

Safeguards

Objective

To provide credible assurance to the international community that nuclear materials and other items placed under safeguards are not diverted or misused, and, for States with comprehensive safeguards agreements in force, to provide credible assurance on the absence of undeclared material and activities for States as a whole; and to support the efforts of the international community in connection with nuclear disarmament.

The year 2004 was marked by the international community's increased attention to the Agency's verification programme. In particular, there was strong interest in the Agency's inspection activities related to the compliance by a number of States with their safeguards agreements. The discovery of covert nuclear trade networks and continued uncertainty regarding the nuclear capabilities of the Democratic People's Republic of Korea (DPRK) also contributed to a heightened awareness of the risk of nuclear weapons proliferation.

This increased attention prompted several new multinational initiatives to strengthen the nuclear non-proliferation regime. Within the framework of this regime, and through a number of new initiatives, the Agency continues to play a unique role as an independent, impartial international authority in the field of nuclear verification (Fig. 1).

Throughout 2004, Agency safeguards continued to evolve in response to emerging challenges. Thus:

- The Agency moved from rigid, criteria¹ based safeguards implementation and evaluation to a more flexible and effective approach based on State level considerations. This new approach takes into account a wider range of factors and information, such as the scope and extent of a State's nuclear fuel cycle, the cooperation of the State in implementing safeguards and reports on nuclear related research available in open sources. Agency safeguards remain non-discriminatory, as the verification objectives applied are common to all States.
- The Agency began to develop its own capabilities for in-depth analysis and evaluation of nuclear



FIG. 1. Nuclear safeguards inspectors verifying the active length of a fresh fuel assembly using a gamma ray system at the Mochovce nuclear power plant, in Slovakia, during a training exercise.

trade activities on a global scale. These new capabilities involve techniques to enhance the collection and analysis of information about nuclear supply and procurement activities and the investigation of covert nuclear trade networks with a view to assessing whether these networks are supporting undeclared nuclear activities.

The Agency's Safeguards Mandate

Since 1957, the Agency has — in accordance with its statutory mandate — applied safeguards to ensure “that assistance provided by it or at its request or under its supervision or control is not used in such a way as to further any military purpose.”² With the 1968 Treaty for the Prohibition

¹ Safeguards criteria are a set of guidelines for nuclear material verification activities, traditionally considered by the Agency to be an effective means of fulfilling responsibilities under safeguards agreements.

² Article II of the IAEA Statute.

State Undertakings with Regard to Agency Verification

- **Comprehensive safeguards agreements (CSAs):** All non-nuclear-weapon States party to the NPT, as well as States party to the regional nuclear-weapon-free zone treaties, are required to conclude CSAs with the Agency. The structure and content of CSAs concluded pursuant to the NPT are described in document INFCIRC/153 (Corr). In accordance with the terms of such agreements, a State undertakes to accept safeguards on all nuclear material in all peaceful nuclear activities, within its territory, under its jurisdiction or carried out under its control anywhere for the purpose of verifying that such material is not diverted to nuclear weapons or other nuclear explosive devices. Under these agreements, the Agency has the right and obligation to ensure that safeguards are applied on all such nuclear material.
- **Voluntary offer agreements (VOAs):** The five NPT nuclear-weapon States have concluded safeguards agreements covering some or all of their peaceful nuclear activities. Under the VOAs, facilities or nuclear material in facilities notified to the Agency by the State concerned are offered for the application of safeguards. VOAs serve two purposes: to broaden the Agency's safeguards experience by allowing for inspections at advanced facilities; and to demonstrate that nuclear-weapon States are not commercially advantaged by being exempt from safeguards on their peaceful nuclear activities.
- **Item-specific safeguards agreements:** Agreements in this category cover only specified material, facilities and other items placed under safeguards, and are based on the safeguards procedures approved by the Board of Governors and published in INFCIRC/66/Rev.2 and its earlier versions. States parties to such agreements undertake not to use the material, facilities and/or other items under safeguards in such a way as to further any military purpose. The Agency implements such agreements in the three States that are not party to the NPT.
- **Additional protocols (APs):** These were designed for States having a safeguards agreement with the Agency, in order to strengthen the effectiveness and improve the efficiency of the safeguards system as a contribution to global non-proliferation objectives. States with CSAs may only conclude APs that include all provisions of the "Model Protocol Additional to Agreement(s) between State(s) and the IAEA for the Application of Safeguards" (published in INFCIRC/540 (Corr.)), which was approved by the Board in 1997. Other States may accept and implement those measures of the Model Additional Protocol that they choose with a view to contributing to non-proliferation aims or to the effectiveness and efficiency objectives of the Protocol.

of Nuclear Weapons in Latin America³ and the 1970 Treaty on the Non-Proliferation of Nuclear Weapons, the Agency became the designated verification authority for the implementation of safeguards in States party to these treaties. Other nuclear non-proliferation treaties, such as the nuclear-weapon-free zone treaties in certain regions, also call for the Agency to serve in that capacity.

The Agency's Safeguards Conclusions for 2004

At the end of each year, the Agency draws *safeguards conclusions*, for each State in which it applies safeguards, based upon the evaluation of all information available to the Agency for that year. The Agency, through CSAs, seeks to provide

'credible assurance' on two points: (1) that declared nuclear material has not been diverted; and (2) that no undeclared nuclear material or activities exist. When provided with the necessary authority, access and information, the Agency is able to draw the *conclusion* that all nuclear material⁴ in the State remained in peaceful nuclear activities.

For the Agency to draw such a conclusion credibly, both a CSA and an AP must be in force or otherwise applied for that State, *and* the Agency must have been able to conduct all necessary verification and evaluation activities under those agreements. For States that have CSAs in force and no APs, the Agency does not have sufficient means to draw such a conclusion credibly, and therefore generally only draws the *conclusion* that all *declared* nuclear material remained in peaceful nuclear activities.

³ Now called the Treaty for the Prohibition of Nuclear Weapons in Latin America and the Caribbean.

⁴ Material subject to safeguards; namely, all source or special fissionable material in peaceful nuclear activities within a State's territory, under its jurisdiction or carried out under its control anywhere.

In 2004, safeguards were applied for 152 States with safeguards agreements in force with the Agency.⁵

With regard to 21 States with both CSAs and APs in force or otherwise applied, the Agency concluded that *all nuclear material* in those States remained in peaceful nuclear activities. For 40 other such States, the Agency had not yet completed the necessary evaluations, and could therefore only draw the conclusion that the *nuclear material placed under safeguards* remained in peaceful nuclear activities. For 82 States with CSAs in force and no APs, the Agency was, likewise, only able to draw that conclusion.

The Islamic Republic of Iran (Iran), Libyan Arab Jamahiriya (Libya), Republic of Korea (ROK) and Egypt had been found to have been previously engaged in nuclear activities of varying significance, which they had failed to report to the Agency. Corrective actions are being taken by those States. Verification and evaluation of these States' declarations were still in progress at the end of 2004.

The Agency was not able to perform verification activities in the DPRK in 2004 and could not, therefore, draw any safeguards conclusions regarding nuclear material or activities in that State.

For three States with limited scope item-specific safeguards agreements in force, the Agency was able to reach the conclusion that *the nuclear material and other items placed under safeguards* remained in peaceful nuclear activities.

The Agency also carried out inspections in selected facilities in four States with VOAs in force and was able to conclude that *the nuclear material placed under safeguards* in the selected facilities remained in peaceful nuclear activities.

For 40 States party to the NPT that had not yet concluded *any* safeguards agreement with the Agency, no safeguards conclusions could be drawn by the Agency.

Democratic People's Republic of Korea

The DPRK has had a CSA in force with the Agency since 1992. Since 1993, the DPRK has been in non-compliance with its safeguards agreement.

As a result of the unilateral action by the DPRK in December 2002 to terminate the Agency's safeguards

activities in the DPRK, the Agency has been unable to perform any verification activities in that State. Information about the DPRK's nuclear programme has since that time been gained only through open sources and other available information. As a consequence, the Agency is not in a position to assess the extent of the DPRK's nuclear programme.

Given this lack of information, and the unanswered questions concerning the DPRK's nuclear capabilities and its statements that a nuclear weapons capability now exists, the situation in the DPRK continues to pose a serious challenge to the nuclear non-proliferation regime. The Agency, hopeful that a resolution to this situation can be achieved through bilateral and multilateral actions by the international community, has continued to maintain the capability that would be required to resume verification in the DPRK at short notice.

Islamic Republic of Iran

Iran has had a CSA in force with the Agency since 1974. In 2003, the Agency found that, for 18 years, Iran had pursued an undeclared nuclear programme which had included uranium conversion and enrichment.

During 2004, the Director General submitted four reports⁶ to the Board of Governors on the implementation of safeguards in Iran, and the Board adopted four resolutions on this subject⁷. The Agency's verification activities throughout the year further enhanced its understanding of Iran's current and past nuclear programme. The Agency's investigations focused on issues that remain unresolved concerning Iran's past undeclared nuclear programme. The two key outstanding issues are:

- The origin of the enriched uranium contamination found at several locations in Iran;
- The scope of Iran's enrichment programme.

The Agency made some progress towards resolving both of these issues.

With regard to the first issue, Iran has asserted that the uranium contamination originated from components acquired from third parties. At the end of 2004, the Agency's overall assessment with respect to this issue was that the environmental sampling data available tended, on balance, to support Iran's

⁵ For the official text of the safeguards conclusions, see <http://www.iaea.org/OurWork/SV/Safeguards/es2004.html>.

⁶ GOV/2004/11, GOV/2004/34, (GOV/2004/34/Corr.1), GOV/2004/60, GOV/2004/83.

⁷ GOV/2004/21, GOV/2004/49, GOV/2004/79, GOV/2004/90.

statement about the foreign origin of the observed contamination. However, other possible explanations cannot be excluded, and the Agency is continuing its investigations to confirm the actual source of contamination.

With regard to the issue of enrichment, the Agency is continuing its investigation into the covert supply network that provided equipment for Iran's centrifuge enrichment programme, in order for the Agency to be able to conclude its assessment.

The Agency is also still assessing other aspects of Iran's past nuclear programme, including statements made about past plutonium separation experiments.

In December 2003, Iran signed an AP to its safeguards agreement. Although the AP was not ratified as of the end of 2004, Iran has undertaken, since 2003, to act as if it were in force. In May 2004, Iran delivered to the Agency its initial declarations under the AP.

Iran cooperated with the Agency in accordance with the provisions of its CSA and AP by providing access to requested locations. However, information often continued to be slow in coming and was provided in response to Agency requests, rather than proactively.

Another point of Agency focus during 2004 was Iran's voluntary suspension of its enrichment related and reprocessing activities. At the request of both Iran and the Board of Governors, the Agency has been verifying and monitoring this suspension. Containment and surveillance measures were applied at the Uranium Conversion Facility at Esfahan and the Pilot Fuel Enrichment Plant at Natanz. In addition, the suspension of centrifuge component production was verified at declared production locations, and associated essential equipment was placed under containment and surveillance measures.

Progress made during 2004 enabled the Agency to conclude that all declared nuclear material in Iran had been accounted for, and that, therefore, such material was not diverted to prohibited activities. However, the Agency is not yet in a position to conclude that there are no undeclared nuclear material or activities in Iran. The process of drawing such a conclusion, based on the implementation of all safeguards measures including those contained in an AP, is normally a time consuming

process. In view of the past undeclared nature of Iran's nuclear programme, and its past pattern of concealment, drawing this conclusion in the case of Iran can be expected to take longer than in normal circumstances.

Libyan Arab Jamahiriya

Libya has had a CSA in force with the Agency since 1980. Nonetheless, for more than 20 years Libya pursued a clandestine programme aimed at uranium conversion and enrichment, which it has acknowledged was for the production of nuclear weapons. Starting in the early 1980s and continuing until the end of 2003, Libya imported nuclear material and conducted a wide variety of nuclear activities that it concealed from the Agency. Some development work on these technologies had been pursued within Libya, but substantial assistance — including nearly all the equipment involved — had been received from foreign sources, either directly or through intermediaries.

In December 2003, Libya announced its decision to eliminate all materials, equipment and programmes leading to the production of internationally proscribed weapons — including nuclear weapons. Since then, the Agency has conducted a number of verification missions in Libya. During 2004, the Director General provided three reports to the Board of Governors⁸ on the implementation of safeguards in Libya and the Board adopted a resolution on the subject⁹. Libya has cooperated with the Agency by providing prompt and unhindered access to all requested locations.

On 10 March 2004, Libya signed an AP, and in May it submitted its initial declarations under the AP to the Agency. Although the AP was not yet ratified as of the end of 2004, Libya has undertaken, since December 2003, to act as if it were in force.

The Agency's assessment to date is that Libya's declarations concerning its uranium conversion programme, enrichment programme and other past nuclear related activities appear to be consistent with the information available to and verified by the Agency. There are some areas related to the acquisition of uranium hexafluoride, uranium conversion technology, plans for weaponization and enrichment technology that need further

⁸ GOV/2004/12, GOV/2004/33, GOV/2004/59, (GOV/2004/59/Corr.1).

⁹ GOV/2004/18.

investigation in order for the Agency to verify the completeness and correctness of Libya's declarations. These investigations are ongoing.

Other Safeguards Issues

Republic of Korea: The ROK's AP entered into force on 19 February 2004. In August 2004, the ROK began submitting declarations under the protocol. At the time of submission of these declarations, the ROK informed the Agency that ROK scientists had, on a number of occasions, conducted experiments that involved uranium conversion and uranium enrichment. According to the ROK, these activities had been carried out without the Government's knowledge. Earlier in 2004, the Agency had also been informed about the details of an experiment conducted to study the separation of plutonium, in the early 1980s. None of these activities had been declared in a timely manner to the Agency, as required under the ROK's CSA.

The Agency carried out a number of verification missions at various locations in the ROK to clarify the extent of these past undeclared activities. The ROK has actively cooperated with the Agency and provided information and access to personnel and locations.

Based on information provided by the ROK and verified by the Agency, there is no indication to date that these undeclared experiments have continued. However, the Agency is continuing to verify the correctness and completeness of the ROK's declarations.

Egypt: The CSA between Egypt and the Agency has been in force since 1982. In 2004, the Agency identified several open source documents, which indicated the possibility of hitherto unreported nuclear material, activities and facilities in that State. The Agency has sought clarification of these matters and has carried out several inspections and visits in connection with them. Egypt has cooperated with the Agency and provided information and access to personnel and locations. At the end of 2004, the Agency was still in the process of verifying the correctness and completeness of Egypt's declarations.

Implementation of Safeguards

The AP assists the Agency in verifying a State's compliance with its safeguards obligations and helps the Agency reach a broader conclusion regarding the status of nuclear material and activities in a State. Under an AP, the Agency has enhanced rights of access to locations and information and, thus, can obtain a broader range of information regarding a State's nuclear fuel cycle. Throughout 2004, the implementation of APs continued to demonstrate their effectiveness.

With APs entering into force for 24 States (including 15 Member States of the European Union), 2004 saw a record number of new parties to these protocols (Fig. 2). The Agency continued to encourage States to conclude NPT safeguards agreements and APs, and continued to provide assistance to States at their request¹⁰. Australia, Burkina Faso and Namibia hosted regional seminars on the conclusion of APs, and an interregional seminar on this topic was held in Vienna. By the end of the year, the number of States with APs in force had risen to 62¹¹, including three nuclear-weapon States (China, France and the United Kingdom).

Assistance to State Systems of Accounting for and Control of Nuclear Material

A key feature of effective safeguards implementation is the cooperation of the State systems of accounting for and control of nuclear

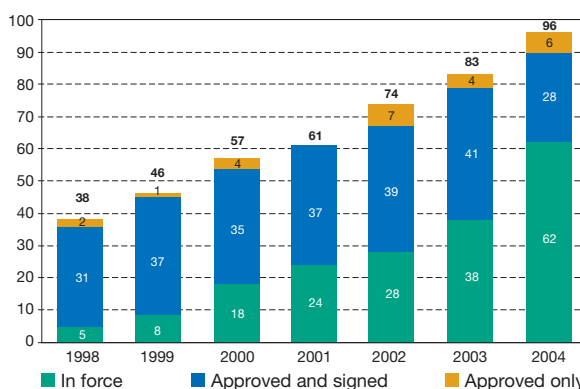


FIG. 2. INFCIRC/540 type additional protocols, 1998–2004.

¹⁰ Further information on the Agency's action plan to encourage the conclusion of safeguards agreements and APs is available at http://www.iaea.org/OurWork/SV/Safeguards/sg_actionplan2005.pdf.

¹¹ Additional protocols were also being provisionally applied in Iran and Libya, pending entry into force. In addition, the Agency applied safeguards, including the measures foreseen in the Model Additional Protocol, in Taiwan, China.

material (SSACs). In 2004, the Agency initiated a number of steps to help Member States upgrade the quality and performance of their SSACs. In this regard, the Agency is revising its guidelines for SSACs, and developing the objectives and basic structure for the new SSAC Advisory Service (ISSAS) missions. The first pilot ISSAS mission was conducted in Indonesia in June 2004.

Information Analysis and Remote Monitoring

The analysis of open source information, including satellite imagery, has played a key role in guiding inspectors to locations relevant to issues of particular safeguards concern, and has made a major contribution to the State evaluation process. Hundreds of satellite images were collected in 2004, and new three-dimensional visualization products were introduced to better support inspections. New arrangements were established with providers of imagery and cartographic information in order to diversify the Agency's sources.

Given recent experience which has demonstrated the value of collecting and analysing open source information, the Agency substantially increased its coverage of scientific and technical information. At the end of 2004, the Agency had access to over 5000 scientific journals and information on thousands of commercial entities. In addition, the Agency extended its capabilities for retrieving information in languages other than English.

The Secretariat continued to work on a four year project budgeted at more than \$20 million to: re-engineer the IAEA Safeguards Information System (ISIS); improve the effectiveness and efficiency of information analysis; and reduce the risk of failure of its antiquated safeguards computer system — much of which is more than 20 years old.

The number of Agency surveillance systems operating with remote transmission capabilities nearly doubled last year. Presently, 60 surveillance systems (with 191 cameras) are operating in remote monitoring (RM) mode in 11 States¹². In addition, 26 unattended spent fuel flow monitoring systems are operating with independent RM capability at facilities in Canada and Lithuania.

Also, during 2004, all RM systems in the ROK¹² were upgraded to enable data transmission over high speed Internet connections secured by virtual private network technology, a more cost effective

approach to the establishment of RM for verification purposes.

Detecting Undeclared Nuclear Material and Activities: New/improved Technological Capabilities and Methodologies

The Agency established a new research and development project to explore, with the advice and support of Member States, the potential use of advanced technologies in detecting undeclared nuclear material and activities. Areas of investigation include: means of detecting undeclared reprocessing plants and reactors and new technologies for monitoring declared enrichment facilities and detecting indications of undeclared enrichment activities.

Environmental sampling is one measure used by the Agency to detect undeclared nuclear activities in a State. Such sampling may be carried out at any location to which the Agency has access under a safeguards agreement or an AP. Through the collection and analysis of environmental samples, the Agency can determine whether nuclear activities and types of nuclear material are consistent with those declared; and whether the presence of undeclared nuclear material and activities is indicated.

A number of factors can have an impact on the efficiency of environmental sampling. The evaluation of 'urgent' samples is usually performed in a timely fashion. However, the evaluation of routine samples is often substantially delayed, at times due to the higher priority given to more urgent samples. To remedy this situation, the Agency is expanding its Network of Analytical Laboratories (NWAL). However, this requires an advanced technological and logistical infrastructure and substantial financial commitments from the States involved.

Implementation of Integrated Safeguards

The term 'integrated safeguards' describes the optimum combination of all safeguards measures available to the Agency under CSAs and APs. A prerequisite for the implementation of integrated safeguards is the broader safeguards conclusion to be drawn by the Agency for the State concerned. Once implemented, the combination of measures

¹² And in Taiwan, China.

The Network of Analytical Laboratories (NWAL)

The NWAL comprises a number of laboratories worldwide that have been qualified to analyse safeguards samples — that is, nuclear material or environmental samples. Several of these laboratories specialize in the measurement of individual micrometre sized particles collected on environmental samples, using methods such as scanning electron microscopy, secondary ion mass spectrometry or fission-track thermal ionization mass spectrometry.

In addition, some laboratories belonging to the NWAL apply 'bulk analysis' to environmental samples. This means that the entire sample is dissolved and chemically separated to extract elements of interest (such as uranium, plutonium and americium) for subsequent analysis.

When taking environmental samples, Agency safeguards inspectors typically collect a number of replicate samples so that these can be sent, in parallel, to different laboratories that perform particle or bulk analysis. Monitoring the consistency of results from these replicate samples adds an element of quality control to the entire sampling, handling and analysis process.

Representatives of laboratories meet regularly to review the performance of the NWAL in terms of accuracy, precision, sensitivity and reliability of the data, as well as the response time of the laboratories. Candidate laboratories are invited to send observers to these meetings as a way of preparing them for future membership in the NWAL. A number of safeguards Member State Support Programme tasks are dedicated to assisting laboratories in the development of capabilities that would enable them to join the NWAL. Increasing the number of participating laboratories would improve the overall capability, capacity, throughput and response time of the system.

enables maximum effectiveness and efficiency of safeguards measures. In countries with extensive nuclear fuel cycles, the opportunities for substantial savings due to reduced field verification activities are particularly evident.

An important milestone was reached in 2004 when the Agency was able to draw a broad safeguards conclusion for the first time for Japan, a State with a large and complete nuclear fuel cycle. Following this, the Agency began to implement integrated safeguards as of September 2004, focusing initially on LWRs without mixed oxide plutonium fuel, research reactors and critical assemblies, as well as LWR spent fuel storage facilities.

During 2004, the Agency also began to implement integrated safeguards in Hungary and Uzbekistan.

Status of the Rokkasho Reprocessing Plant Project

The Rokkasho Reprocessing Plant (RRP) in Japan is the biggest commercial reprocessing plant under Agency safeguards. An important milestone was reached in December 2004 with the introduction of uranium into the facility.

Change of Safeguards Approach by Euratom

In December 2004, the European Commission (EC) formally provided the Agency with information

about proposed reductions in its safeguards activities in the countries of the EU. The EC's plans for reducing its safeguards inspection activities would require significant adjustments to the existing cooperation agreement between the Agency and Euratom under which the two organizations have shared inspection activities and associated equipment costs over the past 13 years. Consultations were started on adjustments to these cooperation arrangements. The Agency will seek to ensure that there is no loss of safeguards effectiveness in Member States of the EU should the plans of the EC be further pursued and implemented, and that the necessary resources are available to the Agency to compensate for Euratom's reduced activities.

Review of the Safeguards Programme and Criteria

Two reviews, one covering the effectiveness of safeguards implementation, and the other covering the safeguards criteria, were completed in 2004.

The first review, by an independent panel of external experts, found that the Secretariat had done well in implementing safeguards strengthening measures, particularly given existing resource constraints. The panel concluded that the Agency's ability to provide credible assurance regarding the absence of undeclared nuclear material, as well as ongoing assurance that declared nuclear material has not been diverted, had significantly improved over the past five years.

The second review, carried out by the Agency's Standing Advisory Group on Safeguards Implementation (SAGSI), addressed the role, structure and content of the Agency's safeguards criteria. SAGSI found the safeguards criteria to be essentially sound, but identified areas for improvement, acknowledging that some of the changes it endorsed had already been initiated by the Agency. Both SAGSI and the external panel concluded that wider implementation of integrated safeguards, with its greater effectiveness and efficiency, should remain a programme priority.

Beyond State Borders: Covert Nuclear Trade Networks

During 2004, an extensive covert supply network of sensitive nuclear technology was revealed in connection with Iran's undeclared nuclear activities and Libya's clandestine nuclear weapons programme. The Board of Governors asked the Agency to evaluate further the activities resulting from these revelations, with a view to improving the detection of undeclared nuclear activities in breach of international commitments.

In response, the Secretariat established a new unit focused on documenting, investigating and analysing nuclear trade activities worldwide. The overall aim of this effort is to reveal covert nuclear trade networks that could indicate the existence of undeclared nuclear material and activities.

These activities complement other Agency activities in connection with safeguards, such as its analysis of open source information. The Agency's effectiveness and efficiency can be further enhanced with Member States' support, for example through their making available relevant information on denials of exports and on attempts to procure sensitive nuclear technology.

Additional Initiatives Supporting the Nuclear Non-Proliferation Regime

Illicit Trafficking

In 2004, the Agency continued to receive reports from Member States on events involving trafficking in nuclear and other radioactive material. The number of reported events involving nuclear material increased in 2004. One case of trafficking involved approximately 170 grams of HEU. None involved plutonium other than in trace amounts. Further information on the Agency's work in the area of illicit trafficking can be found in the 'Nuclear Security' chapter of this report.

It is important for Member States to promptly and fully inform the Agency of any case of trafficking involving nuclear material, to facilitate sampling of the seized material for forensic analysis and to provide all relevant information that could help the Agency in its analysis of trafficking routes and potential users.

International Project on Innovative Nuclear Reactors and Fuel Cycles

Determining the proliferation resistance of future nuclear systems continued to be an important component of the Agency's International Project on Innovative Reactors and Fuel Cycles (INPRO). In addition to their work with INPRO, Agency experts continued to participate in the Proliferation Resistance and Physical Protection Evaluation Methodology Expert Group of the Generation IV International Forum (GIF). Proliferation resistance has become an important area of collaboration between INPRO and GIF, and further developments in this area are expected in 2005. (The Agency's work in the area of innovative nuclear reactors is discussed in greater detail in the Nuclear Power chapter of this report.) ■