrorism.

A vigorous public debate involving all of these issues is essential if there is to be dramatic growth in nuclear power in the United States--as envisaged by the Global Nuclear Energy Partnership—and perhaps also around the world. It is important to understand current perceptions of the public and opinion leaders in the United States and around the world, as well as the underlying issues framing the reemerging debate. In this context, the Los Alamos National Laboratory (LANL) in cooperation with the Woodrow Wilson International Center for Scholars (WWICS) held a second workshop on the future of nuclear power on November 30, 2006 in order to understand and assess the issues surrounding the debate over and the prospects for public acceptance of the growth of nuclear power.

**Prospects for Nuclear Power Growth**

While the talk of a nuclear renaissance increases – perhaps somewhat prematurely — nuclear power is growing in many parts of the world, especially in Asia. What are the prospects for growth? It was argued that the global prospects for growth in nuclear capacity are greater than they have been for decades. The advantages of nuclear over coal and natural gas in the generation of baseload power were noted in this regard. While coal based electricity generation is expected to remain the main source of electricity for some time due to its cost, increasing global concerns over carbon emissions is providing an impetus to consider alternatives. As for natural gas, recent increases in cost have demonstrated the volatility in the price of electricity produced from this source. Concerns regarding intentional interruptions of natural gas supplied through transnational pipelines have also grown.

In addition to these factors, it was noted that in 2002 the US Congress approved Yucca Mountain as a geologic disposal site for spent fuel. Additional legislative initiatives are underway (S. 2099) which would eliminate the legal cap on Yucca mountain disposal capacity (70,000 metric tons of spent fuel) and would support efforts to establish an interim spent fuel storage facility on the site. The passage of the Energy Policy Act of 2005 in the United States also represents a significant boost to nuclear power, extending existing investor protections and offering new incentives. Loan guarantees for new construction were offered, limited compensation was made available to protect against delays in plant startup, and production tax credits (1.8 cents per kWh for 8 years) were offered to the first 6000 MW of installed capacity.

Finally, and perhaps most importantly, the expanding economies in China, India and elsewhere are producing enormous demands for energy. Meeting this demand will likely require energy from all sources, including nuclear.

Given this emerging climate, has the issue of public acceptance of nuclear energy been put to bed in the United States? Public opinion polling and interpretations look surprisingly good for nuclear energy's public acceptance – 20 years after Chernobyl--and many indicators point in a positive direction for nuclear power.

The Bush Administration's GNEP initiative emerged in the context of, and is designed to realize, this promise. GNEP seeks to increase U.S. and global energy security and promote nonproliferation through the expanded use of proliferation-resistant nuclear energy to meet growing electricity demand. Key elements of GNEP include:

- Creation of a mechanism for providing "Reliable Fuel Services" to assist states in producing safe, affordable nuclear energy while limiting the spread of enrichment and reprocessing;
- Development and deployment of new technologies to recycle spent nuclear fuel that do not involve the separation of pure plutonium and that reduce global stocks of separated plutonium in the long run;
- Development and deployment of advanced burner reactors to minimize nuclear waste as well as produce energy from recycled nuclear fuel;
- Implementation of advanced safeguards approaches, especially during facility design and construction, to enable the International Atomic Energy Agency (IAEA) to more efficiently and effectively monitor and verify state declarations about their nuclear material and activities; and
- Design and development of reactor concepts, such as small-scale nuclear reactors, that are well suited for deployment in developing economies.

Nonproliferation is important to GNEP. The Partnership offers a bold, comprehensive vision of the future of nuclear energy that seeks to address the challenges posed by a number of the most pressing of today's proliferation problems. It attempts to address the spread of sensitive nuclear technology and the concerns posed by the prospect of vast and growing stockpiles of separated plutonium, as well as to meet the nonproliferation demands of a global nuclear energy renaissance.

GNEP seeks to influence and restructure the future international fuel cycle in a manner that yields a net gain for nonproliferation. A critical element of GNEP is the creation of a cradle-to-grave fuel leasing regime that could provide a reliable, affordable fuel supply as well as spent fuel disposition in a manner avoiding the need to separate plutonium. The ability to provide these services on a cost-competitive basis to states seeking to enter into the commercial nuclear power arena, or to expand the contribution nuclear power already makes to their national energy grids, would provide a strong incentive for those states to voluntarily refrain from the pursuit of indigenous enrichment and reprocessing capabilities where they are unnecessary from an economic or energy standpoint.

If successful, GNEP will minimize the proliferation risks associated with the expansion of nuclear energy primarily through institutional measures that discourage the spread of enrichment and reprocessing capabilities beyond those states that already possess such capabilities. This regime will also require successful development and deployment of advanced recycling and fast reactor technologies that reduce the availability and attractiveness of materials and processes for weapons purposes and require enhancements to the state-of-the-art of nuclear safeguards methods and instrumentation. GNEP's promise of proliferation risk reduction is not a function of any single institutional or technical measure, but rather the combination of measures within the entire GNEP fuel cycle architecture.

GNEP has become central to the debate on nuclear power, which is raging again, as proponents and opponents battle to sway public opinion to their side.

It is important to ask whether there are languishing issues from the debate of the 1970s. It was recalled that the first coming of nuclear energy was brought to a halt by a number of developments, including:

- The overselling of nuclear technology's benefits, including the promise of "energy too cheap to meter;"
- The accidents at Three Mile Island (TMI) and Chernobyl, the latter especially highlighting the potential of large, uncontrollable accidents and grave environmental impacts; and
- The regulatory framework/environment and the sophisticated tactics of the nuclear energy's opponents in exploiting it.

These developments led to increased costs and delays in reactor construction. They challenged the credibility of nuclear advocates in the industry and government. These developments were exacerbated by:

- General disillusionment with big science and technology;
- Growing challenges to authority, whether scientific, technical and political; and
- The military history and technical links to nuclear power, along with proliferation problems and governmental policies to address them.

There was some sense this legacy is affecting us today, but the issue was not exhaustively addressed.

## The Public Debate

As in the 1970s to a large extent, the current debate is shaped by the realities of oil prices and possible shortages, energy security concerns, and – a new issue – global warming.

There is a growing sense of the urgent need for nuclear energy in the United States. Changing public opinion shows that in the United States today nuclear power is seen very favorably, a changing perspective suggesting the United States shares a view long held in states like France, Japan and Russia, among others.

The comparable results of several public opinion polls were presented and discussed. One presentation on public opinion reported that a new national survey found unprecedented public awareness about nuclear energy's benefits, coupled with strong favorability and support for nuclear energy.

In this poll conducted in September 2006, nearly 7 in 10 Americans favor the use of nuclear energy to produce electricity and would support building a new reactor at the existing nuclear power plant site closest to where they live.

Nearly 60 percent of the participants in the poll had read or heard about the need for nuclear energy during the past year. Almost half heard about the need to build more reactors, as well as the efficiency and clean-air benefits of nuclear energy. It was noted that by comparison, a May 2003 survey found only 9 percent recalled hearing or reading any favorable news about nuclear energy.

It appeared that greater public awareness of its benefits is changing nuclear energy's public image. For years, nuclear energy has experienced a "perception gap." Although the majority of Americans favor nuclear energy, most are unaware of that fact and believe there is not widespread favorability of nuclear energy. It was argued that as people learn more about nuclear energy's benefits, however, this perception gap is beginning to close.

While public opinion appears favorable, there are questions about the "fickleness" of polls as well as the limited knowledge of publics about the technical and other difficult issues raised by an expansion of nuclear power, as well as by GNEP. It was noted that there remains factors against public acceptance. Factors favoring public acceptance include:

- A belief that nuclear power is beneficial (avoiding global warming, high fossil fuel prices, Middle Eastern wars, etc.);
- A problem-free operational record;
- Low costs; and
- The appearance of a nuclear waste "solution," i.e., an operational repository, federal ownership and custody of wastes.

Among the factors against public acceptance are:

- Fear (of nuclear weapons, radiation, accidents, etc.);
- Nuclear power plant cost overruns;

- Absence of waste disposal “solutions;” and
- Demonization by political pressure groups.

### **Analyzing the Issues**

Changing public opinions in the US (and elsewhere) must be tempered by an appreciation of the softness of opinions and the unresolved issues that are suggested by the factors for and against public acceptance noted above. There remain concerns about nuclear power’s economic competitiveness, safety, proliferation and terrorism risks, etc. Of these issues, what is real and what is perceived? And does it matter? Moreover, a number of key issues were discussed. What issues are crucial to public acceptance of nuclear power in the United States? Around the world? Are there issues that can derail a nuclear revival here?

A number of key issue areas were discussed.

### ***Economics***

Although the economics of nuclear power was not central to the discussions, it was recognized that without favorable economics, there will be no revival of nuclear energy in the United States and long-term limits on growth in the rest of the world. Plant performance is a key issue in assessing the economics of nuclear power, but there are other key issues as well. How competitive is nuclear power in comparison to alternatives? What can be done to improve its economics? Definitive economic assessments are difficult and much will be determined on local, i.e., state-specific economic and regulatory factors. However, it was recognized that advances in design, construction and materials hold promise for future capital cost reductions, and that licensing and other regulatory reforms are occurring. These changes are promising as means to reduce investment risk and make nuclear more attractive to Wall Street.

### ***Safety***

The safety of current nuclear power reactors has been well demonstrated, and there is an expectation that new designs will enable further improvements. As a consequence, the public perception of the safety of nuclear power has become a positive to some degree. It was noted that TMI demonstrated that old safety measures worked to prevent a release of radiation, and even Chernobyl’s consequences do not appear as grave as many believed<sup>1</sup>. Nonetheless, safety remains an issue.

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<sup>1</sup> A UN report published in the last few years concluded that the health impacts from the Chernobyl accident are not as severe as feared. “The health effects of the accident were potentially horrific, but when you add them up using validated conclusions from good science, the public health effects were not nearly as substantial as had at first been feared.” The study noted that while as many as 4000 may ultimately die; around 50 deaths can be directly attributed to radiation exposure to date, mostly from those fighting the fire at the reactor. “Chernobyl’s Legacy: Health, Environmental and Socio-Economic Impacts,” UN Chernobyl Forum

***Environmental Impact***

One of the critical factors in the prospects for nuclear power will be its environmental impact. As with safety, in contrast to past perceptions, at present, nuclear power looks to many to be an environmentally sound energy alternative. It appears as an important means of reducing global warming. What impact will a rise in nuclear power have on greenhouse gas emissions? How large must the nuclear expansion be to affect global warming? One related question, which also is an economic issue, will be how long can the operating licenses of existing plants be extended. The fate of existing coal fired plants and the future of clean coal technologies is also relevant. If existing baseload production capacity is removed, there will be even greater pressures for new nuclear plants.

***Back-end/waste management***

The back-end issues, including waste management and the possibility of closing the fuel cycle are highly contentious, and can be expected to raise economic, environmental, safety and proliferation issues. Waste is clearly a negative in public perceptions of nuclear energy. In response to these concerns, some advocate a closed fuel cycle as necessary to meet waste management goals and believe it will be economically viable in the future, but this perspective is challenged by critics on economic, proliferation and other grounds. The absence of an operational waste repository creates issues for the US government as it is required by law to accept nuclear waste from energy production. It was noted that centralized temporary storage, perhaps for decades, also needs to be addressed.

***Proliferation and Terrorism Risks***

It is important to understand the impact of the proliferation and terrorism risks of nuclear power. If they are assessed to be unrealistically high, it will create a sense that nuclear power is too dangerous, even with “Fort Knox”-style security. If the risks are dismissed, public confidence may decline in the face of another “whitewash.” With these considerations in mind it was noted that, risks posed to the nuclear enterprise could involve a multitude of actors and take a variety of forms. Nuclear proliferation can encompass everything from a virtual capability to produce weapon-usable materials to a full weapon program. Nuclear terrorism can range from the threat or use of a nuclear weapon to the dispersal of radiological material and the attack/sabotage of nuclear facilities or transport.

These risks appear to vary widely in both their likelihood and in public perceptions of their consequences. In this context, how do risks of proliferation and terrorism, both real and perceived, compare to other issues important for public acceptance of nuclear power? How serious are these risks? For reactors? For enrichment? For reprocessing? Can these risks be addressed? How can this be done?

Unlike the issues of economics, plant performance, safety and environmental impacts, the importance of proliferation and terrorism risks in the calculus of public acceptance is difficult to gauge. Many nongovernmental organizations focus on these issues and at least some polls suggest they are highly important. They clearly need to be addressed. The prospect of nuclear energy growth raises certain concerns. It was recognized that

current practices have resulted in the generation of a significant amount of separated plutonium in several countries. More than 200 metric tons of separated civilian plutonium is currently in storage awaiting fabrication into fuel. This buildup is the undesirable result of a variety of independent decisions taken by states utilizing nuclear energy. It was seen as presenting unnecessary security risks from nation states and subnational terrorist organizations. In addition, should nuclear power grow, it was argued that there will be a corresponding increase in demand for uranium enrichment. Pressures to address spent fuel issues could also lead to an expansion in the use of reprocessing. Both of these technologies are sensitive due to their potential use in a nuclear-weapon program.

It was argued that none of these outcomes are inevitable, and that proposals for international fuel cycle centers, various fuel supply arrangements and the Global Nuclear Energy Partnership seek to fundamentally alter the manner in which nuclear power is used around the world. These proposals and others, it was recalled, were discussed at the recent IAEA special event on “Assurances of Nuclear Supply and Nonproliferation.”

### **The Impact of GNEP**

How important is a US revival –and GNEP – for nonproliferation and efforts to combat nuclear and radiological terrorism?

Some argued that GNEP increased proliferation risks by moving to a closed fuel cycle, and resulted in charges of discrimination because it divided the world into “fuel cycle” and “reactor” states. Others argued that many states have already rejected the once – through cycle which would in any case not be sustainable over time, and that it was important to develop alternatives to current practices involving PUREX and MOX recycling. They noted that through reliable fuel supply, advanced safeguards and enhanced proliferation resistance, GNEP would, if successful, bring significant nonproliferation benefits in these and other areas.

Discussions of the nonproliferation elements of GNEP in the context of their impact on public acceptance for the Partnership and for nuclear power growth generally revealed a mixed tally sheet.

From a public acceptance perspective, some elements were seen to be uncontroversial while others were seen as highly controversial. Providing reliable fresh fuel supply is clearly uncontroversial. The production, storage and transport of natural or low enrichment uranium raises few risks and therefore limited public interest. However, a commitment to dispose of nuclear waste, particularly if it was of foreign origin, is difficult because even though progress has been made, no state has completely solved its waste disposal problems. Such a commitment would be controversial because publics would not likely be eager to accept high-level radioactive waste for disposal in their county, state or country.

Despite these problems, it was argued that the prospects for public acceptance of spent fuel take-back could be dramatically improved if the burden of waste disposal itself were

reduced. Work is proceeding to develop fuel forms that would enable the transmutation of key radionuclides and expand US repository capacity, and the fast reactors needed to burn such fuel are also being developed. A successful transmutation program could make spent-fuel take-back both plausible and publicly acceptable. Spent fuel take-back could also be more acceptable if the public was convinced that a greater good is being served. Concerns over carbon emissions motivate an expansion of nuclear power but do not by themselves necessitate the front-end and back-end arrangements envisioned under GNEP.

Even in this climate, depending on their location, new reprocessing facilities and probably fast reactors will face challenges in siting and licensing. As nuclear power must still compete with other sources of energy in privatized energy markets, it was noted that cost issues will also remain. How much of a premium will be necessary and who should pay?

It was also noted that transportation issues will grow in significance for a more globally integrated fuel cycle. Rail and ship transfers of radioactive waste and separated plutonium have garnered much attention in the past, primarily due to safety and security concerns. The necessary increases in transnational nuclear transfers could present a major challenge for an expanded system of global fuel services. GNEP does offer a path to address these issues in part through co-location of facilities.

We may then have a bold path to meeting proliferation and terrorism concerns in GNEP, although political and technological uncertainties with the Partnership remain. Will this be sufficient to ensure nuclear power growth, or is the politics paramount—and more Byzantine or elusive?

### **Implications for Nuclear Power**

To what extent does the growth of nuclear power depend on public acceptance? Will public acceptance be exclusively driven by the perceived need for nuclear power or by other issues? These questions were recognized to be difficult.

The potential impact of the nuclear debate for future nuclear growth is ambiguous. Evidence of support for new nuclear power is wide spread, but this support may be somewhat tenuous and one participant argued it may represent a new “group think.”

It was argued that public opinion may not have a significant role in most states’ decision-making process, although it clearly does so in the United States.

In this context, can public acceptance be achieved in the United States and other key countries? What is needed to promote acceptance of nuclear power? It was argued by some that public acceptance required a clear and sustainable policy, an articulated need for nuclear power, realistic expectations, an effective and credible regulator and a strategic view of infrastructure issues (personnel, manufacturing, capability, etc.). The importance of long-term, effective and sustainable public education campaigns to build nuclear support was seen as critical of participants. Nuclear power needs to be seen in

the United States as a national security rather than a merely commercial matter for industry.

It was noted by a number of participants that questions on expected economic performance and other issues, while important, fail to recognize the most important one. In this view, whether the United State will have a renewed and expanded nuclear power future depends on whether we wish to provide a stable decision-making environment for such projects. Countries where nuclear power has done best are all characterized by stable decision-making climates, it was argued, but for the past three decades the unpredictability of the US safety regulatory system resulted in an unstable environment. This, it was noted, has had a large effect upon private investment decisions in nuclear power.

### **Conclusions and Next Steps**

A nuclear renaissance does not necessarily mean significant changes to the way the international fuel cycle functions. Reductions in carbon emissions can be met with existing approaches. Incentives will be necessary if alternatives are desired. The public may support fundamental changes to the nuclear fuel cycle (such as spent fuel take-back arrangements) but there must be real benefits to doing so that are clearly articulated. Nonproliferation arguments can be compelling in this regard. Fostering international cooperation and coordination will be important from the outset and may be one of the legacies of the proposals of today. As a consequence of the importance of international cooperation highlighted in this workshop, as in the first, LANL and WWICS will focus on this topic at the third workshop in the series which will be held in the spring of 2007.

**Workshop on Nuclear Power Growth: Domestic and International Public Acceptance**

**Woodrow Wilson International Center for Scholars, Washington, DC  
November 30, 2006**

**Agenda**

9:00-9:30 am

**Welcome/Introduction**

9:30-11:00 am

**Panel I. Debating Nuclear Power Growth**

V. Reis

A. Scheinman

11:00-11:15 am

Break

11:15 am-12:45 pm

**Panel II. The Public Debate**

A. Bisconti

R. Hagengruber

M. Golay

J. Hughes

12:45-2:00pm

Lunch

2:00-3:30 pm

**Panel III. Analyzing the Issues**

H. Feiveson

J. Herczeg

K. Budlong Sylvester

3:30-3:45 pm

Break

3:45-5:15 pm

**Panel IV. Implications for Nuclear Power**

M. Fertel

R. Meserve

T. Bjornard

D. Poneman

5:15-6:00 pm  
**Wrapup**

6:00-7:30 pm  
**Reception**