

VERIFICATION OF WEAPON-ORIGIN FISSILE MATERIAL IN THE RUSSIAN FEDERATION & UNITED STATES

BY THOMAS SHEA

New directions are opening for the international verification of nuclear material through a joint initiative launched in 1996 by the Russian Federation, the United States and the IAEA. Being investigated at this stage are the technical, legal and financial issues associated with IAEA verification of fissile materials determined to be excess to defense purposes in the two States.

The prospective verification system will provide a new role for the IAEA. Specifically:

■ First, the new verification system is intended to provide assurance that steps taken in conjunction with the reduction of nuclear arsenals are irreversible. Hence, the verification objectives and framework are relevant to Article VI of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) and therefore differ in fundamental ways from the IAEA safeguards system which is designed for non-proliferation purposes.

■ Second, the pace of dismantling nuclear weapons in the Russian Federation and USA is much greater than the current ability to process the recovered fissile materials to make them difficult to re-use in nuclear weapons.

The USA, Russian Federation, and the IAEA are considering verification measures which could be applied early in this process to stored materials

-- including the components of dismantled nuclear weapons -- in ways that will allow the Agency to derive credible and independent assurance, while preventing access by Agency inspectors to classified information.* Consistent with the commitments of the USA and Russian Federation under Article I of the NPT, the provisions required for fissile material with classified characteristics restrict the types of information that the States are able to declare and the types of verification activities the Agency can carry out.

■ Third, while some types of facilities will be the same as or similar to those currently subject to IAEA safeguards, some will be quite different, and the provisions for inspector access and the performance of inspection duties will be carried out under security arrangements which are unlike those encountered elsewhere.

Background & Objectives. The President of the United States on several occasions has made announcements concerning fissile material designated by the US Government as no longer required for military purposes and the intention of the United States to place such material under international verification. Currently, 174 tonnes of highly enriched uranium (HEU) and

52 tonnes of plutonium have been so designated. Of these, in September 1994, the USA submitted two tonnes of plutonium and 10 tonnes of HEU to IAEA safeguards under its Voluntary Offer Safeguards Agreement (VOA) with the IAEA (INFCIRC/288). The US Government stated its intention to increase these amounts and to keep that plutonium and HEU under IAEA safeguards on an indefinite basis, with a proviso that, under the VOA, the HEU could be withdrawn for non-explosive military applications, if needed.

In 1995-98 the USA downblended 13 tonnes of HEU at Portsmouth, and the IAEA participated in a verification experiment to confirm the amounts of HEU downblended in that facility from December 1997 onward. A further 50 tonnes of HEU will be downblended at the BWXT Facility and IAEA inspections under the VOA to verify that downblending have begun.

In April 1996, the President of the Russian Federation made the following statement to the Moscow Summit on Nuclear Safety and Security:

"All nuclear materials resulting from conversion should be used in the civil nuclear area. And, as it is known, this will require no

**The term "classified" refers to information related to the design of nuclear weapons or other aspects of nuclear weapons, as determined by nuclear-weapon States.*

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less than 20 to 30 years. Hence, we stand for the construction of secure storage facilities for nuclear material. We have completed the design work and are constructing now a similar storage facility at the site of the 'Mayak' industrial complex with US participation. This storage facility will accommodate about 40% of the Russian weapons-grade plutonium. We are planning to place this facility under the IAEA safeguards."

In September 1996, the Minister of the Russian Federation on Atomic Energy, the US Secretary of Energy, and the IAEA Director General agreed to work together to investigate the technical, legal and financial issues associated with a common verification system that would allow each State, according to its national programmes, to submit to IAEA verification weapon-origin fissile materials and other fissile materials determined to be excess to the defense purposes of the States. A trilateral working group was established to carry out the investigations.

Main Objectives. The removal of weapon-origin fissile material from the Russian and US defense programmes is in response to the obligations of the two States under Article VI of the NPT. The IAEA's verification pursuant to this initiative is intended to promote international confidence that fissile material made subject by either of the two States to Agency verification remains irrevocably removed from nuclear weapon programmes.

The US Secretary of Energy and Russia's Minister of Atomic Energy have noted the importance of these commitments as a significant

contribution to the fulfillment of the Principles and Objectives for Nuclear Non-Proliferation and Disarmament agreed upon at the 1995 NPT Review and Extension Conference. Further, the Secretary and the Minister have stated that with this initiative, the Russian Federation and the United States have confirmed the interest of their respective Governments in international verification of the irreversible removal of fissile material from their respective weapons programmes.

Disposition Programmes. Both the USA and Russia have indicated their intention to dispose of excess HEU by blending it down to low enrichment levels (such that the uranium-235 content is less than 20%), and making that uranium available for use in nuclear power reactors.

The USA will dispose of its excess plutonium either by manufacturing mixed plutonium-uranium oxide (MOX) fuel assemblies and irradiating them in nuclear power reactors, or by immobilizing the plutonium. The irradiated fuel and the immobilized plutonium would ultimately be placed in a geological repository.

The US Department of Energy has announced that the Savannah River Site is the preferred location for the storage and processing activities. Existing facilities could be converted and new facilities could be constructed for converting metallic plutonium nuclear weapon components into oxides, for manufacturing MOX fuel for nuclear power reactors, and for immobilizing plutonium. The new facilities at

Savannah River are scheduled to commence operations between 2005 and 2007. Plutonium now stored at other locations is to be transported to Savannah River beginning in early 2000.

In the Russian Federation, plutonium recovered from dismantled nuclear weapons will be stored, pending disposition, at the new Mayak Fissile Material Storage Facility (FMSF). The specific steps to be taken thereafter are under consideration but not as yet resolved. Prior to storage, the nuclear weapon components may be recast into forms in which the shape and mass of plutonium are no longer classified. FMSF is presently under construction by the Mayak Production Association at Ozersk (previously called Chelyabinsk-40) on behalf of the Ministry of Atomic Energy (Minatom). Storage at FMSF is scheduled to begin in 2002.

Activities under Joint Initiative. In assessing a potential verification role for the IAEA, the first priority was to ascertain that technical solutions could be found which would allow the Agency to draw independent and credible conclusions while ensuring that no classified information could be acquired by the inspectors. Once the technical measures have been defined, a legal framework would need to be worked out to reflect the rights and obligations of the parties with respect to the agreed verification arrangements. On this basis, the Secretariat would then develop cost estimates.

Work is being done to develop the verification arrangements for specific facilities identified by the Russian Federation and the

USA where the new agreements would apply. In the USA, discussions between US and IAEA experts are well advanced on the methods to be applied at the K-Area Material Storage Facility, located at the Savannah River Site. In the Russian Federation, discussions are under way between Russian and IAEA experts on the verification methods to be applied at the Mayak FMSE.

Technical Measures. Under the arrangements foreseen, the Russian Federation and the USA would determine independently the forms and amounts of fissile material that each would submit for verification, the locations where that material would be submitted, and the timing of the submissions. It is foreseen that each State would submit to IAEA verification weapon-origin fissile material. The USA would also submit to IAEA verification other fissile material no longer required for defense purposes.

Thus, the verification arrangements must be in conformity with the obligations of the two States under Article I of the NPT. For any IAEA verification of classified forms of weapon-origin fissile material to proceed, the Russian Federation and the USA must be confident that neither inspector observations nor measurements would allow IAEA inspectors to gain access to classified information. At the same time, the IAEA must be confident that the verification is credible and independent.

In the past year, substantial progress was made in developing and testing verification equipment. Specifically, a prototype verification system for plutonium was built and demonstrated at the Los Alamos

National Laboratory using plutonium similar to that anticipated, but not having classified characteristics. The prototype combined standard non-destructive measurement techniques that are used for IAEA safeguards inspections at plutonium plants.

A new technology known as "information barriers" was introduced that is intended to allow the inspectors to derive sufficient information for the verification to be credible and independent, while preventing access to classified information. The prototype provided a means to evaluate the previously identified concepts, and the tests showed that verification under the security constraints can be carried out in a way that will meet the security concerns of the States and the verification requirements of the IAEA.

During the 1999 IAEA General Conference, Minister Adamov, Secretary Richardson and Director General ElBaradei opened an exhibit of verification equipment and methods under development for this initiative. The exhibit included information on the Mayak Fissile Material Storage Facility at Ozersk, Russia, where weapon-origin plutonium from the Russian Federation will be stored; non-destructive neutron and gamma ray assay equipment using information barrier technology to prevent the disclosure of classified nuclear weapons information; remote monitoring via the Internet involving test installations at the Sandia National Laboratories, USA and at Sarov (Arzamas-16), Russia; and integrated radio frequency sensor platforms that will be a key element in inventory monitoring systems

for use at the storage facilities being established for excess weapon-origin fissile material.

In the coming year, second generation prototype verification systems will be produced to a common technical specification in the Russian Federation and in the USA. These second generation prototypes will be designed to reflect as closely as possible the field conditions under which such verification is foreseen. Together with integrated monitoring capabilities, these verification measurements are expected to permit the IAEA to conclude that weapon-origin fissile material in storage submitted to verification remains removed from nuclear weapon programmes.

Model Verification Agreement. While developing possible technical verification measures, the legal instruments that would allow their implementation are being looked at by the US, the Russian Federation and the IAEA. A few preliminary aspects are discussed below.

The possibility of implementing the necessary verification activities through the existing VOAs between the IAEA and the Russian Federation and between the IAEA and the USA was considered but two main reasons argue against their use: ■ VOAs place no continuing and irrevocable obligation on the State to maintain safeguards on nuclear material submitted under such an agreement. They permit each State to withdraw at its own discretion nuclear material from safeguards and to remove facilities from the list submitted by the State under the VOA. Moreover, there is



no obligation on the Agency to implement safeguards at facilities or on material submitted by the State under the VOAs.

■ When safeguards are applied under the VOAs, detailed information on the material's characteristics is required from the State, and the safeguards verification instruments and laboratory analyses provide independent measurements of all safeguards-relevant characteristics of the nuclear material. However, if classified forms of weapon-origin fissile material are submitted to IAEA verification, much of the information required for safeguards would be inaccessible since nuclear-weapon States are prohibited from disclosing information relevant to the design of nuclear weapons under Article I of the NPT, and traditional safeguards methods and techniques would not be permitted.

Taking into account these limitations, a Model Verification Agreement is being developed which, subject to approval by the IAEA Board, could be used as the basis for negotiating bilateral agreements between the Agency and each of the States for the verification of fissile

material pursuant to this initiative.

As the purpose of IAEA verification under such agreements would be to promote international confidence that weapon-origin fissile material (or any other fissile material) subject to IAEA verification under the agreements remains removed from nuclear weapon programmes, the basic undertaking of States parties to such agreements would likely include the following elements:

■ a commitment by the State not to withdraw material submitted to IAEA verification under the agreement, thereby establishing an irrevocable commitment by the State to continue IAEA verification on such material indefinitely, or until the material has been altered so as to require chemical reprocessing or re-enrichment for use in nuclear weapons; and
 ■ provisions for IAEA verification measures that would serve the goal of providing assurance of the irreversible removal of material submitted to IAEA verification under the agreement from nuclear weapon programs; and a stipulation that the IAEA would be permitted to implement its verification activities in a manner that will

permit it to derive credible, independent conclusions based upon the activities carried out and the results obtained.

Future Steps. The IAEA verification system for weapon-origin fissile material is expected to become operational in about two years. The associated costs will be estimated as the national programmes are made known and as the specific verification arrangements are defined. Alternative funding arrangements are under consideration to cover IAEA costs related to this mission.

Minister Adamov, Secretary Richardson and Director General ElBaradei have committed their respective organizations to a work programme for the coming year aimed at the adoption of the basic technical measures associated with the verification of fissile material covered by the initiative and approval of an appropriate model verification agreement by the IAEA Board of Governors. Negotiation of the framework of such an agreement is expected to be completed in the coming months. Thereafter, technical verification annexes will be prepared as the required technical capabilities are demonstrated. □

Photo: In September 1999, US Secretary of Energy Bill Richardson, Russian Minister of Atomic Energy, Evgueny Adamov, and IAEA Director General Mohamed ElBaradei opened an exhibition at the IAEA General Conference in Vienna of verification equipment under development for this initiative and relevant facilities. Shown at right is Dr. Dennis Mangan of the US Sandia National Laboratories, who is demonstrating a radio communication security seal that permits real-time inventory monitoring in situations where thousands of containers of plutonium are stored.
 (Credit: R. Glen/IAEA)