INSTITUT DES NATIONS UNIES POUR
LA RECHERCHE SUR LE DÉSARMEMENT

UNITED NATIONS INSTITUTE
FOR DISARMAMENT RESEARCH

Tel: + 41 (0)22 917 14 40
Fax: + 41 (0)22 917 01 76
yyudin@unog.ch
www.unidir.org

Palais des Nations
CH-1211 Geneva 10
Switzerland

UNIDIR project "Multilateral Approaches to the Nuclear Fuel Cycle"

Summary of the first study paper[*]

It is predicated that global nuclear power capacity could double by 2030. Several factors are driving this potential expansion in the use of nuclear energy worldwide. Among them are the anticipated increase in global energy demand, the increased awareness of the dangers and effects of global warming and climate change, the increasing demand for energy-intensive water desalination plants, and the anticipated need for large amounts of electricity and heat for future hydrogen production. To a large part the expected "revival" of nuclear power will be driven by the power plant construction programmes in countries that do not currently have established nuclear power industries. This could result in worldwide dissemination of uranium enrichment and spent fuel reprocessing technologies. These sensitive nuclear technologies present obvious risks of nuclear proliferation since they are capable of providing states with materials that are directly usable in a nuclear weapon or a nuclear explosive device—high enriched uranium and separated plutonium. The risks are aggravated by the fact that there are no technological barriers between peaceful and military uses of these technologies.

Technical measures and safeguards alone would not compensate for the limitations of the existing nuclear non-proliferation regime. Some international institutional mechanisms, which are non-technical in nature and involve various political, economic or diplomatic strategies for controlling access to sensitive materials, facilities or technologies, are needed for dealing with this problem.

The rationale for multilateral approaches to the nuclear fuel cycle is relatively straightforward. These arrangements are generally aimed at denationalizing sensitive fuel cycle activities by placing decisions on the operation of nuclear facilities, as well as on the disposition of their product, in the hands of a number of nations or international organizations rather than individual states. If appropriately arranged, these multilateral arrangements appear to meet energy security concerns by providing participants with a legal and economic stake in the supply system, and to meet non-proliferation concerns by limiting the spread and the number of sensitive facilities, making it more difficult for any individual state to break out, and giving less opportunity for diversion and theft.

The Director General of the IAEA recently proposed a three-stage process in developing a new multilateral mechanism:

- the first step would be to establish a system for assuring supply of fuel for nuclear power reactors—and, if necessary, supply of the actual reactors;
- the second step would be to have all new enrichment and reprocessing activities in the future put exclusively under multilateral control; and
- the third step would be to convert all existing enrichment and reprocessing facilities from national to multilateral operations.

[*] The full text of the study paper is available on UNIDIR's website at <www.unidir.org>.

The project “Multilateral Approaches to the Nuclear Fuel Cycle” of the United Nations Institute for Disarmament Research (UNIDIR) seeks to carry out a detailed study on the political and legal aspects of the various proposals for multinational approaches to the nuclear fuel cycle, as well as extensive outreach to ensure awareness and increased uptake by the international community of the proposals developed. The first study paper contains an overview and analysis of the twelve existing proposals on multilateralization of the nuclear fuel cycle, including evaluation of the pros and cons of the various projected international mechanisms.

In recent times the focus of international efforts has been to try to develop a system of credible guarantees of supply of low enriched uranium (LEU) and nuclear fuel to assure customer countries that they will have a reliable fuel supply that will not be disrupted for political reasons. Over the past few years, 12 proposals have been put forward by states, the nuclear industry and international organizations, which aim at thwarting the spread of uranium enrichment and spent fuel reprocessing technologies, in particular, by suggesting means of assuring nuclear fuel supplies and establishing international fuel cycle centres. These are as follows and are listed in chronological order:

Reserve of nuclear fuel: United States of America (INFCIRC/659, September 2005). The United States announced in Vienna in September 2005 at the 49th regular session of the General Conference of the IAEA that it would commit up to 17 metric tonnes of high enriched uranium (HEU) to be down-blended to LEU “to support assurance of reliable fuel supplies for states that forego enrichment and reprocessing”.

Statement on the Peaceful Use of Nuclear Energy: Russian Federation (INFCIRC/667, February 2006). Vladimir Putin, President of the Russian Federation, outlined a proposal to create “a global infrastructure that will give all interested countries equal access to nuclear energy, while stressing reliable compliance with the requirements of the non-proliferation regime”, including “the creation of a system of international centers providing nuclear fuel cycle services, including enrichment, on a non-discriminatory basis and under the control of the IAEA” as a key element in developing this new infrastructure.

Global Nuclear Energy Partnership (GNEP): United States of America (February 2006). The USA announced GNEP as a comprehensive strategy to increase US and global energy security, encourage clean development around the world, recycle nuclear fuel using new proliferation-resistant technologies to recover more energy and reduce waste, and reduce the risk of nuclear proliferation. One of the elements of GNEP is a proposed “fuel services program to enable nations to acquire nuclear energy economically while limiting proliferation risks. Under GNEP, a consortium of nations with advanced nuclear technologies would ensure that countries who agree to forego their own investments in enrichment and reprocessing technologies will have reliable access to nuclear fuel”.

Ensuring Security of Supply in the International Nuclear Fuel Cycle: World Nuclear Association (May 2006). A World Nuclear Association (WNA) Working Group on Security of the International Nuclear Fuel Cycle, including representatives of the four principal commercial enrichment companies, proposed a three-level mechanism to assure uranium enrichment services: (a) basic supply security provided by the existing world market, (b) collective guarantees by enrichment companies supported by governmental and IAEA commitments, and (c) government stocks of enriched uranium product.

Concept for a Multilateral Mechanism for Reliable Access to Nuclear Fuel: France, Germany, the Netherlands, Russian Federation, United Kingdom and United States of America (GOV/INF/2006/10, June 2006). The six enrichment-service supplier states proposed essentially two levels of enrichment assurance beyond the normally operating market. At the “basic assurances” level, suppliers of enriched uranium would agree to substitute for each other to cover certain supply interruptions to customers in states that have “chosen to obtain suppliers on the international market and not to pursue sensitive fuel cycle activities”. At the “reserves” level, participating governments could provide physical or virtual reserves of LEU that would be made available if the “basic assurances” were to fail.

IAEA Standby Arrangements System for the Assurance of Nuclear Fuel Supply: Japan (INFCIRC/683, September 2006). Japan proposed an information system to help prevent interruptions in nuclear fuel supplies. The system, to be managed by the IAEA, would disseminate information contributed voluntarily by IAEA member states on their national capacities for uranium ore, uranium reserves, uranium conversion, uranium enrichment and fuel fabrication. The proposal is described by Japan as complementary to the concept of reliable access to nuclear fuel as proposed by the six countries, described above.

IAEA-Owned LEU Stockpile: Nuclear Threat Initiative (September 2006). The Nuclear Threat Initiative (NTI) offered to contribute $50 million to the IAEA to help create an LEU stockpile owned and managed by the Agency that could be made available should other supply arrangements be disrupted. The offer is contingent on the following two conditions being met within two years from when the offer was made: (a) that the IAEA takes the necessary actions to improve establishment of the reserve, and (b) that one or more IAEA member states contribute an additional $100 million in funding or an equivalent value of LEU. Every other element of the arrangement—the structure, its location, the conditions of access—would be up to the Agency and its member states to decide. In December 2007, the US Congress authorized a $50 million contribution; in February 2008, Norway pledged $5 million; and in August 2008, the United Arab Emirates pledged $10 million. In December 2008, the European Union pledged €25 million to the NTI nuclear fuel bank proposal.

Enrichment Bonds: United Kingdom (September 2006; INFCIRC/707, June 2007). The United Kingdom proposed a "bonding" principle that would, in the event that the Agency determines that specified conditions have been met: (a) guarantee that national enrichment providers would not be prevented from supplying enrichment services; and (b) provide prior consent for export assurances. Germany and the Netherlands are cooperating with the United Kingdom in the development of the enrichment bonds concept. Recently the name of the proposal has been changed and the new name is the UK Nuclear Fuel Assurance proposal.

International Uranium Enrichment Centre at Angarsk: Russian Federation (January and May 2007; INFCIRC/708, June 2007). As an element in the creation of a "global nuclear power infrastructure", earlier propounded by President Vladimir Putin, the Russian Federation proposed the establishment of an International Uranium Enrichment Centre (IUEC) at the Angarsk Electrolysis Chemical Combine "to provide guaranteed access to uranium enrichment capabilities to the Centre's participating organizations". On 10 May 2007 the first agreement in the framework of the IUEC was signed between the Russian Federation and the Republic of Kazakhstan. A mechanism is being developed to set aside a stockpile of LEU that might contribute to a broader assurance of supply mechanism, and "a regulatory basis will be developed in the sphere of export control such that the shipment of material out of the country at the request of the Agency is guaranteed". In June 2007, Russia offered to set up an LEU reserve of 120 metric tons under IAEA auspices, and stored under safeguards at Angarsk, for use by IAEA member states.

Multilateral Enrichment Sanctuary Project: Germany (INFCIRC/704, May 2007; INFCIRC/727, May 2008; INFCIRC/735, September 2008). Germany proposed the creation of a multilateral uranium enrichment centre with extra-territorial status, operating on a commercial basis as a new supplier in the market, under IAEA control, providing enrichment services. From there, potential users could then obtain nuclear fuel for civilian use under strict supervision. Germany has then developed this proposal into a Multilateral Enrichment Sanctuary Project (MESP) for a multilateral enrichment facility established by a group of interested states on an extra-territorial basis in a host state, supervised by the IAEA, owned and operated by a multinational commercial consortium.

Multilateralization of the Nuclear Fuel Cycle: Austria (INFCIRC/706, May 2007). Austria proposed a two-track multilateral mechanism. The first track would "optimiz[e] international transparency going

beyond current IAEA safeguards obligations". The second track would place all nuclear fuel transactions under the auspices of a "nuclear fuel bank" to "enable equal access to and control of most sensitive nuclear technologies, particularly enrichment and reprocessing".

Nuclear Fuel Cycle: European Union non-paper (June 2007). The EU non-paper noted that flexibility would be appropriate in considering an approach to fuel supply options and proposed criteria for assessment of a multilateral mechanism for reliability of fuel supply. These criteria included, inter alia: (a) proliferation resistance—minimization of the risk of unintended transfer of sensitive nuclear technology; (b) assurance of supply—reliability of long-term supply arrangements; (c) consistency with equal rights and obligations—obligations of private companies, supplier states, consumer states and the IAEA; and (d) market neutrality—avoiding any unnecessary disturbance or interference in the functioning of the existing market.

Almost all the proposals put forward to assure the supply of fuel for nuclear power reactors call for the active participation of the IAEA, envisaging that the status of the Agency would give potential consumer states greater confidence in a multilateral approach. The provisions of the IAEA's statute are sufficiently broad to allow the Agency to establish its own stock of nuclear material purchased from, or donated by, member states; to facilitate the supply of nuclear fuel from one member state to another; and also to facilitate uranium enrichment and fuel fabrication services by one member state for another or for the IAEA.

The abovementioned proposals for a multilateral approach to the nuclear fuel cycle differ considerably in their vision, scope, targets and time required for their implementation. The majority of the proposals are rather limited in their scope dealing primarily with the front end of the nuclear fuel cycle, that is, the supply of nuclear fuel and in particular LEU for power production.

The US national reserve of nuclear fuel, the Russian IUEC at Angarsk, and the Six-Country Concept combined with the WNA proposal and supplemented by the UK Enrichment Bonds and the Japanese Standby Arrangements, can be considered as proposals that can be implemented in the short term. Realization of these projects would not require much work by the international community because they rely to a great extent on national policies. Many key elements of these projects are already in place and, what is more, two of these projects—the US national reserve of nuclear fuel and the Russian IUEC at Angarsk—now move ahead full-steam.

The NTI fuel bank and the German MESP proposal are multilateral projects that would require new physical infrastructure and contain complex political, legal and financial issues that must be solved before making these projects a reality. Nevertheless, the NTI fuel bank can be counted as a simpler short-term project, while the German MESP proposal represents a more complex mid-term project.

The Russian Global Nuclear Power Infrastructure (GNPI), the US GNEP and the Austrian proposal on multilateralization of the nuclear fuel cycle are in fact long-term conceptual visions, many details of which are still to be defined.

It is evident that there would be no single, generic multilateral formula that would be satisfactory for all technologies and all countries and that successful implementation of the multilateralization would depend on the flexibility of its application. The establishment of multilateral fuel cycle arrangements should be implemented step by step, with existing proposals pursued on their own merits drawing important lessons for the future.

While the current emphasis is on concepts for LEU and fuel supply assurances, they may only have modest incentives for customer states to participate, since the commercial market already provides reliable supplies of LEU and nuclear fuel. Proposals that respond to the "entitlement" motivation of the customer states in terms of their participation in ownership, management, operation, decision-making, profit-

sharing, etc., perhaps would be more attractive for these states than just backup mechanisms for the existing market.

Proposals that would include taking away spent nuclear fuel after it was used, as well as providing other back-end fuel cycle services (spent fuel interim storage or reprocessing, and spent fuel or waste disposal services), would create far stronger incentives to rely on international mechanisms for fuel supply.

Having guaranteed access to LEU will not help customer states immediately because they require a reliable supply of fabricated fuel assemblies to load into their power reactors. Creating a backup supply system for fuel fabrication would be more complicated because fuel design is specific to each reactor design. Fuel fabrication technology for uranium oxide fuel with LEU is not sensitive from a proliferation perspective. If countries choose to establish their own fabrication capabilities to produce fuel assemblies for their own nuclear power reactors, without establishing uranium enrichment or spent fuel reprocessing capabilities, this should not pose significant international concerns.

Many countries recognize that an international regime to control nuclear-fuel-cycle technologies and materials is “an idea whose time has come”. At the same time, the existing ideas for multilateralization of the nuclear fuel cycle have all come from suppliers of front-end fuel cycle services while the prospective customers have generally been lukewarm because they often, yet not always fairly, consider these ideas as technology denial approaches. The international mechanisms for multilateralization of the nuclear fuel cycle cannot credibly be tied to demands on the customer states to forgo some of their rights (sovereign rights, rights under the NPT, and rights under the IAEA statute). Instead they should dissuade these states from going to the trouble and expense of developing indigenous sensitive fuel cycle technologies by offering palatable political and economic incentives as well as providing certain “entitlement” motivations to participate. The issue of a multilateral approach to the nuclear fuel cycle needs to be addressed in terms of opportunity and advantage, not in terms of denial.

Although the success of implementation of multilateral approaches to the nuclear fuel cycle is by no means guaranteed, greater progress in this direction has been recently made than during the 1970s and 1980s. The Russian IUEC should start rendering its uranium enrichment services in early 2009; and Russia decided to provide uranium for the first IAEA-controlled LEU reserve, which would contain 120 metric tons of LEU and be located in Angarsk. With down-blending of HEU to be completed in 2010, the proposed US-controlled LEU stockpile will be de facto created. Several other proposals are also being actively pursued, including the NTI fuel bank and the German MESP proposal.

Any real progress toward a multilateral approach to the nuclear fuel cycle can be achieved only in the context of broad agreement that, in the face of global problems such as nuclear proliferation and nuclear terrorism, an international non-discriminatory nuclear-fuel-cycle control regime has the potential to benefit the whole of humankind. Inhibiting the spread of sensitive nuclear technologies and nuclear-weapons-usable materials, while promoting better access to safe and clean energy, is undoubtedly in the interests of the world community.

A multilateral approach to the nuclear fuel cycle is by no means a “magic bullet solution” that will resolve all non-proliferation problems once and for all. These mechanisms cannot eliminate all motives for acquiring enrichment and reprocessing technologies, and any multilateral arrangement could hardly deter the committed proliferator or any state determined to acquire the full nuclear cycle for reasons of national independence or prestige. But nevertheless they have a substantial potential to ensure that the benefits of nuclear energy are made available to all countries, while further strengthening the nuclear non-proliferation regime, ensuring safe and secure management of the nuclear fuel cycle, and reducing incentives to build new nuclear fuel cycle facilities in countries that do not now have them.

Existing proposals for a multilateral approach to the nuclear fuel cycle by timeframe and scope

Time frame	Proposal	Scope
Short-term	Russian IUEC at Angarsk	Establishment of an IUEC under the IAEA safeguards; establishment of an IAEA-controlled LEU reserve
	U.S. Reserve of Nuclear Fuel	Establishment of a nationally-controlled LEU reserve
	Combination of Six-Country Concept and WNA proposal supplemented by UK Enrichment Bonds and Japanese Standby Arrangements	Backup assurances of LEU and nuclear fuel supply in addition to the existing commercial uranium market; establishment of nationally-controlled LEU reserves
	NTI Fuel Bank	Establishment of an IAEA-controlled LEU reserve
Mid-term	German MESP Proposal	Establishment of an IAEA-controlled international uranium enrichment plant in an extraterritorial area
Long-term	Russian Global Nuclear Power Infrastructure	Establishment of a global supply mechanism. A system of international centers providing fuel cycle services from uranium enrichment and fuel supply to spent fuel take-back and reprocessing
	U.S. Global Nuclear Energy Partnership	Establishment of a global supply mechanism. Front-end and back-end services provided by a limited number of supplier states using new proliferation-resistant technologies
	Austrian Proposal on Multilateralization of the Nuclear Fuel Cycle	Establishment of a mechanism directed on eventual placing of the existing civilian enrichment and reprocessing facilities and fuel supply activities under multilateral control