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Assessing Proposals on the International Nuclear Fuel Cycle

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The global stocks of poorly secured weapons-usable nuclear material present an acute challenge to international security. Enough weapons-usable uranium and separated plutonium exist today to produce well over 100,000 Hiroshima-sized nuclear devices, much of it potentially vulnerable to theft by terror groups, black marketeers, or potential proliferant states. Yet more of these materials are produced everyday and additional countries are acquiring the means to produce them for both civil and military purposes. Moreover, in the wake of recent events, there is increased concern that states are or may in the future misuse the international non-proliferation regime to advance their nuclear weapons ambitions.

Under the Non-Proliferation Treaty, states can produce and stockpile considerable amounts of weapons-usable nuclear materials as long as the facilities and materials are placed under International Atomic Energy Agency safeguards. This stockpiled material could be used in the production of weapons if possessing states withdraw from or violate their treaty obligations, and production facilities could be used for weapons purposes should the possessing states withdraw from the NPT. IAEA Director General Mohamed El-Baradei has observed that "should a state with a fully-developed fuel cycle capability decide, for whatever reason, to break away from its non-proliferation commitments, most experts believe it could produce a nuclear weapon within a matter of months."[1] As cracks emerge in the global non-proliferation consensus and the perceived incentives for states to acquire nuclear weapons increase, this arrangement threatens to undermine efforts to prevent proliferation and maintain a stable global security order.

The issue of the international fuel cycle has re-emerged as a current topic, especially after President George W. Bush's February 11 speech at the National Defense University. The President stated that . . .

> "[T]he world must create a safe, orderly system to field civilian nuclear plants without adding to the danger of weapons proliferation. The world's leading nuclear exporters should ensure that states have reliable access at reasonable cost to fuel for civilian reactors, so long as those states renounce enrichment and reprocessing. Enrichment and reprocessing are

[1] Mohamed El-Baradei, Towards a Safer World, The Economist, 16 October 2003.

not necessary for nations seeking to harness nuclear energy for peaceful purposes."[2]

These remarks came after calls by the IAEA's El-Baradei to reassess the current fuel cycle and his personal endorsement of proposals to place the most proliferation sensitive aspects of the fuel cycle – uranium enrichment, plutonium separation and spent fuel process – under multinational control. This proposal has been followed by that of the US President and other officials, including British Foreign Minister Jack Straw and outside experts.

It appears that momentum is growing for a broader international discussion on the fuel cycle and what changes to the current system may be useful in advancing the goal of non-proliferation. The interest comes 20-years after the International Fuel Cycle Evaluation (INFCE) and Peaceful Uses of Nuclear Energy (PUNE) activities of the late 1970s and early 1980s which failed to produce an international consensus on key fuel cycle issues. High-level interest in the fuel cycle has been rekindled by the revelation that Pakistan's A.Q.Khan had sold uranium enrichment information, technology and equipment and weapons designs to at least three countries (North Korea, Iran and Libya). This raised concerns that technology denial efforts to prevent the dissemination of sensitive fuel cycle technology were breaking down, compounded by the failure to effectively confront North Korea's ongoing nuclear program and to dissuade Iran from pursuing a complete set of fuel cycle capabilities.

In assessing current proposals, it is important to note that people holding views on the fuel cycle issue can mostly be divided into two camps: those that believe the world is facing a systemic fuel cycle problem, and those that believe the world is dealing with a "Pakistan" problem. Those in the first camp are more willing to consider comprehensive and ambitious proposals than those who believe more limited, focused changes are sufficient to deal with the current challenges. Regardless of their disposition, however, there is a general appreciation for the fact that the spread of fuel cycle capabilities to additional states increases the risk for diversion and misuse of materials and undermines international confidence in the non-proliferation regime and norm.

Overall, the fuel cycle related proposals made over the past year can be divided into two categories: tactical and strategic. Tactical proposals have been far more detailed and can be more directly assessed than the broader, more ambitious, but less well defined proposals on the future of the fuel cycle overall. Even among those who agree that the spread of enrichment and reprocessing technology poses an increased risk of proliferation, there are debates. The long history of conflict between factions on nuclear fuel cycle and energy issues has made many actors hesitant to set overly ambitious goals or even to engage the issue in any sustained way. Others believe however that more drastic actions are required and that the global focus on the danger of nuclear proliferation presents an historic moment to adjust the international nuclear fuel cycle.

[2] See text of the speech by President George W. Bush on February 11, 2004 at www.whitehouse.gov.

Tactical Proposals

Rescinding fuel cycle rights

One set of proposals, made by officials including UK Foreign Minister Jack Straw and IAEA Deputy Director General for Safeguards Pierre Goldschmidt include the idea that states who violate their safeguards should have their rights to develop fuel cycle facilities rescinded by the international community[3]. Goldschmidt has suggested this might be accomplished via an a priori UNSC resolution that would automatically strip fuel cycle rights from states that are not in full compliance with their IAEA safeguards obligations. The UK Foreign Minister's proposals did not lay out a precise mechanism for enforcement[4]. In the case of violating states that possess fuel cycle facilities, it has been proposed that the IAEA should oversee the dismantling of those sites, raising the obviously difficult challenge of enforcement and the risk of a conflict between the international community and the violating party.

The role of the United Nations Security Council in these proposals, either in an a priori or case by case basis, is also a serious question. Members of the UNSC have been hard pressed to develop a consensus on actions to confront nonproliferation challenges. No UNSC action has yet been taken in the face of North Korea's violations of its safeguards and withdrawal from the NPT and the recent experience with Iraq is still very much a factor. Without a considerable diplomatic effort or strategic shift, it would be difficult to envision the UNSC passing a binding resolution in advance of any crisis empowering the IAEA to dismantle the nuclear facilities of another state. Obvious questions about enforcement would need to be answered in advance of any such proposal being accepted.

More modestly, FM Straw has suggested that states violating their safeguards should be simply denied supply of fresh fuel for reactors. If a violating state were to come back into compliance, fuel services could be resumed. While straightforward, even this modest proposal may also be difficult given the recent experience in trying to determine Iran's status with its safeguards agreement. Often, determining that a state is not in compliance with its obligations is a major challenge. Iran has clearly and systematically violated its safeguards agreement by not reporting major elements of its nuclear program to the IAEA. Yet political circumstances and the negotiating process have delayed any decision by the IAEA Board of Governors in making such a determination. Relying only on this process may not be adequate to address the security concerns under consideration.

No Safe Harbor

A set of other proposals are contained in the recently report *Universal Compliance – a Strategy for Nuclear Security*[5] prepared by the Carnegie Endowment on International Peace that would both deter and help prevent the misuse of safeguarded facilities by NPT member states. These in turn build on those put forward by other experts. The proposals

[3] See Pierre Goldschmidt, "The Increasing Risk of Nuclear Proliferation: Addressing the Challenge" Belgian Nuclear Society Symposium, 26 November 2003.

[4] See "Countering the proliferation of weapons of mass destruction," Written ministerial statement by the Foreign Secretary, Jack Straw, 25 February 2004.

[5] The full report can be found at www.ceip.org/strategy.

would pass binding Chapter VII UNSC resolutions making any state that violated the NPT safeguards responsible for those violations even if they withdraw from the NPT. These could build on those proposals made by DDG Goldschmidt, but raise similar questions of enforcement. The legal standard would be set in advance of any crisis, however, and provide an additional tool for the international community should it choose to take action to confront clear non-proliferation threats. In addition, the Carnegie proposals also call for the UNSC resolution to require that any nuclear facilities or capabilities acquired under the protection of the NPT by a state would have to be dismantled or eliminated should a state withdraw from the NPT. This would deny a state the ability to advance its nuclear weapons options as a result of its membership and subsequent withdrawal from the NPT.

The IAEA's Additional Protocol

Other tactical steps are designed to prevent or detect state who might seek to duplicate safeguarded facilities and produce nuclear materials outside of IAEA monitoring. Almost without exception, the proposals here are to make the IAEA Additional Safeguards Protocol universal to all states. President Bush has called for the Nuclear Suppliers Group to make the supply of controlled items conditional on the acceptance by recipients of the Additional Protocol, but the Group of 8 stopped short of a full endorsement of this policy at its June 2004 meeting. The group members did pledge to work to make the Additional Protocol universal and to strengthen NSG guidelines. The experience in trying to have the NSG adopt the basic full-scope safeguards agreement as a condition of supply in the 1990s suggest this effort may be hard to achieve. President Bush's direct involvement, however, has increased hope that diplomatic efforts to condition the sale of nuclear items on adoption of the Additional Protocol may be successful.

Enhanced Inspections

DDG Goldschmidt has also sought to further enhance the impact of the additional protocol by calling on all states to sign agreements with the IAEA facilitating the implementation of anytime, anywhere inspections. This is a right that is explicit in current full scope safeguard agreements and was reaffirmed by the IAEA Board of Governors in the 1993 stand off with North Korea. The proposal would invigorate the legal obligation for states to facilitate such rapid, intrusive inspections and could serve as a powerful deterrent to violations. This is a valuable concept and should be explored further. Nuclear weapon states, however, would clearly resist any such moves on national security grounds and the ability of the nuclear weapon states in particular to accept this provision would likely be limited only to specific sites under voluntary safeguards. This distinction might increase the sense of discrimination felt by some states of the overall inspection system. Moreover, industrialized states that already complain about the cost and impact of inspections might grouse about the burden of such a system. Thus, such a proposal should be compared carefully with the additional benefit such measures would add to the additional protocol itself.

Export Bans

President Bush also called in his February 11 speech for the NSG to ban the sale of uranium enrichment and plutonium reprocessing technology and related equipment to states that do not already have full-scale, functioning plants. The G-8, at its recent summit, agreed that for at least one year it would be prudent to avoid new initiatives to export or sell enrichment or reprocessing equipment and technology to additional states. In effect, however, the NSG members have not exported such items for some time and many states have standing laws or policies along these lines. The goal is useful and could help create and strengthen a norm of non-sale of such items, but in itself the proposals will not significantly affect the plans of some states to pursue such capabilities. Moreover, the case of the A.Q. Khan network makes clear that the NSG no longer has a monopoly of sensitive capabilities. Any measure to improve technology denial efforts will need to address a broader collection of states and even non-state actors such as corporations. UNSC Resolution 1540 is a good step in this direction, as is the Proliferation Security Initiative, but a broader, more interactive approach among key states is clearly required.

Strategic Proposals

As noted above, strategic proposals made for the fuel cycle are less well formed and specific than those tactical steps discussed here. Several prominent officials have laid out possible end points or goals, but have not yet developed or presented specific mechanisms for pursuing them. The Carnegie Endowment *Universal Compliance* report lays out some options in addition to the goals put forward by key officials.

President Bush and Dr. ElBaradei have both called for new approaches to providing fuel cycle services as a means of preventing additional states from acquiring the means to produce weapons-usable nuclear materials. President Bush has proposed having the international market provide a guaranteed supply of fresh fuel to states that do not possess or pursue fuel cycle facilities. Thus, fuel services would be used as an incentive for states to forgo their options to pursue an independent fuel cycle. The DGs approach would place all sensitive fuel cycle facilities under international control of some kind, although it is not clear if these new arrangements proposed by the DG would allow for the expansion of fuel cycle to additional states as long as they too were under similar arrangements. This last issue would be of serious concern to those seeking to prevent Iran and other states with questioned commitments to non-proliferation from acquiring the means to produce nuclear weapons.

President Bush's approach would allow states currently possessing such capabilities to maintain and even enhance them, while seeking to prevent additional states from acquiring the same capabilities. The DG's approach would appear to be more comprehensive and recognizes the difficulties associated with perpetuating a technological division between haves and have not states. In addition, the DGs vision would also presumably include providing international control over the back end management of spent fuel, a component missing from US proposals but a critical issue for states pursuing nuclear power. Thus the goal of bringing all fuel cycle activities under new control mechanisms, including possible international or multinational control

is far more ambitious plan that President Bush's approach that would deal only with denying sales of sensitive technologies to new states and providing a legal means to ensure the supply of fuel to such states in exchange for a commitment not to pursue fuel cycle facilities. Both ideas, and those that will reinforce and build off of these proposals will take years to assess, develop and implement, and all will require the development of a greater consensus on both the need and the means to pursue the new arrangements.

President Bush's proposals clearly seek to remove the economic need for domestic fuel cycle facilities by providing a guaranteed supply of fresh fuel to states that agree not to develop fuel cycle capabilities. It is assumed these are defined as including uranium enrichment and plutonium reprocess, but might also include certain plutonium production reactors, isotope separation capabilities (hot cells) and uranium processing and conversion facilities. President Bush has not offered specifics on how such guarantees might be made and what steps might give to guarantees the strength to confidence recipient states to foreswear domestic development of fuel cycle capabilities. A number of possible options exist, including those listed in Table 1.

There appear to two main motives for developing and providing fresh fuel guarantees to states that cede their rights to possess fuel cycle facilities. The first is to reduce the perceived need for states to possess independent capabilities that could in fact be used or misused to produce weapons-usable materials. Japan and other states have pursued or considered independent fuel cycle capabilities in large part for issues related to energy independence. The second motive, however, is more complex and can be used as part of the diplomatic efforts to undercut the economic and energy security arguments some states may use to legitimize the pursuit of weapons-usable technologies. If significant incentives are available for states to forgo independent fuel cycle capabilities, then additional international scrutiny may be justified in the case of states that decide to ignore or forgo those benefits. This does not mean that states that go it alone are pursuing weapon programs, but it would provide a useful validating mechanism that could help focus international efforts on states in certain circumstances. This litmus test is controversial among some states, but may be a useful tool in confronting states with concealed weapon ambitions.

Of the ideas to develop enhanced guarantees proposed to date, it is not clear that any would provide sufficient confidence beyond the current commercial market for states to forgo their ability to develop fuel cycle capabilities in the future. Concerns will likely remain that a state that decides to curtail the supply of fuel might also seek to prevent others from stepping in to take its place, just as the United States has done in previous cases. The legality of certain assurances in the face of UN sanctions, moreover, would need to be fully examines, as it is not clear that any mechanism would be able to supercede a UNSC decision to ban certain trade with states, even for unrelated reasons.

The more ambitious goal of putting all fuel cycle facilities under international control might be more promising, however. The term international could include joint corporate ownership involving entities in several countries or true international ownership under the control of the UN, IAEA or some other newly established organ.

On the corporate side, examples include that of URENCO, where several nations jointly own and operate facilities under international treaties and safeguards, and Eurodif where vendor and client states combined to finance and build facilities for enrichment services. Both examples raise concerns, however. URENCO technology was stolen by A.Q. Khan, who was employed by the company, to give birth to the Pakistani enrichment program. There is nothing inherent, however, about the international ownership of URENCO that made this espionage possible and adequate control on access to sensitive technology and personnel screening can be implemented to reduce these risks to an acceptable level. In addition, the Eurodif is a difficult model since certain participants such as Iran who invested in the project were then denied access to the technology and product at a later date. This model is unlikely to inspire confidence in the inviolability of contracts for fuel services.

Options that could be pursued to facilitate international ownership could include corporate stock swaps between the main enrichment providers in the United States, Europe and Russia. This joint ownership would not need to imply broader corporate control of the plants but could be used as a way to draw multiple countries into providing backing guarantees that contracts will be fulfilled by one of the providing states. This international corporate ownership would also be a model incorporating institutional arrangements and institutional barriers to the misuse of sensitive facilities. Facilities with financial and legal obligations to multiple countries could be harder (albeit not impossible) to misuse for illicit purposes. The URENCO arrangement raises the barrier to the misuse of such facilities since they would involve violations not only of IAEA safeguards but also domestic and international laws and treaties between sovereign states. Joint ownership between firms might offer similar institutional benefits.

The concept of full internationalization of fuel cycle facilities, which includes having the UN or some new internationally mandated organization take actual ownership of facilities raises complex legal and political issues. It is hard to imagine sovereign states such as Russia, the United States or Japan (just to name a few) ceding the title of expensive and sensitive facilities to international ownership. However, should an international consensus develop on the need to take such steps as a critical component to prevent the continued and dangerous spread of enrichment and reprocessing services to new states, such concepts could be pursued. The key would be for all such facilities to operate under the same rules to eliminate the creation of a discriminatory regime. Other simpler arrangements may possibly prove effective, but the potential benefits of such an ambitious approach deserve serious consideration.

Conclusions

The renewed interest in fuel cycle initiatives and the recognition that the current system carries unforeseen and unacceptable security risks may lead to progress on controlling the spread of sensitive nuclear technology and the means to produce nuclear weapons. Any non-proliferation efforts will need to take these civil and technological issues into consideration if they are to reinforce the norm and the means of achieving non-

proliferation. Moreover, with the exception of a few near term proposals, most of the initiatives being considered will require the creation of a broad and sustainable international consensus that includes broad understanding of the technical, economic, cultural and security consideration in a wide range of states. In the end, those options that minimize the discriminatory nature of the regime and that place all states on a level playing field will have a greater likelihood of success, but only if those solutions meet the security needs of all states involved. In sum, the steps considered must clearly and demonstrably reduce the risk that additional states will acquire the means to produce nuclear weapons.

Table 1
Options for Providing Guaranteed Supplies of Nuclear Fuel

There are a number of possible arrangements for ensuring that states that abandon fuel cycle capabilities can obtain guaranteed access to fuel services. The goal in each case would be to undercut the economic argument from programs to develop enrichment capabilities

A Commercial consortium of fuel providers: Government-backed collections of fuel producing states/companies could form supply groups to commercially out compete domestic fuel production programs. Three or more fuel providing entities could offer reinforcing contracts to prospective buyers (if one company drops out, another would be obligated to fulfill the contract). The fuel could be sold or leased, depending on the recipient states' ability to manage spent fuel. Such an initiative would require a new level of cooperation and coordination between companies that have fiercely guarded their commercial relationships and would require intense government/corporate interactions. All of the affected companies, however, already have close (if not coordinated) relationships with their national governments, which could be used to ensure cooperation with the proposed new arrangements.

Internationally managed stocks of fuel: The IAEA statute allows for states to donate nuclear materials to the control of the agency, which it can then use as directed by the Board of Governors. States could transfer the "flag" or ownership of fresh nuclear fuel that could then be transferred by the agency to states on an economically-viable basis. Transfers could be made in lieu of in addition to voluntary contributions to the IAEA, or seed money could be used to start a cost neutral program of fuel transfers by the Agency. In addition, the IAEA could take possession of stocks in smaller amounts to serve as a backup to commercial contracts. In the event that political, economic or technical factors led to the end of a fuel supply arrangement, the IAEA could step in, backstopping and thereby guaranteeing continuous supply.

Blind auctions of fuel: Fuel supply guarantees could be provided not to states but to the IAEA, which could then be empowered to conduct auctions to eligible states for the material. This would mean that states/companies would not be in a direct position to deny fuel services, since the fuel would be provided directly to and by the IAEA or some alternate body. Companies might commit themselves (or be persuaded to commit) to provide the Agency with a certain amount of fuel per year. Providing states would then have to fulfill these commitments, increasing the resiliency of the guarantees. A political commitment could also be envisioned where all such sales were required to go through the IAEA as a form of control and transparency.

IAEA as Guarantor: The IAEA could itself provide fuel guarantees to states that had abstained from acquiring fuel cycle capabilities. In turn, supplying companies and / or states would then be required to fulfill IAEA obligations for fuel supply. Leading supplying states could sign agreements with the IAEA to fulfill commitments made by the Agency on their behalf.

Source: *Universal Compliance – A Strategy for Nuclear Security,* Carnegie Endowment for International Peace, June 2004

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