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US International Nuclear Energy Policy: Change and Continuity

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Abstract

The renewed interest in and activities related to nuclear power worldwide have raised concerns about proliferation, safety and security. The Obama administration is constructing policies that are at the same time consistent with and different from those of the Bush administration. For example, the administration is proceeding with efforts to win support for tighter rules on sensitive nuclear technologies in the Nuclear Suppliers Group (NSG) and to establish international nuclear fuel banks and other supply assurances. By contrast, the fate of the Global Nuclear Energy Partnership (GNEP), a centrepiece of the Bush administration's nuclear approach, is still to be determined. However, concerns such as enhancing safeguards and security and efforts against nuclear terrorism will be integral to President Obama's international nuclear energy policies.



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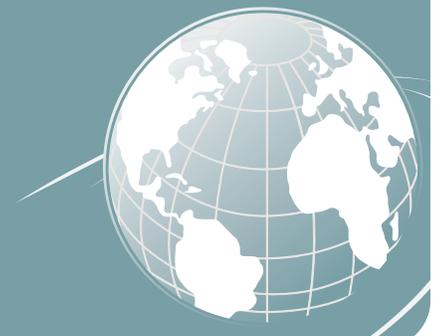


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CIGI's Nuclear Energy Futures Project

CIGI's Nuclear Energy Futures Project is chaired by CIGI distinguished fellow Louise Fréchette and directed by CIGI senior fellow Trevor Findlay, Director of the Canadian Centre for Treaty Compliance at the Norman Paterson School of International Affairs, Carleton University, Ottawa. The project is researching the scope of the purported nuclear energy revival around the globe over the coming two decades and its implications for nuclear safety, security and nonproliferation. A major report to be published in 2010 will advance recommendations for strengthening global governance in the nuclear field for consideration by Canada and the international community. This series of papers presents research commissioned by the project from experts in nuclear energy or nuclear global governance. The resulting research will be used as intellectual ballast for the project report.

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Introduction

As the Obama administration settles into office, it is beginning to construct a set of policies intended to manage a revival of interest in nuclear power worldwide so as to minimize proliferation, safety and security risks. These policies represent both change and continuity from the policies of the Bush administration. President Barack Obama has moved forward with a bilateral nuclear cooperation agreement with the United Arab Emirates (UAE) that the Bush administration signed in its final days, while slow-rolling one with Russia. In both cases, broader foreign policy objectives have played a larger role relative to narrower energy concerns. The new administration is pushing forward with its predecessor's efforts to win support for tighter rules on sensitive nuclear technologies in the Nuclear Suppliers Group (NSG) and establish international nuclear fuel banks and other supply assurances. Obama intends to scale back, refocus and possibly eliminate the Global Nuclear Energy Partnership (GNEP), a centrepiece of its predecessor's international nuclear energy approach. At the same time, he intends to emphasize other concerns, such as enhancing nuclear safety, security and safeguards, and linking an effort against nuclear terrorism more tightly to his international nuclear energy policies.

Both the Obama and Bush administrations' policies have been driven in large measure by two events that occurred in 2002-2003: revelations of Iran's clandestine uranium enrichment program and the discovery of the A.Q. Khan black market nuclear network. In the wake of the 9/11 terrorist attacks, the discoveries prompted concerns that ever more countries would obtain access to the sensitive nuclear technologies of uranium enrichment and spent fuel reprocessing, which can both produce fuel for nuclear power plants and fissile material for nuclear weapons. They prompted leaders such as Presidents Bush and

Obama, International Atomic Energy Agency (IAEA) Director General Mohamed ElBaradei and others to look for new ways to stop the spread of these technologies.

In doing so, both Bush and Obama have struggled to find an appropriate mix of international rules, technology alternatives, and incentives and disincentives that would prevent additional countries from gaining access to these sensitive technologies.

Bush's approach relied more on technology and attempts by major nuclear suppliers to impose new international rules on other states. In a February 11, 2004, speech President Bush called on governments to limit the right of states to possess enrichment or reprocessing technology. (Bush, 2004). Bush also sought to win support from the NSG and the G8 to prevent such technology transfers to new countries. His administration sought to convince non-nuclear-weapon states to accept strengthened (IAEA) inspection and accounting procedures ("safeguards") to prevent nuclear fuels and technology from being diverted to weapons. Under GNEP, Bush administration officials sought to transform an existing research program on advanced spent fuel reprocessing techniques (the Advanced Fuel Cycle Initiative) into a means of minimizing the dual-use dilemma of enrichment and reprocessing. The Bush's administration's original vision of nuclear fuel banks would only have granted access to those countries that renounced enrichment and reprocessing.

The shortcomings of this strategy were evident before the end of Bush's second term and the administration's efforts to limit the spread of sensitive nuclear technology met two sets of objections. One objection was on principle: some non-nuclear-weapon states saw the initiative as an attempt to restrict their rights to peaceful nuclear technology under Article IV of the NPT. The other was on

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economic grounds: the non-nuclear-weapon states argued that the Bush administration was using a spurious non-proliferation argument to cover up its true rationale: advancing the commercial interests of enrichment companies in the advanced nuclear states. In some ways, the effort backfired, encouraging countries such as Argentina, Canada and South Africa to state their interest in enrichment in order to ensure they would not be cut off from future opportunities to profit in this sector. Other countries, such as Australia, publicly weighed the possibility.

Facing these problems, the Bush administration began to test some new approaches in its waning days. Obama has picked up on a few of these alternative approaches, while dropping some of the earlier Bush ideas. For example, Obama endorsed the creation of an international fuel bank which would not require recipients to renounce enrichment and reprocessing, an approach ultimately supported by Bush and the previous Democratic Congress. He has continued to support a Bush administration attempt to reach a compromise on new NSG rules that will be tighter than current standards, but would not be as strict as those Bush initially proposed. And he backed a bilateral nuclear cooperation deal the Bush administration negotiated with the UAE (albeit with a few changes), which many considered a model for efforts to contain proliferation in the Middle East.

At the same time, the Obama administration has phased out key areas of GNEP and de-emphasized others. By calling for a nuclear-weapons-free world and taking practical steps in that direction, Obama has sought to counter criticism from non-nuclear-weapon state signees of the Nonproliferation Treaty (NPT) that the United States under the Bush administration demanded more of them even though Washington was not meeting the treaty's disarmament requirements. Nonetheless, whether Obama's approach will be more successful than Bush's in meeting their common goal is still an open question.

The Bush Administration's Approach

The Global Nuclear Energy Partnership

Soon after taking office, the Bush administration turned its attention to energy policy, with Vice President Dick Cheney leading a National Energy Policy Development (NEPD) Group. The group placed particular emphasis on nuclear power, urging that it be expanded in the United States "as a major component of our national energy policy" (National Energy Policy Development Group, 2001). It

also recommended that spent fuel reprocessing should once again become integral to the US nuclear program, although it had been largely discouraged by American policy makers since the 1974 Indian use of reprocessed nuclear fuel to test a "peaceful nuclear explosive." The policy was changed despite the ostensible success of the previous effort, which encouraged a decline in spent fuel reprocessing worldwide (Lyman and von Hippel, 2008).

In particular, the NEPD Group recommended that:

- in the context of developing advanced nuclear fuel cycles and next generation technologies for nuclear energy, the United States should reexamine its policies to allow for research, development and deployment of fuel conditioning methods (such as pyroprocessing) that reduce waste streams and enhance proliferation resistance. In doing so, the United States will continue to discourage the accumulation of separated plutonium worldwide.
- The United States should also consider technologies (in collaboration with international partners with highly developed fuel cycles and a record of close cooperation) to develop reprocessing and fuel treatment technologies that are cleaner, more efficient, less waste-intensive, and more proliferation-resistant (National Energy Policy Development Group, 2001).

The effort appeared aimed less at addressing nonproliferation concerns than finding some means of handling the tons of spent fuel accumulating at US nuclear plants because of the federal government's failure to open a long-term geological repository. Under the 1982 Waste Policy Act, the US government was supposed to begin accepting civilian-used nuclear fuel for disposition in 1998. Utilities have successfully sued the federal government for failing to meet its responsibilities, winning up to US\$500 million in damages annually with estimates that total costs could reach well over US\$60 billion (Nuclear Energy Advisory Committee, 2008: 9). The administration argued that using reprocessing technology to remove some of the elements of spent fuel with the greatest radiotoxicity and which produce the greatest heat would allow more fuel to be placed in the proposed Yucca Mountain repository, particularly if newer reprocessing technologies such as "UREX+" and "pyroprocessing" were employed.

Administration officials also contended that the newer reprocessing technologies, which they envisioned ultimately providing fuel for a new generation of "fast spectrum" reactors, were more "proliferation-resistant" than traditional

PUREX technologies.¹ PUREX had been designed by the United States to extract pure plutonium for nuclear weapons. In PUREX reprocessing, spent fuel is dissolved in hot nitric acid. Plutonium and uranium of high purity are extracted separately by bubbling an organic solvent through the mix. Under UREX+, five solvent extraction processes are used to separate spent fuel into seven separate fractions. In a typical variant, one fraction includes plutonium and neptunium (another transuranic element) (Vandegrift et al., 2004). In pyroprocessing, spent fuel is cut into pieces and heated and turned into a powder. This process also burns off volatile fission products such as Krypton and Xenon as well as some of the semi-volatile fission products such as Iodine and Cesium. (The hotter the process the more that is burned off). The spent fuel oxide powder is transformed into a metal and then put in a molten bath of Lithium and Potassium Chloride salts. An electric current is then run through the salts to dissolve the metal and to separate elements in several stages, beginning with the recovery of uranium from the molten salt bath. This uranium recovery operation is continued until the concentration of transuranics such as plutonium, neptunium, americium, and curium in the molten salt reaches a level where they too can be separated from the bath, along with a significant amount of fission products, such as cerium, neodymium, and lanthanum making the resulting material less usable in weapons. It can then be directly fabricated into metallic fast reactor fuel without any further processing or purification. This process does not produce pure separated plutonium. In both cases, the Bush administration claimed that retaining other elements in this material along with the plutonium could provide a new type of fuel while being less attractive for weapons production than pure plutonium, thus discouraging proliferation (ONEST, 2003).

This argument, however, has been heavily criticized. In the case of UREX+, some observers noted that the new fuel would be much less proliferation-resistant than spent fuel that was not reprocessed. They claimed that leaving plutonium mixed with such minor actinides as neptunium would offer little proliferation resistance. Neptunium, for example, is usable in weapons and is less radioactive than plutonium: "Adding it to plutonium therefore would not decrease at all the attractiveness of the mixture for weapon purposes," wrote Edward Lyman and Frank von Hippel. If uranium was also included in the mix, they

¹ Fast spectrum reactors (also known as fast reactors) are nuclear reactors that try to utilize more of the neutrons in a sample of uranium (the more numerous U-238 neutrons as well as the much rarer U-235) by operating at higher energy levels. Unlike common light water reactors in North America, for example, they do not use moderators such as water or hydrogen to slow neutrons down.

wrote, "the uranium dilutant could be separated out with very simple chemical processing" (Lyman and von Hippel, 2008).

In contrast, these critics acknowledged that "pyroprocessing does produce a mixture that is more radioactive than the pure plutonium produced by PUREX." But they said that "the difference is not great enough to justify claims that it is significantly more proliferation resistant and certainly not great enough to justify assertions by some US officials that 'pyroprocessing is not reprocessing.'" They further argued that pyroprocessing should not be compared to PUREX, but to the current practice of simply storing spent fuel. In that context, they claimed "pyroprocessing appears anything but proliferation resistant" (Lyman and von Hippel, 2006; Aryaeinejad et. al., 2006; Wymer et.al., 1992: 80).

Others, however, dispute these criticisms. As one supporter of pyroprocessing wrote:

Although the resulting product contains recovered plutonium it also contains too many transuranic impurities from pyroprocessing to be suitable material for a bomb; the material is thermally and radioactively far too hot and generates far too many spontaneous neutrons. Producing suitable bomb material would require further purification of plutonium product, which in turn would require an additional wet processing facility like a PUREX plant (Park, 2009).

Still, both supporter and opponents would agree, as Lyman and Von Hippel argued, that unlike with UREX+ whose product might be used in current nuclear reactors (as part of mixed-oxide fuel),

"[p]yroprocessing suffers from a clear practical problem: it is designed to treat metal fuel for liquid sodium-cooled reactors and is not optimal for the ceramic uranium-oxide fuel used by the light water reactors that are today's standard reactors."

Nonetheless, the US Energy Department moved forward in 2003 with the Advanced Fuel Cycle Initiative (AFCI), a program to develop the new reprocessing technologies and build on ongoing research. The Republican-controlled Congress expressed clear support for the program in its early days, topping up funding and granting it statutory authorization in the Energy Policy Act of 2005, including support for international cooperation (Holt, 2008: 5-6).

In 2006, President Bush sought to address both the problems of nuclear waste and the newly urgent nonproliferation

considerations raised by Iran and A.Q. Khan by initiating GNEP. At its heart were the AFCI research efforts to develop more advanced technologies for reprocessing spent fuel. Under GNEP, advanced nuclear energy states would provide developing non-nuclear-weapon states with fresh fuel and reactors in return for the resultant spent fuel so long as those developing states agreed not to engage in enrichment or reprocessing. Advanced nuclear states would eventually reprocess this material in new facilities using the newer “proliferation-resistant” technologies such as UREX+.

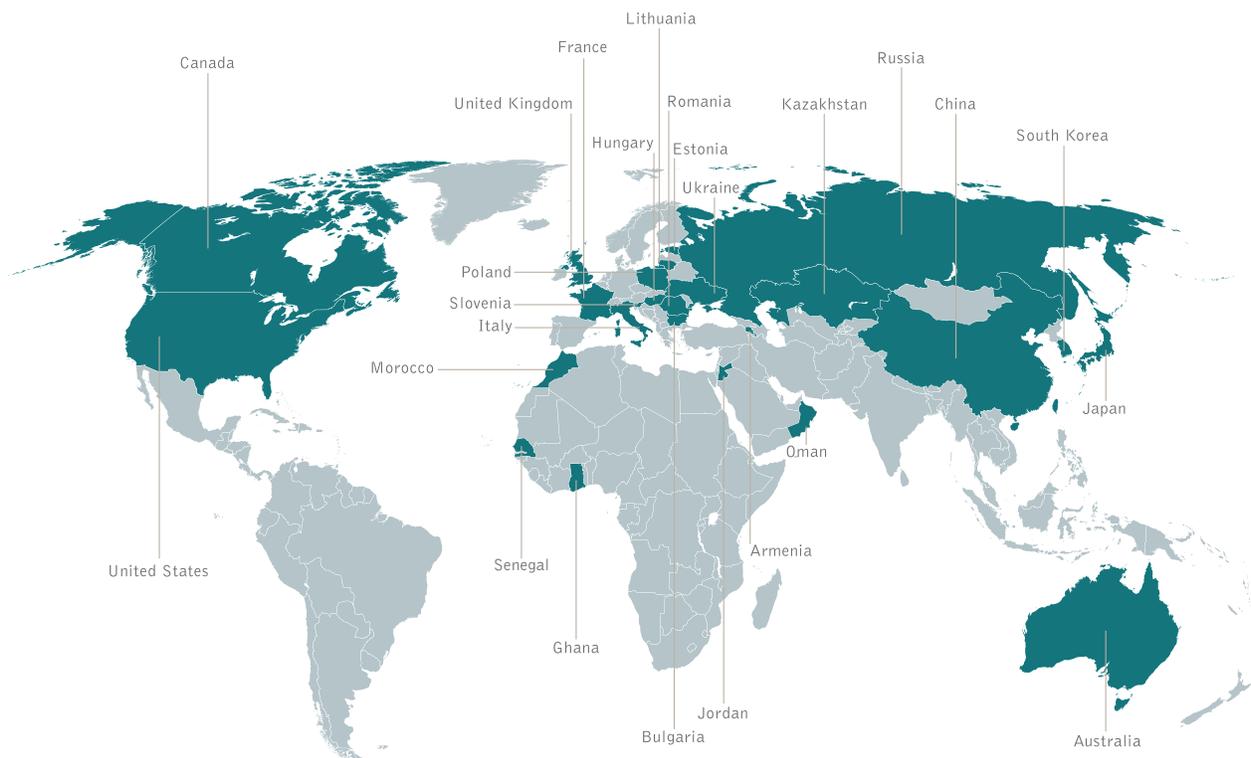
Not only did this proposal run into objections from non-nuclear-weapon states on philosophical and economic grounds, but some more advanced countries, including some nuclear-weapon states were reluctant to sign onto the effort because GNEP’s emphasis on newer types of reprocessing technology threatened their existing technology. This group included France, Japan and Russia, which have accumulated tons of separated civil plutonium as part of decades-old reprocessing efforts using PUREX.

In order to garner sufficient support to launch the international initiative, the Bush administration made major concessions to both groups, diluting the partnership’s

purported nonproliferation benefits. France was appeased after the administration opened the way to support current technologies, as long as fairly minor changes were made to ensure that pure separated plutonium was not produced. The White House hoped France and her cohorts would eventually move to newer technologies. In particular, the advanced nuclear GNEP members pledged to “develop and demonstrate, inter alia, advanced technologies for recycling spent fuel for deployment in facilities that do not separate pure plutonium” (DOE, 2007).

Some non-nuclear-weapon states were mollified by the draft of GNEP’s non-binding “statement of principles” which said that participating countries “would not give up any rights,” implicitly referring to their Article IV rights. “We’re not asking countries to sign a statement that they will never enrich or never reprocess,” said US Assistant Secretary of Energy Dennis Spurgeon (Pomper, 2007a: 3). The move convinced some countries such as Australia to sign onto the statement of principles when they were unveiled in September 2007. South Korea, which has been seeking to persuade the United States to allow it to pyroprocess US fuel, also signed the initiative (Pomper, 2008a).

Figure 1: GNEP Members



Source: Pomper (2008c).

However, the concession was insufficient to win over South Africa, which had previously developed an enrichment capability as part of its nuclear weapons program. This capacity was eliminated when the weapons program ended in 1994. “We were concerned that some aspects of the GNEP declaration would conflict with our national policy,” Buyelwa Sonjica, the country’s minerals and energy minister, told reporters in Vienna on September 18, 2007. “It is a sovereignty issue, to deal with our own nuclear fuel reserves and fuel supply,” Tseliso Maqubela, the ministry’s nuclear program director, told Reuters on the same day (Heinrich, 2007).

Other countries the administration hoped would join the partnership also refused. As the administration wound down, it sought to expand GNEP from a couple dozen members to as many as 46 countries. Only a handful of additional countries joined (Pomper, 2008c).

Still, GNEP’s international efforts acquired some momentum, with 25 countries eventually joining the group. The group held another ministerial level meeting in September 2008. Participants formed a steering committee chaired by Edward McGinnis, a US deputy assistant energy secretary, along with vice chairmen from China, France and Japan. They also established three working groups on issues of nuclear infrastructure, reliable fuel services and “grid-appropriate” reactors.

The Infrastructure Development Working Group sought to address the “infrastructure development challenges facing countries interested in beginning or expanding a nuclear power program, including shortages in human capital and manufacturing capacity.” A second working group on reliable nuclear fuel services looked at means of establishing nuclear fuel banks and nuclear fuel assurances to persuade countries not to engage in their own uranium enrichment programs. The final working group focused on the development of grid-appropriate reactors, which are typically 250-500 megawatt facilities. Such reactors are considered (though not yet proven) more affordable and practical for the limited electric grids and needs of developing countries than the 1,000 megawatt or so light-water reactors typically sold by the major nuclear reactor manufacturers. A final October 2008 ministerial meeting added one further initiative: a call for states to “pursue new ways to support nuclear energy projects through finance mechanisms” (GNEP Executive Committee, 2008).

Meanwhile, the US Department of Energy was planning to move forward quickly with an ambitious domestic leg to the program. In 2007, Spurgeon said the department

was planning to move ahead in 2008 with a decision on a “technology path forward” for GNEP, that is, a choice between a UREX+ type system and pyroprocessing technology. The approach called for the construction of three types of facilities: a reprocessing plant to separate plutonium and other materials from spent reactor fuel and convert them into a new fuel, an advanced reactor to use the new fuel, and a research and development facility. Spurgeon said industry studies proposed that reprocessing facilities begin operation between 2018 and 2028 and that prototype fast reactors be deployed between 2018 and 2025. The pace and scale of the proposed effort came under withering criticism from Capitol Hill and from outside experts who claimed the energy department was moving too quickly to attempt building a commercial-scale reprocessing facility based on unproven technology (Pomper, 2008b).

The House of Representatives, which came under Democratic control in 2007, was particularly critical of the program. In a June 2007 report, the House Appropriations Committee said it “does not support the Department’s rushed, poorly defined, expansive, and expensive Global Nuclear Energy Partnership (GNEP) proposal, particularly the administration’s intention to move quickly to commercial-scale reprocessing facilities.” Both the report and a companion Senate bill called for the administration to focus instead on research. The House report also dismissed claims of GNEP’s proliferation resistance as “unpersuasive and largely contradictory” (US House of Representatives, 2007).

An October 29, 2007, report by a National Research Council (NRC) panel was commissioned by the energy department. The panel sided strongly with the critics, concluding that the department should “not move forward” with the domestic leg of GNEP, particularly efforts to develop new commercial-scale facilities for reprocessing and burning a new type of nuclear fuel. Citing a lack of urgency and appropriate technical knowledge, the NRC panel called on the department to return to an earlier course and conduct a “less aggressive research program” (Committee on Review of DOE’s Nuclear Energy Research and Development Program, 2007).

The NRC panel claimed that making such a decision during the next year would be unnecessarily hasty. “Domestic waste management, security, and fuel supply needs are not adequate to justify early deployment of commercial-scale reprocessing and fast-reactor facilities,” the panel wrote. In particular, it was not clear if a second waste repository would be needed. The panel also argued that the knowledge of appropriate technologies was not

sufficient to move to commercial-scale facilities; the program would be far more expensive than proceeding with the current “once-through” system that stores rather than reprocesses spent fuel, a conclusion backed by the Congressional Budget Office in testimony before the Senate panel. The NRC panel noted that “qualifying” the new fuel – ensuring it could be used appropriately in the reactor – would take many years. Instead, the panel advocated returning to a lower-level research program to provide more basic information before choosing a path forward.

The energy department responded to this criticism by trying a different approach to quickly deploy reprocessing technologies, settling on a two-stage process. Under this plan, while AFCI looked at longer-term, more proliferation-resistant types of reprocessing, the Department of Energy would move ahead with using current reprocessing technologies. In an October 2007 interview, Spurgeon said the department had decided to attempt signing a contract in 2008 for facilities “using current technologies, since more advanced technologies are not yet proven on a commercial-size scale with an appropriate degree of reliability” (Pomper, 2007a: 2).

The first stage of the department’s plan would involve co-extraction (COEX) technologies that are nearly ready for commercial deployment. These technologies would separate the uranium and plutonium from spent fuel and reprocess them into mixed-oxide (MOX) fuel that can be used in current light water reactors. The aim would be to have such a fairly basic US reprocessing facility in place by 2020-2025. A second stage, which DOE officials said they did not expect to take place before 2050, would involve reprocessing spent MOX fuel again, using the more advanced techniques.

Critics noted that the first stage would offer few proliferation benefits and might in fact increase proliferation risks. The resulting uranium could be easily separated from plutonium – mixed-oxide fuel is considered “direct use material” for nuclear weapons by the IAEA because of the ease of this conversion.

Among the private critics of the administration’s proposal were the energy department’s own scientists, according to Robert Rosner, director of the Argonne National Laboratory. At a conference in April 2009, Rosner said “the National Lab Directors Council a year ago wrote a letter and a white paper to the then DOE Secretary Bodman that stated very clearly that we were opposed to – and we thought on technical grounds, not cost grounds, but technical grounds – that thermal reprocessing was a

mistake. And this was actually at that time contrary to the position of the nuclear energy program within DOE” (Rosner, 2009a). Those laboratory directors included Stephen Chu, now secretary of Energy in the Obama administration.

Public criticism at the time came from the Congressional watchdog, the Government Accountability Office (GAO), which published a report in April 2008 taking issue with the department’s plans. The report noted that DOE’s plans differed from the initiative’s original call for smaller engineering-scale facilities to research and develop more advanced technologies (Government Accountability Office, 2008).

“DOE’s accelerated approach of building commercial-scale facilities would likely require using unproven evolutions of existing technologies that would reduce radioactive waste and mitigate proliferation risks to a much lesser degree than anticipated from more advanced technologies,” the report stated. It added that “DOE is unlikely to attract enough industry investment to avoid the need for a large amount of government funding for full-scale facilities.” Therefore, the GAO recommended “that DOE reassess its preference for an accelerated approach to implementing GNEP” (Government Accountability Office, 2008).

Like the National Research Council, the GAO found that DOE’s earlier approach had its drawbacks. The GAO report concluded that the DOE had erred in planning to build an engineering-scale reprocessing plant before developing reprocessed fuel. The report recommended that DOE defer building the plant until “conducting sufficient testing and development of recycled fuel to ensure that the output of such a plant is suitable for recycling” (Government Accountability Office, 2008: 11).

As Congress debated Bush’s final budget in 2008, it was clear there was little support on Capitol Hill for GNEP. Administration officials announced that Secretary of Energy Samuel Bodman’s report on how and when to move forward with GNEP would be postponed and altered so that it would merely serve as a transition document for the new administration. Shortly before the 2008 presidential election, the energy department released a nearly 1,000-page draft programmatic environmental impact statement (PEIS) supporting the shift to a closed fuel cycle involving reprocessing. After public comment, the draft was supposed to form the basis of a final environmental impact statement (EIS) and ultimately a “record of decision” (Horner and Loveless, 2008).

The Bush administration's proposal listed six options for a future US nuclear fuel cycle, ranging from continuing the current once-through fuel cycle to several spent fuel reprocessing approaches. Several quite different alternatives involving the use of thorium fuel and high-temperature gas cooled reactors were also explored. Officials indicated they favoured closed fuel cycles involving reprocessing. The PEIS acknowledges that the transition to a fuel cycle based on spent-fuel reprocessing would be more complicated than the alternatives (DOE, 2008); but, they contended that closed cycles using either current light-water reactors, future fast neutron reactors or both were required to minimize the need for additional geological repositories for spent fuel. The report also ruled out the possibility of centralized interim storage, contending it is illegal and impractical because of "additional costs and risks associated with the handling and transport of the spent fuel from utilities to the interim storage site, and then again to a repository for disposal or to a recycling facility for processing" (DOE, 2008).

As anticipated, the draft PEIS was far less ambitious than the administration had earlier suggested, leaving to the Obama administration any decisions on a "technology path forward" (DOE, 2008). The administration's plans at one time called for the construction of three types of commercial-scale facilities: a reprocessing plant to separate plutonium and other materials from spent reactor fuel and convert them into new fuel; an advanced reactor to use the new fuel; and a research and development facility. After receiving criticism from such outside groups as the Government Accountability Office and the National Academy of Sciences, however, Bush administration officials backed away from constructing facilities. "DOE determined that to make project-specific or sites specific decisions regarding any of the three originally proposed facilities would be premature," the draft PEIS stated (DOE, 2008).

Efforts at the G8 and in the NSG

The revelations about A.Q. Khan and Iran that inspired the formation of GNEP also led to other US efforts to halt the spread of enrichment and reprocessing facilities.

In his February 2004 speech, Bush argued that the NSG ought to be prevent members of the NSG from plants acquiring such capabilities (Bush, 2004; Boese, 2004a). Bush also argued that those states which renounce enrichment and reprocessing technologies should have reliable access, at reasonable cost, to fuel for civilian reactors. He suggested requiring countries seeking imports for their civilian nuclear programs to adhere to

the IAEA's 1997 Model Additional Protocol. This measure empowers the IAEA to conduct more intrusive inspections and requires states to volunteer more information on their nuclear programs (Bush, 2004; Boese, 2004a).

At a June 2004 summit at Sea Island, Georgia, leaders of seven of the other richest countries in the world endorsed much of Bush's agenda. The Group of Eight (G8) announced their intention to push for new NSG guidelines that would incorporate measures aimed at preventing sensitive items with proliferation potential from being exported to states "that may seek to use them for weapons purposes, or allow them to fall into terrorist hands" (G8, 2004; Kohlmeier, 2004).

To forestall proliferation, the G8 established a one-year moratorium on new transfers of enrichment and reprocessing equipment and technology to additional states. Over the next four years, the Bush administration convinced the G8 to support a series of annual extensions to the moratorium, but failed to achieve its goals of updating the NSG guidelines before the president left office. The G8 similarly failed to achieve its goal of making the Additional Protocol "an essential standard of nuclear supply arrangements" and to incorporate the protocol into NSG guidelines by December 2005 (G8, 2004).

Several NSG members objected that barring enrichment and reprocessing exports could be considered a violation of their rights under the nuclear Non-Proliferation Treaty (NPT) (Boese, 2004b). Some NSG members were reluctant to enact measures that might be construed as widening the divide between nuclear "haves" and "have-nots," for fear of hampering progress in discussions on the NPT. The Bush administration, however, hampered its own efforts when it struck a bilateral civilian nuclear cooperation deal with India, a state which had nuclear weapons but had not signed the NPT. The deal required the NSG to ease its rules, making it more difficult for NSG members to tighten restrictions on those states that did belong to the NPT.

A 2004 French proposal gradually gained greater support, but failed to win final approval by the end of the Bush administration. The proposal included both objective and subjective criteria, but its core was a call for NSG members to suspend nuclear deals with countries the IAEA Board of Governors charged with failing to meet their NPT obligations. These included requirements that potential recipients be states-parties to the nuclear Nonproliferation Treaty (NPT) and have no outstanding breaches of IAEA safeguards. The first criterion would rule out India, Israel, North Korea and Pakistan, while the second

criterion would have excluded Iran (Boese, 2008; Nikitin, et al., 2008).

The proposed criteria were intended to bolster NSG guidelines, which vaguely instructed members to exercise restraint in exporting technologies and materials that could be used to produce nuclear weapons (Boese, 2008).

While the language is vague, very few transfers have actually been authorized by governments in possession of these technologies since the original guidelines were agreed upon in 1976. The best known acknowledged cases are Germany's mid-1970s transfer of jet-nozzle enrichment technology to Brazil and Australia's 2004 transfer of SILEX enrichment technology to the United States (Spector and Scheinman, 2009).

While generally supporting the French proposal since its inception, the Bush administration waited nearly until the end of its term to produce its own additional criteria. It proposed in 2008 that permissible enrichment and reprocessing exports be conducted in ways that impede recipients from replicating the technologies or building their own indigenous facilities.

This later proposal triggered objections from Canada and, reportedly, from fellow NSG member South Africa. Both countries have large uranium deposits but no current enrichment capabilities. Exporters can profit more from selling enriched uranium than just natural uranium, a consideration that has been assuming greater significance in Ottawa and Pretoria as a growing number of countries contemplate starting or increasing nuclear energy operations (Jackson and Dormuth, 2009).

South Africa has been a strident critic of further restrictions on nuclear trade to non-nuclear-weapon states and previously produced its own enrichment technology. South African diplomats said they were particularly reluctant to oppose further restrictions on nuclear trade to NPT members after other developing country NPT members complained about Pretoria's support for extending nuclear trade to India, which has not signed the treaty.

Nonetheless, the administration stepped up its efforts at the NSG in the wake of its campaign to win congressional support for the controversial nuclear cooperation agreement with India. As part of her lobbying effort on the India deal, Secretary of State Condoleezza Rice promised Rep. Howard Berman (Democrat, California), chairman of the House Committee on Foreign Affairs, that the United States would make achieving a decision at the next NSG plenary meeting to prohibit exports of enrichment and

reprocessing equipment and technology to other non-NPT states its highest priority.

Those efforts came close to fruition during the waning days of the Bush administration, after three stumbling blocks were cleared away.

First, the United States demanded that if enrichment or reprocessing transfers occurred, they should be executed only via "black box" techniques wherein only the supplier can access and own the technology. Canada opposed this provision, thereby blocking consensus on the package. Diplomats essentially backed the US position, but agreed to an exemption that might potentially benefit Canada. The NSG approved the proposal, but would consider proposals from members such as Canada to export any enrichment technologies developed on their own as long as "black box" techniques were used for the transfers. The Canadian mining giant Cameco has a stake in a laser enrichment joint venture with General Electric and Hitachi and some diplomats have said this language was crafted to allow Canada some means of gaining access to this technology.

Second, Brazil, which refused to sign an additional protocol, has opposed making the protocol a condition for sales of enrichment and reprocessing technologies. The NSG again conceded and agreed on rules that could benefit Brazil, which has a unique bilateral safeguards arrangement with Argentina. The rules would allow the additional protocol standard to be waived if regional arrangements offer similar levels of nonproliferation confidence. Nonetheless, Brazil remains unsatisfied. Local officials are said to fear that implementation of the protocol will interfere with its nuclear submarine program (Hibbs, 2009b; Hibbs, 2009c; Pomper, 2008d).

Diplomats also stated that the compromise made comprehensive, or full-scope IAEA safeguards on all nuclear materials and facilities within their borders a condition of supply to non-nuclear-weapon states. Such safeguards are required of all non-nuclear-weapon-states that have signed the NPT unless they have small quantities protocols (SQPs) in force with the IAEA.

Ostensibly, then the new requirements would rule out transfers to non-NPT states – India, Israel, North Korea and Pakistan – which either have no safeguards or one only on certain facilities. India, however, has claimed that the exemption it received from NSG rules on exports of other nuclear technology should also extend to reprocessing and enrichment exports.

Likewise, the requirements would seem to rule out transfers to states such as Saudi Arabia, for example, which have an SQP in force. SQP protocols allow a state to forgo certain inspection and reporting requirements due to the absence of nuclear activities above a certain threshold. Such a protocol must be rescinded once a country obtains a sufficient amount of nuclear material, as defined in its safeguards agreement, or when it introduces nuclear material into a nuclear facility. The IAEA has been pushing to strengthen these protocols, adopting an amended model small quantities protocol several years ago (Kerr, 2005). Saudi Arabia and a few other states, however, have yet to sign an amended version.

Fuel Banks and Fuel Assurances

During the course of the Bush administration, more than a dozen proposals were advanced by governments, industry, international organizations and leading NGOs for fuel banks and fuel assurance schemes. A few won particular attention from Washington and are either being implemented or are under serious consideration. These included fuel banks in the United States and Russia, an IAEA controlled fuel bank and a multinational fuel cycle facility in Russia.

The most rapidly advanced effort was announced by Secretary of Energy Samuel Bodman at the IAEA General Conference in September 2005. It committed the United States to downblend 17.4 metric tons of former military highly enriched uranium (HEU) to low-enriched uranium (LEU), which could be made available to countries not presently pursuing indigenous enrichment or reprocessing technologies (IAEA, 2005; NNSA, 2007). This downblending is already underway and is expected to yield 290 tons of LEU by the time the effort is completed in 2010.

The Bush administration also offered its support to a Russian proposal unveiled the next year that would create an International Uranium Enrichment Center (IUEC) and a 120 ton LEU fuel bank at Angarsk in Siberia, under IAEA supervision. The enrichment center is a joint facility in which other countries would own shares and Russia's shares would drop to 51 percent as other partners are admitted. Already, Kazakhstan and Armenia and Ukraine are in the process of doing so. The membership of Kazakhstan and Ukraine is particularly significant because some experts in those countries previously suggested building their own enrichment facilities. In order to address concerns regarding the spread of technology, the IUEC will be structured in such a way that no enrichment technology or classified knowledge will be

accessible to foreign participants. Sergey Kislyak, Russia's ambassador to the United States, likened it in a recent interview to "offering a Mercedes if you know how to shift gears and drive the car, but there will be somebody else, specialists, who will take care of your engine" (Kimball and Pomper, 2008; Pomper, 2009a).

The Bush administration also supported another fuel bank, initiated by the private Nuclear Threat Initiative (NTI). NTI advocated providing US\$150 million to allow the IAEA to create an LEU stockpile, which would be owned and managed by the agency. The stockpile would be funded by US\$50 million from NTI (provided by billionaire Warren Buffett) and more than US\$100 million from a number of countries. During the Bush administration, Congress provided US\$50 million for this effort. While earlier draft legislation in the House and Senate was tied to restrictions on developing a national fuel cycle, such restrictions were not included in the final measure (Spector and Scheinman, 2009).

Many of these proposals fall under the rubric of the Concept for a Multilateral Mechanism for Reliable Access to Nuclear Fuel (RANF), an effort by six countries, including the United States, to develop a tiered mechanism of fuel supply assurances.²

The proposal envisioned the first, or "basic," assurance of supply mechanism as being the existing and normally operating market. Similarly, the RANF mechanism envisioned a second layer of assurance being offered by suppliers of enriched uranium agreeing to substitute for each other to cover certain supply interruptions. A final, third layer of assurance in both proposals incorporated the fuel bank concept by suggesting governmental creation of enriched uranium stocks, either virtual or physical (Simpson, 2008).

The Attractive Offer (Nuclear Cooperation Agreements) and Non-Papers

Fuel banks and fuel assurances were not the only incentives the Bush administration proposed dangling before countries newly interested in nuclear power. At a summit in St. Petersburg in July 2006, Bush and then Russian President Vladimir Putin called on their governments to forge a bilateral action plan to further US-Russian global and bilateral nuclear energy cooperation.

² The other five countries are France, Germany, the Netherlands, Russia and the United Kingdom.

Six months later, Samuel Bodman and Russian Nuclear Energy Czar Sergei Kiriyenko announced a framework for cooperation. The plan called for cooperation in designing exportable small- and medium-power reactors; advanced fast spectrum reactors; enhanced and integrated safeguards; new types of fuel for fast spectrum reactors; and new technologies for spent fuel reprocessing and separations, transmutation and waste isolation.

In July 2007, Bush and Putin agreed on further steps to promote nuclear energy expansion worldwide while limiting the spread of nuclear technologies that could be exploited to build nuclear weapons. The two countries declared their willingness to provide or facilitate financial assistance, infrastructure support, and regulatory and technical training.

This offer was repeated in a Strategic Framework declaration at the two leaders' final summit on April 6, 2008, in Sochi, Russia:

We will provide assistance to countries considering nuclear energy in the development of the necessary infrastructure (including nuclear reactors), consider ways for facilitating financing, and will ensure, inter alia, provision of fresh fuel and spent fuel management. (The White House, 2008)

Proposals on spent fuel and financing, for example, were laid out in non-papers submitted by the United States to Russia (US Non-Paper, 2008).

James Timbie, one of the architects of the administration's approach, wrote that these and other incentives, such as helping to build "grid appropriate," reactors could be offered as incentives for states willing to forego enrichment and reprocessing. Timbie wrote that the Bush-Putin initiative was "designed to bring together this range of activities in a comprehensive way to offer economical and reliable access to nuclear energy and create an attractive alternative to the acquisition of sensitive fuel cycle facilities" (Timbie, 2009).

The Bush administration's clearest implementation of this approach was in the Middle East; Bahrain, Jordan, Saudi Arabia and the UAE signed bilateral memoranda of understanding with the United States, under which they pledged not to seek enrichment or reprocessing facilities. The UAE went a step further and signed an initial nuclear cooperation agreement with the US in the final days of the administration.

The initial agreement was groundbreaking in several ways. With its demand for ever increasing amounts of energy and desalination capability, the UAE plans to build as many as 10 nuclear reactors – making it the first Middle Eastern country with a substantial fleet of nuclear power reactors. The initial agreement also included two nonproliferation provisions not typically found in other US nuclear cooperation pacts. A key provision permits the United States to terminate cooperation and demand the return of any nuclear "material, equipment or components...and any special fissionable material produced through their use" if the UAE fails to fulfill its commitment not to engage in enrichment or spent reprocessing, a pledge it has vowed to enshrine in law. The other provision requires both parties to give "due consideration...to non-proliferation and physical protection aspects" when selecting a storage facility for special fissionable material (Blanchard and Kerr, 2009: 6).

It also is worth noting that an Agreed Minute to the initial US-UAE agreement included a provision which, as a Congressional Research Report noted, effectively "establishes its conditions as minimum standards for future such US agreements in the Middle East" (Blanchard and Kerr, 2009: 7). "[T]he fields of cooperation, terms and conditions" accorded by the agreement "shall be no less favorable in scope and effect than those which may be accorded, from time to time, to any other non-nuclear-weapon State in the Middle East in a peaceful nuclear cooperation agreement." The minute explains that, in the event that Washington concludes a more favorable agreement with another regional government, the US will consult the UAE at the latter's request "regarding the possibility of amending" the agreement in order to make its terms equally favourable to the new agreement.

A similar provision in a 1981 US-Egypt nuclear cooperation agreement required the United States to ensure the agreement with the UAE would be at least as stringent if it did not want to reopen the pact with Egypt. Since the UAE agreement is even more stringent, it has effectively established a higher standard for future US agreements in the region (Blanchard and Kerr, 2009).

The agreement also provided a means for the UAE to transfer spent nuclear fuel to other countries. The Agreed Minute states that the UAE may transfer spent nuclear fuel to France or the United Kingdom for storage or reprocessing. Previously, only Japan, Switzerland and Norway had been given such consent. The transferred material is to be held within EURATOM, and separated plutonium cannot be returned to the UAE without additional US consent.

In addition to providing an incentive for the UAE to sign the deal, the possibility of reprocessing in Europe appears to be designed to encourage France, which is likely to build many of the reactors, to adhere to the US conditions on enrichment and reprocessing. French officials say they support such efforts, but have not included them in their own nuclear agreements with the UAE and other countries (Bouchard, 2009). UAE officials claim their agreements with France and other countries “include” commitments to not engage in enrichment or reprocessing; but, they have not spelled out whether these agreements merely restate general policy statements by the UAE or provide options for the other countries to take actions like those spelled out in the US-UAE agreement.

The Obama Administration’s Approach

The Obama administration has continued to support the expansion of nuclear energy worldwide and steps to limit enrichment and reprocessing, but has couched both efforts within a different context than did its predecessor. While the Bush effort often cited energy security as an important reason for growing nuclear energy, the Obama administration has placed greater emphasis on including nuclear energy as part of a series of efforts to provide low-carbon energy and minimize climate change. The fight against enrichment and proliferation, meanwhile, has been placed in the context of President Obama’s call for a nuclear-weapons-free world, with the issue of nuclear fuel banks and fuel assurances given greater weight. Nowhere was this change of emphasis clearer than in Obama’s historic April 5 speech in Prague:

We should build a new framework for civil nuclear cooperation, including an international fuel bank, so that countries can access peaceful power without increasing the risks of proliferation. That must be the right of every nation that renounces nuclear weapons, especially developing countries embarking on peaceful programs. And no approach will succeed if it’s based on the denial of rights to nations that play by the rules. We must harness the power of nuclear energy on behalf of our efforts to combat climate change, and to advance peace and opportunity for all people. (Obama, 2009)

Obama’s advocacy of an international fuel bank has already run into some obstacles. At a June 2009 meeting, the IAEA board considered two proposals related to fuel banks: the Russian plan for a 120 ton fuel bank and the NTI/IAEA plan for a 60-80 ton facility. Developing

countries on the board agreed to continue negotiations, but rejected a request by ElBaradei to develop a detailed plan for approval in September. The NTI/IAEA plan in particular ran into problems. Despite protests to the contrary by ElBaradei and supplier states (ElBaradei, 2009; Berdennikov, 2009), developing countries fear the proposal could impinge on their Article IV rights to peaceful nuclear technology. The developing countries warned others on the board of “attempts meant to discourage the pursuit of any peaceful nuclear technology on grounds of its alleged “sensitivity” (Westall, 2009). Differences also emerged between countries such as India that want the fuel banks open to all IAEA members (so it could participate) or those like Egypt that want it limited to NPT member states (so Israel could not participate) (The Economist, 2009). A November 27, 2009 IAEA board meeting, however, did endorse concluding and implementing an agreement with Russia to establish the LEU reserve (IAEA, 2009).

The Obama administration has had no more luck than its predecessor in winning support at the NSG for new rules on enrichment and reprocessing transfers, despite explicitly renouncing efforts to impose a ban or even a moratorium. Administration officials, if ever they can get an agreement, it is likely to be considerably weaker than the previous rules. In addition, G8 leaders meeting in L’Aquila, Italy, agreed in July 2009 to implement for the next year the compromises the Bush administration reached in November 2008, pending further progress at the NSG. They also urged the NSG to “accelerate its work and swiftly reach consensus this year to allow for global implementation of a strengthened mechanism on transfers of enrichment and reprocessing facilities, equipment, and technology” (G8, 2009).

The administration had better luck with the nuclear cooperation agreement with the UAE, which President Obama submitted to Capitol Hill on May 21, 2009, and which Congress did not make a serious attempt to overturn its review period, despite vocal opposition from some members of Congress (Stein, 2009).

Nonetheless, the odds are stacked in favour of the agreement, which will move forward unless a majority of lawmakers act within 90 days to approve a resolution of disapproval. They would then need a two-thirds majority to overcome an all but certain presidential veto. Opponents are unlikely to muster such numbers, especially as the powerful pro-Israel group AIPAC (American Israel Public Affairs Committee) has not weighed in significantly on the issue and some key lawmakers are backing

the administration. Howard Berman, chairman of the House Committee on Foreign Affairs; John Kerry (D-Massachusetts), chairman of the Senate Committee on Foreign Relations; and Kerry's Republican counterpart, Richard Lugar of Indiana, have introduced resolutions supporting the agreement. Introducing the resolution July 14, Berman said:

I am satisfied that this agreement is in the nonproliferation interest of the United States. This is a model that any future US civilian nuclear cooperation agreement, and all other nuclear supplier states, should follow... [However,] I and many of my colleagues are concerned about whether the UAE is doing everything possible to prevent Iran from advancing its illicit nuclear activities by using the UAE's territory and financial institutions to acquire equipment and technology. The government of the UAE should consider further steps to satisfy these concerns as soon as possible (US House of Representatives, 2009).

Moreover, the Obama administration and the UAE have recently taken steps to bolster the agreement and the UAE's nonproliferation credentials. On April 8, the UAE and the IAEA signed an additional protocol to the UAE's safeguards agreement. US and UAE negotiators also strengthened the UAE's commitment not to engage in reprocessing and enrichment by adding a new provision that explicitly prohibits the UAE from possessing sensitive nuclear facilities or engaging in enrichment or reprocessing within its territory. In the end, the administration won its argument that the agreement should be endorsed, given the UAE's willingness to refrain from such activities. The agreement was seen as a potential model for other countries and a valuable tool for isolating Iran (The White House, 2009). In addition, given the fact that France had already signed a nuclear cooperation agreement with the UAE, the emirates' involvement in nuclear energy was seen as inevitable. (The White House, 2009, Early, 2009).

How widely this model might be applied is still open to question. Jordan, for example, is a close US ally and supposedly agreed to similar restrictions in a memorandum of understanding signed by the two countries in 2007, according to US officials. These commitments, however, have yet to be formalized in a nuclear cooperation agreement. A recent *Nucleonics Week* report indicated that Jordanian officials wanted to keep the enrichment option open and believe they could obtain nuclear power plants from other suppliers, such as South Korea, without such restrictions (Hibbs, 2009a).

At the same time, the administration has continued to hold off on resubmitting the nuclear cooperation agreement with Russia (the Bush administration withdrew it in September 2008 after the August 2008 military clash between Russia and Georgia over South Ossetia). The White House seeks to use it as leverage to win additional cooperation from Moscow on restraining Iran's nuclear program. "I think this agreement will be conditional on Russia's approach to Iran," a senior administration nonproliferation official told a Washington audience in March, "But then if I had my choice everything in the relationship would be."

The Obama administration's clearest break with its predecessor is its effort, best dramatized by Obama's Prague speech, to make a renewed commitment to nuclear disarmament. This effort is being made to win support from key allies and developing countries at the 2010 NPT review conference for additional restrictions on nuclear energy development. According to a senior administration official, the White House is seeking several restrictions, including: making the additional protocol a condition of supply; requiring the IAEA to automatically suspend a country's ability to engage in enrichment if they are non-compliant with the NPT; and making it more difficult for states to withdraw from the NPT, including automatically placing any withdrawal notification on the UN Security Council's agenda. The administration's new conciliatory approach contributed to a positive atmosphere at the May preparatory meeting for the 2010 event, but it not clear how much substantive progress it will yield. Egypt, for example, has welcomed the new approach but has threatened to bring the 2010 conference to a halt – as it helped do in 2005 – unless the language it wants concerning efforts to create a nuclear-weapon-free zone in the Middle East is implemented (Pomper, 2009b; Pomper, 2009c; Johnson, 2009).³

Nearly as sharp a reversal occurred in April 2009, when a US Department of Energy spokeswoman confirmed that the domestic component of GNEP had been cancelled while the international component was under review. "The Department has already decided not to continue the domestic GNEP program of the last administration," said Deputy Press Secretary Jen Stutsman in an April 15 statement to Nuclear Engineering International. In essence, the administration will return to focusing on the underlying AFCI program "The long-term fuel cycle research and development program will continue but not the near-term

³ The reviews of US and Egyptian positions in this report are based on discussions and presentations (under Chatham House rules) with relevant officials.

deployment of recycling facilities or fast reactors. The international component of GNEP is under interagency review" (Nuclear Engineering International, 2009b).

Stutsman said that, given the doubts about the future of the program, it was not clear if a final environmental impact statement or record of decision for GNEP would ever be completed.

Separately, administration officials have indicated that some of the efforts will likely be continued after the review, if perhaps under a different name, and the program as a whole will be more tightly linked to broader nuclear efforts (Nuclear Engineering International, 2009a). In particular, they expect GNEP to be tied to Bush era efforts to improve nuclear safeguards (such as the Next Generation Safeguards Initiative), security (such as the Global Initiative to Combat Nuclear Terrorism) and safety.

The US Congress, which held off final approval of this year's energy department budget until Obama took office, eliminated funding for GNEP and cut Bush administration proposals for AFCI from US\$302 million to US\$145 million. The funding bill specifies that research should be focused on "proliferation resistant fuel cycles and waste reduction strategies." Steven Chu also made clear that he considers reprocessing a subject of long-term research rather than a near-term domestic option (Horner, 2009).

Still, GNEP's international meetings appear to be moving forward under the new administration. At an October 2009 ministerial meeting in Beijing, energy ministers agreed to a new vision and possible new name for GNEP (International Nuclear Energy Framework) that both ties it to broader nuclear efforts on nuclear safety, security, safeguards, and nonproliferation and that places renewed emphasis on the back end of the fuel cycle and "cradle to grave fuel services." A sub-working group on "Approaches for Selecting Back End Fuel Cycle Options," is supposed to identify long-term and advanced options for the back-end of the fuel cycle and recommend measures for developing fuel cycle arrangements and closing the fuel cycle for the short and long terms (Global Nuclear Energy Partnership Executive Committee, 2009; Kwon 2009).

Analysis

While the Obama administration's international nuclear energy policies are still somewhat inchoate, their apparent direction generally seems appropriate. However, it is not clear exactly how they will be received and whether they will be any more successful than the Bush administration's pursuit of an expansion in nuclear energy while limiting

its proliferation dangers (particularly, ensuring that new countries do not engage in enrichment and reprocessing). While the unique conditions in the US-UAE nuclear cooperation agreement represent a nonproliferation advance, it is not clear whether other countries in the Middle East will be willing to follow its example and voluntarily renounce these technologies.

Nor is it clear whether other nuclear suppliers will seek similar commitments or undercut the US effort. The Obama administration is not certain to be more successful getting the NSG to agree to new criteria on exports of sensitive nuclear technology than its predecessor. Judging by some of the remarks at the recent preparatory commission meeting for the nuclear NPT review conference, developing states will continue to resist efforts to make the additional protocol the new standard for IAEA safeguards. More broadly, during a May 2009 preparatory session for the 2010 nuclear NPT review conference, Egypt noted that these proposals seemed to originate less out of concerns about supply than from concerns about suppliers, and questioned the notion that NPT states should not be trusted with enrichment or reprocessing technology. As the Egyptian delegate stated, if

"emerging nuclear programs should only give birth to proliferation-resistant reactors without front or back ends [of the fuel cycle], would not those states who continue to run front and back-end and heavy water reactors be, by definition, irresponsible? Or must we consider that what is irresponsible for some is responsible for another?" (Abdelaziz, 2009)

Indeed, the IAEA board's inability, so far, to move forward on a quite anodyne fuel bank proposal does not bode well. The administration has said it will seek to advance these and other initiatives by having President Obama and Vice President Joseph Biden "go over the head of the professional disarmament diplomats to talk to key heads of state." But given the full slate of other issues on the White House plate, including such arms control and nonproliferation issues as North Korea, Iran and the START follow-on negotiations, they may not want to spend their political capital on this problem.

Even if approved, some of these efforts might provide less of a payoff than the administration hopes. If the Russian and IAEA proposals for nuclear fuel banks are approved and implemented, they may not spark much interest among potential consumers; they have not done so to date and even the voluntary proposals have stirred some resentment. Moreover, the commercial market functions well and such a fuel bank may not make

significantly change a country's decision of whether or not to engage in enrichment and reprocessing. States may want their own facilities for other reasons, including to enhance their prestige or energy security.

Ultimately, the most effective guarantee may still be a fully multinational nuclear fuel cycle. In the near term, however, the United States has to take care that the other major nuclear suppliers, particularly Russia and France, do not attempt to undercut its efforts to toughen nonproliferation rules by offering less stringent conditions. Several lawmakers had the right idea when they recently wrote to President Obama asking him to "begin discussions with the other major supplier states to adopt standards equal in content and effect to our own in their bilateral nuclear cooperation agreements and nuclear policies." Such standards, in some ways, have already become the de facto standards for nuclear trade, but have yet to win formal sanction. The most feasible short-term approach may be for nuclear vendor states to agree informally to enforce provisions sought by the United States and other Western countries in the NSG and IAEA. As Lawrence Scheinman and Leonard Spector have written:

At present, the rules governing the first phase of the expansion of nuclear power production to new states, viz., the transfer of nuclear power reactors, are evolving. One of the fresh conclusions of this study is that as these rules gel, they will establish the environment in which rules governing multilateral enrichment centers and fuel banks are developed. The more rigorous the rules for basic nuclear trade, the easier it will be to limit transfers of enrichment and reprocessing [technologies] and to establish similarly stringent standards governing fuel assurance arrangements. (Spector and Scheinman, 2009)

They argue that the states most likely to launch nuclear programs in the short term are probably prepared to abide by strengthened rules on nuclear transfers, safeguards, security and safety. They maintain this argument despite the vocal opposition of some states, such as South Africa and Brazil, in international fora:

This growing de facto consensus by the principal stakeholders has been obscured, however, because decisions on establishing these strengthened standards as formal rules must be taken by such organizations as the NSG and the IAEA, where obtaining de jure consensus has proven difficult. At the NSG, this is because of the particularized concerns of one or two states, as well as complaints that it is unfair to require

added restraints on states launching nuclear power programs that were not required of their predecessors. At the IAEA, strict rules for access to the pending fuel bank proposal have been rejected to avoid the appearance of infringing on states' inalienable right to enjoy the full benefits of nuclear energy under Article IV of the NPT. (Spector and Scheinman, 2009)

Finally, some new issues loom and new approaches should be considered. Given that the Obama administration's support for nuclear power is contingent largely on the view that it is a necessary part of the effort to stem global warming, how should nuclear energy be managed in the context of the December 2009 climate change negotiations in Copenhagen? For example, should countries (primarily developing countries) building nuclear power plants be eligible to receive funds for carbon offsets, as some experts have suggested? According to some observers, the kinds of carbon pricing discussed by policy makers for an international carbon-trading system would translate into a subsidy of nuclear power that would essentially cover the entire cost of fuel and some operations of the reactor.

Former US Deputy Energy Secretary Ernest Moniz recently suggested that carbon credits might be provided to those countries already participating in a fuel leasing program whereby they received fresh fuel from nuclear suppliers and then repatriated the spent fuel. Moniz is on the right track – it would be wise to limit such subsidies to countries that encourage nonproliferation, nuclear safety and security. To be eligible for credits, for example, states could be required to have an additional protocol in place; be compliant with their NPT and/or IAEA safeguards obligations; use "proliferation-resistant" designs; and adhere to relevant safety, security and liability conventions. If fuel leasing restrictions are rejected, nuclear suppliers could consider offering other incentives for developing states that voluntarily renounce enrichment and reprocessing. The value of any offsets in such states, for example, could be matched by funds from suppliers. Similar caution should be exercised in involving the World Bank, other international financial institutions and the US Export-Import Bank to finance nuclear reactors and technology, an approach considered by the Bush administration. The Export-Import Bank could also consider orienting its financing towards grid-appropriate reactors.

The Obama administration should move forward with a Bush administration effort to develop a private-public partnership to develop a design for such a reactor and win Nuclear Regulatory Commission approval to ease its sale overseas (Law and Health Weekly, 2008; DOE, 2008).

The Obama administration has been wise to continue discussions in GNEP on small and medium reactors. Trying to find ways to bring smaller versions of today's light-water reactors to market could have a rapid non-proliferation payoff; otherwise, more proliferation-prone reactors, such as the smaller heavy-water reactors operated by India, might be the preferred export (Squassoni, 2009).

Such restrictions could be coupled with demands that only nuclear power plants scheduled to be built in the United States that deploy advanced proliferation-resistant, safety and safeguard technology be eligible for domestic loan guarantees and that small- and medium-sized reactors receive special consideration. Nuclear vendors have had difficulty obtaining financing from commercial banks for these kinds of reactors, however, because of long pay-back periods, regulatory uncertainty and perceived safety dangers. Such a rule could also alleviate some of the resentment that developing countries feel at being singled out under supplier-initiated rules, move such technologies forward, and allow the United States to take the moral high ground.

The administration also made the right call in halting the domestic leg of GNEP, while continuing long-term research under AFCI. Robert Rosner and others have suggested some useful directions for the research program to take that are longer term, but may offer better rewards in terms of proliferation and waste than GNEP. They include the possibility of building reactors with much higher burnup that still rely on a once-through fuel cycle (Rosner, 2009b).

Even under these conditions, the administration should take care not to advance nuclear energy as the best solution for developing country needs. While these countries will ultimately make their own decisions in this regard, support for alternative energy and energy efficiency projects could provide a less costly, less technically complicated approach to meeting these country's requirements. There would also be no proliferation implications. The administration should be commended for recently joining the new International Renewable Energy Agency (IRENA) as a way of helping provide funding and expertise to developing countries in this regard. Ultimately, the administration should encourage IRENA and the IAEA to cooperate on appropriate forms of energy assistance for countries.

Several lawmakers and outside experts have also urged the Obama administration to finally implement Title V of the Nuclear Nonproliferation Act of 1978, to help

developing countries meet their energy needs through renewable energy (Sokolski, 2009; Weiss, 2009). The United States and other industrialized nations may have found one way to do this in the the Climate Renewables and Efficiency Deployment Initiative that US Energy Secretary Steven Chu announced at the Copenhagen climate change conference on December 14, 2009. Another way to ensure these considerations are taken into account would be for Congress to require that the nonproliferation assessment the administration must provide with any nuclear cooperation agreement include a section on the country's relative energy efficiency and use of alternative energy. Ultimately, states should be encouraged to make the best market-based decisions. As Henry Sokolski has written, most advanced states claim to do so already by supporting the principles backed in the Energy Charter Treaty and Global Charter on Sustainable Energy (Sokolski, 2009). Given the cost of nuclear energy, if these principles were fully implemented, economic imperatives would likely rule out nuclear energy for many countries, especially those not participating in a carbon tax or a cap-and-trade scheme.

Conclusion

For President Obama, US international nuclear energy policy is clearly not as high a priority as it was for his predecessor. Seven months into his administration, he has yet to appoint experts to several key posts in this field, and only won Senate confirmation of Warren Miller as assistant secretary of energy for nuclear energy on August 7. This contrasts sharply with the direct attention he and his deputies have paid to alternative energy policies; funding; and nuclear security, nonproliferation and arms control.

To some degree, this change is welcome. The Bush administration focused too narrowly on nuclear energy, mistakenly perceiving it as a magic bullet to deal with the issues of climate change and energy security, and ignoring proliferation and other problems. Considering nuclear energy within the broader context of energy demand and alternative sources of energy makes a great deal of sense. Many of the policy choices the administration has made to date – seeking to advance the initiatives on enrichment and reprocessing at the NSG and G8, scaling back the domestic leg of GNEP, and working to create an international fuel bank – are similarly prudent.

Nonetheless, US international nuclear energy policy demands more significant attention and strategic thinking if it is to achieve some of the goals Obama has embraced. For

example, given the setbacks for the IAEA fuel banks at the June 2009 IAEA Board of Governors meeting, will the administration continue struggling to move the process forward, seek other alternatives or give up? Will the United States enlist other nuclear suppliers to strike deals similar to the one Washington reached with the UAE? What is the future international role of GNEP and, given US decisions to seek alternatives to the Yucca Mountain repository, how should countries deal with spent fuel in the future? How will nuclear energy be dealt with in the Copenhagen round of negotiations on climate change? If the United States does not answer these questions soon, other countries will be more than happy to provide the answers – even if they are not to Washington’s liking.

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