

Securing the Nuclear Fuel Cycle: What Next?

by S. V. Ruchkin and V. Y. Loginov

The greatest challenge to the international nuclear non-proliferation regime is posed by nuclear energy's dual nature for both peaceful and military purposes. Uranium enrichment and spent nuclear fuel (SNF) reprocessing (here after called "sensitive nuclear technologies") are critical from the non-proliferation viewpoint because they may be used to produce weapons-grade nuclear materials: highly enriched uranium and separated plutonium.

When the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) was signed in 1968 a compromise was reached between the nuclear-weapon States and the non-nuclear-weapon States to refrain from attempts to develop or acquire nuclear weapons by the latter (Article II) in exchange for "...the inalienable right of all the Parties to the Treaty to develop research, production and use of nuclear energy for peaceful purposes..." (Article IV), not excluding access to sensitive nuclear technologies. However, as time has shown, some countries, under the guise of peaceful nuclear programmes, were involved in clandestine activities aimed at acquiring nuclear weapons capabilities.

Sensitive Nuclear Technologies

In the 1970s the world community started to develop further measures to curb the spread of sensitive nuclear technologies. The establishment of a Nuclear Suppliers Group (NSG) in 1975 was one such measure. The NSG united countries which voluntarily agreed to coordinate their legislation regarding export of nuclear materials, equipment and technologies to countries not possessing nuclear weapons.

Alongside measures to limit the spread of sensitive nuclear technologies, multilateral approaches to the nuclear fuel cycle (NFC) started to be discussed. These ideas were reflected in the final document of the NPT review conference in 1975 and in a number of IAEA projects on multilateral approaches. However, due to various reasons, including the freezing of nuclear power programmes following the Three Mile Island (1979, US) and Chernobyl (1986, USSR) accidents, these intentions never materialized.

Subsequent years have presented new challenges to the international nuclear non-proliferation regime, among them illegal transfers of nuclear materials and equipment, substantially increased political instability (terrorist threats) in traditionally tense regions and the booming development of informa-



Alternative initiatives to securing the nuclear fuel cycle are once again on the table. Here, at one of the final stages of fuel assembly, a technician checks nuclear fuel rods. Photo: Dean Calma

tion and communication technologies which simplify access to sensitive information.

Spiralling prices for hydrocarbons and prospects of their imminent extinction are encouraging more and more countries to look at nuclear energy as an alternative means to ensure their sustainable development. To this end, it's becoming increasingly important to link the objective need for an expanded use of nuclear energy with strengthening nuclear non-proliferation by, in particular, preventing the spread of sensitive nuclear technologies and securing access for interested countries to NFC products and services.

Multilateral Nuclear Approaches

With this in mind, at the IAEA General Conference in 2003, IAEA Director General Mohamed ElBaradei called for establishing an international experts group on multilateral nuclear approaches. The proposal was supported, and in February 2005 the international experts, headed by Bruno Pellaud, issued a report (published by the IAEA as INFCIRC-640; see www.iaea.org) with recommendations on different multilateral approaches.

The recommendations can be generalized as follows: reinforcement of existing market mechanisms; involvement of governments and the IAEA in the assurance of supply,

including the establishment of low-enriched uranium (LEU) stocks as reserves; conversion of existing national uranium enrichment and SNF reprocessing enterprises into multilateral ones under international management and control, and setting up new multilateral enterprises on regional and international levels.

What has been done in this area since then, and what are the prospects for development of multilateral approaches in the use of nuclear energy?

As noted earlier, one of the instruments to enhance the security of supply of NFC products and services suggested in the experts' report is reinforcement of existing market mechanisms. In this connection it looked quite logical for the World Nuclear Association (WNA) to set up, in August 2005, a dedicated working group comprising experts from the world nuclear industry. Representatives of the four leading world uranium enrichment services suppliers were in the group: AREVA (France), TENEX (Russia), URENCO (Germany, the Netherlands and UK), and USEC (US). As a result, in May 2006, the WNA produced a report entitled "Ensuring Security of Supply in the International Nuclear Fuel Cycle" (see WNA website at www.world-nuclear.org/security.pdf)

The report's most important highlights are:

✓ **The existing world market and the capabilities** of producers assure a reliable level of supply over the entire spectrum of the NFC products and services required by the world nuclear power industry, and are the prime guarantor of supply. Therefore, questions of additional assurances may be raised not to solve supply problems, which, luckily, do not exist today, but as a safety net in case of a disruption of market mechanisms.

✓ **Additional assurances of enrichment services** can be given by enrichment companies as a collective commitment, with support from the IAEA and governments, on the basis of a three-level concept similar to the defense-in-depth concept in ensuring nuclear safety. This mechanism can be triggered only if and when a commercial supply contract is disrupted due to political reasons unrelated to non-proliferation. In any case the additional assurances must not impact negatively the existing world market.

✓ **Introduction of additional assurances** will be on the precondition that the recipient State meets all the non-proliferation requirements pre-defined and agreed upon by the parties, reinforced by intergovernmental agreements and controlled by the IAEA.

In September 2005, the six enrichment services supplier-States, under the leadership of the US, set up an intergovernmental working group to develop a multilateral mechanism for reliable access to nuclear fuel (RANF). The group presented its proposal to IAEA Member States in June 2006 and consultations continue on the next steps regarding their offer,

under certain conditions, to provide low enriched uranium to States not pursuing sensitive nuclear activities.

Global Nuclear Power Infrastructure

On 25 January, 2006 Russian President Vladimir Putin announced an initiative to develop a Global Nuclear Power Infrastructure (GNPI) capable of providing secured and non-discriminatory (equal) access to the benefits of nuclear energy to all interested countries in strict compliance with non-proliferation requirements. Establishment of a network of international NFC centers (INFCC), including enrichment services, under IAEA safeguards will become a key element of such an infrastructure. The GNPI-INFCC initiative is aimed primarily at countries who are developing nuclear power but not planning to establish indigenous uranium enrichment and SNF reprocessing capabilities.

As a first step, Russia volunteered to initiate a joint project to establish an International Uranium Enrichment Center (IUEC) on the basis of its enrichment plant in the city of Angarsk (Irkutsk region). Interested Russian governmental and business structures have been working on the basic principles of establishing such a center. Despite the fact that work is far from complete, key principles have been formulated:

① **Equal, non-discriminatory membership** for all interested countries not envisaging the development of indigenous sensitive nuclear technologies and meeting the established non-proliferation requirements;

② **IUEC membership "advantages"** (political, economic, scientific and technical) for the enrichment services recipient countries should outweigh the "disadvantages" of refraining from the development of domestic NFC capabilities; in particular, it is clear that the establishment of national NFC capabilities can be economically justified only for a large fleet of nuclear power plants;

③ **Transparency of commercial IUEC activities** (according to international practices), its cost-effectiveness and investment attractiveness in the long term;

④ **IUEC enrichment capacities are to be placed** under IAEA safeguards; possible involvement of the IAEA in the Center's management;

⑤ **Conclusion of an intergovernmental agreement** between the interested countries (and possibly the IAEA), joint elaboration and approval of its Charter;

⑥ **Possible (vertical) integration of the enricher**, LEU recipients, and suppliers of source uranium under the aegis of the IUEC;

⑦ **IUEC products**, in the form of enriched uranium hexafluoride, should meet the nuclear reactor requirements of the participants;

❖ **Foreign IUEC members** will have no access to Russian uranium enrichment technology.

Through IUEC membership, countries intending to build nuclear power plants would be able to pursue their diversification policies and benefit from an additional security of LEU supply on market conditions. This is due to:

- ❖ **Commitments by Russia** and other participating countries resulting from the intergovernmental agreement;
- ❖ **IUEC international status**, involvement of the IAEA in its activities;
- ❖ **Russian enrichment plant capabilities** possessing proven, high-tech and competitive enrichment technology.

There may be some follow-up stages of GNPI-INFCC implementation. These are related to:

- ◆ Timely solution of SNF management issues by reprocessing and the disposal of residual waste within the framework of international NFC centers with the use of modern fast reactor and spent fuel management technologies;
- ◆ Expansion of international collaboration on innovative nuclear reactors and associated NFC technologies (IAEA INPRO Project and Generation IV) both on bi-lateral and multi-lateral bases, including the establishment of dedicated international NFC centers;
- ◆ Establishment of international centers to train and qualify personnel for countries developing nuclear power. The Russian Presidential initiative builds upon G8 policies on curbing the spread of sensitive nuclear technologies and is a practical input into the implementation of the (G8) accords reflected in the Declarations on Non-Proliferation at the summits in Gleneagles (Scotland, 2005) and St. Petersburg, (Russia, 2006). The initiative is also intended to further the efforts of the IAEA and the enrichment services supplier states on multilateral nuclear approaches (MNA).

Global Nuclear Energy Partnership

The US Administration recently put forward a new initiative on a Global Nuclear Energy Partnership (GNEP). The main objective of the US initiative, as well as of the Russian one, is to contribute to the development of a global partnership on the peaceful use of nuclear energy taking into account the global problems facing mankind.

In the area of non-proliferation of sensitive nuclear technologies, GNEP suggests establishing an international consortium comprised of developed countries with full NFC capabilities, including advanced nuclear technologies (a horizontal integration). The members of the consortium are assumed to become the main suppliers of uranium enrichment and SNF reprocessing services to other countries. GNEP also assumes development by NFC services suppliers of a nuclear fuel lease-

ing scheme with developing countries incorporating SNF return in order to discourage them from acquiring indigenous NFC capabilities.

It's obvious that all the above initiatives (RANF, WNA, GNPI-INFCC, GNEP) have common elements related to the security of supply. Therefore, the initiatives may benefit from harmonization. In our opinion, an attempt should be made to develop an International Assured Nuclear Fuel Cycle Products and Services Supply Framework (IANSF) aimed at limiting the spread of sensitive nuclear technologies and, therefore, strengthening the international nuclear non-proliferation regime, and at the same time assisting expansion of peaceful uses of nuclear energy worldwide.

The framework is to be based on the world market of NFC products and services, which is the main guarantor of their availability. In case of a disruption of market mechanisms, some extraordinary measures could be introduced to give additional assurances of supply and encourage the recipient countries to forgo the development and use of sensitive nuclear technologies—collective guarantees of commercial suppliers reinforced by government commitments and the establishment of reserve LEU stocks.

In line with IAEA recommendations, other multilateral approaches could be used—an international NFC center set up based on an existing national plant by converting it into a multilateral enterprise under international control (IAEA safeguards), or international consortia to be made up of supplier States over the entire range of NFC products and services. In both cases one could expect new players in the world market to appear as a result of vertical and horizontal integration.

The concept of an international framework is an attempt at a systematic approach to the efforts of interested countries, the IAEA and the world nuclear industry. It is aimed at the growing role of nuclear energy and strengthening the nuclear non-proliferation regime by granting countries developing nuclear power, without using sensitive nuclear technologies, additional assurances of access to NFC products and services. In our view a harmonization of the recent international initiatives and development of a coordinated plan of action will contribute to reaching the declared goals in the short and long term.

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