SECURITY OF RADIOACTIVE SOURCES
THE EVOLVING NEW INTERNATIONAL DIMENSIONS

BY ABEL J. GONZALEZ

Security of radioactive sources has become an issue of serious public concern after the devastating terrorist attacks of 11 September 2001. Yet it is worth asking how serious the the problem actually is, given the fact that hundreds of dangerous chemicals and biological agents pose perhaps greater terrorist threats that need to be urgently reduced.

Radioactive sources do not contain the type of nuclear materials that would allow someone to build a nuclear bomb and trigger a major catastrophe. Though radioactive sources can be potentially dangerous for anyone coming into close contact with them, they are safely used in everyday life for medical care and treatment, among other applications in fields of industry, agriculture, and science.

However, there is increasing apprehension that radioactive sources could be turned into a terrorist tool — what the media call a "dirty bomb". This term is used to describe a radioactive source shrouded by a conventional explosive (similar to TNT), obviously built with malevolent intent. If detonated in a public domain, this mélange could cause widespread dissemination of radioactive particles and for this reason it also is known as a radiological dispersal device, or RDD. Such a weapon would not create a nuclear explosion with its dreaded mushroom cloud producing calcinating heat, devastating shock waves and vast amounts of radioactive fallout.

Although there have been unfounded suggestions that a dirty bomb explosion would kill thousands and render entire cities uninhabitable, these scenarios of devastation are highly exaggerated. If such an attack actually occurred, the device would probably scatter radioactive material over a small area, restricting contamination to possibly a few city blocks. Casualties affected by the radiation would be limited, and the perpetrators likely would be harmed by direct radiation exposure from manipulating the source.

However, even if an RDD would not injure many people, it could certainly cause much terror and psychological distress. The media recently stated that "in the wrong hands, even a relatively small amount of radioactive material can cause the kind of low-grade terror seen in the spate of anthrax-laced mail sent to US government and media offices". Moreover, they reported that "terror, indeed, appears to be a dirty bomb's greatest attraction: the image of moon-suited cleaning crews with Geiger counters in a big city downtown is bound to cause panic."

The "dirty bomb"scenario is certainly not unique in the menu of nuclear terror. Nuclear installations with large radioactivity inventories, such as nuclear power plants and radioactive waste depositories, can be attacked and their radioactive materials dispersed. In the worst nightmare scenario, a nuclear weapon can fall into terrorist hands, and the detonation of a nuclear device with even a small nuclear yield in a major metropolitan area is sure to have devastating effects.

The odds of a radiological dispersal device falling into malevolent hands have triggered particular public anxiety, perhaps because the likelihood is perceived to be higher. Fears have been largely augmented by the aftermath trauma caused by the New York and Washington attacks. Not surprisingly, security of radioactive sources has been placed high on the international agenda.

The need for securing radioactive sources is not new. Security has always been required for preventing

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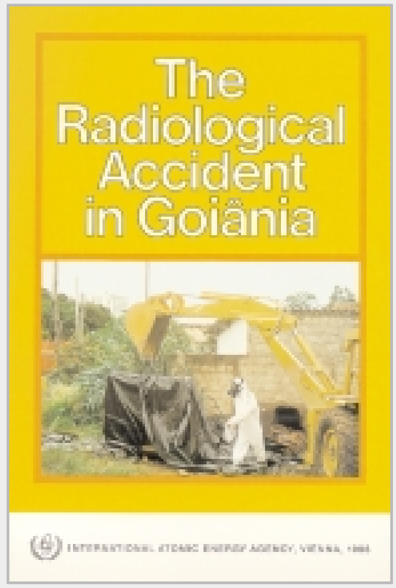
CLARIFYING ISSUES & TERMS



Safety & Security. Public apprehension generated by the new security dimension runs parallel with (and is perhaps enhanced by) confusion over technical terms and issues, often exacerbated by translation. The IAEA has long recognized this problem and comprehensively reported on it.*

Safety and security — "sûreté and sécurité" — are two distinct terms in English and French; in many other major languages, a common word is used for these two concepts. Not surprisingly, therefore, many people wonder what the distinction is between safety and security. If they reached for their dictionaries, they would perhaps be none the wiser, because one of the definition of security is safety and vice versa. In the context of *radiation sources*, both words are used to denote a combination of administrative, technical and managerial features for two different purposes that can occasionally coincide but may also clash.

- *Safety of radiation sources* is used to cover features that diminish the likelihood of accidents with a source, as a result of which people may be injured, as well as to cover those that may mitigate the consequences of such mishaps.
- *Security of radiation sources* refers to the features that prevent any unauthorized possession of the source and, as a result, any non-permitted action with it. Security is achieved by ensuring that control of the source is not relinquished and improperly acquired.

Radiation & Radioactive Sources. Frequently, the terms radiation and radioactive are interchangeably misused to qualify a source. This misrepresentation has also been a cause of confusion. Some devices can be sources of radiation without necessarily being "radioactive".

- Typical *non-radioactive radiation sources* are various types of electrical generators of radiation, such as X-ray machines and particle accelerators, which emit radiation while in operation but whose emitting properties cease as soon as the electricity supply is cut.
- Conversely, *radioactive radiation sources* (or radioactive sources for short) contain radioactive materials, namely substances formed by radioactive elements emitting radiation themselves (the so-called radioactive elements). Typical examples of radioactive sources are the sealed capsules containing radioactive elements such as cobalt-60 and caesium-137, which are widely used in radiological medicine and industry. A radioactive source never ceases to emit radiation but the radiation intensity decays over time depending on the type of radioactive elements in the source. The term *half-life* is used to indicate the period in which the radioactivity decreases by half due to radioactive decay. For instance, as caesium-137 has a half-life of around 30 years, a radiation source of this radioactive element diminishes its intensity by half every 30 years.

Security of Radioactive Sources: Clarifying Aims. Security of radioactive sources aims to ensure that control of radioactive materials is not relinquished and improperly acquired, therefore preventing such materials from going astray and causing harm to people and the environment or from being diverted for malevolent acts such as terrorism. While safety is of relevance to all types of radiation sources, either non-radioactive or radioactive, security is usually limited to radioactive sources alone.

Sometimes safety and security oppose each other: for instance, the clear marking of radioactive sources is imposed on safety grounds, but it makes radioactive sources more vulnerable to security breaches. The dichotomy has become evident in discussions of the controversial issue of transporting radioactive sources by sea: while many coastal States request that comprehensive information on sources being transported near their shores must be provided by transporter States because of *safety*, the latter prefer to keep information restricted for reasons of *security.*

**See Vol. 41, No. 3, which covers issues of radiation safety and security, accessible on the IAEA's WorldAtom site at http://www.iaea.org/worldatom/Periodicals/Bulletin.*

radioactive materials going astray, and, as a result, causing harm to people. Security of radioactive sources has always been an important component of the IAEA radiation safety programme. In mid-1999, the *IAEA Bulletin (Vol. 41, No.3)* covered it extensively in an edition, focusing on the IAEA response to key problems.

Today, in the face of the new challenges presented by the recent terrorist attacks, a new dimension of security emerges: deterring the diversion of radioactive materials from legal to illegal and criminal uses – such as terrorist violence. The IAEA is adjusting its response to this new and remarkable reality. In September 2001, as the US terror drama was evolving, the IAEA General Conference requested a review of IAEA work in the area, and in December an initial report from the IAEA Director General was discussed by the IAEA Board of Governors. Security of radioactive sources was one of the report's topics. *(See the Insert in this edition.)*

REASONS TO BE CONCERNED?

Security of radioactive sources is not a simple issue: the world has abundant radioactive sources; their security is not homogen-eously stringent around the world and a number of sources are outside any governmental regulatory control. As a result, radioa-ctive sources may be more likely to land in the wrong hands than, for instance, the nuclear materials used in the production of nuclear weapons or the civilian nuclear installations used for nuclear power production. Nuclear materials, devices and facilities are both scarcer and better secured than radioactive sources.

Abundance of Radioactive Sources. Radioactive sources are extensively and commonly used in a wide range of medical, industrial, agricultural and research applications. They vary widely in physical size and properties, their amount of radioactivity, and ease of access. The radioactivity of a source is measured in units termed becquerel (abbreviated Bq). Years ago the unit termed curie (Ci) was widely employed and is still used. One becquerel is a tiny amount of radio-activity. One curie, which is equivalent to the radioactivity of 1 gram of the radioactive element radium, is equivalent to 37 billion becquerel.

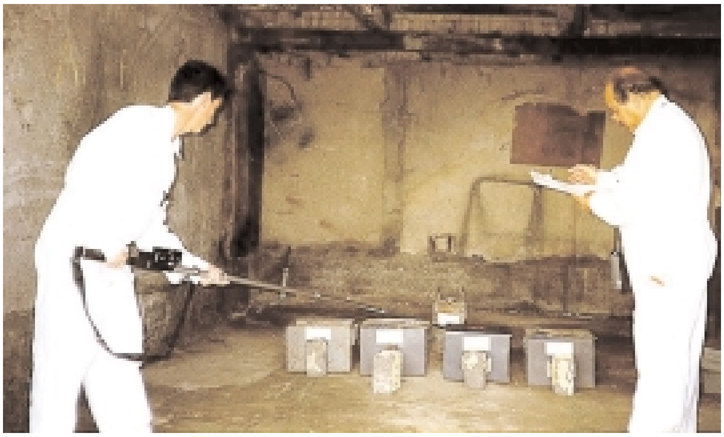
Medical Sources. In medicine, radiation sources are used for both diagnostic and therapeutic purposes. Radio-diagnostic techniques commonly employ non-radioactive radiation sources — usually X-ray machines — which do not present an evident security threat. When radioactive sources are used for diagnostic purposes — notably in nuclear medicine procedures — the amount of radioactivity used is small and again does not present an evident security threat.

Conversely, in radiotherapy, radioactive sources containing large amounts of radioactive materials are common. There are two main radiotherapeutic techniques, namely: the irradiation of tumors either with a radiation beam external to the body (usually termed teletheraphy), or placing the radiation source in contact with tissue (a technique usually called brachytherapy, which comprises the interstitial intracavitary, intraluminal, and superficial applications of sources). Teletherapy can also be performed with "accelerators", a non-radioactive radiation source which, as the X-ray machines, do not present an evident security threat.

Many medical sources are mainly made from the radioactive element termed cobalt-60, which is a metal and has a half-life of around 5 years. Less frequently, the radioactive element caesium-137, with a half-life of around 30 years, is employed. Many caesium sources were manufactured using the compound caesium chlorine (CsCl), a salt whose physical form is a highly dispersible powder similar to talc in its spreading properties.

More than 10,000 teletherapy sources containing a capsule of cobalt-60 are in use worldwide. Each source has a radioactivity of around one or several hundred trillion becquerel, or 10^{14} becquerel, which is equivalent to around 2000 curie. Cobalt, being a solid metal, is not easy to disperse. However, the capsules usually contain around 1000 pellets, each pellet having a radioactive content of around 10^{11} becquerel or several curie.

The available information on external beam therapy sources containing the radioactive element caesium-137 is scarcer. These sources were used when this type of therapy first started but their use was abandoned in favour of cobalt-60. The number of sources still in service (or awaiting disposal or return to suppliers) is estimated



to be low. The amount of radioactivity of each source is similar to the cobalt-60 sources, i.e. around 10^{14} becquerel. From the standpoint of security, the difference, however, is the high dispersibility of the caesium compound, which makes them particularly tailored to any malevolent intent to contaminate a public environment.

Brachytherapy sources are more abundant than teletherapy sources but their individual radioactivity is orders of magnitude lower. The technique is commonly performed manually with sources of radium-226, caesium-137, and iridium-192, with a radioactivity content of around 10^8 to 10^{11} becquerel per source, and sometimes using the method known as remote after-loading.

Industrial Sources. Many more radioactive sources are used in industry through applications such as irradiation of products, radiography, and gauges. There is a large number of industrial irradiators around the world. These are huge installations containing large amounts of radioactivity; they are usually employed for sterilizing medical products, such as syringes, and for preserving food. Their number approaches around 300 major facilities worldwide. Their radioactivity content is so high that it is cumbersome to express it in becquerel; they range from 10,000 to 1 million curie per facility — or a million billion becquerel. In addition, there are a few thousand smaller self-contained units, each with a radioactivity of around a hundred trillion becquerel, or a few thousand curie.

The radioactive element used in industrial irradiators is mainly metallic cobalt-60, with numerous "rods" containing thousands of pellets of cobalt-60 composing the source, but some facilities are still equipped with sources of caesium-137. The radioactive sources of industrial irradiators could pose a serious security hazard; but they are not easy to steal, as thieves would probably die almost instantaneously from overexposure.

Numerous radioactive sources are used for purposes of industrial radiography, the number estimated at several tens of thousands. About 80% of the sources contain the radioactive element iridium-192; the remainder are sources of cobalt-60, selenium-75 and ytterbium-169. The typical activity is around 50 to 100 curies each or around three trillion becquerel. Their physical form is usually encapsulated metal, which makes them robust to desegregation. While these sources are therefore unlikely to pose a serious contamination hazard, they can produce significant injuries to individuals in contact with the source. It is relatively easy to steal an industrial radiography source, but difficult to accumulate a larger number as they are usually stored at different industrial locations. Currently, around 10,000 iridium-192 industrial radiography sources are supplied annually and replaced approximately every half a year. Their activity is around 1 to 300 curies, but typically 50 or 100 curies. Their physical form is a metal pellet. The supply of cobalt-60 sources is a few hundred per year with more than a thousand in circulation. Their activity is between 10 to 500 curies, but mostly 100 curies. In addition, around 1000 sources of selenium-75 and ytterbium-169 are supplied annually; their activity range is about 10 to 30 curies.

Finally, millions of sources having a relatively low radioactive content are used as industrial gauges and in other

Photo: The IAEA has responded to a number of incidents involving radioactive sources that have endangered people and the environment because of breaches in safety and security. More needs to be done to assist countries to upgrade their radiation safety and security capabilities.

applications. They usually contain cobalt-60, caesium-137, or americium-241, come in many physical forms and their regulatory control is particularly gentle in many countries. They pose a minor risk, but could lead to small-scale but easily measurable contamination.

Orphan Sources. Competent governmental regulatory authorities around the world exercise control over the vast majority of radioactive sources. The authorities usually subject the sources to a system of registration, licensing, authorization and regular inspection. However, as the sources reach the end of their expected working lives, they are no longer needed and sometimes they are discarded by relinquishing their control. Thus, radiation sources may become "orphaned" of any control. The term "orphan" sources refers to sources that may never have been subjected to regulatory control or, initially regulated, but then eventually abandoned, lost or misplaced, stolen or removed without authorization.

Hundreds of industrial and medical radioactive sources are abandoned, lost or stolen worldwide each year. It is not clear how many orphan sources are in the world and their location is largely unknown.

There have been reports of incidents involving orphan sources in the new States resulting from the dissolution of the USSR. A notable case refers to thermoelectric generators containing huge amounts of the radioactive element strontium-90 (the amount of radioactivity per source is similar to the release of this radioactive element from the Chernobyl accident). In the Republic of Georgia a number of such devices were found to have gone astray and it appears that a number of them were manufactured by the former USSR and placed in some of the now independent States. A serious accident involving orphan sources, apparently from military origin, in Lilo, again in Georgia, was recently reviewed and reported by the IAEA.

Light Security. Often, no tight security measures are applied to radioactive sources. Traditionally the security aim has been confined to prevent accidental access to the sources or petty theft (such as stolen shielding materials). In particular, sophisticated anti-terrorist security measures for radioactive sources are not currently in place. In fact, even well regulated radioactive sources could be stolen and diverted with relative ease, as is the case for most chemical or biological substances. Potentially the control of regulated sources can be simply relinquished by the user and, as a result, they could be easily taken away. Obviously, orphan sources are even easier to divert.

Both non-controlled regulated sources and orphan sources are prone to fall in malevolent hands. An embezzled source can be transferred without difficulty. It can be easily concealed in a truck, can fit into a suitcase and be easily removed, particularly if the perpetrator is willing to disregard his or her personal safety. By shrouding a radioactive source with explosives, and detonating it in an appropriate manner, radioactive contamination could be spread in the environment, and public terror easily created.

Mainly Petty Theft, Rarely Malevolence. It is to be noted, however, that the theft of sources has not traditionally come from malevolent criminal intent. Rather, the sources were stolen more for economic benefit or simply out of curiosity or ignorance. In fact there is no record of a radioactive source being stolen for sabotage or terrorist activities — except for a number of reported cases related to the Republic of Chechnya in the Russian Federation. (According to Russian press reports, six years ago, Chechens used a canister containing the radioactive element caesium to scare shoppers in a Moscow marketplace and, in 1998, officials in the Republic defused a booby-trapped explosive attached to a container of radioactive material).

Benchmarking Possible Consequences. Serious radiological consequences from non-criminal security breaches with radioactive sources have already occurred. These cases, many of which have been reviewed and reported by the IAEA, could be used as benchmark for estimating the consequences of terrorist use.

For instance, around a decade ago, in the large city of Goiânia in Brazil, a security breach occurred leading to a radiological accident that can be considered as a yardstick for what could happen in a terrorist act involving a radioactive source. A private radiotherapy institute moved to new premises and left in place a caesium-137 teletherapy unit without notifying the licensing authority. The former premises were subsequently partly demolished and the caesium-137 source became insecure. Two scavengers entered the premises and, not knowing what the unit was but thinking it might have scrap value, removed the source assembly from the radiation head of the machine. This they took home and tried to dismantle. In the attempt the source capsule was ruptured. Contamination of the environment ensued. As result of this event, 14 people were overexposed and four died within four weeks. Around 112,000 people had to be monitored and 249 were found contaminated. Hundreds of houses had to be monitored, 85 were found to be contaminated and hundreds of people had to be evacuated. The full operation of decontamination produced 5000 m^3 of radioactive waste. The social impact was such that an outlying village to Goiânia, where the waste repository was installed, has incorporated the three-foil symbol of radioactivity into the village flag.

This was not the only case of security breaches intensively studied and reported by the IAEA. For instance, in the Estonian village of Tammiku, in 1995, five people in one home were affected after someone found a tiny radioactive metal fragment in a nearby field and put it in a kitchen drawer. The fragment, whose origins are unknown, exposed the family to high radiation levels over several weeks. In another example, in Samut Prakarn, Thailand, in 2000, a group of scrap dealers cut through the shiny metal innards of a stolen cancer treatment machine and removed the cobalt-60 radioactive source. Three of the dealers died and eleven others suffered severe radiation. Investigators found two more stolen cancer treatment machines awaiting the scrap dealers in a suburban Bangkok parking lot.

Authorities and the media have reported on other similar events. Last year, an Egyptian farmer and his young son died from radiation exposure after taking home a cylindrical source left behind in their village by a construction crew. Five other family members were hospitalized with skin eruptions, and some of their neighbors fell ill. The tiny metal cylinder, containing radioactive iridium, came from a radiography source commonly used to screen welded pipes. In Algeciras, Spain, a few years ago, an orphan radioactive source of unknown origin mixed with metal scrap landed in a foundry and was melted down. The incident, which contaminated the premises and involved mild releases of radioactive materials into the environment, prompted a general enhancement of control by the Spanish authorities.

BUILDING ON THE IAEA RESPONSE

Strengthening the security of radioactive sources is not a new challenge for the IAEA. The "UN nuclear watchdog", as the media have labeled the IAEA, has an international mandate in the protection of health against exposure to ionizing radiation, and such exposure may be caused by breaches in the security of radioactive sources. The IAEA is authorized by its Statute to establish pertinent international standards and to provide for their application at the request of a State. Jointly with other specialized agencies within the UN system, it has set up international radiation protection and safety standards that include requirements for the security of radioactive sources. These are the so-called *International Basic Safety Standards for Protection against Ionizing Radiation and the Safety of Radiation Sources*, or BSS in short, which since 1992 require *inter alia* that radioactive sources shall "be kept secure so as to prevent theft or damage…by ensuring that…control of a source not be relinquished…"

In order to provide for the application of these international standards, the IAEA uses a variety of mechanisms — including the performance of peer-review appraisals of the safety and security situation in a requesting State, the provision of technical cooperation and education and training, and the fostering of information exchange. The IAEA has also a mandate in the implementation of relevant obligations undertaken by States through international "conventions", notably the conventions of notification of radiological emergencies and of emergency assistance that are applicable should a crisis involving a dirty bomb occur.

The Dijon Conference and the International Action Plan. While the IAEA security standards can be traced back to 1992, it was not until 1998 that governments became fully aware of the international dimensions of the security threat associated with radioactive sources. In that year, the IAEA jointly with Interpol, the World Custom Organization, and the European Commission organized the first international Conference on the issue, in Dijon, France. In the Dijon Conference, hundreds of specialists and governmental representatives from member States of these organizations discussed the problem for the first time and produced concrete recommendations.

Following suit, the IAEA General Conference decided to implement an international Action Plan that included measures to strengthen the global security of radioactive sources. Among other relevant actions already completed, the sources deemed to be a security threat were generically identified and classified, and a non-binding "Code of Conduct" for States has been adopted and published by the IAEA.

The Buenos Aires Conference: Concerns of the National Controllers. More recently, in December 2000, another topical international conference, this time assembling national authorities regulating the security of radioactive sources, was convened by the IAEA in Buenos Aires, Argentina.* The Conference recommended updating and strengthening of the Action Plan.

At its March 2001 session, the IAEA Board of Governors was informed about the major findings of the Buenos Aires Conference, and welcomed the fact that the Conference had achieved its purpose of facilitating a broad exchange of information among national authorities. The Board noted its major findings and requested the Secretariat to assess their implications for the Action Plan, to implement any adjustments to the Action Plan that might become necessary in light of those major findings and of comments by Member States. It further requested the Secretariat to inform the Board and the General Conference of any such adjustments.

The IAEA Board of Governors and the General Conference approved a revised Action Plan at their meetings in September 2001... just at the same time when the terrorist attacks on New York and Washington took place.

Assisting the Developing World. Even the smaller and less developed countries make use of radioactive sources. It is to be expected that where resources are scarce, the tight control of radioactive sources is not a high priority. The IAEA has been responsive to this situation and, some years ago, launched a technical co-operation project (as an IAEA Model Project) aimed at strengthening national regulatory infrastructures in developing Member States, and thus enhancing the security of their radioactive sources.

The Model Project was launched in 1995 and 52 developing countries have participated from the outset. One of the project's milestones refers to the strengthening of regulatory infrastructures, which when reached would obviously enhance the security of radioactive sources.

By September 2001, the status of implementation of these milestones is as follows:

- About 7% of the participating countries had promulgated related laws and established a regulatory authority; more than 42% had adopted regulations; about 80% of them had established an inventory system of the radioactive sources under their jurisdiction; and
- About 50% had a system for the notification, authorization and control of radioactive sources.

The assessment of the effectiveness of the programme has been carried out by peer review teams that went to 32 countries. The reasons why many countries have not yet

**The International Conference of National Regulatory Authorities with competence in the Safety of Radiation Sources and the Security of Radioactive Materials was organized by the IAEA in cooperation with Argentina's Nuclear Regulatory Authority, and hosted by the Government of Argentina in Buenos Aires in December 20002. It was attended by 89 representatives of regulatory bodies in Angola, Argentina, Australia, Bolivia, Brazil, Canada, Chile, China, Costa Rica, Croatia, Cuba, the Czech Republic, the Dominican Republic, Ecuador, Estonia, Ethiopia, France, Georgia, Germany, Ghana, Hungary, India, Indonesia, Iraq, Ireland, Italy, Japan, Jordan, the Republic of Korea, Latvia, Madagascar, Mongolia, Namibia, Norway, pakistan, Panama, Peru, Philippines, Portugal, Romania, the Russian Federatin, Slovakia, Slovenia, Spain, Sudan, Sweden, the Syrian Arab Republic, the Former Yugoslav Republic of Macedonia, Turkey, Uganda, Ukraine, the United Kingdom, the United Republic of Tanzania, the United Statees, Viet Nam, Yemen, and Yugoslavia.*

COUNTRIES IN THE IAEA MODEL PROJECT ON UPGRADING RADIATION PROTECTION INFRASTRUCTURE

AFRICA
Cameroon
Côte d'Ivoire
Democratic Republic of the Congo
Ethiopia
Gabon
Ghana
Madagascar
Mali
Mauritius
Namibia
Niger
Nigeria
Senegal
Sierra Leone
Sudan
Uganda
Zimbabwe

LATIN AMERICA
Bolivia
Colombia
Costa Rica
Dominican Republic
El Salvador
Guatemala
Jamaica
Nicaragua
Panama
Paraguay

EUROPE
Albania
Armenia
Belarus
Bosnia and Herzegovina
Cyprus
Estonia
Georgia
Latvia
Lithuania
Republic of Moldova
The Former Yugoslav Republic of Macedonia

EAST ASIA
Jordan
Kazakhstan
Lebanon
Qatar
Saudi Arabia
Syrian Arab Republic
United Arab Emirates
Uzbekistan
Yemen

WEST ASIA
Bangladesh
Mongolia
Myanmar
Sri Lanka
Viet Nam

Notes: Since 11 September 2001, another 29 countries have made requests to the IAEA to join the Model Project. In Africa, they are Angola, Burkina Faso, Egypt, Kenya, the Libyan Arab Jamahiriya, Morocco, Tunisia and the United Republic of Tanzania; in East Asia, China, Indonesia, Malaysia, Pakistan, the Philippines, Singapore and Thailand; in West Asia, the Islamic Republic of Iran and Kuwait; in Europe, Bulgaria, Croatia, Hungary, Malta, Portugal, Romania, Slovenia and Turkey; in Latin America, Ecuador, Haiti, Uruguay and Venezuela.

attained the targets of these milestones include: time-consuming legislative procedures; institutional instability; budgetary constraints; overlapping responsibilities; limited regulatory independence and empowerment; inadequate implementation; and insufficient financial and technical resources, trained staff and support services.

Thus, in spite of the fact that substantial progress has been made in upgrading the infrastructures of control in participating countries, it is obvious that the development of a mature infrastructure requires years of effective national effort with continuous government commitment. By the end of September 2001, the IAEA had received a request from another 29 countries to join the Model Project. *(See box.)*

It is to be noted, however, that IAEA assistance can only be rendered to those developing countries that are Member States of the IAEA. Around 50 countries of the UN membership are not IAEA members. In addition, there are a number of political entities that do not even have UN membership. In all of these territories, radioactive sources are being used and they do not receive IAEA assistance. It is suspected that in many of them the control of radioactive sources does not exist; perhaps the local authorities are not even aware that they have a problem to attend.

The vocation of the developing world to tackle this problem is clear. For instance, the issue was debated in April 2001, during the First Africa Workshop on the Establishment of a Legal Framework governing Radiation Protection, the Safety of Radiation Sources and the Safe Management of Radioactive Waste, which was organized by the IAEA, held in Addis Ababa, Ethiopia, and attended by 35 participants from 14 Member States (Angola, Egypt, Ethiopia, Ghana, Kenya, Libya, Mauritius, Namibia, Nigeria, Sudan, Tanzania, Uganda, Zambia, and Zimbabwe).

The Workshop adopted a "Common Position on the Establishment of a Legal Framework governing Radiation Protection, the Safety of Radiation Sources and the Safe Management of Radioactive Waste" (the Common Position). In the Common Position, the participants *"recogniz[ed] that most African countries lack the capacity for the environmentally sound disposal of sources that have outlived their useful life"* and *"not[ed]… that manufacturers of radioactive sources should be required to return sources to the country of manufacture and that exporting States should be responsible for ensuring that manufacturers duly carry out their duties of reshipment and disposal of sources that have outlived their useful life"*. The participants also *"not[ed] the need for the adoption and implementation of an internationally legally binding instrument setting out appropriate rules and procedures regarding the return of sources that have outlived their useful life in importing African countries"*. *In addition, the participants called upon the IAEA to "create a forum for African countries to consider the Code of Conduct on the Safety and Security of Radioactive Materials and give it a legally binding effect so that the safe and peaceful use of nuclear technology is not compromised"*.

Maintaining the Strategy; Widening the Scope. The overall IAEA strategy in the security of radioactive sources can be briefly formulated as follows: assisting Member States to create and strengthen national regulatory infrastructures in order to ensure that significant radioactive sources are localized, registered, secured and controlled from "cradle to grave".

While this strategy is immutable, its application has to be adapted to the new security dimension. Before it was targeted to breaches in security caused by innocent mistakes or petty theft. Today, the scope is being widened to include malevolence and terrorism. Moreover, following the recent attacks, three new elements, associated with seemingly new characteristics of potential perpetrators, must be particularly taken into account, namely:

- intent to cause widespread panic and harm among civilian populations;
- ability to work with modern technologies; and
- a suicidal approach.

OUTLOOK FOR BETTER SECURITY

A number of new initiatives are being considered by the IAEA Secretariat and the IAEA Board of Governors.

On 30 November 2001, IAEA Director General submitted a report on "Protection Against Nuclear Terrorism" to the IAEA Board of Governors. The Board is considering a set of measures related to upgrading the security of nuclear material, radioactive material, and nuclear facilities. The proposed measures, as they are being developed, would substantially expand and strengthen IAEA programmes for the physical protection of nuclear material and facilities, and for the security of radioactive sources and material.

The Report notes that while the IAEA has developed important international standards for radiation protection, these contain general, but no detailed, requirements on the security of radiation sources. It further notes that the main threat associated with radioactive material, such as sources and radioactive waste, lies in deliberately exposing individuals to radiation or the dispersion of the material, with consequent harmful effects to people, property, and the environment. While the consequences of this threat may be limited in comparison with threats related to other types of nuclear security risks, the likelihood may be somewhat greater. This is because the security of radioactive sources is lax in some States — keyed more to the protection of property than to radiological risk. As a consequence, an undetermined number of sources have become "orphaned" from regulatory control, and their location is unknown.

To increase the protection of radiation sources, the IAEA proposes a number of measures to strengthen regulatory control and to update its standards and expanding programmes in respect to terrorism threats.

The proposals include:

- introducing a peer review service to appraise State regulatory infrastructures for the security of radioactive sources, including protection during transport;
- examining the feasibility of helping States to locate large orphan sources to bring them under regulatory control;

- reviewing and eventually revising the *Code of Conduct on the Safety and Security of Radioactive Sources* to make it more comprehensive in relation to security and to determine how compliance might be monitored;
- reviewing the requirements on the security of radioactive sources contained in the *International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radioactive Sources* on and updating other relevant documents;
- exploring the practicability of an international marking system for large significant sources and of establishing a norm for a more secure physical form for such sources;
- assessing the threats, and possible actions, relating to malicious acts involving radioactive waste.

In addition to these proposals, the IAEA Secretariat has initiated and the Board is considering measures for improving the security of nuclear material that would be applicable to the security of radioactive sources and material. These measures are aimed at increasing the capabilities of States to detect and respond to theft, illicit trafficking, and other malicious acts or threatened use of such material. *(See the article, page 12, and the Insert to this edition.)*

The Report to the Board also covers improved emergency response capabilities. The IAEA has the only international response system in position to immediately react and assist countries in the event of a radiological emergency caused by a nuclear terrorist threat. The IAEA, among other steps, proposes to upgrade its Emergency Response Centre to improve the speed, efficiency, reliability and quality of the response in case of a large radiological emergency. Its Emergency Preparedness Review Service also can provide thorough appraisals of national emergency response programmes, as well as training to increase a State's capability to respond effectively to the possible consequences of a radiological emergency.

The Report also proposes to set up international response standby teams that could be promptly dispatched to States needing urgent assistance.

The Board next meets on the Agency's ongoing efforts to reinforce its security programmes in March 2002.

Like other aspects of nuclear security, upgrading the security of radioactive sources requires a global response. In addition to national measures, there is an indispensable need for international measures to ensure that security is effective worldwide. The International Atomic Energy Agency can contribute in many areas to establish and ensure the application of international norms and standards, provide international forums for information exchange, identify deficiencies and propose strategies to resolve them, and coordinate bilateral and international support to States in need of assistance.

As IAEA Director General ElBaradei emphasized in his statement to the Board in November 2001, nuclear security is only as good as its weakest link, and effective and stringent standards must be globally applied, and security upgrades must be measured against such standards:

"Traditional thinking — that nuclear security is exclusively a national responsibility — must yield to the reality that a combination of national and international measures is fundamental to an effective nuclear security regime. In my view, the time has come to adopt a new approach to the whole question of nuclear security. Just as we have developed an effective regime to counter the possible diversion of nuclear materials by States, we need an equally effective regime to counter possible acts of theft and violence involving nuclear facilities, nuclear material and other radioactive sources — a regime with internationally agreed standards for security and appropriate mechanisms which, while taking account of the need for confidentiality, also ensure effective implementation. This approach will require the sustained support of all — but equally will be of benefit to all."

A monumental security agenda lies ahead for national governments and the Agency. Concerning the security of radioactive sources, one of the main challenges will be to address the problem squarely and effectively, weighing its importance relative to the potential range and scale of all types of threats posed by terrorists, including the possible use of chemical or biological agents as tools of terror and destruction. ❒