

**Proceedings of**  
**MIT's Workshop on**  
**Internationalizing Uranium**  
**Enrichment Facilities**

**Executive Summary**

**October 20 - 21, 2008**

**James Goodby and Geoffrey Forden**

## Contents

<b>Introduction.....</b>	<b>3</b>
<b>Workshop Agenda.....</b>	<b>4</b>
<b>Summary of Talks.....</b>	<b>7</b>
<b>Commissioned Papers.....</b>	<b>16</b>

## Introduction

The prospect of a “renaissance” in nuclear energy coupled with the spread of dual-use technologies, has increased interest in finding new ways to promote nuclear energy while maintaining strong barriers to proliferation. Many feel that some form of multinational arrangement should be the way forward. In fact, as Tariq Rauf and Zoryana Vovchok pointed out in the latest issue of the IAEA Bulletin, there are at least twelve such proposals coming from a wide spectrum of countries and organizations.

This workshop is intended to explore some of these ideas as well as look at existing models of international nuclear collaboration. The application of these models in various regions of the world will be considered as well as economic, monitoring and verification, and broader disarmament aspects. We believe that this workshop comes at an auspicious time: we are in the run up to a very important NPT review conference in 2010 as well as critical meetings of the Nuclear Suppliers Group that the new administration will have to address very soon after taking office.

Ambassador James E. Goodby  
Dr. Geoffrey Forden

# MIT Workshop on Internationalizing Uranium Enrichment Facilities

Dates: October 20-21, 2008

## Monday, October 20, 2008

- 8:15 – 8:45 AM      Breakfast
- 8:45 – 9:00 AM      Opening remarks with Goodby and Forden
- 9:00 – 10:20 AM     Session One: What problems does internationalizing the fuel cycle address?  
**Discussion Leader: Tariq Rauf**  
1. Matt Bunn  
2. Laura Holgate  
3. Larry Scheinman  
  
Discussion: 20 minutes
- 10:20 – 10:30 AM    Coffee Break
- 10:30 – 11:45 AM    Session Two: Economic Analysis of Multinational Enrichment Centers.  
**Discussion Leader: Charles Forsberg**  
1. Geoffrey Rothwell  
2. Steve Goldberg  
3. Thomas Wood  
  
Discussion: 20 minutes
- 11:45 – 1:05 PM     Session Three (part 1): Models of Multinational Enrichment Facilities: Existing Industrial Models  
**Discussion Leader: Myron Kratzer**  
1. Sam Shakir/Alan Hanson- AREVA  
2. Mark Marano- GE-Hitachi  
3. James Timbie—USEC  
  
Discussion: 20 minutes
- 1:05 – 2:00 PM      Lunch
- 2:00 – 3:45 PM      Session Three (part 2): Models of Multinational Enrichment Facilities: New Concepts  
**Discussion Leader: Pierre Goldschmidt**

1. Diakov/Podvig—Russia’s plans for Angarsk
2. Carol Kessler—International Fuel Services Center
3. John Thomson—Iran as a Pioneer Case for Multilateral Enrichment Centers
4. Chaim Braun—Fuel assurances for Iran

Discussion: 30 minutes

3:45 – 4:00 PM Coffee Break

4:00 – 5:30 PM Session Four: Improving Proliferation Barriers for Multinational Enrichment Centers

**Discussion Leader: Marvin Miller**

1. Houston Wood
2. Brian Boyer
3. Geoffrey Forden

Discussion: 30 minutes

6:30 – 8:30 PM Reception & dinner at the Marriott Hotel

8:30 PM END OF DAY ONE

Tuesday, October 21, 2008

8:30 – 9:00 AM Breakfast

9:00 – 10:45 AM Session Five: International Frameworks—Legal Structures, NSG, etc.

**Discussion Leader: Thomson**

1. Fred McGoldrick
2. Daryl Kimball
3. Yuri Yudin
4. Jeffrey Bedell

Discussion: 30 minutes

10:45 – 11:00 AM Coffee Break

11:00 – 1:00 PM Session Six: Responding to needs in: Asia/Pacific, Middle East, Africa, South America, North America.

**Discussion Leader: Mark Hibbs**

1. Chaim Braun—India/Pakistan
2. Carlos Feu Alvim—South America
3. Larry Scheinman—Japan

4. Fiona Simpson—Middle East

Discussion: 30 minutes

1:00 – 2:00 PM

Lunch

2:00 – 3:15 PM

Session Seven: Relationship between multinationalization of the fuel cycle and nuclear disarmament.

**Discussion Leader: Steve Fetter**

1. John Steinbruner

2. Paul Meyer

Discussion: 30 minutes

3:15 – 3:30 PM

Coffee Break

3:30 – 4:30 PM

Session Eight: Wrap up and conclusions

**Discussion Leader: James Goodby**

4:30 PM

END OF WORKSHOP

**Summary**  
**MIT's Workshop on Multinational Enrichment Facilities**

**Monday, October 20, 2008**

*Session One: What problems does internationalizing the fuel cycle address?*

**Tariq Rauf** told us that the many IAEA Member States, particularly those from the NAM/G-77, are suspicious of being deprived of their "inalienable right" to develop nuclear energy for peaceful purposes as enshrined in Article IV of the NPT. He traced this reaction in part to President Bush's speech at NDU in February 2004 that proposed limiting enrichment and reprocessing to those States that already have these technologies at a mature level. He added that many IAEA Member States are opposed to creating a new discrimination within the NPT -- that of technology-holders and technology-recipients -- in the context of nuclear fuel cycle options, and that such States strongly support a non-discriminatory and equitable approach.

**Matt Bunn** said that while the commercial market is doing well at providing reliable supplies of nuclear fuel, countries refuse to give away rights they consider they have to develop their own fuel cycle services. He suggested that offering some help on the back end of the fuel cycle had great potential and that a lease-take back system had the makings of an attractive incentive to relieve any desires for indigenous fuel cycle services.

**Laura Holgate** described five reasons underlying national decisions to acquire domestic enrichment facilities: security of fuel supply, commercial interests in selling enriched uranium, technical prestige (or "nuclear nationalism"), a desire to develop nuclear weapons, or to create a weapons "hedge" or "virtual" program. She saw the problem as how to meet the first three while exposing the last two. She thought it was not obvious that an international structure is inherently superior to other means, although three or four countries running a plant might be less inclined to pick fights with suppliers or consumers. She urged attention to specific circumstances under which benefits could occur.

**Larry Scheinman**, speaking through Marvin Miller, emphasized that advocacy and promotion of multilateral facilities needs to be considered in a broader context than just how to manage the fuel cycle, in particular the nature and extent of progress being made (or not) on nuclear disarmament to which many in the non-aligned are particularly attentive and maintain expectations of forward movement especially as they see the NPT as a bargain involving give and take on all sides. This relates as well to Article IV of the NPT that speaks of the "inalienable right to develop research, production and use of nuclear energy for peaceful purposes without discrimination and in conformity with articles I and II of this Treaty." Efforts to interpret this provision as excluding sensitive nuclear technologies and of limiting the right to pursue them to a small number of countries is widely, and in some cases, vigorously disputed. The option of limiting

enrichment needs to be addressed in terms of opportunity and advantage, not in terms of denial – hence the relevance of exploring the possibility of partnering in multinational enterprises with a technology holder in which investing partners share in decision making and profits and have priority access to product but agree not to “compete with themselves” by developing competitive national capabilities. The alternative of a two-tiered world based on denial and discrimination is not viable in the longer run.

*Session Two: Economic Analysis of Multinational Enrichment Centers.*

**Charles Forsberg** presented an analysis showing that the capital costs of reactors were by far the biggest expense in civil nuclear power programs and the largest component in the cost of electricity from nuclear power plants. The cost of enrichment services and spent fuel disposal is a small fraction of the cost of electricity. However, the capital costs of enrichment facilities and spent fuel repositories are high. There are very large economies of scale for enrichment facilities and spent fuel repositories and large incentives for these types of facilities to service large numbers of reactors. Large nuclear programs tended to favor owning fuel cycle facilities. Major uranium suppliers have an advantage in determining the rules and may have strong incentives to build enrichment plants to maximize the revenue and jobs. Finally, he pointed out how inefficient uranium enrichment is. Because uranium enrichment processes are inefficient, there are strong financial incentives to develop new enrichment processes and the potential for breakthroughs that might radically alter the characteristics of uranium enrichment.

**Geoffrey Rothwell** also discussed economies of scale, mentioning that in the case of MOX fabrication there were increasing returns on scale. Smaller facilities were way up in the cost curve. He mentioned that although USEC was heavily subsidized, it might fail. Speaking of incentives to refrain from building fuel cycle facilities, he mentioned lower prices for nuclear fuel.

**Thomas Wood** drew attention to the public good of nonproliferation versus the private good of technology supply. He mentioned the costs of concealment of nuclear activities. The lack of a carbon footprint also was a public good and this was a separate issue from economies of scale. He also stressed the value of dealing with the back end of the fuel cycle.

**Steve Goldberg** discussed a three topics: (1) an enhanced leasing arrangement, multilateral in nature, whose acronym is TRUST, that would support new nuclear consumer countries being supplied economically competitive nuclear fuel and disposition services; (2) large financial transactions that would both support a multinational enrichment capability and would be essentially "off-budget" transactions from the Federal budget perspective; and (3) in-fashion deals for financing new nuclear projects that are trending toward public-private partnerships. Based on his experience in privatizing USEC, he suggested that the assets that were the basis for brokering the HEU agreement could be utilized in facilitating the establishment of a multinational enrichment facility. Regarding the last point, more research is needed on the ownership and contractual framework underpinning USEC, keeping in mind the foreign ownership

constraints imposed by Section 193(f) of the USEC Privatization Act.

***Session Three (part 1): Models of Multinational Enrichment Facilities: Existing Industrial Models***

**Myron Kratzer** said that supply concerns had not existed in his experience. Long-term contracts have worked quite well. He then described the organization and functioning of URENCO.

**Alan Hanson** agreed with the other speakers that the backend of the fuel cycle could be attractive if the practicalities could be worked out. The enrichment part might be too small of a sector to be interesting. He agreed that the bottom-up approach was the right way to proceed. He thought that AREVA would be open to multinational ownership of facilities because, among other things, this would provide access to capital.

**Sam Shakir** discussed black box protection of technology, pointing out that the AREVA model works for some countries but not for others. He said that the Georges Besse facility in France was moving to multinational ownership. He thought the same model might be followed at AREVA's Eagle Rock facility in the United States.

**Jim Timbie** described USEC's evolution from a government enterprise to a private company. USEC produces 5.5-6 million SWU annually at its 50-year-old Paducah gaseous diffusion plant and imports 5.5 million SWU from Russia under the HEU Agreement. USEC sells 10-12 million SWU per year, about equal to total U.S. demand, but sells most of the Paducah production to Asia, so nearly all of the enrichment actually used by U.S. utilities is supplied by Russia and Europe. This distortion of the market is a price we pay for the nonproliferation benefits of the HEU Agreement. Approval by the USG of loan guarantees to USEC would be essential for that company to complete development and deployment of advanced centrifuge technology. (A brief discussion ensued on criteria for blackbox practices.)

***Session Three (part 2): Models of Multinational Enrichment Facilities: New Concepts***

**Peter Goldschmidt** favored long-term generic export licenses in a common fuel procurement agency for small utilities. He explained why he did not see multinational enrichment facilities as responding to current needs.

**Pavel Podvig** described arrangements at Angarsk international nuclear fuel center. He thought it could be a good testing ground for safeguards in such facilities.

**Carol Kessler** described the IAEA's possible roles in the assured nuclear fuel supply proposals presented to the IAEA Special Session on this in September 2006. The IAEA

roles range from applying safeguards to owning the low enriched uranium in a reserve and managing its allocation. The roles are all authorized in the IAEA statute with the exception of predicting the successful operation of the international fuel market. The IAEA will increase customer assurance in the reliability of supply the more it is engaged. But the IAEA does not seem well-suited to own or operate a facility. The IAEA's role should be balanced with the nonproliferation benefits gained, as it remains important to conserve IAEA resources for those activities with greatest nonproliferation benefit.

**John Thomson** stressed the difficulties facing the nonproliferation regime. Security of supply was not the most important factor. An increasing number of countries take a very different view of the whole enterprise than we in the room do. He then described the Forden-Thomson generalized multilateral idea. He rejected the notion that this would help countries develop indigenous nuclear weapons capabilities. Citing the Iran case, he thought we were well past the time when we could continue profitably on the present course.

**Chaim Braun** described his proposed modification of the Forden-Thomson model that would build on current Iranian centrifuge technology at the early phases of engagement with Iran, before importation of advanced western centrifuges could, or should, be considered. He stressed the need to maintain low enriched Uranium in Iran only in the form of fabricated fuel assemblies for Bushehr and follow on Iranian reactors. To that purpose he suggested internationalizing the conversion/fabrication complex in Esfahan, along similar lines to the multi-lateral management of the Iranian enrichment plant in Natanz. He thought, as one option, that AREVA or URENCO could manage the enrichment facility while the Russians could manage fuel conversion and fabrication. Chaim suggested that the Forden-Thomson model could be implemented as follow-on program, once successful internationalization of the Iranian fuel cycle industry was demonstrated based on his early engagement model.

**Jim Timbie** explained why the US administration had favored modest steps to provide assurance of reliable supply that would improve the current situation rather than the more ambitious multilateral enrichment facilities that were the subject of the workshop. He thought the existing commercial market meets the demand quite well and underscored the enormous expense of building facilities that would compete with established large companies with advanced proprietary technology developed over decades. He also pointed out that regardless of ownership structure, multilateral facilities would face the same legal and regulatory constraints on exports of nuclear materials imposed by governments where they are located, and therefore would not be in a position to make unqualified commitments to supply enriched uranium under all circumstances.

#### ***Session Four: Improving Proliferation Barriers for Multinational Enrichment Centers***

Regarding safeguards, **Marvin Miller** discussed laser enrichment technologies and its proliferation potential.

**Houston Wood** pointed to the small number of enrichment cascades required to build bombs as opposed to the large number it takes to supply reactors with fuel. He emphasized the need for people on the ground to find clandestine facilities.

**Bryan Boyer** described the basis for IAEA safeguards at gas centrifuge enrichment plants. He stated the goals of IAEA safeguards at these facilities and the challenges of safeguarding such bulk material handling facilities. He noted that it is very difficult for the IAEA to detect undeclared feed and undeclared products under the safeguards regime formulated by the Hexapartite Safeguards Project during the 1980's. He then discussed how IAEA safeguards are done at the URENCO facilities and briefly described improvements in the safeguards approach and technology to handle better verifying undeclared feed and undeclared products .

**Geoff Forden** concluded the day with a discussion of safeguards in the Forden-Thomson plan. He stressed that AQ Khan was the symptom, not the cause of the current problem. The supply-side approach no longer worked. We are in a new technological environment where precision engineering is widespread. We need to get the developed and developing countries working together.

**Tuesday, October 21**

*Session Five: International Frameworks—Legal Structures, NSG, etc.*

**John Thomson** said that the US has now changed its laws to accommodate the US-India deal, which will have some ill effects. The agreement shows what happens when nonproliferation is not given first priority. Indian foreign policy cannot be bought: it will be exactly what it would have been without the deal. As to giving up rights to the fuel cycle, developing countries will not give up rights at least legally. The P5 will have to be more adroit to get even a "maybe" from developing countries to forego the nuclear fuel cycle. Problems of the NSG include the fact that it does not include countries like Singapore, Malaysia, and Iran, countries that manufacture relevant equipment. Such countries might well refuse an invitation to join. They represent the dominance of the big powers and prefer to retain freedom of action. The crucial point is that multilateralism is one way to get wider acceptance of nonproliferation. The US will have to embark on ratification of the CTBT and the FM CT will have to be pursued seriously, in order to have a successful 2010 Review Conference.

**Fred McGoldrick** said that existing NSG guidelines call for restraint in the transfer of enrichment technology and encourage supplier involvement or multinational participation as an alternative to national plants. The language of denial and renunciation contained in the Bush 2004 nonproliferation proposal on fuel assurance was damaging and motivated countries to assert their rights to enrichment technology. The U.S. proposals to change the NSG guidelines have not been accepted and the NSG is now engaged in a debate on the merits of requiring black-boxing of enrichment transfers. The US could help promote norm of multinational enrichment by proposing the NSG adopt a statement of principles

on security of supply and an offer to multi-lateralize US enrichment facilities. These efforts could be advanced in the run-up to the NPT review conference.

**Daryl Kimball** said that lessons from the NSG decision of September 6 on India will undermine the NSG and the nonproliferation system as a whole. He then discussed the circumstances surrounding that event. He urged that the United States and other nuclear suppliers adopt more stringent guidelines on the transfer of enrichment and reprocessing technology along the lines of the "criteria-based" proposal that was discussed at the NSG's May 2008 meeting.

**Jeffrey Bedell** associated himself with McGoldrick's views regarding the NSG, and stated that the NSG is not treaty based and is an informal arrangement and therefore may not be the best forum to mandate enrichment plant MNAs as a new norm. He noted the NSG is not supposed to promote or inhibit legitimate commercial trade, but rather is primarily an export control group for proliferation controls. In this context enrichment plant MNAs could be useful, but should preferably serve to minimize technology transfer. He then reviewed the MNA and blackbox options discussed in the first days session. He thought the Angarsk system might be the best, since this model seemed to afford the best technology protection. As regards the Forden-Thomson and Braun plans for Iran, he expressed concern that this would enable Iran to build replicate facilities. He saw a technology transfer issue here. "Black boxes" are not a perfect solution everywhere, and also may be less applicable for other enrichment processes. In the ensuing discussion McGoldrick said that he thought the problem was not urgent but that careful thought and consultation should be useful for a new normative framework for the fuel cycle. The United States would have to accept the same norms it was asking other countries to accept. Thomson advised that we should try not to be too stuck on the ideal solution but try to get the concept into people's heads.

***Session Six: Responding to needs in: Asia/Pacific, Middle East, Africa, South America, North America.***

**Mark Hibbs** said that we may be reaching a consensus that multilateralism will not take place overnight. As regards Canada and Australia, uranium enrichment as well as the back end of the fuel cycle would be an interesting possibility for cooperation. There are, however, obstacles in both countries. Neither country is likely to accept spent fuel. As regards China, this is a real possibility for operation. It might be willing to take on a role in low enrichment uranium fuel provision. The Asian region could support a regional uranium facility, involving the ROK, but supplying Europe might be more likely. Japan is not a candidate for multilateral facilities. Tokyo was looking for US leadership. The participation by the US would be necessary because of security concerns. All the smaller countries of Asia are looking at nuclear power. Vendors will probably come in to sell fuel cycle services.

**Chaim Braun** spoke about India and Pakistan, first describing the Indian plan for major nuclear power build-up. He characterized the Indian plan for installing forty ALWRs by 2020 as "irrational exuberance." He thought that smaller capacity would ultimately

become operational by that time. India has a small centrifuge program for Naval and research reactors. Pakistan's power program is much smaller. Currently, reactor and fuel cycle plans are driven to some extent by military requirements. Pakistan is working toward separation to two nuclear programs, one civilian, and one military, similar to the Indian plan. It would not justify a large international enrichment plant based on need, for several decades. It would make sense eventually for India to build an enrichment facility for itself given its nuclear build-up plans. Ten to twenty GW of operating ALWRs would justify an enrichment facility, in the 2020-2030 time frame or later. Imported enrichment technology on black-box model could be obtained from Rosatom, Areva, or Urenco. Low enriched Uranium would be provided under IAEA safeguards to similarly safeguarded ALWRS. The Indian enrichment plant could be constructed to partially serve the requirements of an 'extended' region including South Asia and beyond.

**Carlos Feu Alvim** described the Economic and Energy Organization. If the motivation for building a fuel cycle is nuclear proliferation, it can be solved in a regional framework. Thus Argentina-Brazil cooperation was created. The Carter restrictions convinced Brazil that it must rely on its own nuclear fuel capacity. Venezuela and Chile can be considered for the future. However, technology would not be shared. The host country would be the country that has the technology. After all, the Brazilian Navy doesn't even want to share technology with the Brazilian civilian nuclear industry. No sense of urgency is felt and will not be unless there are restrictions on fuel supply. Regional or bilateral mechanisms can be more secure than larger groupings. But the Additional Protocol reduces the role of regions and is not felt to be helpful in the region.

**Fiona Simpson** described the current nuclear status of several Middle Eastern countries. Demand for energy is growing, leading to ambitious goals for nuclear power. In the short-term, it may be more practical to locate an enrichment facility outside the region. Leasing and take-back are attractive and should be given greater consideration as both a non-proliferation measure and as a benefit for states with new and revived nuclear programs, such as are envisioned in the Middle East. No state in the region, however, has publicly expressed interest in obtaining a complete domestic fuel cycle, except Iran, although many states remain concerned in principle regarding the possible erosion of their rights under the NPT. Recent suggestions regarding joint activities on other parts of the fuel cycle, or creating a joint company for the purchase of fuel, would be interesting in the Middle East.

**Ambassador Gumbi** shared South Africa's preliminary views regarding internationalizing the nuclear fuel cycle. As much as this is work in progress he stated that disparity between states that have nuclear technology and those that do not should be eliminated. The world must avoid creating new cartels. There should be no presumption that new technologies are safer in the hands of some countries but not in others. The IAEA should be involved in all such endeavors.

***Session Seven: Relationship between multinationalization of the fuel cycle and nuclear disarmament.***

**Steve Fetter** observed that we need to keep the problem in a broader framework, arguing that nuclear disarmament would encourage multilateral arrangements for enrichment.

**John Steinbruner** described the background to the current discussion. For many countries the unique military capabilities possessed by the United States are both the principal source of threat and the only source of reliable protection. The US must convey global reassurances if it is to legitimize its military advantage. It is a better strategy for those countries threatened by the US to get security assurances rather than nuclear weapons. The six party agreement with North Korea is a good model for Iran, but would probably require some provision allowing Iran to continue limited enrichment activities under robust IAEA scrutiny with international control of the product. Alternatively, participation in a state-of-the-art enrichment plant with international management might be an attractive option. In general, internationalizing the nuclear fuel cycle has a better chance of working in a broader program of security accommodations.

### *Session Eight: Wrap up and conclusions*

**Ambassador James Goodby** saw a splitting of the audience into two groups. For those who saw the nonproliferation crisis as fairly limited in scope, fuel supplies assurances rather than multinationalizing facilities, would be the main tool to deal with concerns about equity. Others felt that the only way to prevent proliferation and further strengthen the NPT were for developed countries to get more involved in the nuclear programs of developing countries. Several methods were presented and discussed. Some participants were dubious about the security of multilateral enrichment facilities and whether interest among consumer nations really existed.

On the economic side, there was agreement that economies of scale are clearly present as regards enrichment and spent fuel reprocessing. Cost and pricing policies also could be used to provide incentives for nations to forego enrichment facilities. The problem is to allocate costs of enrichment to assure efficiencies, equity, and nonproliferation.

Cost considerations argued in favor of leasing arrangements instead of sales, several argued. In this connection, it was generally agreed that the backend of the fuel cycle would offer considerable incentives for nations to accept lease-take back arrangements instead of buying fuel. Some questioned whether the "nuclear renaissance" would take off on the scale once envisioned, given the financial complications present today.

As regards further steps in the NSG, there was general agreement that criteria should continue to be pursued to clarify export procedures in the aftermath of the US-India deal. The "black box" idea should be further discussed. However it was recognized that the NSG had a limited mandate and the pursuit of broader goals, such as promotion of multilateral enrichment facilities, should be carried on elsewhere, probably in the context of the preparation for the NPT Review Conference.

The possibility of regional approaches was discussed from the point of view of their own special advantages, in contrast to the methods of global organizations. Since proliferation

problems often arise in a regional context, perhaps regional solution should be given more emphasis. Prohibitions of nuclear weapons should require controls over enrichment and reprocessing. Internationalizing of uranium enrichment facilities should be the *quid pro quo*.

As to multilateral uranium enrichment facilities, the participants in the conference from AREVA and GE Hitachi expressed the opinion that the companies would welcome additional shareholders from the international community. This model was not seen as a true multilateral facility, however, although it does convey advantages to the ownership. Some participants expressed the opinion that USEC might be ready for foreign participation and ownership, recognizing that this would require consultation with the U.S. Congress.

As regards new models for cooperation in this area, the Iranian case was the most thoroughly discussed. Two different versions were presented and defended. Critics doubt that Iran could be expected to act in good faith even if it accepted the idea. Angarsk, on the other hand, was seen as an interesting model, possibly one that could be emulated elsewhere. China might be interested in becoming a supplier of LEU along Angarsk line, but possibly not on a regional basis. Some view this as a promising option. Japan was perceived as unlikely to be interested in multilateral approaches.

Jim Timbie suggested that, as an alternative to the development of assurance mechanisms acceptable to the NAM and the G77 and approved by the IAEA Board of Governors, a conceptually different approach would be to proceed one-by-one. For any country that desires assurance of reliable fuel supply, the USG is prepared to negotiate a bilateral 123 agreement for cooperation or a trilateral project and supply agreement with that country and the IAEA. With that legal basis in place, if a supply disruption should occur, we could move quickly to supply enriched uranium. The USG is moving this direction, with 123 agreements already in place or under negotiation with a number of countries considering nuclear energy, and we encourage other suppliers to do the same. This approach avoids questions about rights and provides assurances to those that want them.

## Multinationalizing USEC

Fred McGoldrick

### Introduction

The United States has long recognized that limiting the spread of enrichment facilities must be an important element of an effective global nonproliferation regime. A few large multinational enrichment facilities that would provide appropriate participation by foreign utilities and/or their governments and offer reliable nuclear fuel assurances on attractive terms could help persuade some countries that they do not need to acquire their own national enrichment plants.

Some existing enrichment plants, namely those operated by Urenco<sup>1</sup>, Eurodif<sup>2</sup>, and the Russian centrifuge facility at Angarsk<sup>3</sup> already entail some form of multinational participation. Argentina and Brazil are in the process of establishing a bi-national agency that would provide enrichment services.<sup>4</sup> In addition, the multinational firm Urenco is building the Louisiana Enrichment Services (LES) / National Enrichment Facility (NEF) centrifuge plant in New Mexico. The French firm AREVA is building an enrichment facility in Idaho with the AREVA and Urenco joint venture Enrichment Technology Company, LTD (ETC) supplying the centrifuge technology. The Silex plant planned for the United States will involve participation by GE-Hitachi Nuclear Energy and its subsidiary Global Laser Enrichment, (GLE) as well as the Canadian firm Cameco. The

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<sup>1</sup> Urenco is a consortium composed of the UK Government; the Dutch government; and several German nuclear companies. Urenco operates three similar uranium enrichment plants in the UK, The Netherlands and Germany. The facilities are subject to safeguards of EURATOM and/or the International Atomic Energy Agency (IAEA).

<sup>2</sup> Eurodif S.A. is a private company that was formed in the 1970's to build and operate the gaseous diffusion plant located at the AREVA Tricastin site in southern France. AREVA owns approximately 60% of the Eurodif shares. Other shareholders include Spain's ENUSA, Belgium's SYNATOM, and Italy's ENEA. Eurodif does not share its technology with its investment partners. The facility is subject to EURATOM safeguards

<sup>3</sup> Russia is in the process of establishing the International Uranium Enrichment Center (IUEC) on the site of the Angarsk Electrolysis Chemical Complex in which other countries are invited to participate. The Russians have invited the IAEA to apply safeguards to the center. The Russian facility is oriented chiefly to providing enrichment services to states not developing uranium enrichment capabilities on their territory. Russia will not transfer its centrifuge technology to participants in the IUEC. Kazakhstan and Armenia have joined this effort.

<sup>4</sup> Brazil will not share its centrifuge enrichment technology with Argentina. Any enrichment facilities involved in the bilateral agency would be subject to IAEA safeguards and to the safeguards of the Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials (ABAAC).

fact the U.S. is allowing new multinational enrichment plants on its territory may help others to accept this model as an international norm.

However, other plants in the United States, Russia, China and Japan have no multinational involvement. If existing technology holders, particularly those in nuclear weapon states, are not prepared to invite some form of multinational participation in their own facilities, it will be difficult to establish multinational control of sensitive nuclear facilities as a global nonproliferation norm that is acceptable to the majority of states. The United States Government should propose that new commercial uranium enrichment facilities should be multi-nationally owned and subject to safeguards agreements with the International Atomic Energy Agency (IAEA). To this end, the U.S. Government should give serious consideration to the merits and feasibility of encouraging appropriate multinational participation in the new centrifuge facility being built by the United States Enrichment Corporation (USEC).

### **USEC: A Candidate for Multinational Participation?**

USEC runs the only currently operating enrichment facility in the United States – a gaseous diffusion facility in Paducah, Kentucky, which it is leasing from the U.S. Department of Energy (DOE). USEC plans to shut down the Paducah facility once it opens its new American Centrifuge Plant (ACP) that is under construction at Piketon Ohio. USEC secured the necessary license from the NRC in 2007 in order to build and operate the ACP, which will use a new gas centrifuge technology developed by DOE. The ACP, which is scheduled to begin operation in 2010 and to be fully built by the end of 2012, has a planned capacity of 3.8 million SWUs.

The ACP does not involve any foreign investment or participation, but USEC would clearly welcome an infusion of funds from abroad to help meet its pressing financial needs. There do not appear to be any legal barriers to foreign investment in ACP, and there are no national security reasons for barring appropriate foreign participation in this plant. What may work against foreign investment in the new USEC enrichment facility are some uncertainties about the commercial and operational reliability of the new ACP centrifuges. Attracting foreign investment may require U.S. Government subsidies that would allow USEC to service a wider body of enrichment customers (i.e., utilities in consumer countries who do not have their own enrichment capacity) at attractive prices.

### Legal Considerations

USEC, originally a government corporation, was created as a result of the Energy Policy Act of 1992 to privatize uranium enrichment for civilian use. USEC later went public in 1998 through an initial public offering. Section 193 (f) of the Atomic Energy Act provides that “No license or certificate of compliance may be issued to the United States Enrichment Corporation or its successor under this section or section 53, 63, or 1701, if the Commission determines that–

- (1) The Corporation is owned, controlled, or dominated by an alien,

a foreign corporation, or a foreign government; or

(2) The issuance of such a license or certificate of compliance would be inimical to—

(A) the common defense and security of the United States; or

(B) the maintenance of a reliable and economical domestic source of enrichment services.

NRC Regulations (10 CFR 70.40 and 10 CFR 76.22) implement the restrictions of Section 193 of the AEA. Under NRC regulations implementing the national industrial security program (NISP) (10 CFR Part 95), a certificate holder or licensee is required to obtain a facility clearance for any location where classified information will be used, stored or handled. The NRC review for determining whether to grant a facility clearance involves examining whether there is any foreign ownership control or influence (FOCI). NRC regulations define FOCI as follows:

*Foreign Ownership, Control, or Influence (FOCI)* means a foreign interest that has the power, direct or indirect, whether or not exercised, and whether or not exercisable through the ownership of a U.S. company's securities, by contractual arrangements or other means, to direct or decide matters affecting the management or operations of that company in a manner which may result in unauthorized access to classified information or may affect adversely the performance of classified contracts.

According to a recent USEC press release,

“In September 2008 we created new wholly owned subsidiaries to carry out future commercial activities related to the American Centrifuge project. These subsidiaries will own the American Centrifuge plant and equipment, provide operations and maintenance, manufacture centrifuge machines and conduct ongoing centrifuge research and development. This corporate structure will separate ownership and control of centrifuge technology from ownership of the enrichment plant and also establish a separate operations subsidiary. This structure will facilitate DOE loan guarantee financing and potential third party investment at the project level, while also facilitating any future plant expansion.”

According to USEC, these wholly owned subsidiaries will allow for foreign investment as long as it remains under 50% of the total shares. The certificate of incorporation for USEC Inc. contains certain restrictions with respect to foreign ownership of common stock, and the Board of Directors of USEC, Inc. has the right to review any foreign ownership of common stock. In addition, foreign ownership of any U.S. enrichment

facility may also require review by the Committee on Foreign Investment in the United States (CFIUS).<sup>5</sup>

Other forms of multinational participation. Foreign investment in USEC may offer improved fuel assurances to participants and thus reduce their incentives to build national facilities. Another mechanism for enhancing confidence in fuel supply would be to offer some form of participation by foreign investors in the overall policy and management of USEC. The U.S. could also follow the Russian example at Angarsk by establishing an advisory committee which would include not only the foreign investors but also the Director General of the IAEA. Section 1304 provides that USEC, Inc.'s board of directors must be citizens of the United States. According to USEC officials, however, participation in the board of directors of its subsidiaries is permissible under the law.

Thus there appear to be no legal barriers to investment by foreign entities or their participation in the board of directors of or as advisors to USEC, Inc.'s subsidiaries.

### National Security Considerations

Protection of Restricted Data and Sensitive Nuclear Technology. Any option to invite multinational participation in USEC will require arrangements that prohibit the dissemination of Restricted Data or sensitive nuclear technology to foreign participants.<sup>6</sup> Section 144 (a) of the Atomic Energy Act prohibits the transfer of Restricted Data except pursuant to an agreement for cooperation entered into in accordance with section 123 of the Act.

Limiting Participation to Countries that do not have their own enrichment facilities. The U.S. may also wish to consider offering foreign participation in the USEC ACP only to those countries that do not have their own parallel national enrichment activities. The Russian facility at Angarsk operates on this model.

Safeguards. It is assumed that the new USEC facility will be placed on the list of facilities eligible for IAEA safeguards in accordance with the U.S.-IAEA safeguards agreement. Under this agreement the United States has agreed to permit the Agency to apply safeguards on all source or special fissionable material in all facilities within the United States, excluding only those facilities associated with activities with direct national security significance to the United States. This means in practice that, while the

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<sup>5</sup> PL 110-90 requires the Committee on Foreign Investment in the United States (CFIUS) to review all "covered" foreign investment transactions to determine whether a transaction threatens to impair the national security, or the foreign entity is controlled by a foreign government, or it would result in control of any "critical infrastructure that could impair the national security."

<sup>6</sup> ETC, the 50/50 joint venture between Urenco and AREVA, does not share its technology with its shareholder/customers. In fact, strong "firewalls" must exist at all times between ETC employees and Urenco and AREVA employees. ETC supplies only "black boxed" technology to Urenco's and AREVA's enrichment facilities in Europe and the U.S. France does not permit access to its gaseous diffusion barrier technology by its investment partners in its Eurodif enrichment enterprise. Russia will not transfer to participants in its centrifuge facility at Angarsk uranium enrichment technology or information that constitutes a state secret.

IAEA would have the right to apply safeguards, it would not actually do so since the IAEA has limited funding for safeguards and has placed priority on safeguarding nuclear materials in non-nuclear weapon states. If the United States wished the IAEA to apply safeguards to the new USEC facility, it would have to finance such safeguards through a voluntary contribution to the IAEA.

Production of naval fuel and tritium. In order to attract foreign participation in USEC, it will be important to maintain a separation of the USEC facility from any nuclear weapons or military activities. As noted, the ACP should be placed on the eligible list of the U.S.-IAEA safeguards agreement. Under that agreement, the United States has the right to withdraw materials or facilities from the eligible list upon notification to the Agency. USEC has argued in its petition on a recent anti-dumping case that USEC is the only domestic company that employs uranium enrichment technologies available to meet defense needs.<sup>7</sup> However, there should be no need to call upon the USEC facility for the production of either tritium for nuclear weapons or for naval reactor fuel. The United States has a supply of tritium sufficient to meet future needs for well over a decade. Moreover, as of mid-2007 the United States has set aside some 128 tons of highly enriched uranium for naval fuel. In addition, the United States has large numbers of warheads awaiting dismantlement. Once these warheads are dismantled, further HEU would become available for naval uses. Furthermore, under the 2002 Strategic Offensive Reductions Treaty (SORT or Moscow Treaty), the United States and Russia have committed to reduce their arsenals to 1700–2200 deployed strategic warheads each by 2012, and proposals have been made for further reductions down to 1000 total warheads for each country. Such reductions would provide additional quantities of HEU which should be ample for any naval propulsion or for blending down to LEU for any needed tritium production.<sup>8</sup> The U.S. Nuclear Regulatory Commission's license for the ACP authorizes USEC to enrich uranium only up to 10 percent of the fissile isotope uranium-235—an enrichment well below what is currently used in U.S. naval fuel.

Peaceful Use Assurance. Under the U.S.-IAEA safeguards agreement, the United States has the right to withdraw any nuclear facility that is on the eligible list from the safeguards agreement. In order to enhance confidence among potential foreign participants in the peaceful uses of the ACP, the U.S. should give serious consideration to making a political commitment to the IAEA that it will not withdraw ACP from the U.S.-IAEA safeguards agreement.

### Commercial Considerations

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<sup>7</sup>In *USEC, Inc v. Eurodif SA et al*, brief number 55, USEC has argued that it is the only entity that employs U.S. enrichment technology free of restrictions that encumber all other available sources of enriched uranium for the military needs of the United States, that it is the sole supplier of LEU used to fuel the government-owned nuclear reactors that produce tritium, a radioactive isotope necessary to maintain the U.S. nuclear arsenal in the future as stocks for the current stocks of HEU needed for the U.S. Navy's nuclear powered submarines and aircraft carriers are depleted.

<sup>8</sup> The U.S. DOE presently uses TVA's civilian light-water reactors (the Watts Bar and Sequoyah facilities) to produce tritium to help maintain the existing nuclear weapons stockpile. There is no legal bar to enriching uranium outside of USEC's facilities for supply at the TVA reactors.

Some observers have serious doubts about whether USEC can be competitive against other enrichment suppliers. To date, the high cost of operating the outmoded and energy intensive gaseous diffusion technology has made it difficult for USEC to remain competitive in the U.S. and international market. This cost problem has been exacerbated by recent significant increases in power charges by TVA which supplies electricity to the Paducah facility.

On the other hand, USEC's competitiveness has benefited from a) obtaining relief under U.S. trade law and b) acquiring 50% of their LEU needs from the Russian Federation under the 1992 High Enriched Uranium (HEU) Agreement based on prices at or "below their cost of producing the LEU." These prices were negotiated with the Russian Federation, via their executive agent TENEX, under the HEU Agreement.

The U.S. Department of Commerce had made a preliminary affirmative dumping determination against Russian uranium imports in 1992. Before that determination became final, the U.S. Government entered into a "Suspension Agreement" with Russia under which Russia and the other former Soviet countries "voluntarily" limited their exports to the United States. The resulting import restrictions allowed Russia only a minimal share of the U.S. market. In 2008, the U.S. and Russia reached an agreement that allowed an increase in Russian exports of uranium to the United States beginning in 2011 over a ten-year period. This would, in effect, allow Russia to compete for 20% of the U.S. market from 2014 to 2020 and to compete without any restraints after that date. Legislation passed by Congress in September 2008 (the "Domenici Amendment") confirms the 20% allowance for Russian SWU imports but places all LEU purchased under SWU or enriched uranium product contracts under the 20% quota, regardless of U.S. court interpretations of SWU as a service or a product. Moreover, the U.S.-Russia HEU purchase agreement terminates in 2013, and the Russians have given every indication that they do not intend to extend the deal on its current terms. Russia's reasons for entering the original deal, namely the need for hard currency to pay for Russian nuclear assets, no longer apply. Finally, USEC will no longer be the only U.S. enrichment provider, since three new enrichment plants are being contemplated in the United States, LES/NEF, AREVA and GE-Hitachi, which will compete with USEC's new centrifuge plant.

#### ACP's competitiveness

There are also a number of concerns about the commercial competitiveness of the ACP, including the untried nature of the new centrifuge technology, the project's creditworthiness, rising construction costs and delays in scheduling, as well as questions about USEC's ability to produce SWU at prices that generate returns above its cost of capital. Significant price pressure on labor, commodities and construction materials has increased the company's anticipated cost for completing the ACP.

Technical uncertainties. Although USEC has confidence in the reliability of its new centrifuges (the AC100 series centrifuge machine), some experts believe that USEC's failure to test the new design adequately could adversely and seriously affect the

reliability of the machines in commercial operation. To these skeptics, it is particularly worrisome that USEC plans to start operations of its second Lead Cascade using 40 – 50 centrifuge machines manufactured for the first time by its supplier group in March 2009 but has yet to settle on its final value-engineered design. Other concerns from technical experts relate to the fact that USEC’s centrifuge machine design calls for 350 SWU/machine while the top-of-the-line ETC machine runs at 80-90 SWU/machine and ETC has been manufacturing and operating centrifuge machines for over 35 years. ETC has chosen a “no maintenance” machine philosophy but this leads one to think that the USEC machine may be difficult to maintain in commercial operation.

Costs. Originally, USEC had anticipated the project to cost \$1.7 billion. In May 2008 USEC estimated the project cost to be about \$3.5 billion. This amount includes project spending to date but does not include financing costs or financial assurance, which USEC hopes to cover through a loan guarantee which it is seeking from DOE. USEC is trying to reduce its ACP machine manufacturing costs through value-engineering the centrifuge design but this could come at a price of reducing the reliability of its new centrifuges.

Need for additional ACP funding. USEC may also run into cash flow difficulties or have to slow the ACP construction in the future if it does not receive additional financing funds for the ACP. USEC received some \$775 million in the form of equity shares and bonds in September 2007, but these funds are rapidly being consumed for the ACP construction. USEC’s stock price, which was \$14.25 per share at the IPO opening in 1998, is now below \$4.00, and its corporate debt has a high yield or “junk bond” rating.

USEC is thus in need of funding to continue the ACP project. The omnibus fiscal year 2008 appropriations act authorized DOE to issue \$2 billion worth of loan guarantees through the end of fiscal year 2009 for advanced "front-end" nuclear fuel cycle facilities. USEC has submitted the required phase I and phase II applications for the loan guarantee to DOE.<sup>9</sup> USEC is likely to obtain this loan guarantee from the DOE and will also acquire the funding itself from the U.S. Government through the Federal Financing Bank. (USEC’s deteriorating credit rating has made obtaining loans from private banks for the ACP highly problematic.) Even if DOE approves the loan guarantee for USEC, the credit subsidy cost will need to be scored by the Office of Management and Budget, and USEC may have to pledge significant funds to pay this cost even before the construction of the ACP.

USEC would likely welcome foreign investment in the ACP, which could help provide crucial help in funding for USEC. However, investing in USEC’s ACP could be a high-risk venture, and under present conditions the U.S. Government may be the only entity prepared to take that risk.

Market uncertainties. USEC currently delivers around 12 – 13 million SWUs per year to the market. If it sticks by its decision to close its Paducah gaseous diffusion plant once ACP begins operations, USEC SWU capacity will significantly drop to 3.8 million SWUs. These SWUs are planned to be committed to domestic customers. (Japan is

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<sup>9</sup> AREVA has also applied for a loan guarantee under this program for its proposed plant in Idaho.

already moving to other sources of supply as USEC will be unable to supply any of the enrichment needs of the Japanese utilities after the HEU Agreement ends in 2013 if the GDF is also shut down leaving USEC with only the 3.8 million SWU of ACP capacity). Unless USEC decides to continue operation of its high-cost gaseous diffusion plant, it will not be in position to offer new enrichment contracts to foreign customers. Hence, it is not certain that USEC will be in a position to attract investment from foreign utilities or governments based on assurance of supply at competitive prices, unless it keeps the gaseous diffusion plant operating or expands the ACP well beyond its current planned initial capacity of 3.8 million SWU. (The ACP facility is licensed for up to 7.0 million SWU so USEC could continue to add centrifuge capacity to the ACP after it reaches the 3.8 million SWU level).

In addition, AREVA, Russia and Urenco are increasing their SWU capacity, and some estimates project that by the year 2018, this increased supply will be sufficient to meet global demand. Thus USEC is in a race to secure a market position before this capacity comes on line. Another question that could affect the future of the enrichment market is the laser enrichment process being developed by GE-Hitachi (GEH) using the Silex laser isotope separation process. If the GEH Silex process realizes its potential within the next decade, it will be far more competitive than the centrifuge.

In sum, USEC faces considerable market uncertainties, and it is open to question whether it will be able to offer enrichment services to foreign utilities at competitive prices.

### Conclusions

Encouraging foreign participation in the ACP would enable the U.S. to take a leadership role in establishing a global norm that all new enrichment plants should be multinational in nature and subject to IAEA safeguards agreements. It would also further U.S. national interests by helping to maintain a reliable and competitive source of domestic enrichment services. An appropriate international financing scheme to operate a U.S.-based enrichment facility could service nuclear consumer countries that do not have their own enrichment capability. Finally, the economic competitiveness of USEC could be enhanced with a more robust financial structure that includes “credit-quality” international financial players. USEC could reduce its financial risks by expanding the financing structure with foreign entities and by offering firm contracts at attractive prices.

However, offering foreign utilities or governments an opportunity to participate in USEC’s ACP facility will present some challenges. USEC is facing a highly competitive market with a commercially unproven technology, a cost basis that may not prove to be competitive with other enrichment providers and substantial uncertainties in the future of the enrichment market. There is some doubt that USEC will be able to survive without the DOE loan guarantee of \$2.0 billion. There is greater than 50 % probability that USEC will receive such a loan guarantee in the near future, but there is only a 50/50 chance that USEC will be able to absorb the front-end costs of such a loan guarantee, depending on the credit subsidy cost requirements.

It is open to question whether foreign utilities or governments would be willing to make what appears to be a high-risk investment in USEC unless USEC has strong political and financial support from the U.S. Government. If the U.S. Government decides that such support is in the national interest for economic, nonproliferation or other reasons, then multinational participation in USEC may be feasible. Offering participation in the ACP to foreign utilities or states, however, will require strong leadership from the Executive Branch and close consultations with the key Congressional leaders and the relevant Committees of Congress.

**The Nuclear Suppliers Group  
and  
Multinational Enrichment Plants**

## Fred McGoldrick

The United States has long sought to limit the spread of enrichment and reprocessing facilities. Most recently, pursuant to the United States-India Nuclear Cooperation Approval and Nonproliferation Enhancement Act, President Bush certified that, “It is the policy of the United States to work with members of the Nuclear Suppliers Group, individually and collectively, to agree to further restrict the transfers of equipment and technology related to the enrichment of uranium and reprocessing of spent nuclear fuel.”

The 45 members of Nuclear Suppliers Group (NSG) seek to prevent the spread of nuclear weapons through the implementation of guidelines for the nuclear and nuclear related exports. Each participating government applies the guidelines in accordance with its national laws, regulations and policies.

The NSG Guidelines were originally published in 1978 as International Atomic Energy Agency (IAEA) Document INFCIRC/254. The guidelines include a number of conditions for the export of nuclear materials and equipment that were identified on a “trigger list,” so-called because the export of these items “triggered” a requirement that the recipient state provide certain nonproliferation assurances as a condition of supply. These included the acceptance of IAEA safeguards in perpetuity and a pledge that the transferred items would be used only for peaceful, non-explosive purposes as well as agreement to apply physical protection measures and to accept controls on retransfers of such items.

The NSG has evolved over time in order to keep pace with technical innovations and political developments and in response to various challenges to the nonproliferation regime. Among other things, the NSG now controls dual-use items and technology, i.e., articles that have both nuclear and non-nuclear applications and that could make a significant contribution to a nuclear explosive activity or an unsafeguarded nuclear facility. It also requires that a recipient of items on the NSG nuclear trigger list must accept IAEA safeguards on all its peaceful nuclear activities as a condition of new supply—so-called comprehensive or full-scope safeguards.

The original NSG guidelines included provisions for the transfer of sensitive nuclear technology (SNT), which included enrichment, reprocessing and heavy water production technology. These included the following provisions:

Nonproliferation conditions. Safeguards, peaceful use assurances, physical protection and controls over retransfer should apply to facilities for reprocessing, enrichment, or heavy-water production, utilizing technology directly transferred by the supplier or derived from transferred facilities, or major critical components thereof.

Restraint in the transfer of sensitive nuclear technology. Suppliers should exercise restraint in the transfer of sensitive facilities, technology as well as weapons-usable materials.

Multinational or supplier involvement. “If enrichment or reprocessing facilities, equipment or technology are to be transferred, suppliers should encourage recipients to accept, as an alternative to national plants, supplier involvement and/or other appropriate multinational participation in resulting facilities, Suppliers should also promote international (including IAEA) activities concerned with multinational regional fuel cycle centres.”

No Production of HEU. The guidelines required an assurance by the recipient nation that any transferred enrichment or reprocessing technology or a facility based on such technology will be designed or operated for the production of uranium enriched no higher than 20 % without the consent of the supplier.

Replication of SNT. The NSG members agreed that the transfer of sensitive nuclear facilities, or major critical components thereof, or related technology, should require an undertaking (1) that IAEA safeguards apply to any facilities of the same type (i.e. if the design, construction or operating processes are based on the same or similar physical or chemical processes, as defined in the trigger list) constructed during an agreed period in the recipient country and (2) that there should at all times be in effect a safeguards agreement permitting the IAEA to apply Agency safeguards with respect to such facilities identified by the recipient, or by the supplier in consultation with the recipient, as using transferred technology. This provision was designed to prevent a recipient state that did not have full-scope safeguards from importing SNT under safeguards and then replicating another plant free of international safeguards. This requirement was subsequently deleted from the guidelines when the NSG adopted the requirement of full-scope safeguards as a condition of supply in 1992. Now that the NSG has exempted India from its full-scope safeguards requirement, the absence of a replication provision leaves a potential loophole, if members ever supply enrichment or reprocessing technology to India.

Facilitation of the Application of Safeguards. Finally, the guidelines called upon suppliers to encourage the designers and makers of sensitive equipment to construct it in such a way as to facilitate the application of safeguards.

While the NSG has made a number of amendments and additions to its guidelines over the years, the provisions for transfer of SNT have not changed except for the deletion of the replication provision.

In the wake of the revelations about the clandestine transfers of enrichment technology from Pakistan (the A.Q. Khan network) to the DRPK, Iran and Libya, President Bush called for two new initiatives designed to prevent the spread of enrichment and reprocessing capabilities. In a speech on February 11, 2004, President Bush proposed that

a) the members of the NSG should refuse to sell enrichment and reprocessing equipment and technologies to any state that does not already possess full-scale, functioning enrichment and reprocessing plants and b) 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.

These proposals were not well received by many non-nuclear weapon states who saw them as a demand to forego or compromise their sovereign rights as independent states or their right under Article IV of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) to pursue their own peaceful nuclear program, including enrichment technology. Although the Bush Administration backpedaled from the language of renunciation and denial, suspicions remain about U.S. intentions.

Thus far the members of NSG have been unable to reach agreement on President Bush's proposals for enrichment and reprocessing transfers. Although the U.S. sought a new guideline that would ban the transfer of SNT except to countries already possessing such capabilities, most NSG members favored an approach suggested by France that would allow NSG members to export SNT to countries that meet specific criteria. The criteria approach would require that recipients meet at least all of the following criteria:

Is a party to the NPT and is in full compliance with its obligations under that Treaty;

Is implementing a comprehensive safeguards agreement and has an Additional Protocol in force or is acting in accordance with the AP while actively working with the IAEA to conclude and implement an Additional Protocol;

Has not been identified by the IAEA as being in serious breach of its safeguards agreement, is not the subject of Board of Governors decisions calling upon it to take additional steps to comply with its safeguards obligations or to build confidence in the peaceful nature of its nuclear program, nor has been reported by the IAEA Secretariat as a state where the IAEA is currently unable to implement its safeguards agreement.

Is adhering to the NSG Guidelines and has reported to the Security Council of the United Nations that it is implementing effective export controls as identified by Security Council Resolution 1540;

Has concluded an intergovernmental agreement with the supplier including assurances regarding non-explosive use, effective safeguards in perpetuity, and retransfer;

Has made a commitment to the supplier to apply mutually agreed standards of physical protection based on current international guidelines;

Has committed to IAEA safety standards and adheres to accepted international safety conventions.

In addition the criteria-based proposal calls upon suppliers to consider:

Whether the transfer would have a negative impact on the stability and security of the recipient state;

Whether the recipient has a credible and coherent rationale for pursuing an enrichment or reprocessing capability in support of civil nuclear power generation programs.

If enrichment or reprocessing facilities, equipment or technology are to be transferred, suppliers should encourage recipients to accept, as an alternative to national plants, supplier involvement and/or other appropriate multinational participation in resulting facilities. (This language is already in the present NSG guidelines and would remain unchanged in the new criteria-based approach.)

U.S. eventually came to accept the criteria-based approach but proposed three additional criteria:

The transfer must take place under conditions that will not permit or enable the replication of the technology (the so-called “black-box” approach).

Suppliers have to take into account whether a transfer would stimulate other countries in a region to seek their own SNT or whether it might lead to instability in the area.

Suppliers will not transfer SNT to countries that have agreed to refrain from acquiring such technology. This is aimed at the South Korea and North Korea and their 1992 agreement under which both states agreed to refrain from possessing enrichment or reprocessing plants.

The additional criteria proposed by the United States were not accepted by some members of the NSG. The most significant difference concerned the criteria of black-boxing transfers of technology. Canada suggested that, instead of requiring black-boxing as a criterion for transferring SNT, suppliers would only have to consider the option of black-boxing the technology, or operating a turn-key operation when deciding whether to transfer enrichment or reprocessing to states in good nonproliferation standing. The U.S. and Canada are now trying to reach a compromise on this issue. Canada has recently proposed to accept the U.S. position but only for enrichment technologies that are already commercially deployed. The U.S. is insisting that the criteria apply to all enrichment technologies identified on the NSG trigger list, including those that are not yet commercially proven. In addition, some other members of the NSG have taken the position that no state that is in good nonproliferation standing should be denied access to enrichment and reprocessing technology. Thus at this time, NSG members have been unable to agree on a new guideline for enrichment and reprocessing transfers.

If the NSG can agree on a new set of criteria on transfers of enrichment technology, it would strengthen, or at least give some specificity to, the existing guideline on encouraging “supplier involvement or appropriate multinational participation” as an alternative to national enrichment plants by providing that transfers should not permit or enable the revelation of sensitive information to the recipient.

The U.S. should also consider other steps that the NSG could take to promote a global norm that enrichment facilities should involve some appropriate form of multinational participation. First, the U.S. could propose reviving the debate that took place in the initial meetings of the NSG the mid-1970s when some states argued for a guideline that suppliers should “require” rather than encourage “supplier involvement” or “appropriate multinational participation” as an alternative to national enrichment plants. Some non-nuclear weapon states members may see this as a form of discrimination and a violation of their rights under Article IV of the NPT. However, objections to this criterion might be mitigated if NSG members who are also technology holders were to agree to invite multinational participation in their own enrichment facilities. The U.S. should explore with other technology holders whether they would be willing to make such an undertaking.

Second, the U.S. could attempt to persuade NSG members to assume a more positive and cooperative role in international nuclear cooperation. The NSG has an image problem. Some non-nuclear-weapon states, particularly developing countries, have viewed the NSG as a cartel aimed at denying them the benefits of the peaceful uses of nuclear energy and at relegating them to a position of technical and commercial inferiority. The language employed initially by the Bush Administration requiring renunciation of enrichment and reprocessing as a condition for receiving improved fuel assurances has only heightened this suspicion. The NSG could seek to assume a more positive and cooperative role in promoting international peaceful nuclear commerce rather than one that is devoted exclusively to imposing nonproliferation conditions on nuclear exports. For example, the NSG could adopt a common statement of principles that NSG members will strengthen the security of supply to importing countries and will not interfere with their supply arrangements as long as such states are in full compliance with their nonproliferation obligations. (See attachment for a suggested statement of such principles.) One of these principles could contain an offer to countries that do not possess enrichment facilities and that are in good nonproliferation standing the opportunity to participate in the enrichment plants of NSG member states. Such participation would include guaranteed supplies of nuclear fuel but would not include access to enrichment technology.

As an informal multilateral arrangement whose primary purpose is to control nuclear exports, the NSG can play only a limited role in promoting the idea of multinationalizing enrichment plants. Support for making multinational rather than national enrichment facilities an international norm will require a wider consensus that includes consumers and non-nuclear-weapon states. One possible way to accomplish this is by trying to persuade the 2010 Review Conference on the Treaty on the Non-Proliferation of Nuclear Weapons to endorse this norm. However, this will require considerable effort, given the sensitivity of many states to maintain their rights under Article IV of the Treaty.

Attachment:

### **Suggested NSG Nuclear Supply Principles**

The members of the NSG:

Reaffirm the inalienable right of all parties to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) to the use of nuclear energy for peaceful purposes in conformity with their obligations under the NPT.

Agree to promote international cooperation in the peaceful uses of nuclear energy.

In this spirit, NSG members agree to:

Implement all nuclear supply agreements and contracts in good faith and with due regard to the legitimate commercial interests of importing states.

Avoid hampering or delaying the peaceful nuclear activities in the territories of importing states.

Avoid hindering, or interfering in, the peaceful nuclear activities in the territories of importing states.

Take full account of the long-term requirements of the nuclear energy programs in the territories of importing states.

Will not use their supply agreements or contracts to secure unfair commercial or industrial advantage to the disadvantage of the importing state, or to restrict trade or to hamper the international or domestic commercial or industrial interests of the importing states.

Will not use authorizations, including export licenses and authorizations or consents to third parties relating to trade or industrial operations, in order to restrict peaceful nuclear trade.

Will cease cooperation or suspend nuclear supplies only if an importing state materially violates its nonproliferation obligations.

Will urge other nuclear suppliers to cease cooperation or suspend nuclear supplies to a state only if that state materially violates its nonproliferation obligations.

In addition, members of the NSG who operate uranium enrichment plants are prepared to provide states that do not have such facilities and are in full compliance with their nonproliferation obligations the opportunity to participate in their enrichment plants. Such participation would include guaranteed access to nuclear fuel supplies.