



# Fuel for Thought

by Tariq Rauf and Zoryana Vovchok

***A multilateral approach to the nuclear fuel cycle would help cope with the expected expansion of nuclear power use and strengthen the nuclear non-proliferation regime.***

**T**he increase in global energy demand is driving a potential expansion in the use of nuclear energy and over the last few years there has been a growing interest in the possible development of a new, multilateral approach to the nuclear fuel cycle. This is widely believed to be a key measure to cope with the expected expansion of nuclear power use and, at the same time, strengthen the nuclear non-proliferation regime.

The establishment of a new framework that is equitable and accessible to all users of nuclear energy acting in accordance with agreed nuclear non-proliferation norms would be a complex endeavour that needs to be addressed through a series of inter-linked, progressive steps.

The first step would be to establish mechanisms for assurances of supply of fuel for nuclear power

reactors — and, as needed, assurance of supply for the acquisition of such reactors. The second step would be to have future enrichment and reprocessing through multilateral operations. The third step would be to convert existing enrichment and reprocessing facilities from national to multilateral operations. In this context, it will be crucial to negotiate and implement a global, internationally verifiable treaty on the prohibition of fissile material production for nuclear weapons (FMCT).

## **IAEA Special Event**

There are, at present, 12 mutually complementary proposals for a multilateral approach to the nuclear fuel cycle that have been put forward. The scope of these proposals ranges, inter alia, from providing backup assurances of supply to establishing an IAEA-controlled low enriched uranium (LEU) reserve and to setting up international uranium enrichment centres.

---

*Photo: Nuclear fuel pellets in production.*  
Credit: Melox

At the IAEA General Conference in September 2006 a special event on a new framework for the nuclear fuel cycle to focus on the existing proposals took place. Experts from many States and from all relevant fields discussed ways and means to move forward.

The summary of the report on the special event, submitted to the 2006 IAEA General Conference mentioned, in part, that the recent proposals for assuring supplies of uranium-based nuclear fuel can be seen as one stage in a broader, longer-term development of a multilateral framework that could encompass assurance-of-supply mechanisms for both natural fuel and LEU, as well as nuclear fuel and spent fuel management. In this context, establishing a fully developed multilateral framework that is equitable and accessible to all users of nuclear energy is a key consideration for the IAEA and its Member States.

The summary also pointed to why an assurance of supply mechanism is needed. This could address two specific challenges. The first is to deal with the possible consequences of interruptions of supply of nuclear fuel due to political considerations that are not related to non-proliferation and not related to commercial or other aspects in terms of fulfillment of contractual obligations. Such interruptions might dissuade States from initiating or expanding nuclear power programmes. At the same time, such a mechanism would reduce the vulnerabilities that might create incentives for States to build new national enrichment and reprocessing capabilities, rather than opting for reliance on the international nuclear fuel market and supply assurances.

## Déjà vu all over again

More than fifty years after the 1953 Atoms for Peace initiative, the time has come not only to think of but to implement a new framework for the use of nuclear energy — a framework that accounts for both the lessons learned and the current realities. This new framework potentially could include: innovative nuclear technology that is inherently safer, proliferation resistant and more economical; universal application of comprehensive safeguards and the additional protocol; concrete and rapid progress toward verified nuclear disarmament; a robust international nuclear security regime; and an effective and universal nuclear safety regime.

The Baruch Plan of 1946 eerily warned that “Behind the black portent of the new atomic age lies a hope, which seized upon with faith can work our salvation... Science has torn from nature a secret so vast in its potentialities that our minds cower from the terror it creates. Yet terror is not enough to inhibit

the use of the atomic bomb. The terror created by weapons has never stopped man from employing them.” Baruch envisioned an internationalization of the nuclear fuel cycle that was ahead of its time. Three decades later, the 1976 International Nuclear Fuel Cycle Evaluation (INFCE) considered multilateral approaches to the nuclear fuel cycle but could not agree on the way forward. Another 30-years later, in 2006, the IAEA special event fostered discussion on assurances of enrichment services, international fuel centres and multilateral control over all fuel cycle facilities and paved the way for further action.

In the global discussion on clean energy options, there is now increasing talk about a potential nuclear renaissance. For the past couple of decades, some 16% of the world’s energy has come from nuclear sources, and this percentage has remained relatively stable. But over the next couple of decades, the projections are that nuclear power capacity will increase. As the world’s energy requirements increase exponentially, and the pressures of reducing carbon emissions become even more pressing on governments, there is expected to be an increasing reliance on ‘clean’ nuclear energy. Furthermore, if there is to be this nuclear renaissance, there will be a major new demand for nuclear energy inputs, both in terms of reactors, but also in terms of fuel supply. The question then is where will the new nuclear fuel supply come from? Will it remain in the hands of the few existing suppliers who might then perhaps expand their capacity? Would new States develop their own national indigenous enrichment and reprocessing capabilities? The vision of a new framework is that all new enrichment and reprocessing should be exclusively under multinational control and eventually all such sensitive nuclear fuel cycle technologies are operated multilaterally together with an assurance of supply mechanism.

## New Framework for the Nuclear Fuel Cycle

The main challenge now is to find a framework that draws upon the common elements of the existing proposals and thus outlines a possible framework for assurances of supply.

It has become abundantly clear that different States will choose different policies and solutions for their energy requirements. These will depend on their specific situation such as geography, technical abilities, national priorities and choices. Thus, in this context, it is of the utmost importance to retain flexibility and not try and suggest solutions that are

perceived to be imposed, particularly on the consumer States. This was made absolutely clear at the IAEA special event on the nuclear fuel cycle.

Hence, an assurance of supply mechanism would be envisaged solely as a backup mechanism to the operation of the current normally functioning market in nuclear materials, fuels, technologies and services. This would not be a substitute for the existing market, nor would it deal with disruption of supply due to commercial, technical or other failures. And in this context, an assurance of supply mechanism would be available to all States that abide by agreed nuclear non-proliferation norms. No State would be asked or expected to give up or abridge any rights under the nuclear Non-Proliferation Treaty (NPT) or the IAEA Statute.

A possible new framework for the nuclear fuel cycle can be established on three levels. The first level is the existing market, based on existing commercial and other arrangements. The second level would rely on backup commitments provided by suppliers of enrichment and fuel fabrication services and their respective governments to assure nuclear fuel supply in cases of political disruptions when predetermined conditions and criteria are met. This can be viewed as a combined virtual enrichment and fuel fabrication reserve mechanism. In the event that some States still might not be fully assured by the first two levels, a third level is essential. The third level would be a reserve of LEU stored in one or several separate locations and made available to consumer States through a set of arrangements and agreements, involving the IAEA and supplier States and companies. A virtual reserve based on supply guarantees, could also provide assurances of supply and would avoid the need to tying up LEU in a physical reserve. Extended assurances could include fuel fabrication services as well. All assurance of supply frameworks under the Agency's auspices should be open to participation by all Member States of the Agency on the basis of accepted criteria.

The release of material under any framework for the assured supply of nuclear fuel would be determined by criteria established in advance and applied in a consistent manner without prejudice to any State's future options regarding its fuel cycle in the context of multilateral approaches.

The framework would envision that once a request for supply is received from a consumer State experiencing a political supply disruption, the IAEA Director General would consider the request and decide whether it meets the established criteria. And, if the decision is positive, the supply framework would be triggered.

Possible criteria for a workable assurance of supply framework, though neither definitive nor exhaustive, could include: a disruption of supply for a political reason (as defined previously); a safeguards agreement in force that covers the material to be supplied; a conclusion drawn by the Agency for the consumer State on the non-diversion of declared nuclear material in the most recent available Safeguards Implementation Report (SIR); no safeguards issues relating to the consumer State under current consideration by the Board of Governors, in respect of the consumer State; and, other relevant criteria such as nuclear security and nuclear safety requirements based on applicable Agency standards. Such criteria would need to be agreed in advance and applied uniformly. States would continue to have the option of participating or not participating in the new framework without prejudice to their nuclear fuel cycle options.

As regards legal authority, under its Statute, the IAEA already has the required authority to provide fuel cycle related services to its Member States and has been assisting Member States upon request for many years through IAEA programmes. The IAEA therefore is in a position to facilitate an assurance of supply framework through international nuclear fuel centres and virtual or actual nuclear fuel banks.

## The Way Forward

A multilateral approach to the nuclear fuel cycle has the potential to facilitate the continued and expected increased use of nuclear energy for peaceful purposes. It has the potential to provide the benefits of cost-effectiveness and economies of scale in the use of nuclear technologies. And, it also can provide additional assurance to the international community that the sensitive parts of the civilian nuclear fuel cycle are less vulnerable to misuse for non-peaceful purposes. Thus, nuclear energy, non-proliferation and economic considerations can coincide and be mutually reinforcing, while providing security of supply of nuclear fuel to consumer States.

The way forward points to consultations involving interested Member States, the nuclear industry and other stakeholders, on the common themes and the elements of multilateral approaches to the nuclear fuel cycle.

---

*Tariq Rauf is Head of Verification and Security Policy Coordination at the IAEA. E-mail: T.Rauf@iaea.org. Zoryana Vovchok is an intern at the IAEA's Office of Legal Affairs. E-mail: Z.Vovchok@iaea.org.*

# 12 Proposals

*Over the past few years a number of proposals have been made regarding a*

## 1. Reserve of nuclear fuel

**USA.** The USA announced in Vienna in September 2005, at the 49th regular session of the General Conference, 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”.

(Ref: INFCIRC/659, September 2005)

## 2. Statement on the Peaceful Use of Nuclear Energy

**Russian Federation.** Vladimir Putin, President of the Russian Federation, outlined a proposal that included “the creation of a system of international centres providing uranium enrichment services, including enrichment, on a non-discriminatory basis and under the control of the IAEA”.

(Ref: INFCIRC/667, February 2006)

## 3. Global Nuclear Energy Partnership (GNEP)

**USA.** One of the elements of GNEP is a proposed “fuel services programme 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 forgo their own investment in enrichment and reprocessing technologies will have reliable access to nuclear fuel”.

(Ref: “Department of Energy Announces New Nuclear Initiatives”, USDOE, 6 February 2006)

## 4. Ensuring Security of Supply in the International Nuclear Fuel Cycle

**World Nuclear Association.** A working group, including representatives of the four principal enrichment companies, proposed a three-level mechanism to assure enrichment services:

- (1) basic supply security provided by the existing world market;
- (2) collective guarantees by enrichers supported by governmental and IAEA commitments; and
- (3) government stocks of enriched uranium product.

(Ref: WNA Report, May 2006)

## 5. Concept for a Multilateral Mechanism for Reliable Access to Nuclear Fuel

**France, the Federal Republic of Germany, the Netherlands, Russian Federation, UK and USA.** The six enrichment services 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 had “chosen to obtain supplies 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.

(Ref: GOV/INF/2006/10, June 2006) (restricted access)

## 6. IAEA Standby Arrangements System for the Assurance of Nuclear Fuel Supply

**Japan.** Japan proposed an information system to help prevent interruptions in nuclear fuel supplies. The system, to be managed by the Agency, would disseminate information contributed voluntarily by 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 and described under paragraph 5.

(Ref: INFCIRC/683, September 2006)

## 7. Nuclear Threat Initiative

The Nuclear Threat Initiative offered to contribute \$50 million to the Agency 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:

- (1) that the Agency takes the necessary actions to approve establishment of the reserve; and
- (2) that one or more 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 for access —

# On The Table

## Assurance of supply and the establishment of international fuel cycle centres.

would be up to the Agency and the Member States to decide (In December 2007, the US Congress authorized a US\$50million contribution, and in February 2008, Norway pledged \$5million).

(Ref: NTI Letter, September 2006)

### 8. Enrichment Bonds

**United Kingdom.** The UK 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 UK in the development of the enrichment bonds concept.

(Ref: INFCIRC/707, June 2007)

### 9. International Uranium Enrichment Centre at Angarsk

**Russian Federation.** Following adoption of the necessary enabling legislation in January 2007, the Russian Federation will establish 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 by the Russian Federation and the Republic of Kazakhstan.

A mechanism is being developed to set aside a stockpile of LEU which 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 MT under Agency auspices, and stored under safeguards at Angarsk, for use by IAEA Member States.)

(Ref: INFCIRC/708, June 2007)

### 10. Multilateralizing the Nuclear Fuel Cycle

**Germany.** Germany proposed the creation of a multilateral uranium enrichment centre with extraterritorial status, operating on a commercial basis as

a new supplier in the market, under Agency control, providing enrichment services. From there, potential users could then obtain nuclear fuel for civilian use under strict supervision. Such a plant could also help assure the supply of enriched uranium to qualifying States (Germany has proposed a “Multilateral Enrichment Sanctuary Project” for an international enrichment centre established by a group of interested States, on an extra-territorial basis in a host State.)

(Ref: INFCIRC/704, May 2007)

### 11. Multilateralisation of the Nuclear Fuel Cycle

**Austria.** 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.”

(Ref: INFCIRC/706, May 2007)

### 12. Nuclear Fuel Cycle

**European Union (EU).** 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 suppliers, companies, consumer States and the IAEA; and
- d) market neutrality — avoiding any unnecessary disturbance or interference in the functioning of the existing market.

(Ref: EU non-paper, June 2007)

*Note: This list is taken from GOV/INF/2007/11 which is a restricted access document.*