United States General Accounting Office

GAO

Report to the Ranking Minority Member, Subcommittee on Financial Management, the Budget, and International Security, Committee on Governmental Affairs, U.S. Senate

May 2003

NUCLEAR NONPROLIFERATION

U.S. and International Assistance Efforts to Control Sealed Radioactive Sources Need Strengthening

GAO
Accountability ⋆ Integrity ⋆ Reliability

GAO-03-638

May 2003

NUCLEAR NONPROLIFERATION

U.S. and International Assistance Efforts to Control Sealed Radioactive Sources Need Strengthening

GAO Accountability•Integrity•Reliability

Highlights

Highlights of GAO-03-638, a report to the Ranking Minority Member, Subcommittee on Financial Management, the Budget, and International Security, Committee on Governmental Affairs, U.S. Senate

Why GAO Did This Study

Sealed radioactive sources, radioactive material encapsulated in stainless steel or other metal, are used worldwide in medicine, industry, and research. These sealed sources pose a threat to national security because terrorists could use them to make "dirty bombs." GAO was asked to determine (1) the number of sealed sources worldwide and how many have been reported lost, stolen, or abandoned; (2) the controls, both legislative and regulatory, used by countries that possess sealed sources; and (3) the assistance provided by the Department of Energy (DOE) and other U.S. federal agencies to strengthen other countries' control over sealed sources and the extent to which these efforts are believed to be effectively implemented.

What GAO Recommends

GAO recommends that the Secretary of Energy (1) develop a comprehensive plan for DOE to guide its future efforts, (2) take the lead in developing a governmentwide plan to strengthen controls over other countries' sealed sources; and (3) strengthen efforts to increase program expenditures in the countries requiring assistance.

DOE agreed with our recommendations to strengthen the program but believes it has fully coordinated with other federal agencies. DOE's contention is contrary to other agencies' views.

www.gao.gov/cgi-bin/getrpt?GAO-03-638.

To view the full report, including the scope and methodology, click on the link above. For more information, contact Gene Aloise at (202) 512-3841 or aloisee@gao.gov.

What GAO Found

The precise number of sealed sources in use is unknown because many countries do not systematically account for them. However, nearly 10 million sealed sources exist in the United States and the 49 countries responding to a GAO survey. There is also limited information about the number of sealed sources that have been lost, stolen, or abandoned, but it is estimated to be in the thousands worldwide. Many of the most vulnerable sealed sources that could pose a security risk are located in the countries of the former Soviet Union.

All of the 49 countries that responded to GAO's survey reported that they have established legislative or regulatory controls over sealed sources. However, nuclear safety and security experts from DOE, the Departments of State and Defense, the Nuclear Regulatory Commission (NRC), the International Atomic Energy Agency, and the European Commission told GAO that countries' controls over sealed sources vary greatly and are weakest among less developed countries.

In fiscal year 2002, DOE established a program focusing on improving the security of sealed sources in the former Soviet Union and has started to fund security upgrades in Russia and other former Soviet countries. The Departments of Defense and State and NRC also have programs to help countries strengthen controls over sealed sources. DOE plans to expand its program to other countries and regions in 2003 and is developing a plan to guide its efforts. However, the department has not fully coordinated its efforts with NRC and the Department of State to ensure that a governmentwide strategy is established. In addition, as of January 2003, the majority of DOE's program expenditures totaling $8.9 million were spent by DOE's national laboratories in the United States.

Abandoned Electrical Generators Containing Large Amounts of Radioactive Strontium-90 in a Former Soviet Union Country

Source: International Atomic Energy Agency.

Contents

Tables

Figures

Abbreviations

DOD	Department of Defense
DOE	Department of Energy
GAO	General Accounting Office
IAEA	International Atomic Energy Agency
MINATOM	Russian Ministry of Atomic Energy
NRC	Nuclear Regulatory Commission
USAID	U.S. Agency for International Development

United States General Accounting Office
Washington, D.C. 20548

May 16, 2003

The Honorable Daniel K. Akaka
Ranking Minority Member
Subcommittee on Financial Management,
the Budget, and International Security
Committee on Governmental Affairs
United States Senate

Dear Senator Akaka:

Since September 11, 2001, U.S. and international nuclear safety and security experts have raised concerns that terrorists could obtain radioactive material used in medicine, research, agriculture, and industry to construct a radiological dispersion device, or "dirty bomb." This radioactive material is encapsulated, or sealed, in metal, such as stainless steel, titanium, or platinum, to prevent its dispersal and is commonly called a sealed radioactive source. These sealed sources are used throughout the United States and other countries in equipment designed to, among other things, diagnose and treat illnesses, preserve food, detect flaws and other failures in pipeline welds, and determine the moisture content of soil. Depending on their use, sealed sources contain different types of radioactive material, such as strontium-90, cobalt-60, cesium-137, plutonium-238, and plutonium-239. If these sealed sources fell into the hands of terrorists, they could use them to produce a simple and crude, but potentially dangerous, weapon by packaging explosives, such as dynamite, with the radioactive material, which would be dispersed when the bomb went off. Depending on the type, amount, and form (powder or solid), the dispersed radioactive material could cause radiation sickness for people nearby and produce serious economic costs and psychological and social disruption associated with the evacuation and subsequent cleanup of the contaminated area.

Given the concerns about the security of sealed sources worldwide, you asked us to determine, to the extent possible (1) the number of sealed sources worldwide and how many are reported lost, stolen, or abandoned; (2) the controls, both legislative and regulatory, used by countries that possess sealed sources; and (3) the assistance provided by the Department of Energy (DOE) and other U.S. federal agencies to strengthen other countries' control over sealed sources and the extent to which these efforts are believed to be effectively implemented. To address these objectives, we distributed a survey to 127 International Atomic Energy Agency (IAEA)[1] member states to determine, among other things, how countries control sealed sources. Appendix I presents our scope and methodology, appendix II presents the results of the survey, and appendix III contains a list of the countries we sent the survey to, including those that responded to it. We also met with or had discussions with officials from several countries to learn more about how they regulate and control sealed sources and met with officials from international organizations, such as IAEA and the European Commission,[2] to obtain their views on the problem of uncontrolled sealed sources. A forthcoming report will address controls over sealed sources in the United States. We conducted our review from May 2002 through May 2003 in accordance with generally accepted government auditing standards.

Results in Brief

The precise number of sealed sources that is in use today or that has been lost, stolen, or abandoned is unknown because many countries do not systematically account for them. Some estimates are available, however. For example, about 2 million licensed sealed sources are currently being used in the United States, according to the Nuclear Regulatory Commission (NRC), and the 49 countries that responded to our survey reported that 7.8 million sealed sources are in use. Limited information exists about the number of sealed sources that has been lost, stolen, or abandoned—commonly referred to as "orphan sources"—but it is estimated to be in the thousands worldwide. In the United States, about 250 sealed sources or

[1]Affiliated with the United Nations, IAEA's aims are to promote the peaceful use of nuclear energy and to verify that nuclear material under its supervision or control is not used to further any military purpose.

[2]As the European Union's executive body, the European Commission has three main tasks: to serve as the sole initiator of policy, to act as guardian of the European Union treaties by investigating treaty breaches, and to supervise the implementation of European Union law in the member states.

devices containing sealed sources are reported lost or stolen annually, but the majority of these sources are recovered. The countries that responded to our survey said that a total of 612 sealed sources had been reported lost or stolen since 1995, 254 of which had not been recovered. U.S. and international nuclear safety and security experts told us that the largest number of lost, stolen, or abandoned sealed sources is located in the former Soviet Union. Of particular concern are as many as 12 electrical generators that were abandoned in the Republic of Georgia. These generators are powered by high activity levels (ranging from 40,000 to 150,000 curies) of strontium-90—a destructive radioactive material. Recently, the United States and other countries—and IAEA—located and secured most of these generators believed to exist in Georgia. However, more than 1,000 additional generators that are not adequately protected and pose a significant security risk are spread throughout the former Soviet Union.

All of the countries that responded to our survey reported that they have established legislative or regulatory controls over sealed sources. However, nuclear safety and security experts from DOE, the Department of State, the Department of Defense (DOD), NRC, IAEA, and the European Commission told us that controls on radioactive sources vary greatly between countries and focus primarily on protecting public health and safety rather than on securing sealed sources from theft or destructive use. These experts also told us that controls over sealed sources are weakest among less developed countries. For example, representatives from several countries of the former Soviet Union told us that their national systems of control need improvement, particularly regarding inventorying, consolidating and securing, and transporting sealed sources. Because of concerns about many countries' inability to control radioactive materials—IAEA has estimated that as many as 110 countries worldwide do not have adequate controls over sealed sources—IAEA established a program to help 88 countries enhance their regulatory infrastructures. Although the program has helped countries improve their regulatory controls, many participating countries continue to have numerous regulatory deficiencies. In the absence of regulatory controls, radioactive sources have been inadequately protected or secured; little or no attention has been paid to the export or import controls of sources; and basic record keeping has been lacking. Finally, officials from the Department of State, the European Commission, and IAEA told us that France has implemented a system for controlling sealed sources that could serve as a model for other countries. France's system requires distributors of sealed sources to assume financial responsibility for recovering and disposing of them.

DOE and other U.S. agencies have funded programs to strengthen controls over sealed sources in other countries. DOE, which has the largest program, received about $37 million since fiscal year 2002 to initiate a program to assist other countries in controlling their sealed sources. According to DOE officials, the program is expected to receive an additional $22 million in supplemental appropriations in fiscal year 2003, including $5 million for securing nuclear material in Iraq. DOE established a program focusing on improving the security of sites containing sealed sources in the former Soviet Union because that is where DOE believed the greatest threat exists. DOE has begun funding site assessments and security upgrades at several locations in Russia, Uzbekistan, the Republic of Georgia, Moldova, and Tajikistan. In Russia, for example, DOE has focused on securing sources at several large nuclear waste repositories scattered around the country. Furthermore, the Secretary of Energy recently announced that the program will expand to other regions of the world. Other U.S. federal agencies have begun efforts to help countries strengthen controls over sealed sources as well. Since fiscal year 2001, DOD has obligated about $1.7 million to inventory, secure, and dispose of sealed sources in Kazakhstan. In fiscal year 2002, the State Department received appropriations totaling about $1.2 million primarily to support IAEA projects on the safety and security of sealed sources. Finally, the NRC received about $250,000 from the U.S. Agency for International Development (USAID) to help Armenia develop a registry of sealed sources and improve Armenia's legislative and regulatory framework for controlling sources.

DOE's initial efforts to secure sealed sources have lacked adequate planning and coordination, and the majority of the program funds were spent in the United States rather than in the countries of the former Soviet Union. DOE is in the process of developing a plan to guide its efforts. However, DOE officials told us that more detailed planning and analysis will be needed to, among other things, (1) determine which countries outside the former Soviet Union present the greatest security risk and most urgently require assistance, (2) identify future funding requirements, and (3) develop performance measures to gauge program success. In addition, Department of State and NRC officials told us that DOE has not fully coordinated its efforts with their agencies. In their view, DOE needs their input to ensure that a comprehensive governmentwide strategy is taken to, among other things, leverage program resources, maximize available expertise, avoid possible duplication of effort, and help ensure future program success. DOE has not systematically undertaken the kind of comprehensive planning that would foster better coordination with the other agencies and could also lead to better coordination with other countries' nuclear organizations. For example, officials from Russia's nuclear regulatory organization, Gosatomnadzor, told us that DOE did not adequately consult them when it initially selected sites in Russia for security improvements. Regarding DOE's effort to secure sealed sources in the former Soviet Union, as of January 31, 2003, DOE had spent about $8.9 million, including $3 million transferred to IAEA. Of the remaining $5.9 million in expenditures, 93 percent was spent in the United States by DOE's national laboratories. DOE officials told us that the program is still in its early stages and that the objective of the program is to place a significant percentage of funds in the recipient countries to improve security.

This report makes recommendations designed to improve the management of DOE's efforts to help improve controls over sealed sources. Specifically, it recommends that DOE (1) develop a comprehensive plan that identifies those countries that most urgently require assistance, establish realistic time frames and resources necessary to accomplish program goals, and establish meaningful performance measures; (2) take the lead in developing a governmentwide plan designed to, among other things, improve interagency coordination; and (3) strengthen its efforts to increase program expenditures in the countries requiring assistance.

Background

Sealed sources are used throughout the world for a variety of peaceful purposes. Until the 1950s, only naturally occurring radioactive materials, such as radium-226, were available to be used in sealed sources. Since then, sealed sources containing radioactive material produced artificially in nuclear reactors and accelerators have become widely available, including cobalt-60, strontium-90, cesium-137, and iridium-192. Radioactive material can be found in various forms. For example, cobalt-60 is a metal, while the cesium-137 in many sealed sources is in a powdery form closely resembling talc. Radioactive materials are measured by their level of activity. The greater the activity level—measured in units called curies[3]—the more radiation emitted, which increases the potential risk to public health and safety if improperly used or controlled. The intensity of radioactive

[3]The curie is a unit of measurement of radioactivity. In modern nuclear physics, it is precisely defined as the amount of substance in which 37 billion atoms per second undergo radioactive disintegration. In the international system of units, the becquerel is the preferred unit of radioactivity. One curie equals 3.7×10^{10} becquerels.

materials decays over time at various rates. The term "half-life" is used to indicate the period during which the radioactivity decreases by half as a result of decay.

Usually, radioactive material with high radioactivity is placed in a sealed container to prevent leakage of the material itself. Because of the varied characteristics of the radioactive material—physical structure (metal, ceramic, or powder), activity level, half-life, and type of radiation emitted,[4] some materials pose a greater risk to people, property, and the environment than others. According to IAEA, the level of protection provided to users of the radioactive material should be commensurate with the safety and security risks that it presents if improperly used. For example, radioactive materials used for certain diagnostic purposes have low levels of activity and do not present a significant safety or security risk. However, powerful sealed sources, such as those used in radiotherapy (cancer treatment) that use cobalt-60, cesium-137, or iridium-192, could pose a greater threat to the public and the environment and would also pose a potentially more significant security risk, particularly if acquired to produce a dirty bomb.

The small size, portability, and potential value of sealed sources make them vulnerable to misuse, improper disposal, and theft. According to IAEA, illicit trafficking in or smuggling of nuclear material, including sealed sources, has increased worldwide in recent years: IAEA reported 272 cases of illicit trafficking in these sources from 1993 to the end of 2002. (See app. IV for more information about illicit trafficking incidents.) While no dirty bombs have been detonated, in the mid-1990s Chechen separatists placed a canister containing cesium-137 in a Moscow park. Although the device was not detonated and no radioactive material was dispersed, the incident demonstrated that terrorists have the capability and willingness to use sealed sources as weapons of terror.

U.S. and international experts have noted that some accidents involving sealed sources can provide a measure of understanding of what the

[4]Radioactive material emits alpha and beta particles, gamma rays, neutrons, or a combination thereof. For example, americium-241 emits alpha particles and gamma rays; cobalt-60 emits beta particles and gamma rays; and strontium-90 emits only beta particles. Alpha particles are not a hazard outside of the body; beta particles can be more penetrating and cause radiation damage. Both, however, are generally most hazardous when ingested or inhaled. Gamma rays are an external hazard because they can easily pass through clothing and skin. Neutron particles are less common but can also cause damage.

possible impacts of a dirty bomb might be. In 1987, an accident involving a cesium-137 sealed source in Brazil killed four people, injured many more, and caused about $36 million in damages to the local economy. This accident had such an enormous psychological impact on the local population that the atomic symbol was added to the region's flag as a lasting reminder of the accident's consequences. Appendix V contains more information about worldwide accidents involving sealed sources.

The Number of Sealed Sources in Use and Lost, Stolen, or Abandoned Worldwide Is Unknown

The precise number of sealed sources that is in use worldwide is unknown because many countries do not systematically account for them. The lack of a full accounting of sealed sources makes it equally difficult to determine the number that has been lost, stolen, or abandoned—referred to as "orphan sources." Orphan sources, which are estimated to number in the thousands worldwide, are considered by U.S. and international officials to pose significant health, safety, and security risks because they are outside of regulatory control. According to U.S. and international safety and security experts, one of the most urgent problems is locating and securing orphan sources in the former Soviet Union because they pose a significant security risk.

The Number of Sealed Sources in Use Worldwide Is Unknown Because Countries Do Not Systematically Account for Them

The number of sealed sources in use worldwide is unknown, but some estimates are available. According to IAEA, millions of sealed radioactive sources have been distributed worldwide over the past 50 years. Approximately 2 million licensed sealed sources are in use in the United States, according to the NRC. In addition, according to the European Commission, approximately 500,000 sealed sources have been supplied to operators in the 15 member states of the European Union, of which about 110,000 are currently in use. The European Commission also estimated in 1999 that approximately 840,000 sealed sources exist in Russia, although Russian officials believe the total number is significantly higher.

The 49 countries that responded to our survey reported a total of about 7.8 million sealed sources that are in use within their countries. These sealed sources are used in various applications, such as industrial radiography and therapeutic medicine. Table 1 summarizes the responses received from the countries surveyed regarding the number of sealed sources in use and their major applications.

Table 1: Regional Distribution of Sealed Sources in Countries Responding to GAO's Survey on the Security of Radioactive Sealed Sources

Region	Number of sealed sources in use	Major applications
Africa	834	Smoke detectors, academic/research, and fixed gauges
Asia	18,420	Fixed gauges, analytical instruments, and academic/research
Europe	4,866,024	Smoke detectors, fixed gauges, and academic/research
Former Soviet Union	20,344	Smoke detectors, irradiation, and academic/research
Middle East	6,545	Medical-diagnostic, academic/research, and portable gauges
North America[a] and Central America	2,887,025	Smoke detectors, fixed gauges, and academic/research
South America	2,836	Smoke detectors, fixed gauges, and medical-diagnostic
South Pacific	1,854	Industrial radiography, smoke detectors, and irradiation
Total	**7,803,882**	

Source: GAO.

[a]The United States was not surveyed for this report.

Several factors contribute to the lack of comprehensive information about the number of sealed sources worldwide. According to IAEA, many countries do not maintain accurate or complete inventories of sealed sources in use or registries of users of sources. In response to our survey, 28 of the 49 countries said they had an inventory of sealed sources. In addition, 17 countries said they were in the process of developing an inventory. However, several countries that reported they had inventories indicated that the number of sources was estimated rather than actual. A few countries, including a European nation, indicated that they did not have the resources necessary to develop a national registry of sources and users.

An additional factor contributing to countries' limited or incomplete inventories is that sealed sources have been imported and exported by distributors and governments without consistent monitoring or tracking by the suppliers, the recipients of the sources, or the appropriate regulatory authority. Appendix VI provides information on the major producers of sealed sources worldwide.

The Chairman of NRC noted in March 2003 that international commerce in these sources is extensive and that existing controls on imports and exports are minimal. For example, most U.S.-origin sealed sources are exported under a general license.[5] This means that in most instances, sealed sources are exported without NRC knowing the type, amount, or activity level of the sources, or their destination. (See app. VII for more information about NRC's export regulations.)

Sealed sources have also been distributed worldwide by a variety of means other than commercial trade without adequate monitoring and oversight. As a result, the sealed sources have not always been properly accounted for and accurately inventoried. For example, sealed sources have been (1) distributed by corporations working in developing countries without formal clearance from or approval by the recipient country's regulatory authority, (2) donated by medical practitioners and nonprofit organizations, and (3) provided through international technical cooperation programs. IAEA has reported that international corporations—such as oil companies—have brought sealed sources used in oil exploration into developing countries. In some cases, there was no competent authority in the country to register or license the sealed sources, and existing national rules were regarded as too complicated or difficult for the corporations to follow. One African country reported in response to our survey that its inventory of sealed sources was incomplete because foreign construction companies had not notified the country's regulatory authority when it imported sealed sources.

According to IAEA, medical practitioners have brought sealed sources into developing countries for the purpose of establishing health clinics and hospitals and a number of sources were not properly accounted for. IAEA reported that hospitals in many developed countries donated large amounts of surplus radium-226 to hospitals in developing countries in the 1960s. One African country responding to our survey noted that according to old records, radium had been imported into the country but could not be

[5]Under NRC regulations sealed sources may not be exported to certain countries and may only be exported to certain other countries in limited quantities. Sealed sources may not be exported to Cuba, Iran, Iraq, Libya, North Korea, and Sudan. 10 C.F.R. § 110.28. Sealed sources may be exported only in limited quantities to Afghanistan, Andorra, Angola, Burma, Djibouti, India, Israel, Oman, Pakistan, and Syria. 10 C.F.R.§ 110.29.

located. Nonprofit organizations have also provided medical equipment using sealed sources to foreign countries. For example, the American International Health Alliance, operating under a series of cooperative agreements with USAID and DOE, has donated medical supplies, pharmaceuticals, and equipment, including those containing sealed sources, to countries in the former Soviet Union and Central and Eastern Europe since 1992.[6] According to an official from the American International Health Alliance, DOD also donated medical equipment containing sealed sources from field facilities to several countries in the former Soviet Union under the auspices of Operation Provide Hope. Since 1992, over 500 airlift deliveries by DOD to Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Ukraine, and Uzbekistan occurred, but the exact number of sealed source devices donated is unknown.

IAEA has supplied sealed sources to many countries through its technical cooperation program.[7] In 1991, IAEA estimated that it had provided many developing countries with 565 sources since 1957. IAEA officials told us that IAEA had provided developing member states with over 1,000 devices containing sealed sources since 1996. Most of these sealed sources are not considered a security risk by IAEA because of their low radioactivity. However, officials did note that about 125 of the 1,000 devices contained sources that could pose security risks if acquired by terrorists. These include (1) teletherapy machines with cobalt-60 sources of activity between 5,000 and 7,000 curies, (2) brachytherapy machines with cesium-137 sources of activity between 0.5 and 1 curie and iridium-192 sources of 10 curies, (3) irradiators with cobalt-60 sources with activity in the range of 12,000 to 200,000 curies, and (4) calibrators with activity around 4,000 curies. IAEA officials said that they were uncertain, however, the extent to which the sealed sources have been included in countries' inventories.

While it is the responsibility of each country—and not IAEA—to maintain accurate inventories of the sources, IAEA has encouraged many of its member states to establish and/or strengthen their radiation and waste

[6]The American International Health Alliance and its partners identify the health needs of local populations, develop strategies for meeting those needs, and implement programs and services to help local populations attain their goals. The equipment supplements voluntary and in-kind commitments of individual health care professionals, partner hospitals, and universities.

[7]IAEA's technical cooperation program is designed to provide its member states with technical assistance by providing equipment, expert services, and training that support the upgrading and establishment of nuclear techniques and facilities.

safety infrastructures via the model project program. In addition, IAEA policy does not allow for the approval of any technical cooperation projects involving the use of significant sealed sources unless the member state in question has, among other things, an effective regulatory framework that includes a system of notification, authorization, and control of sealed sources together with an inventory of sources. IAEA's model project program is discussed on pages 22 and 23 of this report.

DOE has provided countries with sealed sources under the Atoms for Peace Program. According to a March 2002 DOE Inspector General report, *Accounting for Sealed Sources of Nuclear Material Provided to Foreign Countries*, DOE could not fully account for sealed sources loaned to foreign countries and no longer maintained an accounting and tracking system for sealed sources. The report noted that DOE and its predecessor agencies provided 33 countries, including Iran, Pakistan, India, Malaysia, and Vietnam, with 536 sealed sources, which contained plutonium, from the 1950s through the 1970s. Initially, these materials were loaned to foreign facilities, and the U.S. government maintained ownership. However, in the 1960s, the U.S. government began transferring ownership through direct sale or donation, but it still retained title to much of the sealed sources provided to foreign entities. The report concluded that (1) the oversight of sealed sources was inadequate and that inaccurate inventory records limit DOE's ability to protect nuclear materials from loss, theft, or other diversion, and (2) DOE should work with IAEA to establish adequate regulatory oversight of sealed sources in foreign countries. In its response to the report, DOE stated that it is not the current policy of the U.S. government to track sealed sources once they are in the control of foreign entities and that to track loaned sealed sources would require a change in policy and international agreements.

Limited Information Exists about the Number of Lost, Stolen, or Abandoned Sealed Sources

Because many countries cannot account for their sealed sources, there is limited information on the number of sealed sources that are lost, stolen, or abandoned—referred to as "orphan sources." According to the Director General of IAEA, orphan sources are a widespread phenomenon, and 34 of the 49 countries responding to our survey indicated that orphan sources pose problems in their country. In the European Union, up to 70 sealed sources are lost among its member states annually. According to NRC, about 250 sealed sources or devices are lost or stolen in the United States annually, but the majority of the sources have been recovered. NRC said that the European Union does not report sources as being lost unless they are at a certain activity level that exceeds the NRC threshold for tracking purposes. As a result, NRC typically reports a greater number of lost sealed sources than the European Union does.

The problem of orphan sources is most significant in the countries of the former Soviet Union, where the collapse of the centralized Soviet government structure over a decade ago led to a loss of records and regulatory oversight over sealed sources. According to Russia's nuclear regulatory agency, Gosatomnadzor, 51 sealed sources were reported lost in 2002 and 245 were lost in 2000. No information was made available to us for 2001. In the Republic of Georgia, over 280 orphan sources have been recovered since the mid-1990s. Survey respondents reported that 612 sources had been lost or stolen since 1995. Of the 612 reported orphan sources, 254 had not yet been recovered. Table 2 summarizes the number of lost, stolen, and recovered sources reported.

Table 2: Reported Lost or Stolen and Recovered Sealed Sources

Region	Reported lost or stolen sealed sources	Recovered sealed sources
Africa	8	0
Asia	93	11
Europe	298	213
Former Soviet Union	35	14
Middle East	41	24
North America[a] and Central America	72	65
South America	21	10
South Pacific	44	21
Total	**612**	**358**

Source: GAO.

[a] The United States was not included in this survey.

Thirty-five of the 49 countries we surveyed indicated that they had an organized process to search for orphan sources, and several of these countries listed one or more organizations that are responsible for removing the sources once they have been found. However, the remaining 14 countries, spread across different regions, reported that they did not have a similar process to search for orphaned sources. Four of the 14 countries were located in Africa.

Six countries indicated that there were disincentives to finding orphaned sources. In particular, they noted that an individual who reports finding a source might be held responsible for paying for its disposal. Russian officials told us that facilities possessing sealed sources that are no longer used are responsible for disposal costs. The disposal fees are very high and, as a result, the users are reluctant to notify authorities about them and frequently opt to dispose of them illegally.

Certain Lost, Stolen, or Abandoned Sealed Sources Pose a Significant Security Risk

According to U.S. and international safety and security experts, among the most urgent problems are the security risks posed by the approximately 1,000 radioisotope thermoelectric generators located in the former Soviet Union. These generators were designed to provide electric power and are ideally suited for remote locations to power navigational facilities, such as lighthouses, radio beacons, and meteorological stations.[8] Each has activity levels ranging from 40,000 to 150,000 curies of strontium-90—similar to the amount of strontium-90 released from the Chernobyl accident in 1986. These generators pose a security risk because they may not be adequately protected or secured. An international effort was initiated about 2 years ago to recover and secure these generators in remote locations in the Republic of Georgia. Although the exact number of generators in Georgia is unknown, IAEA and Georgian officials told us that at least six generators have been recovered.

[8]The United States had also deployed a small number of radioistope thermoelectric generators in Alaska.

Figure 1: Radioisotope Thermoelectric Generators Manufactured in the Former Soviet Union

Source: IAEA.

We met with the Russian organization that developed the radioisotope thermoelectric generators—the Russian National Technical Physics and Automation Research Institute. Institute officials told us that the generators pose a serious security and safety threat and should all be taken out of service. They noted that the units have a design service life of 10 to 15 years and that no repair or maintenance has been done on any of these units since 1991. However, Russian Ministry of Atomic Energy (MINATOM) officials said that the generators are technically sound and should not be completely removed from service without adequate replacement power. MINATOM officials said they are considering extending the life of the generators in order to keep them in service significantly longer than originally planned. Table 3 shows the estimated number of radioisotope thermoelectric generators located in the countries of the former Soviet Union.

Table 3: Estimated Number of Radioisotope Thermoelectric Generators in the Former Soviet Union

Country	Radioisotope thermoelectric generators
Armenia	1
Azerbaijan	1
Belarus	3
Georgia	12[a]
Kazakhstan	3
Russia	998[b]
Tajikistan	1
Ukraine	12
Total	**1,031**

Sources: NRC, MINATOM, and Russian National Technical Physics Automation Research Institute.

[a]The estimated number of generators in Georgia ranges from 6 to 12.

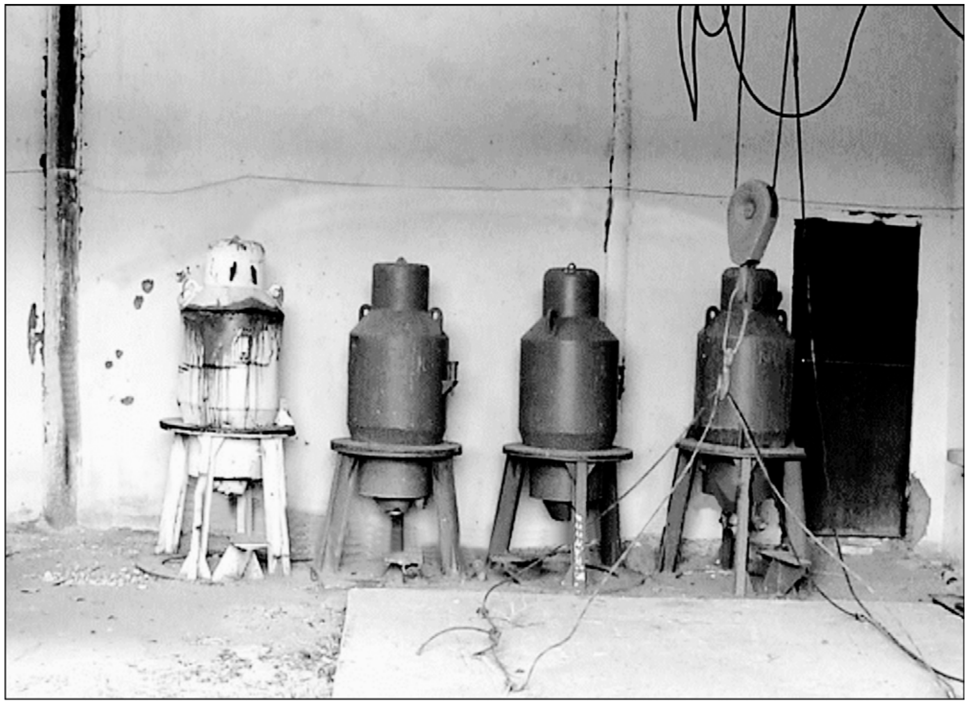
[b]Includes 829 that are operational and 169 that are in storage.

There have been numerous attempts to steal the sealed sources from these generators. For example, in recent years there have been six attempts to disassemble the generators in Kazakhstan and a number of similar events in Georgia and Russia. Some of the strontium-90 sealed sources from the generators have been found in residential areas. In a few instances, people who have stolen the sealed sources have used them for heating and cooking, and officials have speculated that the metal shielding might have been used to make bullets. In 2001, three woodsmen in Georgia who found the strontium-90 sealed source from an abandoned and dismantled generator used it as a heat source and suffered severe radiation burns. IAEA and DOE officials told us that other devices containing sealed sources, such as seed irradiators that were used in the former Soviet Union, pose significant security risks. Seed irradiators were mounted on trucks and used to irradiate seeds in order to kill fungus and inhibit germination. According to IAEA and DOE, each irradiator has activity levels of over 1,000 curies of cesium-137 in powdery form (cesium chloride).

Figure 2: Abandoned Radioisotope Thermoelectric Generator in Russia

Source: Vladivostok News.

Figure 3: Seed Irradiators Used in the Former Soviet Union



Source: IAEA.

IAEA's Director of the Division of Radiation and Waste Safety told us that no one knows the total number of orphan sources or their location in the former Soviet Union. IAEA is continuously obtaining new information about previously unknown devices using sealed sources. This makes it extremely difficult for the agency to develop strategies to locate and recover these sources in a systematic way. The Director also told us that the problem of orphan sources is not unique to the former Soviet Union and that similar problems exist in other parts of the world.

Countries Have Established Legislative and Regulatory Controls over Sealed Sources, but Adequacy of Controls Varies

All of the countries responding to our survey said they have established legislative or regulatory controls over sealed sources. However, U.S. and international nuclear safety and security experts told us that controls placed on radioactive sources vary greatly between countries and focus primarily on protecting public health and safety and not on securing sealed sources from theft or destructive use. According to IAEA, as many as 110 countries worldwide do not have adequate controls over sealed sources and the agency has established a program to help 88 countries upgrade their regulatory infrastructures.

Countries Responding to Our Survey Reported That They Have Established Controls over Sealed Sources

All of the countries that responded to our survey reported that they have established legislative or regulatory controls over sealed sources. The countries that responded to our survey identified various controls over sealed sources, including (1) licensing and inspection; (2) tracking the import and export of sources; (3) maintaining national registries of sources' users; (4) maintaining national inventories of sources; (5) searching for and recovering lost, stolen, or abandoned sources; (6) securing sources; and (7) regulating their safe transport. According to IAEA, controls over sealed sources are based on countries' development of a framework of laws and regulations. Twenty-five of the 49 countries reported that they had established a strong legislative framework to control sealed sources and most of these same countries indicated that they had a strong regulatory framework as well. Several countries characterized their legislative or regulatory framework as weak. The countries that reported having a strong legislative or regulatory framework were spread across many regions, including the former Soviet Union, Europe, Africa, and the South Pacific. Countries reporting that they had weak or nonexistent regulatory frameworks were located primarily in the former Soviet Union, the Middle East, Europe, Africa, and South America.

Countries reported using various guidelines to develop their laws or regulations that serve as the basis for controls over sealed sources. Forty-four of the 49 countries said they used either one or both IAEA guidelines—(1) the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources and (2) the Code of Conduct on the Safety and Security of Radioactive Sources.[9] Twelve of the countries responding to our survey indicated that they base their regulatory controls, in part, on European Union regulations. European Commission officials told us that efforts are under way to strengthen controls over sealed sources, including harmonizing measures among member states for the recovery of orphan sources. These efforts began prior to September 11, 2001, in response to accidents where orphan sources were melted with scrap metal, resulting in significant economic damages. In 2002, the commission adopted a proposed directive to improve controls over sealed sources that emit large amounts of radiation. The proposal urges that necessary measures be taken to protect public health from orphan source exposure. More recently, a commission committee proposed that users of radioactive sources in the European Union be charged a refundable deposit before acquiring sealed sources.

All of the countries responding to our survey identified one or more organizations responsible for regulating sealed sources. Forty-five of the 49 countries reported that regulatory organizations inspect facilities where sealed sources are stored or in use. Regarding enforcement, three countries failed to list any actions that inspectors could take to ensure compliance with laws and regulations. Many of the countries identified more than one enforcement mechanism available, including levying fines, suspending or terminating licenses, and closing a facility. Enforcement mechanisms, however, are not always used. Representatives from one European country—that did not respond to our survey but discussed these matters with us—told us that imposed fines tend to be so low that many users of sealed sources may find it cheaper to pay the fines rather than comply with the regulations.

[9]The International Basic Safety Standards are intended to ensure (1) the protection of individuals and the population against radiation exposure, (2) the safety of radiation sources in order to prevent accidents, and (3) the security of sources to prevent the relinquishing of control over their use. IAEA's Code of Conduct is a nonbinding document that applies to all radioactive sources that may pose a significant risk to health and the environment. It does not cover fissile materials used to construct weapons of mass destruction and sources within military or defense programs. The code is currently being revised to reflect member states' increased concerns about the security risks posed by sealed sources.

All of the countries responding to our survey reported that users of sealed sources are required to secure radioactive materials in their possession. In addition, 39 of the respondents reported that they had facilities to store disused sources. However, only 18 countries indicated that they have a facility to permanently dispose of the sealed sources. Those countries that did not have any storage facilities were primarily located in Africa. Representatives from four former Soviet Union countries told us that the absence of secure storage poses a serious security problem, and an official from the Republic of Georgia told us that a well-protected centralized storage facility was urgently needed.

All but four of the countries responding to our survey said they had regulations covering the safe transport of sealed sources. The countries that did not have such regulations were located in Africa, South America, and the Middle East. Although Russia did not respond to our survey, Russian officials told us that they were concerned about moving sealed sources safely and securely. They said that sources that were no longer being used are moved great distances by trucks and are vulnerable to theft because the operators of the vehicles must stop to rest or lose communications owing to the remoteness of the locations where they are traveling.

Countries' Controls over Sealed Sources Vary and Are Weakest among Developing Countries

Nuclear safety and security experts from the Departments of Energy, State, and Defense; NRC; IAEA; and the European Commission told us that controls placed on sealed sources vary greatly between countries and have focused primarily on protecting public health and safety and not on securing the sources from potential terrorists threats. According to IAEA, as many as 110 countries worldwide lack the regulatory infrastructure to adequately protect or control sealed sources. Many of these countries are considered less developed and are confronted with social, political, and economic problems that divert attention from imposing controls on the many thousands of radioactive sources used in hospitals, research facilities, industries, or universities. In many cases, these countries' regulatory organizations have a limited number of trained personnel. In the absence of regulatory controls, radioactive sources have been inadequately protected or secured; little or no attention has been paid to export or import controls of sources; and there has been a lack of basic record keeping. IAEA's Director of the Division of Radiation and Waste Safety told us that many countries also lack the commitment or political will to exercise controls over sealed sources.

In March 2003 over 700 delegates from more than 120 countries met in Vienna, Austria, to participate in an international conference on the security of radioactive sources. The conference, sponsored by the governments of the United States and the Russian Federation, emphasized that all users of sealed sources share a responsibility for managing them in a safe and secure manner and that the manufacturers of sources and regulators have important roles to play. The conference also noted that high-risk radioactive sources that are not under secure and regulated control, including orphan sources, raise serious security and safety concerns. U.S. and international experts are in the process of developing a systematic approach to identifying the highest-risk sources. In 2000 IAEA established a categorization of sealed sources to, among other things, determine the level of oversight that should be applied to the safety and security of a particular type of source. In response to growing concerns about sealed sources being used as a terror weapon, IAEA has revised the categorization. The categorization, which is still in draft, provides a relative numerical ranking of sealed sources and practices for which they are used. Appendix VIII provides more information about the conference, and appendix IX contains additional details about IAEA's revised categorization of sources.

IAEA Has Implemented a Program to Help Many Countries Improve Regulatory Controls

In 1994 IAEA established a model project program to enhance countries' regulatory infrastructure. This program is available to any IAEA member state upon request. (See app. X for a list of countries participating in the program.) The program has expanded and includes 88 countries. As of December 2002, IAEA had spent $27.7 million to help these countries. Each country's progress is measured through five milestones, including the establishment of a regulatory framework.[10] This milestone is considered the most time-consuming and requires that the country draft and implement radiation protection laws and regulations; designate and empower a national regulatory authority; and establish a system for the notification, authorization, and control of radioactive sources, including the preparation of an inventory of sources and installations. According to IAEA, about 77 percent of the countries participating in the program as of September 2001 had promulgated the necessary laws and established regulatory authorities. In addition, about 42 percent of the countries had adopted the necessary regulations; about 50 percent had systems for the notification, authorization, and control of radioactive sources in place and operational; and about 80 percent had systems in place to inventory sources. Considering that the program had been under way since the mid-1990s, the level of achievement was much lower than expected, and the time necessary to overcome some of the difficulties faced by the countries was underestimated. The reasons that many of the countries had not fully implemented this milestone included (1) time-consuming legislative and regulatory procedures; (2) institutional instability; (3) budgetary constraints, resulting in, among other things, a high turnover of qualified staff; (4) unfocused regulatory structures, resulting in overlapping responsibilities; (5) limited regulatory independence and empowerment; and (6) insufficient financial and technical resources, trained staff, and support services. Several countries responding to our survey indicated that additional assistance is needed to improve controls over sealed sources, including radiation detection equipment and training for regulatory staff.

U.S. and international officials told us that there are about 50 additional countries needing assistance that are not member states of IAEA and are not eligible for assistance under the model project program. According to IAEA, many of these countries have sealed sources that are being used

[10] The five milestones are (1) the establishment of a regulatory framework, (2) the establishment of occupational exposure control, (3) the establishment of medical exposure control, (4) the establishment of public exposure control, and (5) the establishment of emergency preparedness and response capabilities.

without adequate controls. These officials are concerned that without appropriate regulatory oversight, sources in these countries pose a particularly serious threat because they are not adequately protected.

Officials from the Department of State, IAEA, and the European Commission told us that France has implemented a system for controlling sealed sources that could serve as a model for other countries, including many developing nations. France's system requires distributors of sealed sources to assume financial responsibility for recovering and disposing of these sources at the end of their 10-year life. According to French officials, this system has significantly reduced the number of orphan sources. France's system for controlling sources is discussed in more detail in appendix XI.

DOE Has a Program to Help Other Countries Secure Sealed Sources, but Strengthened Coordination and Planning Are Needed

DOE has the primary U.S. government responsibility for helping other countries strengthen controls over sealed sources. Since fiscal year 2002, DOE has received $36.9 million to, among other things, secure sources at several large nuclear waste repositories in Russia and other countries of the former Soviet Union. Other U.S. federal agencies, including the Departments of Defense and State, and NRC have efforts under way to help countries strengthen controls over sealed sources as well. DOE's initial efforts to secure sealed sources have lacked adequate planning and coordination, and the majority of program expenditures have been in the United States. According to DOE officials, efforts are under way to improve the management of the program, including the development of a plan and better coordination with other agencies.

DOE Is Leading the U.S. Effort to Help Other Countries Secure Sealed Sources

DOE is leading U.S. government efforts to help other countries strengthen controls over sealed sources. DOE's effort is part of the overall U.S. national strategy to reduce the risk that terrorist groups could use these materials in a dirty bomb attack against the United States. A congressional report instructs DOE to use a portion of its fiscal year 2002 supplemental appropriation to address the threat posed by dirty bombs.[11] In response to the congressional requirement, the National Nuclear Security Administration's Office of International Material Protection and Cooperation established the Radiological Threat Reduction program in

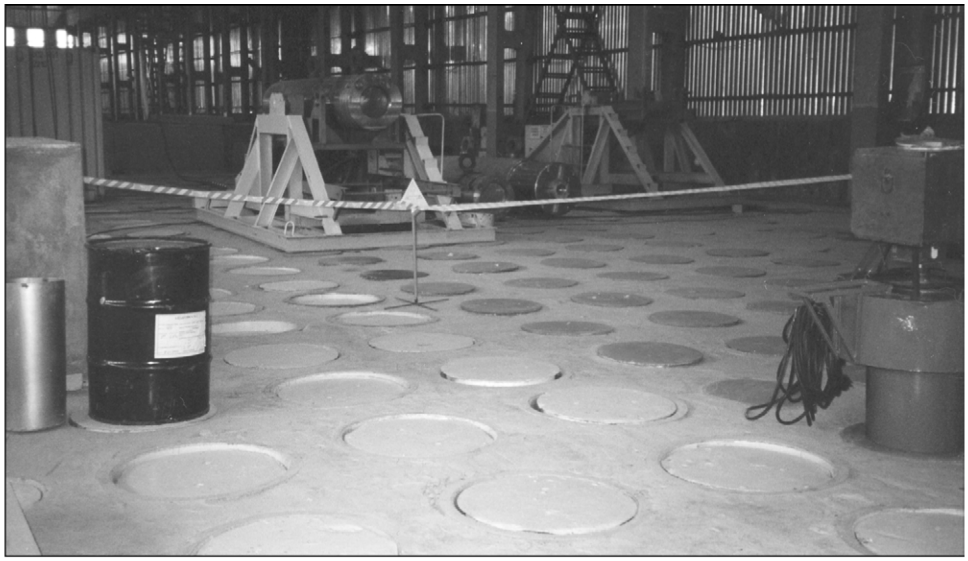
[11]H.R. Conf. Rep. No. 107-350, at 431 (2001).

January 2002, budgeting $20.6 million for the program in fiscal year 2002, and received an additional $16.3 million appropriation in fiscal year 2003. The program is expected to receive an additional $22 million in supplemental appropriations in fiscal year 2003, including $5 million to secure nuclear material in Iraq.

Initially, DOE evaluated the threat to national security from radioactive materials and determined that sealed sources pose a greater threat than other radioactive materials, such as radioactive waste and nuclear fuel, because of their availability; radioactivity; and other physical characteristics, such as half-life. DOE did further studies of the dirty bomb threat, including (1) narrowing the list of sealed sources that are a high priority because of their characteristics and availability, (2) analyzing possible scenarios in which a radiological dispersion device could be used, and (3) determining what the economic consequences of a dirty bomb attack in the United States would be. The former assistant deputy administrator of the Office of International Material Protection and Cooperation told us that it would be impossible to secure all sealed sources but that by determining which sources pose the greatest risk, DOE could prioritize its efforts.

DOE has focused on securing sealed sources in the countries of the former Soviet Union because DOE officials have determined that is where the greatest number of vulnerable sealed sources is located. In April 2002 the Radiological Threat Reduction program initiated its first security upgrade project at the Moscow Radon, a regional facility involved with collecting, transporting, processing, and disposing of sealed sources and low- and intermediate-level radioactive waste. There are 35 Radon facilities in the former Soviet Union, but the Moscow Radon is by far the largest and collects almost 80 percent of the institutional, industrial, and medical radioactive wastes in Russia from almost 2,000 enterprises in the city of Moscow, the Moscow region, and nine neighboring regions. During our visit to the Moscow Radon in October 2002, Radon officials showed us the building for which most of the DOE-funded upgrades are planned. (See fig. 4.) Planned upgrades at the site include surveillance cameras, motion detectors, vehicles, building upgrades, and a security facility where guards can monitor the building where most high-activity sources are stored. Although there have been no known attempts at theft of materials at the site, Radon officials told us that upgrades are needed because existing security is inadequate.

Figure 4: Moscow Radon Building Scheduled for DOE-Funded Security Upgrades



Source: GAO.

The program has also secured sealed sources in Uzbekistan and the Republic of Georgia. In Uzbekistan, DOE has funded security upgrades at research and irradiation facilities and the construction of a national repository for sealed sources, and plans to fund increased physical security upgrades at a dozen regional cancer treatment facilities. In the Republic of Georgia, DOE funded security upgrades at a facility where radioisotope thermoelectric generators and other high-activity sealed sources are stored. Upgrades in both countries included bricking up windows; reinforcing doors; improving or replacing roofs; upgrading storage vaults; installing motion detectors and alarm systems; and other low-cost, “low-tech” measures. Figure 5 shows an example of the security upgrades funded by DOE.

Figure 5: DOE-Funded Physical Security Upgrades in the Former Soviet Union

Source: DOE.

(Top) before: Weak doors and windows; door locked with a simple padlock; and gaps/holes in roof.

(Bottom) after: Reinforced steel doors with double locks that cannot be cut; bricked-up windows; alarm system; patched, reinforced roof.

In June 2002 DOE launched two additional efforts—a bilateral initiative with MINATOM to secure sealed sources at Russian facilities identified by

MINATOM, and a Tripartite Initiative with MINATOM and IAEA. The objective of the Tripartite Initiative is to improve the security of sealed sources in former Soviet states by developing inventories of sealed sources, locating the sealed sources, recovering the sealed sources, storing recovered sealed sources in a secure manner, and disposing of the sources.

Ultimately, DOE hopes that Russia will play a key role in recovering sealed sources in other former Soviet states because many of these sealed sources were manufactured in and distributed from Russia. In July 2002 MINATOM provided DOE with a number of priority projects for funding in Russia. These projects included recovering and securing radioisotope thermoelectric generators, and recovering orphan sources at 45 sites in Russia. According to DOE, the sites will be prioritized according to the type and activity level of the radioactive material present.

DOE has completed site assessments at four Radon sites in Russia. Upgrades at these facilities are expected to be completed by the end of fiscal year 2004. A key criterion for deciding if the site requires upgrades is an inventory of the sealed sources stored there—if the inventory includes sealed sources that DOE has determined to be high risk, security upgrades will be implemented.

Under the Tripartite Initiative, 19 additional Radon sites in other former Soviet states will be assessed. These Radon sites are located in Armenia, Azerbaijan, Belarus,[12] Estonia, Georgia, Kazakhstan, Latvia, Lithuania, Moldova, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan. DOE also plans to perform site assessments and security upgrades at medical, industrial, and research facilities throughout the former Soviet Union, similar to those done in Uzbekistan and Georgia. DOE, IAEA, and MINATOM officials visited Moldova in the fall of 2002 to conduct a physical security evaluation, implement the upgrades at the Moldova Radon, and identify other sites where further work is needed to improve security. DOE and IAEA officials conducted a similar trip to Tajikistan in December 2002. Work in both countries is expected to be complete in the summer of 2003, and DOE plans to initiate projects in Ukraine, Kazakhstan, the Baltics, and possibly Armenia, Azerbaijan, and Kyrgyzstan in fiscal year 2003.

[12]Current U.S. policy is to restrict assistance in Belarus to humanitarian assistance and exchange programs with state-run educational institutions; Russia and IAEA will likely carry out any work to secure sealed sources in Belarus under the Tripartite Initiative.

In March 2003 the Secretary of Energy announced a new initiative to broaden the Tripartite Initiative to other countries needing assistance to secure high-risk vulnerable sources. The emphasis of the expanded initiative will be on developing countries outside of the former Soviet Union. As part of this expanded effort, DOE expects to initiate work in Serbia and Indonesia this year.

Finally, DOE also has a program designed to strengthen other countries' controls over sealed sources managed by the Office of International Nuclear Safety within the National Nuclear Security Administration. The office is working with IAEA, other international organizations, NRC, and the State Department to develop a management program for sealed sources. The purpose of this program is to protect the health and safety of the public and people who work with sealed sources by developing literature and training programs. The program also contributed assistance for the international effort to recover orphan sources in the Republic of Georgia, including providing technical assistance, detection and personnel protection equipment, training, and software. In Armenia, this program is providing training, equipment, and other technical assistance to enhance the safety and security of sealed sources. As of September 30, 2002, DOE had spent about $330,000 for these activities.

DOD, State, and NRC Also Have Programs to Strengthen Other Countries' Controls over Sealed Sources

DOD, through its Cooperative Threat Reduction program,[13] is helping Kazakhstan to inventory, secure, and dispose of about 2,000 sealed sources, primarily cesium-137 and cobalt-60, from an out-of-service industrial facility, and identify other facilities with sealed sources. The manager of the program told us that although sealed sources are not traditionally considered to be weapons of mass destruction, DOD undertook this project because the Kazakhstan government asked for assistance and the quantity and types of sealed sources posed a security threat. The program began in fiscal year 2001, prior to the establishment of DOE's program to secure sealed sources, and DOD does not expect to engage in any further projects to secure sources in the former Soviet Union countries. The $1.7 million project is expected to be completed by the end of fiscal year 2003.

[13]The Cooperative Threat Reduction program is designed to help the countries of the former Soviet Union destroy and prevent the proliferation of nuclear, chemical, and biological weapons of mass destruction.

The State Department is also funding various projects to strengthen controls. For example, State provided IAEA with $1 million in fiscal year 2002 to support the agency's projects related to the safety and security of radioactive sources. Additionally, State allocated $120,000 in fiscal year 2002 from the Nonproliferation and Disarmament Fund[14] for a pilot project to develop and improve radiation safety programs in developing countries, including controls over sealed sources. The project was initially developed by the Health Physics Society[15] and proposed by State's Office of the Senior Coordinator for Nuclear Safety. Health Physics Society members volunteer their time, and State Department funding is used for travel, per diem, the cost of shipping donated equipment to the host countries, and evaluation of the project—about $3,000 spent to date. Four countries—Costa Rica, Ecuador, Jamaica, and Panama—were chosen for the pilot; however, work has been initiated in only two countries. The project was recently reactivated after a suspension of several months because of State Department concerns about program management, security, and liability issues.

The State Department has also contracted with Sandia National Laboratory for a $100,000 study to assess the current laws and procedures governing intercountry transfers of sealed sources. Specifically, the study is looking at six countries that are either major exporters or importers of sealed sources and will provide information on, among other things, the number of sources that is imported and exported, and whether exporters are required to verify whether the countries they are exporting to have controls in place to ensure the safety and security of sealed sources.

In addition, NRC has a program to strengthen controls that focuses on Armenia. NRC has spent $62,000 in Freedom Support Act funds transferred from USAID to assist Armenia. Initially, NRC will help Armenia develop a registry of sealed sources, including identifying the information required; develop the database; and help Armenia gather, assess, develop, and verify existing data on sources. Currently, Armenian regulations on sealed sources and other radioactive materials are spread across different ministries and departments, and many have not been changed since the fall

[14]The mission of the Nonproliferation and Disarmament fund is to undertake high-priority, rapid response projects to halt the proliferation of and destroy or neutralize weapons of mass destruction, and limit the spread of advanced conventional weapons.

[15]The Health Physics Society is a scientific and professional organization whose members specialize in occupational and environmental radiation safety.

of the Soviet Union. NRC plans to assist Armenia with reviewing existing regulations and developing consolidated regulations on, among other things, licensing and inspections of radioactive sources, which will apply governmentwide and meet international standards. In addition, NRC provided Russia and Ukraine with guidance and training on the licensing and regulation of sealed sources in the mid-1990s. NRC has also started working with Canada and Mexico to share information about controls over sealed sources in each country and improve cross-border controls and has provided cost-free experts to help IAEA update its Categorization of Radioactive Sources and Code of Conduct.

Finally, DOE and State are providing funds to support IAEA efforts to strengthen controls over sealed sources. DOE and State have pledged a total of $8.2 million—67 percent of the total $12.2 million pledged—to IAEA's Nuclear Security Fund.[16] This fund was established after the terrorist attacks of September 11, 2001, in conjunction with IAEA's action plan to improve nuclear security worldwide. The State Department has directed $1 million of its contribution specifically toward activities to improve the controls over sealed sources, and DOE's $3 million contribution is entirely directed to these efforts. Planned activities to improve the security of sealed sources in member states include, among other things, enhancing ongoing activities to improve controls of sealed sources; developing standards, guidelines, and recommendations on the security of radioactive sources; establishing security standards for the transport of radioactive material; and locating and securing orphan sources.

Table 4 summarizes the amounts that the Departments of Energy, State, and Defense, and NRC have received, obligated, and spent to help other countries strengthen their controls over sealed sources as of January 31, 2003.

[16]Other countries that have pledged voluntary contributions to the Nuclear Security Fund include Australia, Bulgaria, Czech Republic, France, Greece, Iran, Ireland, Israel, Japan, the Netherlands, New Zealand, Norway, Romania, Slovenia, South Korea, Sweden, and the United Kingdom. The Nuclear Threat Initiative, a nongovernmental organization, has also pledged to contribute to the fund.

Table 4: Assistance to Improve Controls over Radioactive Sources through January 31, 2003

Program/Activity	Description	Received	Obligated	Spent
DOE Radiological Threat Reduction program	Assisting Russia and other former Soviet Republics to secure sealed sources. Includes $3 million for IAEA activities.	$36,900,000	$11,426,600	$8,934,000
DOE International Emergency Management program	Training program for control and management of radioactive materials. Also provides assistance to help locate, handle, and safely remove high-risk sources.	430,000	430,000	330,000
DOD Cooperative Threat Reduction program[a]	Securing, inventorying, and disposing of sources in Kazakhstan.	1,703,884	1,699,214	975,140
State Department Radiation Safety without Borders Pilot project	Assisting to build radiation safety infrastructures in developing countries participating in the IAEA model project.	120,020	120,020	3,094
State Department study conducted by Sandia National Laboratory	Studying protocols on international transfers of sealed sources in several countries.	100,000	100,000	49,300
State Department Nuclear Safety	Funding to IAEA.	1,000,000	1,000,000	1,000,000
Nuclear Regulatory Commission	Designing and developing a registry of sources, and assistance to assess and develop regulations related to radioactive materials in Armenia.	250,000	250,000	62,000
Total		**$40,503,904**	**$15,025,834**	**$11,353,534**

Sources: DOE, DOD, Department of State, and NRC.

[a]DOD figures are through April 1, 2003.

DOE Efforts Have Not Been Well Planned and Coordinated with Those of Other U.S. Agencies

DOE is in the process of developing a plan to guide its efforts to help other countries secure sealed sources. According to DOE officials, initial attempts to develop a plan were stopped in May 2002 because the former administrator of the Office of International Material Protection and Cooperation felt that the program needed to show tangible results quickly. In the absence of a plan, DOE officials told us that the program has modeled its work in Russia on previous DOE projects to secure fissile materials in Russia through its Material Protection, Control, and Accounting program. The director of the program told us that while the initial approach to securing sealed sources in Russia—focusing on improving physical security at Radon sites—was a good idea, it hindered DOE from setting priorities among other sites in Russia. He further noted that the program is now focusing on improving the security of the most vulnerable high-risk sources first.

DOE officials told us that they recognize that the development of a plan is essential. DOE's draft plan has established short- and long-term program elements, including consolidating and securing dangerous materials in vulnerable locations; leveraging critical partnerships, such as continuing to work with IAEA on key efforts such as the model projects program and the code of conduct; and continuing to help countries detect smuggled radioactive materials through its Second Line of Defense program.[17] In addition to the plan, DOE officials said they are also developing a more detailed action plan; radioactivity thresholds for vulnerable high-risk radioactive materials; and guidelines for describing the actions that should be taken by DOE when sources are found to exceed those radioactivity thresholds. As part of its overall effort, DOE officials told us that more detailed planning and analysis will be needed to, among other things, (1) determine which countries present the greatest security risk and most urgently require assistance, (2) identify future funding requirements, and (3) develop performance measures to gauge program success.

Despite these recent initiatives to improve program planning, officials from Gosatomnadzor, the Russian agency responsible for regulating sealed sources in use at almost 8,000 facilities in Russia, told us that beyond an initial meeting, DOE had not consulted with them in the selection or prioritization of sites for physical security upgrades. In particular, Gosatomnadzor officials were surprised that DOE was focusing so much attention on improving security at the Radon facilities in Russia where they believed the probability that sealed sources will be stolen is low. They said that it would be preferable to begin securing sealed sources from other vulnerable sites near Moscow, for example, out-of-service irradiation and research facilities. A systematic approach is required to assess needs, identify priorities, and develop a comprehensive approach to securing sealed sources. In their view, DOE's initial approach had the potential to be superficial.

DOE officials told us that they are now working more closely with Gosatomnadzor. In a March 31, 2003, letter from DOE's Acting Deputy Assistant Secretary for International Material Protection and Cooperation to Gosatomnadzor's First Deputy Chairman, the DOE official noted the need for regulatory oversight of the Russian radiological industry and

[17]See *Nuclear Nonproliferation: U.S. Efforts to Help Other Countries Combat Nuclear Smuggling Need Strengthened Coordination and Planning* (GAO-02-426, May 16, 2002).

suggested that a proposal be formulated jointly with NRC to work cooperatively in this area.

DOE is also seeking to improve planning and coordination of the Tripartite Initiative. According to an IAEA official, DOE coordinated its efforts with IAEA and Russia on the Moldova visit that contributed to a successful start of the Tripartite Initiative. The participants jointly developed and implemented a common approach for securing some vulnerable sealed sources, and arrangements were made to construct a facility to store these sources. However, the IAEA official told us that the Tajikistan assessment was not well coordinated. He noted that DOE was not flexible in scheduling the preliminary assessment visit and that Russia did not participate in the visit. Because of the timing of the visit, IAEA's representative to the Tripartite Initiative was unable to participate in the visit, however, an official from IAEA's Department of Technical Cooperation did accompany the DOE team.

DOE officials told us that they were unable to make changes to their existing itinerary because they would have incurred significant delays if travel dates were changed due to country clearance restrictions for U.S. government travel in Tajikistan. Furthermore, they noted that because of the different roles that DOE, MINATOM, and IAEA play under the Tripartite Initiative, it is not necessary that representatives of each organization be present on each visit. As currently envisioned, the Russian and IAEA participants will act as an advance team, gathering information about which sealed sources exist in a given country and their current level of vulnerability. Subsequently, the U.S. team will visit the country and negotiate contracts to improve security at the vulnerable sites.

IAEA's official also told us that, overall, the Tripartite Initiative has not been well planned. Initial efforts have been ad-hoc, and a more systematic approach is needed as the program continues. He said that improved planning is essential particularly because the Tripartite Initiative will be used as a model to guide future efforts as the program expands worldwide. DOE officials agreed that improved coordination is needed. DOE, MINATOM, and IAEA are working to finalize a "Terms of Reference" document that defines the objectives, scope, roles, operational framework, and procedures to be followed for implementing projects under the Initiative. Furthermore, preliminary schedules for missions to several countries have been jointly developed through August 2003.

Department of State and NRC officials told us that DOE has not fully coordinated its efforts with their agencies, although they noted that efforts were recently under way to improve coordination. These officials told us that DOE needs their input to ensure that a comprehensive governmentwide strategy is taken to, among other things, leverage program resources, maximize available expertise, avoid possible duplication of effort, and help ensure long-term success. DOE has not systematically undertaken the kind of comprehensive planning that would foster better coordination with the other agencies and could also lead to better coordination with other countries' nuclear organizations. For example, DOE did not adequately consult NRC or State when developing the Radiological Threat Reduction program or developing the Tripartite Initiative with MINATOM and IAEA. Officials from NRC and the State Department expressed interest in sharing information and working with DOE to plan and execute the Radiological Threat Reduction program, but told us that there had been limited information sharing between agencies.

Both NRC and the State Department have extensive experience in nuclear regulatory and safety-related issues in the former Soviet Union. NRC has received approximately $50 million from fiscal year 1991 through fiscal year 2002 to support regulatory strengthening efforts in the countries of central and eastern Europe and the former Soviet Union. These efforts have included training other countries' regulators in all aspects of licensing and inspection procedures, advising on how to establish a legal basis for nuclear regulations, and developing a control and accounting system for nuclear materials. The State Department's Office of the Senior Coordinator for Nuclear Safety, which was established about 10 years ago, provides overall policy guidance for efforts to improve the safety of Soviet-designed nuclear power reactors. Since then, the office's mandate has expanded to include the safety of other foreign civilian nuclear facilities, including research reactors and waste facilities. In addition, State Department officials said that more recently, State has been leading U.S. negotiations to revise IAEA's Code of Conduct and leading consultations within the U.S. government with large exporters of sealed sources to strengthen export controls on international transfers of them.

Several officials also told us that DOE was focusing too narrowly on rapid physical security upgrades and not taking into account long-term needs to develop better regulatory infrastructures in host countries. These officials also said that a coordinated, targeted effort to identify and secure the most vulnerable and high-risk sealed sources could eliminate the greatest risks, and that developing regulatory frameworks in host countries would significantly improve the safety and security of sealed sources. DOE noted that part of the program's strategy is to support IAEA initiatives to leverage resources of member states to improve the security of sealed sources in their countries. They are hoping to build on the work IAEA has done in this area, particularly on the development of regulatory infrastructure.

The Majority of DOE's Program Expenditures Have Been in the United States

DOE budgeted $20.6 million for the Radiological Threat Reduction program in fiscal year 2002 and received an additional $16.3 million in fiscal year 2003. DOE had spent about $8.9 million of the total $36.9 million received as of January 31, 2003, including $3 million transferred to IAEA's Nuclear Security Fund. Of the remaining $5.9 million in expenditures, 93 percent was spent in the United States by DOE's national laboratories for labor, travel, equipment, and overhead. Only $407,900 had been spent by the national laboratories in the countries receiving assistance. Table 5 shows expenditures by the laboratories by component of cost as of January 31, 2003.

Table 5: Radiological Threat Reduction Program Expenditures by DOE's National Laboratories as of January 31, 2003

Dollars in thousands

	Program activities in the United States				Program activities in the former Soviet Union		
Laboratory	**Labor[a]**	**Travel[b]**	**Equipment**	**Overhead**	**Travel[c]**	**Services and equipment**	**Total**
Argonne National Laboratory	$707	$82.7	$3.1	$0.4	0	$3.0	**$796.2**
Los Alamos National Laboratory	1,263.9	114.4	103.2	0	29.5	0	**1,511.0**
Lawrence Livermore National Laboratory	65.3	8.4	0.6	-0.1[d]	0	0	**74.2**
Nonproliferation and National Security Institute	142.9	3.5	0	0	0	0	**146.4**
Nevada Operations Office	65.4	6.0	0	9.1	15.7	10.0	**106.2**
Oak Ridge National Laboratory	208.5	0	1.3	0	0	0	**209.8**
Pacific Northwest National Laboratory	2,316.2	132.3	45.8	12.5	0	327.9	**2,834.7**
Remote Sensing Laboratory	175.2	38.5	1.9	7.6	11.8	10.0	**245.0**
Sandia National Laboratory	10.5	0	0	0	0	0	**10.5**
Total	**$4,954.9**	**$385.8**	**$155.9**	**$29.5**	**$57.0**	**$350.9**	**$5,934.0**

Source: DOE.

[a]Includes salaries, wages, fringe benefits, and pensions that are directly chargeable to the Radiological Threat Reduction program. DOE's headquarters employees' salaries are not charged directly to the program but are funded through DOE's Office of International Material Protection and Cooperation.
[b]Includes both travel and per diem costs—foreign and domestic—for laboratory officials and subcontractors.
[c]Includes travel costs for officials from other countries.
[d]The negative amount reflects funds from a prior fiscal year that were returned to the Radiological Threat Reduction program by the laboratory.

DOE officials cited several reasons why only a small percentage of the funds allocated to the program since fiscal year 2002 had been spent as of January 31, 2003, including the following:

- The new program required significant start-up effort to assess the threat posed by sealed sources, determine the potential impacts from the detonation of a dirty bomb, and categorize and prioritize the types of sources that pose the greatest security risk.

- Difficulties and other unforeseen delays are frequently associated with doing work in the former Soviet Union. For example, the Russian Ministry of Construction, which maintains the Radon sites in Russia, raised concerns, after work had already started, that it had to authorize any work performed at those sites. Consequently, work was stopped at the Radon sites for several months. Initially, this Ministry had not been consulted by DOE and MINATOM in discussions about performing work at the Radon sites.

- It took DOE a significant amount of time to establish appropriate contacts in the countries of the former Soviet Union where DOE plans to provide assistance. While DOE has a long history of working with Russia to secure fissile materials through its Material Protection, Control, and Accounting program, DOE was required to identify and work with a different set of organizations responsible for regulating sealed sources.

DOE officials told us that expenditures in countries of the former Soviet Union and other regions of the world are expected to increase as the program evolves. According to DOE, as the program matures security upgrades will be followed by comprehensive and costly consolidation and disposition activities, all of which will take place in foreign countries. DOE has requested an additional $36 million for the program in fiscal year 2004.

The director of the program said that the amount requested was an estimate based on anticipated future funding requirements. He expects that the funds will be allocated for, among other things, continued work in Russia, including securing large numbers of radioisotope thermoelectric generators, additional contributions to IAEA's Nuclear Security Fund, and expanded efforts to secure sources in countries outside of the former Soviet Union. The director also noted that plans to secure sources in other parts of the world are still being developed and that DOE wants to ensure that it has a sound basis for determining which countries to select for assistance.

Conclusions

The attacks that occurred in September 2001 widened the array of potential scenarios and challenges that U.S. decision makers must confront concerning terrorist threats. Sealed sources containing radioactive material, which have many beneficial industrial, medical, and research applications, must now be considered possible terrorist weapons. These sealed sources are in virtually every country of the world and are often inadequately secured or accounted for. The central question is, What can the United States and the world community do to confront this problem, given the likely vast and unknown number of sources that exist and continue to be manufactured and distributed globally?

DOE appears to be well suited to help countries secure sealed sources because of its long history in securing weapons grade material in the former Soviet Union. Further, DOE's efforts to develop a plan to guide its efforts is a step in the right direction. However, additional planning and detailed analyses will be needed to, among other things, systematically identify and prioritize countries that require assistance, establish realistic time frames and resources necessary to accomplish these tasks, and develop meaningful performance measurements. The elements of such a plan assumed greater importance in light of the Secretary of Energy's recent announcement that DOE's program will expand beyond the countries of the former Soviet Union. For this reason alone, it is imperative that a comprehensive plan be established and implemented before significant amounts of appropriated funds are spent to improve international controls over sealed sources. Regarding program expenditures, we agree with DOE's objective to maximize program resources in the recipient countries. To date, the national laboratories have spent the majority of the program funds in United States and we believe that this trend needs to be reversed as the program evolves. We would expect that in the future, a markedly smaller percentage of program funds will be directed toward the national laboratories and the greatest percentage will go to the countries that need the assistance to strengthen controls over sealed sources.

We share the views of Department of State and NRC officials who expressed their concerns that DOE was not adequately coordinating its efforts with the other agencies. The Department of State and NRC have a long history of working on international nuclear safety issues, and their expertise and insights would be valuable, we believe, in crafting an overall governmentwide plan for strengthening controls over sealed sources. In particular, NRC has experience in working closely with many countries of the former Soviet Union to develop and strengthen national regulatory infrastructures. Clearly, any long-term plan requires that countries have a competent regulatory authority that can place appropriate levels of controls on sealed sources.

Recommendations for Executive Action

We recommend that the Secretary of Energy (working with the Administrator of the National Nuclear Security Administration):

- Develop a comprehensive program plan for helping other countries secure sealed sources that includes (1) a unified set of program goals and priorities, including a well-defined plan for meeting these goals in the countries to be included; (2) program cost estimates; (3) time frames for effectively spending program funds; (4) performance measures; (5) ways to sustain upgrades to the facilities and equipment financed, including cost estimates; and (6) an exit strategy for each country, including a plan for transferring responsibilities to the host country for building and equipment maintenance. The plan should be flexible and updated periodically to ensure that long-term efforts are sustainable.

- Take the lead in developing a comprehensive governmentwide plan to strengthen controls over other countries' sealed sources. The plan should be developed in conjunction with the Secretaries of State, Defense, and Homeland Security, and the Chairman of NRC. In addition, this plan should be coordinated with the International Atomic Energy Agency to avoid overlap or duplication of effort.

- Strengthen efforts to increase program expenditures in the countries requiring the assistance.

Agency Comments and Our Evaluation

We provided the Departments of Energy, State, and Defense, and the Nuclear Regulatory Commission with draft copies of this report for their review and comment. We also provided IAEA with pertinent sections of the report for review. DOD had no comments on the draft report. DOE's, State's, and NRC's written comments are presented as appendixes XII, XIII, and XIV, respectively. The three agencies and IAEA also provided technical comments, which we incorporated into the report as appropriate.

DOE's National Nuclear Security Administration agreed with our recommendations that the program needs strengthening and noted that the Secretary and the Administrator are actively involved with the international community to address the security of other countries' sealed sources. However, DOE disagreed with our finding that it had not coordinated its efforts with NRC and the Department of State to ensure that a governmentwide strategy is established. Further, DOE believes that it is important to place the report's findings in context since the program is in its startup phase. Regarding DOE's point about coordination, we had been told several times during the course of our review by NRC and State Department officials that DOE had not systematically included these agencies in the development of a comprehensive strategy to strengthen other countries' controls over sealed sources. In fact, we raised this issue with DOE program officials during our review and these officials acknowledged that DOE needed to do a better job in coordinating its program with other U.S. agencies. Although NRC and State Department officials told us that coordination has improved recently, they endorsed the need for the development of a governmentwide strategy to ensure that they fully participate in future U.S. efforts. Regarding DOE's concern about putting the report's findings in context, we noted in the draft report that the program required a significant start-up effort to, among other things, assess the threat posed by sealed sources, determine the potential impacts from the detonation of a dirty bomb, and prioritize the types of sources that pose the greatest threat.

State agreed with the facts presented in our report and noted that a comprehensive approach to controlling sources will require a concerted diplomatic effort that should be combined with the technical expertise possessed by DOE in recovering and securing sealed sources in other countries. State said that it possesses a unique perspective that is crucial to the success of the program and hoped that we would clarify our recommendation to delineate between DOE's technical programmatic responsibilities and State's overall diplomatic role in guiding international strategies for securing radiation sources. Regarding State's point, we acknowledge State's responsibility to develop and implement international strategies on behalf of the U.S. government. However, we believe, as noted in the report, that DOE is well suited to help other countries secure sealed sources because of its long history in securing weapons grade material in the former Soviet Union and that it should take the lead in developing a comprehensive plan to strengthen controls of other countries' sealed sources.

NRC made several points. First, NRC believed that our report should have focused more attention on high-risk radioactive sources rather than on radioactive sources of all types. NRC stated that the vast majority of radioactive sources in use in the United States and abroad are not useful to a terrorist and that it has been working with DOE and IAEA to finalize IAEA's revised Code of Conduct on Safety and Security of Radioactive Sources and the revised Categorization of Sources. In addition, NRC noted that only a few of the radioactive sources that are lost or stolen in the United States are high-risk and that a majority of the sources reported lost or stolen involve small or short-lived sources which are not useful as a radiological dispersion device. Second, NRC identified various efforts that it has undertaken to improve the security of high-risk sources in the United States. Third, NRC pointed out that we should consider including the Department of Homeland Security in our recommendation that calls for the development of a governmentwide plan to help other countries secure sealed sources.

Regarding NRC's comments, one of the objectives of our report was to specifically determine the number of sealed sources worldwide, and we believe that it is important to develop information, to the extent possible, regarding the number of all sealed radioactive sources that are in use. In fact, IAEA has placed great emphasis, particularly among developing countries, on the importance of developing and maintaining inventories of sources for safety and security purposes. As we noted in our report, current IAEA policy does not allow for the approval of any Technical Co-operation project involving the use of significant radiation sources, unless the member state in question, among other things, complies with the requirements to maintain an effective regulatory framework that includes an inventory of sources.

While we agree with NRC that the highest-risk sources present the greatest concern as desirable material for a "dirty bomb," other sealed radioactive sources could also be used as a terrorist weapon. No one can say with certainty what the psychological, social, or economic costs of a dirty bomb—regardless of the radioactive material used to construct it—would be. In addition, it is important to note that work by NRC, IAEA, and others to characterize sources is still ongoing.

Regarding NRC's comments about its activities to increase the security of the highest-risk sources, we will address these matters in our forthcoming report on U.S. efforts to strengthen controls over sealed sources in the United States. Finally, during the course of our review, no agency we met with was aware of or told us of a role being played by the Department of Homeland Security in securing sealed sources in other countries. However, we agree with NRC that it makes sense to coordinate the development of a governmentwide plan for this activity with the Department of Homeland Security and we have revised our recommendation to include the department.

As agreed with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days after the date of this letter. We will send copies of this report to the Secretary of Energy; the Administrator, National Nuclear Security Administration; the Secretary of State; the Secretary of Defense; the Secretary of the Department of Homeland Security; the Chairman, Nuclear Regulatory Commission; the Director, Office of Management and Budget; and interested congressional committees. We will make copies available to others upon request. In addition, the report will be available at no charge on the GAO Web site at http://www.gao.gov.

If you have any questions concerning this report, I can be reached at 202-512-3841 or robinsonr@gao.gov. Major contributors to this report are included in appendix XV.

Sincerely yours,

Robert A. Robinson

Robert A. Robinson
Managing Director, Natural Resources
and Environment

Scope and Methodology

To answer our objectives related to (1) number of sealed sources worldwide and how many sources are lost, stolen, or abandoned and (2) the legislative and regulatory controls that countries that possess sealed sources use, we distributed a questionnaire to 127 member countries of the International Atomic Energy Agency (IAEA), including 3 countries whose IAEA membership had been approved but had not yet taken effect at the time of our survey. We did not, however, survey all IAEA member states. Specifically, we did not distribute questionnaires to Afghanistan, Cuba, Iran, Iraq, Ivory Coast, Libya, Sudan, Syria, and the Holy See. The State Department recommended that we not correspond with the first eight countries listed. We determined from discussions with IAEA that the Holy See did not have any sealed sources. We did not include the United States because it is being treated separately in another GAO report.

IAEA provided us with a list of the appropriate contacts for most of the countries we planned to survey. These officials were primarily from member countries' regulatory authorities. We pretested the survey with the U.S. Nuclear Regulatory Commission (NRC) and with representatives from Brazil, Poland, the United Kingdom, Uganda, and Uzbekistan. After revising the survey to reflect the comments of these officials, we distributed it in December 2002 via E-mail and fax, and through countries' embassies in Washington, D.C., and Vienna, Austria, where IAEA is located. As a follow-up for nonrespondents, we also distributed questionnaires directly to many countries' representatives who were attending an international conference in Vienna, Austria, on the security of radioactive sources. We also sent out periodic reminders to the countries from January through March 2003 requesting their assistance to complete the survey in a timely fashion. We received responses from 49 IAEA member states (39 percent), including countries from Asia, North and South America, the former Soviet Union, Europe, the Middle East, and Africa. According to IAEA officials, the response rate was consistent with the rate it achieves when it sends out similar types of questionnaires to member states. In addition we were told by IAEA officials and others that there is an inherent difficulty associated with trying to obtain these types of data from countries owing to the sensitive nature of some of the questions and countries' concerns about ensuring the confidentiality of their responses. Our survey results were used without attempting to project the information to the universe of IAEA members. We did not assume that nonrespondent countries would have had similar answers to our survey. Regarding the matter of confidentiality, we notified the countries that the results from the survey would be reported in aggregate and that individual responses would not be disclosed.

We supplemented the results obtained from the survey with interviews with officials from several countries, including Brazil, France, Kazakhstan, the Republic of Georgia, Russia, the United Kingdom, and Uzbekistan to learn more about how they regulate and control sealed sources. We also met with officials from IAEA and the European Commission to obtain their views on the security problems and challenges associated with sealed sources. In addition, we also interviewed and obtained pertinent documents from officials of several U.S. government agencies, including the Departments of Defense, Energy, and State, and NRC.

We attended two DOE-sponsored conferences related to the security of sealed sources. The first conference, held in London, United Kingdom, during September-October 2002, focused on international approaches to nuclear and radiological security. The second conference, which was held in Vienna, Austria, in March 2003, focused on the security of radioactive sources and was attended by representatives from more than 120 countries.

To determine what assistance has been provided by the United States to other countries to strengthen their controls over sealed sources, we obtained budget, obligation, and expenditure data from the four agencies providing assistance—the Departments of Energy, State, and Defense, and NRC. To assess how well the programs were being implemented, we interviewed program officials from each agency and reviewed pertinent documents, including agency plans as available. We also obtained information about these programs through interviews with representatives of IAEA and officials from some of the countries receiving U.S. assistance.

Finally, we visited Russia to obtain a first-hand look at a waste facility that contains sealed sources. Specifically, we traveled to the Moscow Radon site at Sergiyev Posad, located about 90 kilometers from Moscow. While in Russia we also interviewed officials from the Ministry of Atomic Energy, the Ministry of Health, the Kurchatov Institute, Gosatomnadzor (Russia's nuclear regulatory organization), the Russian Academy of Sciences, and the Russian National Technical Physics and Automation Research Institute.

We performed our review from May 2002 through May 2003 in accordance with generally accepted government auditing standards.

Results of Survey of IAEA Member Countries

This appendix presents a copy of the survey sent to 127 IAEA member countries and the results of that survey.

United States General Accounting Office

GAO
Accountability * Integrity * Reliability

Survey on Security of Radioactive Sources

Background

The U.S. General Accounting Office (GAO) is an independent, nonpartisan legislative branch agency that supports the U.S. Congress. GAO serves the public interest by providing Members of the Congress with accurate information, unbiased analyses, and constructive recommendations on the use of public resources to ensure the accountability of federal programs.

Since the attacks on the World Trade Center and the Pentagon on 11 September 2001, concerns have increased over the possibility that terrorists could obtain radioactive sources and use conventional explosives or other means to disperse them, contaminating a wide area and causing significant economic and psychological damage. GAO has been asked by the Congress to determine the security challenge posed by these radioactive sources.

In order to obtain this information, we are seeking the cooperation of radiation safety officials in member states of the International Atomic Energy Agency in completing a questionnaire about radioactive sources in their countries. The objective of this survey is to determine the extent to which controls over radioactive sources are in place and assess the level of international efforts aimed at strengthening regulatory controls over sources. Your participation in this survey is extremely valuable because the survey results may be used by the Congress to make future decisions regarding U.S. participation in efforts to strengthen controls over radioactive sources. We expect to issue our report to Congress in May 2003, and will send all survey participants a copy thereafter.

As defined in the IAEA Code of Conduct on the Safety and Security of Radioactive Sources, "'Radioactive source' means radioactive material that is permanently sealed in a capsule or closely bonded and in a solid form, excluding material within the nuclear fuel cycles of research and power reactors. It also includes any radioactive material released if the source is leaking or broken." For the purposes of this questionnaire, we are only interested in radioactive sources in ***civilian*** (non-military) use.

Directions for Completing this Questionnaire

Please know that results from the survey will be reported in aggregate, and your individual responses will not be disclosed.

Please complete this questionnaire and return it via email or fax within 2 weeks of receipt. To preserve formatting, please **do not** delete any part of the text or questions. If you have any questions, please contact either:

Mr. Glen Levis
Office: 001-202-512-6961
Fax: 001-202-512-8354
E-mail: LevisG@gao.gov

Ms. Kerry Hawranek
Office: 001-202-512-3577
Fax: 001-202-512-8354
E-mail: HawranekK@gao.gov

If you prefer to return the survey via post, the return address is:

U.S. General Accounting Office
Norfolk Field Office
Attention: John C. Wren (Job #360199)
5029 Corporate Woods Drive, Suite 300
Virginia Beach, VA, USA 23462

Although this questionnaire may require input from various individuals, we ask that one person assume responsibility for coordinating its completion. Please list that person's name below in case we have questions or need follow-up. Thank you.

Name:

Title:

Telephone #:

E-mail:

1

Regulatory framework for radioactive sources

1. What authority(ies) does your country have in place to provide for control of radioactive sources? *(Place an "X" in the box to the left of your response)*

43	Legislation
44	Regulations
0	No authorities in place (SKIP TO QUESTION #3)

2. In what year did you first impose some type of legal or regulatory control of radioactive sources?

3. Does your country have regulations to ensure the safe transport of radioactive sources? *(Mark only one response ☒)*

45	Yes
4	No

4. How would you describe the framework of **laws** in place to ensure the security of radioactive sources in your country? *(Mark only one response ☒)*

25	Strong legal framework
14	Moderate legal framework
7	Weak legal framework
1	No legal framework

Page 2

5. How would you describe the framework of **regulations** in place to ensure the security of radioactive sources in your country? *(Mark only one response* ☒)

24	Strong regulatory framework
13	Moderate regulatory framework
2	Weak regulatory framework
7	No regulatory framework

6. Which of the following, if any, were used to develop your country's laws or regulations on radioactive sources? *(Mark all that apply* ☒)

44	IAEA Basic Safety Standards
21	IAEA Code of Conduct
22	Legislation from other country(ies)
2	Assistance from another country(ies)
14	Assistance from an international organization
6	Other, please specify: **[If "Other" click here and type]**

7. Are users of ***sealed*** radioactive sources required to secure material in their possession? *(Mark only one response* ☒)

49	Yes
0	No

8. Are users of radioactive sources required to obtain authorization (e.g. a license or permit) in order to use them in your country? *(Mark only one response* ☒)

48	Yes
1	No

Page 3

Agencies regulating radioactive sources

9. Please list the ministries/agencies/bureaus/departments responsible for regulating radioactive sources in your country, and briefly describe their role/responsibility. (If more than 5 agencies, go to the end of the last row in the table below and hit the "tab key" to insert additional rows).

Agency	Responsibility

Inventory of Radiological Sources

10. Has a national registry of radioactive ***sources*** been established or is one in development? (*Mark only one response* ☒)

28	Yes (established)
17	Yes (in development)
3	No (but planning)
1	No (and no plans of developing)

Page 4

11. Has a national registry of ***users*** of radioactive sources been established or is one in development? *(Mark only one response ☒)*

34	Yes (established)
13	Yes (in development)
2	No (but planning)
0	No (and no plans of developing)

12. Please indicate the methods you use to maintain your inventory of radioactive sources and users of radioactive sources. *(Mark all that apply ☒))*

Inventory of Radioactive Sources		Inventory of Users	
33	Notification	29	Notification
30	Registration	27	Registration
41	Licensing	45	Licensing
46	Inspections	46	Inspections
34	Disposal tracking	29	Disposal tracking
41	Import tracking	33	Import tracking
32	Export tracking	26	Export tracking
4	Other:	2	Other:
1	DOES NOT APPLY	1	DOES NOT APPLY

13. Is there a facility in your country for secure storage of **disused** radioactive sources? *(Mark only one response ☒)*

39	Yes
10	No

Page 5

14. Is there a facility in your country for <u>permanent disposal</u> of radioactive sources? *(Mark only one response ☒)*

18	Yes
31	No

15. Has your country <u>received</u> any ***technical*** assistance from other countries or international organizations since ***January 1, 1995*** to improve controls over radioactive sources? *(Mark only one response ☒)*

29	Yes
20	No

16. Has your country <u>received</u> any ***financial*** assistance from other countries or international organizations since ***January 1, 1995*** to improve controls over radioactive sources? *(Mark only one response ☒)*

11	Yes
38	No **(SKIP TO QUESTION #18)**

17. Please indicate the dollar amount (in US dollars) of the financial assistance you <u>received</u> from other countries or international organizations since ***January 1, 1995***.

18. Briefly describe the international assistance (***technical*** and ***financial***) your country received to improve controls over radioactive sources. Please include the names of those countries or international organizations from which you received assistance.

(30 countries provided information)

Page 6

19. Please indicate the extent to which the international assistance to improve controls was useful to your country. *(Mark only one response ☒)*

12	Extremely useful
16	Very useful
4	Moderately useful
0	Somewhat useful
0	Not at all useful
15	Not received

20. Please describe any additional resources your country needs to improve controls over radioactive sources.

(28 countries described additional resources needed)

21. Has your country provided any ***technical*** assistance to other countries or international organizations since ***January 1, 1995*** to improve controls over radioactive sources? *(Mark only one response ☒)*

14	Yes
35	No

22. Has your country provided any ***financial*** assistance to other countries or international organizations since ***January 1, 1995*** to improve controls over radioactive sources? *(Mark only one response ☒)*

4	Yes
45	No (SKIP TO QUESTION #23)

23. Please indicate the dollar amount (in U.S. dollars) of assistance you provided to other countries or international organizations since ***January 1, 1995.***

24. Briefly describe the international assistance (technical and financial) your country provided to other countries to improve controls. Please include the names of those countries or international organizations to which you provided assistance.

(14 countries provided information)

Page 7

Number of Radiological Sources

25. How many of the following radioactive sources are in your country. [if none, please write "0"]

Isotope	Number of Sources
^{113}In (Indium 113)	22
^{125}I (Iodine 125)	60,533
^{137}Cs (Cesium 137)	40,080
^{192}Ir (Iridium 192)	10,350
^{210}Pb (Lead 210)	331
^{226}Ra (Radium 226)	10,344
^{238}Pu (Plutonium 238) including Plutonium Beryllium sources	164,890
^{239}Pu (Plutonium 239) including Plutonium Beryllium sources	232,204
^{241}Am (Americium 241) including Americium Beryllium sources	1,109,898
^{244}Cm (Curium 244)	427
^{252}Cf (Californium 252)	490
^{32}P (Phosphorous 32)	3,096
^{60}Co (Cobalt 60)	27,615
^{75}Se (Selenium 75)	374
^{90}Sr (Strontium 90)	7,281
^{99m}Tc (Technetium 99m)	18,509

26. Please use the space below to explain any answers to the previous question in more detail.

Page 8

Security Risks from Radioactive Sources

27. In your opinion, to what extent do the following sealed radioactive sources represent a security (proliferation) risk in your country? (*Mark only one response* ☒ in each row)

Isotope		Very high risk	High risk	Moderate risk	Some risk	Little to no risk	Not used in this country
^{113}In	(Indium 113)	0	0	0	6	9	29
^{125}I	(Iodine 125)	0	1	4	11	22	6
^{137}Cs	(Cesium 137)	7	16	9	10	5	0
^{192}Ir	(Iridium 192)	5	12	9	8	7	5
^{210}Pb	(Lead 210)	1	0	1	8	13	21
^{226}Ra	(Radium 226)	5	6	4	14	12	3
^{238}Pu	(Plutonium 238)*	2	2	7	8	9	17
^{239}Pu	(Plutonium 239)*	3	4	3	7	7	19
^{241}Am	(Americium 241)**	4	6	11	11	12	1
^{244}Cm	(Curium 244)	1	0	2	5	11	22
^{252}Cf	(Californium 252)	2	0	5	10	12	15
^{32}P	(Phosphorous 32)	0	0	6	6	20	13
^{60}Co	(Cobalt 60)	8	18	6	9	6	0
^{75}Se	(Selenium 75)	1	1	6	6	11	19
^{90}Sr	(Strontium 90)	1	6	13	12	13	2
^{99m}Tc	(Technetium 99m)	1	0	7	12	15	10

*include Plutonium Beryllium sources
**include Americium Beryllium sources

Page 9

28. To what extent is ***intentional misuse*** of radioactive sources a threat in your country? *(Mark only one response ☒)*

2	Very great extent
3	Great extent
12	Moderate extent
5	Some extent
26	Little or no extent

29. To what extent have concerns about the ***intentional misuse*** of radioactive sources in your country increased since the terrorist attacks on the United States on ***September 11, 2001***? *(Mark only one response ☒)*

3	Very great extent
11	Great extent
7	Moderate extent
12	Some extent
15	Little or no extent

30. Briefly describe any significant security incidents involving ***malevolent use*** of radioactive sources that have occurred in your country since ***January 1, 1995***.

(5 countries provided descriptions of incidents)

31. Briefly describe any known cases of illicit trafficking of any radioactive sources that have occurred in your country since ***January 1, 1995***.

(19 countries provided descriptions of incidents)

Page 10

32. To what extent are ***accidents*** involving radioactive sources a problem in your country? *(Mark only one response ☒)*

3	Very great extent
4	Great extent
9	Moderate extent
15	Some extent
18	Little or no extent

33. Briefly describe any significant ***accidents,*** including the economic and social impact of these accidents, involving radioactive sources that have occurred in your country since ***January 1, 1995***. . If possible, please provide an estimate of these costs (in US dollars) to your country.

(14 countries provided descriptions of accidents)

34. To what extent are orphan sources a problem in your country? *(Mark only one response ☒)*

1	Very great extent
5	Great extent
13	Moderate extent
15	Some extent
14	Little or no extent

Inspection

35. Do regulators in your country inspect facilities on a regular basis where radioactive sources are stored or used? *(Mark only one response ☒)*

45	Yes
3	No **(SKIP TO QUESTION #37)**

Page 11

36. What are the enforcement actions inspectors can use to ensure that laws and regulations are followed? *(Mark all that apply ☒)*

3	No enforcement actions available
38	Notice of Violation/Citation
34	Fines
42	License suspension
40	License termination
37	Facility closure
21	Confiscation of source
17	Imprisonment
3	Other, please specify:

Loss, theft, and recovery of radioactive sources

37. Does your country have a mechanism(s) in place to search for **missing** radioactive sources? *(Mark only one response ☒)*

35	Yes
14	No

38. Does your country have a mechanism(s) in place to secure **found** radioactive sources? *(Mark only one response ☒)*

41	Yes
8	No

39. If an orphan source is found, who is responsible for its removal?

(49 countries provided information)

Page 12

40. What ***incentives***, if any, exist to report found sources?

(19 countries reported incentives)

41. What ***disincentives***, if any, exist to reporting found sources?

(6 countries reported disincentives)

42. How many sources have been reported lost or stolen since ***January 1, 1995***, and of this number, how many have been recovered?

	Number Lost/Stolen	Number Recovered
Lost	286	139
Stolen	326	219

Page 13

Sources Produced, Imported, and Exported

43. Please indicate the numbers of the following types of sealed sources produced, imported, and exported in calendar year ***2002***. [If none, please write "0"]

Isotope		Produced	Imported	Exported
^{113}In	(Indium 113)	506	201	6
^{125}I	(Iodine 125)	5,849	27,044	220
^{137}Cs	(Cesium 137)	412	3,363	425
^{192}Ir	(Iridium 192)	3,256	6,886	1,271
^{210}Pb	(Lead 210)	0	9	0
^{226}Ra	(Radium 226)	0	18	3
^{238}Pu	(Plutonium 238)*	0	49	4
^{239}Pu	(Plutonium 239)*	0	14	0
^{241}Am	(Americium 241)**	1,383	2,598,647	4,815
^{244}Cm	(Curium 244)	0	38	0
^{252}Cf	(Californium 252)	0	147	11
^{32}P	(Phosphorous 32)	493	6,311	528
^{60}Co	(Cobalt 60)	2,175	1,127	2,104
^{75}Se	(Selenium 75)	2	162	5
^{90}Sr	(Strontium 90)	6	1,586	95
^{99m}Tc	(Technetium 99m)	11,943	28,140	7,036

*include Plutonium Beryllium sources
**include Americium Beryllium sources

44. Please use the space below to explain any answers to the previous question in more detail.

(In most cases, countries providing information on production, import, or export of technetium-99m reported that sources reported were molybdenum 99 generators of technetium-99m.)

Page 14

Users of radioactive sources

45. Please indicate the number of current user organizations for the applications listed below. Please estimate if necessary. [If none, please write "0"]

Primary Use	# users	# of sources
Academic/Research	2,896	13,193
Analytical Instruments (Gas Chromatographs)	3,220	8,375
Calibration	545	4,586
Fixed Gauges	5,670	24,549
Industrial Radiography	2,332	6,255
Irradiators	198	3,311
Manufacturers Of Devices That Employ Sources	93	392
Manufacturers Of Sources	30	2,151
Medical--Diagnostic	10,905	9,205
Medical--Therapeutic	1,430	4,809
Portable Gauges	2,099	3,424
Self-Luminous Devices (Exit Signs)	75	250
Smoke Detectors	3,017,988	7,722,061
Well-Logging	153	1,321

46. Please use the space below to explain any answers to the previous question in more detail.

Page 15

47. Please indicate whether the users of sealed radioactive sources listed below are subject to (a) notification, (b) registration, or (c) licensing requirements ***by marking an "X" in the appropriate column***. (*Mark all that apply* ☒)

Primary Use	Notification	Registration	Licensing	Not Applicable
Academic/Research	18	16	42	1
Analytical Instruments (Gas Chromatographs)	17	16	24	5
Calibration	17	19	36	3
Fixed Gauges	15	15	38	3
Industrial Radiography	13	12	44	1
Irradiators	13	11	39	5
Manufacturers of Devices That Employ Sources	9	7	30	14
Manufacturers of Sources	8	5	26	19
Medical--Diagnostic	15	16	40	0
Medical--Therapeutic	13	12	45	0
Portable Gauges	12	16	36	3
Self-Luminous Devices (Exit Signs)	9	3	9	25
Smoke Detectors	14	8	8	20
Well-Logging	13	12	38	5

48. Please provide any additional comments you feel are important about issues raised in this survey or other issues related to the control of radiological sources.

(22 countries provided comments)

Thank you very much for participating in this survey!

Page 16

List of Countries Surveyed by GAO and Responses

Table 6 lists all of the countries that we sent surveys to and identifies whether or not they completed the survey when this report was being written.

Table 6: Countries Surveyed and Surveys Received

Country	Completed the survey	Did not complete the survey
Albania	X	
Algeria		X
Angola		X
Argentina		X
Armenia	X	
Australia	X	
Austria		X
Azerbaijan	X	
Bangladesh		X
Belarus		X
Belgium		X
Benin		X
Bolivia		X
Bosnia and Herzegovina		X
Botswana		X
Brazil		X
Bulgaria	X	
Burkina Faso		X
Cambodia		X
Cameroon	X	
Canada	X	
Central African Republic		X
Chile		X
China		X
Colombia	X	
Costa Rica	X	
Croatia		X
Cyprus	X	
Czech Republic	X	
Democratic Republic of the Congo		X

(Continued From Previous Page)

Country	Completed the survey	Did not complete the survey
Denmark	X	
Dominican Republic		X
Ecuador	X	
Egypt		X
El Salvador		X
Eritrea[a]		X
Estonia	X	
Ethiopia		X
Finland	X	
France		X
Gabon		X
Georgia		X
Germany		X
Ghana	X	
Greece	X	
Guatemala	X	
Haiti		X
Honduras[b]		X
Hungary	X	
Iceland	X	
India		X
Indonesia		X
Ireland		X
Israel		X
Italy	X	
Jamaica		X
Japan	X	
Jordan		X
Kazakhstan		X
Kenya		X
Korea (Republic of)		X
Kuwait	X	
Kyrgyzstan[a]		X
Latvia	X	
Lebanon	X	
Liberia		X

(Continued From Previous Page)

Country	Completed the survey	Did not complete the survey
Liechtenstein		X
Lithuania		X
Luxembourg	X	
Macedonia	X	
Madagascar	X	
Malaysia		X
Mali		X
Malta		X
Marshall Islands		X
Mauritius		X
Mexico	X	
Moldova	X	
Monaco		X
Mongolia	X	
Morocco		X
Myanmar		X
Namibia		X
Netherlands		X
New Zealand	X	
Nicaragua		X
Niger		X
Nigeria	X	
Norway	X	
Pakistan		X
Panama		X
Paraguay	X	
Peru		X
Philippines	X	
Poland	X	
Portugal		X
Qatar		X
Romania	X	
Russian Federation		X
Saudi Arabia	X	
Senegal		X
Sierra Leone		X

(Continued From Previous Page)

Country	Completed the survey	Did not complete the survey
Singapore		X
Slovakia	X	
Slovenia		X
South Africa		X
Spain	X	
Sri Lanka		X
Sweden	X	
Switzerland	X	
Tajikistan		X
Tanzania	X	
Thailand		X
Tunisia		X
Turkey	X	
Uganda	X	
Ukraine	X	
United Arab Emirates		X
United Kingdom		X
Uruguay		X
Uzbekistan	X	
Venezuela		X
Vietnam		X
Yemen		X
Yugoslavia	X	
Zambia		X
Zimbabwe		X

Source: GAO.

[a]IAEA membership has been approved by the IAEA General Conference and will take effect once the necessary legal instruments are deposited.

[b]IAEA member state as of March 17, 2003.

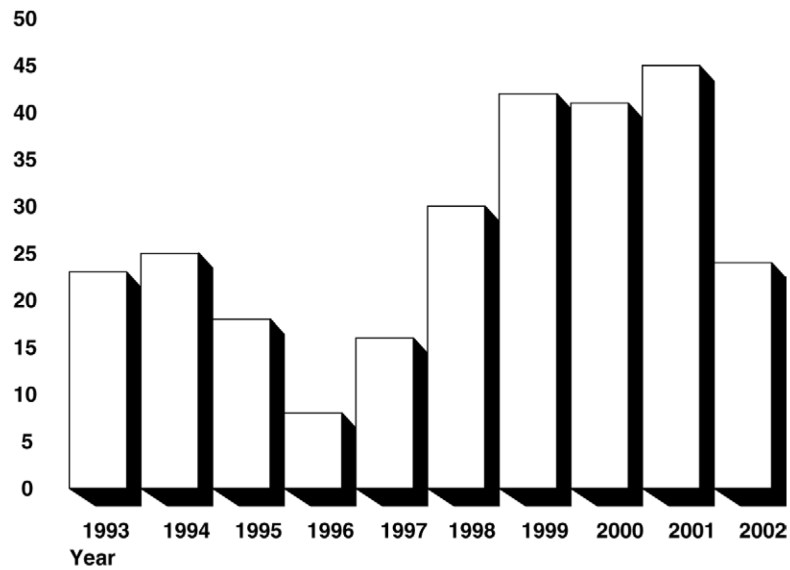
Information on Trafficking Incidents Involving Sealed Sources

This appendix provides information about the illicit trafficking in, or smuggling of, radioactive material over the past decade and focuses primarily on 17 incidents involving sealed radioactive sources. There is sketchy—and sometimes contradictory—information about many of these cases for a number of reasons, including (1) many trafficking incidents are never detected by authorities; (2) some may be known but not reported because the country does not participate in IAEA's Illicit Trafficking Database program; (3) details about these incidents may be considered sensitive by the countries where they occur; and (4) until recently, trafficking of radioactive materials was not considered by U.S. and international nonproliferation experts to be as great a concern as the trafficking of weapons-grade nuclear material. IAEA is encouraging countries to provide more details about all trafficking incidents involving radioactive materials so that better information can be developed and more accurate assessments and analysis can be performed.

Since the early 1990s, there have been numerous reports of illicit trafficking in, or smuggling of, radioactive material worldwide, including sealed sources. According to IAEA, sealed sources, such as cesium-137, cobalt-60, strontium-90, and iridium-192 are considered to pose the greatest security risk. In 1993, IAEA established a database to record incidents involving illicit trafficking in nuclear and radioactive materials. Seventy countries, or about one-half of IAEA's member states, currently participate in the database. As of December 31, 2002, IAEA listed 272 confirmed incidents involving the illicit trafficking of radioactive materials, including sealed sources.[1] According to IAEA, a confirmed incident is one in which the information has been verified to IAEA through official points of contact from the reporting country. Of the 272 confirmed illicit trafficking incidents reported by IAEA, there were 179 incidents with potentially high risk sealed sources that pose the greatest security risks. More than two-thirds of the 179 incidents involving these sources occurred after 1997. Figure 6 depicts the frequency of reported international trafficking incidents involving sealed sources since 1993. Figure 7 provides information on types of sealed sources and other radioactive materials involved in international trafficking incidents.

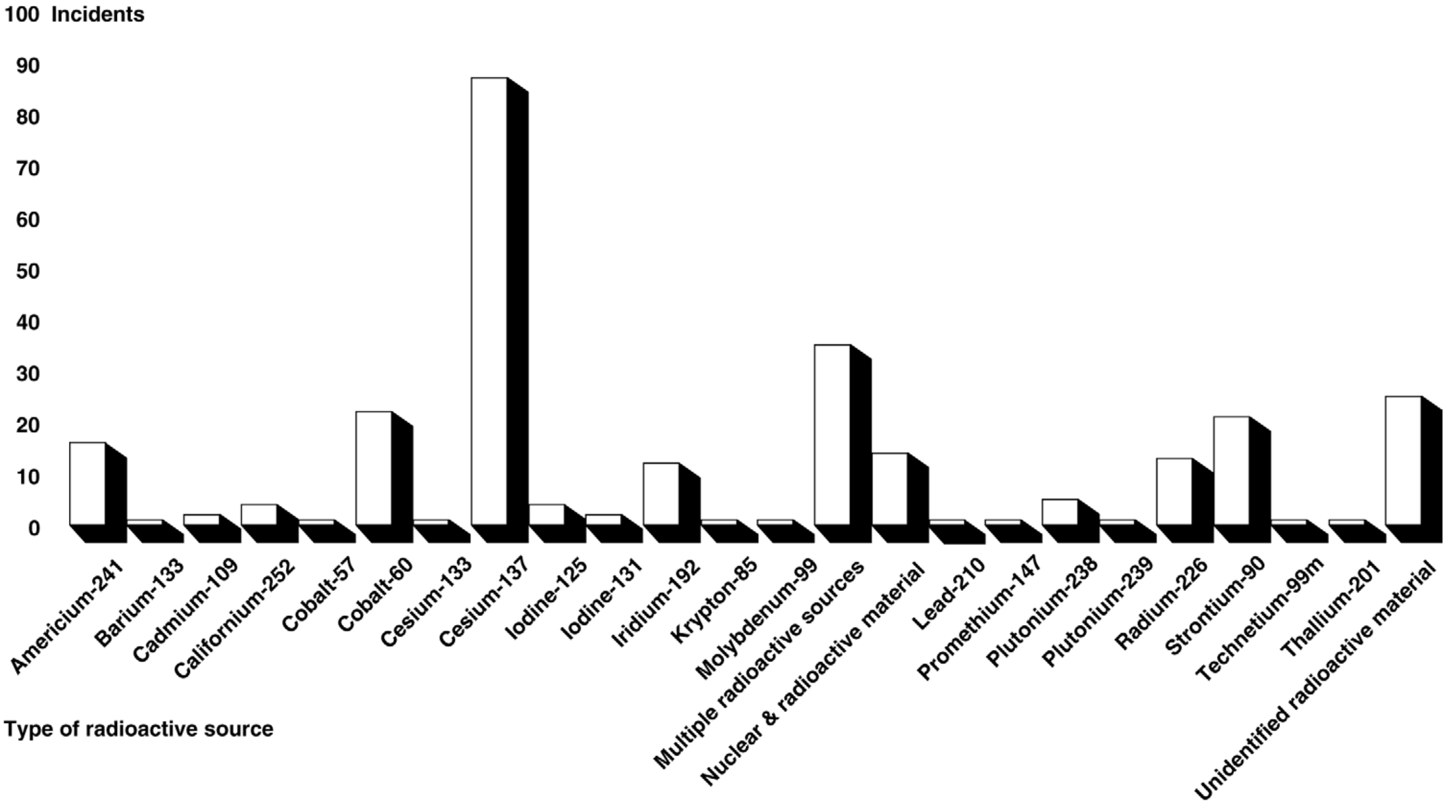
[1]The IAEA database includes incidents since January 1, 1993, that involved radioactive material other than nuclear material. In most cases, the radioactive material was in the form of sealed sources, but some incidents involving unsealed radioactive sources or radioactively contaminated materials, such as contaminated scrap metal, have also been reported to the illicit trafficking database and are included in the statistics.

Figure 6: Reported International Trafficking Incidents Involving Radioactive Sources, 1993-2002



Sources: IAEA (data); GAO (presentation).

Figure 7: Illicit Trafficking Incidents by Type of Radioactive Source, 1993-2002



Sources: IAEA (data); GAO (presentation).

Trafficking Incidents Involving Sealed Sources

Several observations can be made based on the incidents involving the illicit trafficking of sealed sources.

- The majority of the incidents involved deliberate intent to illegally acquire, smuggle, or sell radioactive material. Several other incidents reported, however, do not reflect criminal intent but have resulted from, among other things, the inadvertent transportation of contaminated scrap metal. The unregulated scrap metal industry throughout the former Soviet Union and Eastern Europe poses potential security and safety risks nonetheless because many radioactive sources are stolen for the metal shielding, leaving the source exposed and potentially very dangerous.

- Since the mid-1990s, the trafficking of radioactive materials has generally increased. The increase in illicit trafficking cases may be due, in part, to the increased reporting of these incidents by countries and/or improved radiation detection systems placed at countries' border crossings.

- From 1993 through 1998, trafficking incidents involving radioactive material were primarily reported in Russia, Germany, and Estonia. In the past few years, there appears to have been an increase in trafficking through Ukraine, Bulgaria, and Romania.

- According to the illicit trafficking incidents reported by IAEA, high-risk sealed sources are more likely to be trafficked than weapons-grade fissile material, such as highly-enriched uranium. This is because such sources have numerous beneficial applications and are not as tightly controlled as fissile materials.

IAEA and DOE officials told us that the actual number of trafficking cases involving sealed sources is larger than what is currently being reported because many trafficking incidents are never detected by authorities and many countries are not always willing to share sensitive trafficking information. Another factor that affects the number of confirmed cases reported is the credibility of the information. According to DOE, a significant amount of time and expertise is required to assess a particular incident before it can be deemed credible. Despite difficulties in drawing conclusions from illicit trafficking data, the threat posed by illicit trafficking is a real and growing problem. The Director of IAEA's Office of Nuclear Security also told us that every reported case should be taken seriously. Furthermore, she noted that countries need to report their smuggling incidents more systematically so that better assessments can be performed.

Table 7 provides information about 17 significant cases of illicit trafficking identified by IAEA and others since 1993. A brief discussion of each case follows the table.

Table 7: Significant Seizures of Illicitly Trafficked Sealed Sources Since 1993

Date	Country where material was seized	Material	How material was found
April 1993	Estonia	Cesium-137	Interdiction by police
July 1993	Germany	Strontium-90	Discovered by police investigation
September 1994	Bulgaria	Multiple sources	Discovered by police investigation
October 1994	Romania	Strontium-90	Discovered by police investigation
July 1995	Estonia	Radium-226	Discovered by police investigation
November 1995	Russia	Cesium-137	Tip provided to news reporter
October 1998	Ukraine	Multiple sources	Discovered by customs officials at airport
July 1999	Russia	Californium-252	Discovered by police investigation
August 1999	Turkey	Cesium-137	Discovered by police investigation
September 1999	Ukraine	Strontium-90	Discovered by police investigation
August 1999	Russia	Cesium-137	Discovered by police investigation
February 2000	Ukraine	Strontium-90	Discovered by police investigation
March 2000	Uzbekistan	Radioactively contaminated material	Interdiction at border by customs officials
December 2000	Romania	Multiple sources	Discovered by police investigation
January 2001	Greece	Multiple sources	Discovered by police investigation
January 2002	Belarus	Strontium-90	Discovered by police investigation
May 2002	Bulgaria	Multiple sources	Interdiction by police

Sources: IAEA, Monterey Institute of International Studies Center for Nonproliferation Studies, and Ridgway Center for International Security Studies.

Khohtla-Jarve, Estonia, 1993

This incident involved two men who worked as assistants to an “engine” driver at a mineral fertilizer plant, which is located in Khohtla-Jarve, Estonia. The two men stole a device containing 2.8 grams of cesium-137 and were arrested. According to available information, the suspects intended to sell the cesium to an unspecified buyer.

Saarbrucken, Germany, 1993

In July 1993, German police recovered an unidentified amount of strontium-90 that had been transported from Ukraine. The material, which was packed in small containers, was found by police from information provided by Ukrainian security services. Reportedly, the containers were discovered in three plastic bags after Ukrainian police had told the German police where to find them. Police in Kiev, Ukraine, arrested 17 people in connection with the operation.

Sofia, Bulgaria, 1994

In September 1994, following a 5-day undercover operation, Bulgarian authorities arrested six Bulgarians and confiscated 19 containers of radioactive substances, including plutonium, cesium-137, strontium-90, plutonium-beryllium sources, and thallium-204 that had been stolen from the Izotop Enterprise near the capital, Sofia. According to available information, the theft was made possible by poor security at the laboratory.

Urechesti, Romania, 1994

In October 1994, Romanian authorities arrested three Moldovans, two Jordanians, and two Romanians for trying to sell 7 kilograms of strontium in a lead pipe. One suspect, a former military officer, had smuggled the strontium to Moldova. The material was then passed to intermediaries in the Romanian province of Transylvania, where it was offered to the Jordanians for $400,000.

Tallinn, Estonia, 1995

In July 1995, Estonian security police arrested two Estonians who had radium-226 in their car. According to available information, it was thought that the radium was smuggled into Estonia via middlemen in St. Petersburg, Russia, indicating that more people were probably involved.

Moscow, Russia, 1995

In November 1995, acting on a tip, Russian television reporters discovered a 32-kilogram container, containing cesium-137 and wrapped with explosives, in a Moscow park. According to available information, Chechen separatists were responsible for this incident and had reportedly obtained the radioactive material from either cancer-treatment equipment or an instrument calibration device used in flaw detection equipment. The Chechens threatened to detonate the device if Russia decided to resume combat operations in the region.

Kiev, Ukraine, 1998

In October 1998, a radiation health specialist at a German company that consults on reactor safety was arrested by customs police at Kiev airport in possession of a container of radioactive material from Chernobyl. According to available information, a Russian scientist asked the health specialist to take a metal container holding a small amount of radioactive material out of the country for analysis. Russian officials were unsure of the exact type of material involved, but suspected it contained cesium, strontium, and zirconium.

St. Petersburg, Russia, 1999

In July 1999 Russian law enforcement officials arrested two men who attempted to sell 5 grams of californium-252. One of those arrested, a technician from Murmansk, was approached by a criminal group who enlisted his help to procure californium-252. The technician, who was responsible for removing spent nuclear components from a nuclear-powered icebreaker, smuggled the radioactive material off the icebreaker. Along with an accomplice, the technician packed the californium-252 into a container filled with paraffin, which they placed within a canister of water. After the initial offer from the criminal group fell through, the technician and his accomplice traveled to St. Petersburg in search of another buyer, where they were arrested.

Istanbul, Turkey, 1999

In a joint operation, the Istanbul Organized Crime and Arms Smuggling Office and the National Intelligence Organization arrested five people, one of whom was from the Republic of Georgia, as they tried to sell cesium-137 to policemen acting as buyers in Istanbul in August 1999. The cesium, which was in two separate steel tubes and weighed 49 grams, was smuggled into Turkey from an unknown location.

Uzhgorod, Ukraine, 1999

In September 1999, a Russian citizen was arrested after police officers discovered that he was carrying two containers of strontium-90. The material was discovered on the suspect during a document check by Ukrainian police. It is believed that the suspect was taking the radioactive materials from Russia to Western Europe. The suspect was in possession of a number of forged documents, including a forged diplomatic identification card.

Volgograd, Russia, 1999

In August 1999, Russian security police recovered six containers of cesium-137, which were stolen from a Volgograd oil refinery in May 1998. Earlier efforts to locate the stolen containers, including the establishment of checkpoints with radiation monitors on local roads, had proven fruitless. According to reports, the thieves had hidden the stolen cesium containers to avoid this police dragnet and hoped to sell the material after the search for it had finally been abandoned.

Donetsk, Ukraine, 2000

In February 2000, A Ukrainian law enforcement unit confiscated 27 containers of strontium-90. Five individuals were reportedly involved in the illegal trafficking of this material. The group allegedly tried to contact foreign buyers, who were in fact members of the law enforcement unit. The radioactive material was reportedly stolen from a military unit deployed in the region and was stored in an apartment. Reports stated that the individuals were attempting to sell the 27 containers for $168,000.

Beshkoprik, Uzbekistan, 2000

In March 2000, Uzbekistan customs officers seized an Iranian-registered truck on the Kazakhstan-Uzbekistan border about 20 kilometers from Tashkent, the capital of Uzbekistan, after discovering it contained highly radioactive material. Kazakhstan customs officials had cleared the truck and issued a certificate indicating that it had passed radiation screening. Uzbekistan officials determined that the level of gamma radiation emitted by the cargo was 100 times over the acceptable level. Uzbekistan customs officials then returned the truck to their Kazakhstani counterparts. The destination listed on the truck's manifest was Quetta, Pakistan, and some reports speculated that the incident involved efforts to smuggle radioactive material intended for use by terrorist groups to build a radiological weapon.

Piatra Neamt City, Romania, 2000

In December 2000, five suspects were arrested while trying to sell 1 kilogram of radioactive material (strontium, plutonium, and cobalt), to undercover police officers posing as prospective buyers of radioactive material. The suspects included a former officer of an antiorganized crime police unit in Moldova and four Romanians who were bodyguards in charge of protecting the shipments and who were responsible for organizing the sale of the materials.

Thessaloniki, Greece, 2001

In January 2001, Greek law enforcement officials uncovered several hundred metal “wafers” of commercially available alpha-emitting ionization sources, containing a total of 3 grams of plutonium and americium. The cache was found buried in a forest 12 kilometers from Thessalonki. The sources were believed to be smuggled from Eastern Europe, and there was speculation about organized criminal involvement in the smuggling of these sources. An investigation was launched, but to date, there have been no publicly released results.

Minsk, Belarus, 2002

In January 2002, police in Minsk, Belarus, arrested two persons in connection with an attempt to sell four sealed sources of strontium-90 that one of the suspects had been storing in his apartment. One of the suspects had stolen the sources 4 years earlier during his military service, and the other was arrested while trying to sell them.

Veliko Tarnova, Bulgaria, 2002

In May 2002, Bulgarian authorities seized 101 plutonium sources and an americium-beryllium source from a vehicle near Veliko Tarnova. The sources were detected when police officers stopped a taxi with four individuals during a routine inspection. Thirty-nine of the plutonium sources had certificates indicating that they had been manufactured in 1990 by Izotop-Moscow and had been ordered for a ferryboat station in Varna. Because the 10-year guaranteed service life of the sources had expired, it is possible that the sources were diverted after they had been removed from service for disposal.

Information About Accidents Involving Sealed Sources

According to IAEA and the World Health Organization, there have been more than 100 accidents involving sealed sources over the past 50 years. Many of these accidents have been small and resulted in few injuries. The actual number of accidents worldwide is unknown because many countries do not report or record such events. This appendix describes 10 accidents that occurred since the early 1980s. Although these accidents were not the result of malevolent actions, they are useful in gaining a better understanding of the potential consequences following the loss of control of sealed sources.

We have included, to the extent that it was available, information on the economic impacts of the accidents. The costs associated with lost equipment, damage to property, and the disposal of radioactive waste can be very significant. The cost components associated with radiological accidents include

- medical treatment of exposed individuals;
- radiation surveillance, including searching for lost sealed sources and contaminated areas;
- decontamination and dismantling of contaminated buildings and property,
- loss of production capacity;
- radioactive waste management and disposal;
- monetary compensation to individuals who received excessive doses of radiation;
- rebuilding or possible relocation costs; and
- effects on international trade.

Nonmonetary impacts may include:

- loss of public confidence and credibility in the government, and
- public questions about all uses of ionizing radiation.

Table 8 provides information about 10 significant cases of accidents identified by IAEA and the World Health Organization since 1983. A brief discussion of each case follows the table.

Table 8: Selected Accidents Involving Sealed Sources Since 1983

Year	Location	Type of sealed source involved	Number of significant exposures	Number of related deaths	Associated costs
1983	Juarez, Mexico	Cobalt-60	80	0	$34 million
1984	Morocco	Iridium-192	11	8	Unknown
1987	Goiania, Brazil	Cesium-137	50	4	$36 million
1994	Tammiku, Estonia	Cesium-137	3	1	Unknown
1996	Gilan, Iran	Iridium-192	1	0	Unknown
1997	Lilo, Georgia	Cesium-137	11	0	Unknown
1998	Los Barrios, Spain	Cesium-137	6	0	$28 million
1999	Yanango, Peru	Iridium-192	1	0	Unknown
2000	Samut Prakarn, Thailand	Cobalt-60	10	3	Unknown
2001	Lja, Georgia	Cesium-137	2	0	Unknown

Sources: IAEA and the World Health Organization.

Juarez, Mexico, 1983

A teletherapy unit containing a cobalt-60 source was purchased and imported by a Mexican hospital without compliance with existing import requirements. After the unit was stored for 6 years in a warehouse, its scrap value attracted the attention of a maintenance technician. The technician dismantled the unit and removed the cylinder containing the sources and other metal parts. He then loaded them into a pickup truck, drove to a junkyard, and sold the parts as scrap. Before arriving at the junkyard, he ruptured the sealed cobalt source, dispersing about 6,000 tiny pellets of cobalt-60 in the truck bed.

When cranes moved the ruptured cylinder, the cobalt-60 pellets were spread over the junkyard and mixed with other metal materials. Consequently, pellets and pellet fragments were transferred to vehicles used for transporting the scrap to various foundries. The technician's pickup truck remained parked on the street for 40 days and was then moved to another street, where it remained for an additional 10 days. An unknown number of people passed by the truck each day and children used it as a play area. It was later discovered that contaminated scrap metal from the junkyard had been used to manufacture reinforcing rods and metal table bases. A truck transporting contaminated rods passed near a DOE national laboratory, where radiation detectors indicated the presence of radioactivity. Two days later, the authorities ascertained the origin of the contaminated rods.

U.S. and Mexican officials spent an estimated $34 million to track, recover, and secure these radioactive products. An extensive investigation showed that 30,000 tables and 6,000 tons of reinforcing rods had been made from the contaminated material. In addition, 814 buildings were partly or completely demolished because the radioactivity in the reinforcing rods resulted in higher-than-acceptable levels of radiation. The accident exposed 4,000 people to radiation, and 80 people received significant doses. Table 9 provides a breakdown of the estimated costs associated with the accident.

Table 9: Estimated Costs Related to the Accident in Mexico

Dollars in thousands

Action taken	Cost
Transport and disposal of contaminated material	$15,640
Demolition and reconstruction to remove contaminated reinforcement bars in buildings	8,500
Loss of production capacity	3,740
Value of contaminated material	2,040
Technical and operational personnel and equipment	680
Security and surveillance by police and army forces, and legal or political problems	3,400
Total	**$34,000**

Source: IAEA.

Morocco, 1984

In 1984, iridium-192 sources were being used to radiograph welds in a fossil-fuel power plant under construction. One of these sources dropped to the ground from a radiography camera, where a passerby picked it up and took it home. The source was lost from March to June 1984 and, as a result, eight persons died from overexposure to radiation. In addition, three others suffered severe injuries from overexposure that required hospitalization. It was initially assumed that the deaths were from poisoning. Only after the last family member died was it suspected that the deaths might have been caused by radiation.

Goiania, Brazil, 1987

A private radiography institute moved to new premises and left behind a cesium-137 teletherapy unit without notifying the licensing authority. Because the building was partially demolished, the teletherapy unit was unsecured. Two people entered the building and removed the source assembly. They dismantled the source assembly at home and ruptured the sealed source. After the sealed source was ruptured, remnants of the source assembly were sold for scrap to a junkyard owner. He noticed that the material had a blue glow in the dark. Over a period of days, friends and relatives came to witness the phenomenon. Fragments of the source, the size of rice grains, were distributed to several families. Five days later, a number of persons started to show gastrointestinal distress.

Because the sealed source contained cesium chloride, which is highly soluble and easily dispersed, there was considerable contamination of the environment, resulting in external irradiation and internal contamination of several persons. Some individuals suffered very high internal and external contamination because of the way they had handled the cesium chloride powder, such as rubbing it on their skin, eating with contaminated hands, and handling various objects. Consequently, four people died within 4 weeks of being hospitalized. In total, 249 people were contaminated, and 112,000 people were screened for contamination.

The environment was also severely contaminated. Eighty-five houses were significantly contaminated, and 41 of these had to be evacuated. The decontamination process required the demolition of seven residences and various other buildings and generated 3,500 cubic meters of radioactive waste.

The accident had a great psychological impact on the whole region. Many people feared contamination, irradiation, and incurable diseases. Over 8,000 persons requested monitoring for contamination in order to obtain certificates stating that they were not contaminated. These were needed because operators of commercial airplanes and buses refused to allow people from the region to board and hotels refused to register them. The social and psychological impact of the accident was so great that an outlying region to Goiania, where the waste repository was established, has incorporated the trifoil symbol of radioactivity into the region's flag.

Economically, there was discrimination against products from Goiania, resulting in a 20 percent decrease in the sales of cattle, grains, and other agricultural products from the region. Tourism decreased virtually to zero and the gross domestic product for the region decreased by 15 percent. It took 5 years for the gross domestic product to return to preaccident levels. In total, the direct and indirect costs for emergency response and remedial action are estimated to be $36 million.

Figure 8: Contaminated Radioactive Debris from Demolished Residences in Goiania

Source: International Atomic Energy Agency.

Tammiku, Estonia, 1994

In October 1994 a sealed source that was discovered in scrap metal was recovered and transferred to a radioactive waste repository under the supervision of the national government. Three brothers entered the repository without authorization and removed a metal container enclosing a cesium-137 source and the source fell out of the container. One of the men placed the source in his pocket and took it home. The source remained in the house for 27 days, resulting in the overexposure of five individuals, including one fatality. The sealed source was thought to be part of a gamma irradiator, but none had ever been used or registered in Estonia. According to available information, it is possible that the source was brought into Estonia from the Russian Federation with miscellaneous scrap metals for export to Western Europe.

Gilan, Iran, 1996

At a combined cycle fossil fuel power plant in Iran, radiography equipment with an iridium-192 sealed source was used to examine welds from a boiler. At the end of the radiographer's shift, the source became detached from its drive cable and fell to the floor unnoticed. Later, a worker moving thermal insulation materials around the plant noticed a shiny, pencil-sized metal object in a trench and put it in his pocket. The source was in his chest pocket for approximately two hours, resulting in a high radiation dose. As a result of this exposure, the worker had abnormal redness of the skin, severe bone marrow depression, and an unusually extended radiation injury requiring plastic surgery.

Lilo, Georgia, 1997

Eleven border frontier guards became ill owing to exposure from multiple radioactive sources, including 12 cesium-137 sources, one cobalt-60 source, and 200 radium-226 sources. These sources were abandoned when the military site was transferred from the Soviet Union to the Republic of Georgia. All individuals suffered from skin ulcerations and chronic radiation sickness. No deaths were associated with this accident.

Figure 9: Location Where Sealed Sources Were Found, Lilo, Georgia

Source: International Atomic Energy Agency.

Los Barrios, Spain, 1998

In May 1998, a cesium-137 source was accidentally melted at a stainless steel factory. As a result of the periodic maintenance and cleaning of the filter system at the factory, the dust was removed, and much of it was sent to two different factories several hundred kilometers from the factory. The dust was contaminated with cesium-137, and about 400 people were monitored for contamination. Measurements of a large number of water, air, and soil samples were obtained from nearby towns and at locations several hundred kilometers away. Traces of cesium-137 were found but considered negligible. In countries outside of Spain, the environmental impact was minimal. The economic consequences of the accident, including temporary suspension of factory operations, decontamination operations, and management of the resulting radioactive waste, were estimated to be over $25 million.

Yanango, Peru, 1999

In February 1999 an iridium-192 source fell out of a radiography camera being used at a hydroelectric power plant. Later that day, a welder picked up the iridium-192 source and placed it in the right back pocket of his trousers. For the next several hours, the welder continued his work and later took a minibus home with 15 other people onboard. Once home, the welder's wife fed their 18-month-old child while she was sitting on the welder's trousers, and two other children were 2-3 meters from the iridium source for approximately 2 hours. The welder received extensive radiation burns that required the amputation of his right leg. The wife suffered lesions on her lower back after her brief exposure to the sealed source. No radiation effects were reported for the children.

Samut Prakarn, Thailand, 2000

A company in Bangkok, Thailand, possessed several teletherapy devices containing cobalt-60 without authorization from the Thailand Office of Atomic Energy for Peace. The teletherapy device was originally installed at a hospital in Bangkok, Thailand, in 1969. In 1981, a new source was installed, and the hospital received no further maintenance from the manufacturer of the teletherapy unit and source. When the teletherapy unit was removed from service in 1994, the maintenance contractor had gone bankrupt and the manufacturer was no longer producing cobalt-60 units. As a result, the hospital was left with the disused source to manage and control. Since the hospital did not have sufficient storage space, it sold the device and source to a new supplier without the authorization of the regulatory authority. In 1999 the new supplier was notified that its lease of the warehouse was to be terminated and relocated the device to a parking lot that was owned by its parent company.

In the autumn of 1999, the company relocated the teletherapy devices to an unsecured storage location without the authorization of the national regulatory authority. In late January 2000, several individuals obtained access to the unsecured storage location and partially disassembled the teletherapy device. The individuals took the unit to a residence and attempted to disassemble it further.

In early February 2000, two individuals took the disassembled device to a junkyard in Samut Prakarn, Thailand, to segregate component metals and sell them separately as scrap. While a junkyard worker was disassembling the device, the cobalt-60 source fell out of its housing unobserved by the junkyard workers or the individuals. By the middle of February 2000, several of the people involved, including the finders of the source and junkyard workers, had begun to feel ill and sought medical assistance. Physicians at the hospital suspected the possibility of radiation exposure and reported their suspicions to the regulatory authority. Altogether, 10 people received high doses of radiation from the source. Three of those people, all workers at the junkyard, died within 2 months of their exposure.

Lja, Georgia, 2001

In December 2001 three woodsmen found two heat-emanating metallic containers near their campsite in a forest near the village of Lja in western Georgia. This village is in the Abkhazia region of the Caucasus. This region is subject to political unrest and has sought its independence from the Republic of Georgia. As a result, during the past decade, the region has been largely inaccessible to Georgian and international authorities. The woodsmen involved in the accident used the containers as a heat source and experienced nausea, vomiting, and dizziness within hours of exposure to the containers. At a local hospital in Tbilisi, Georgia, the woodsmen were diagnosed with radiation sickness and severe radiation burns, and at least two of the three were in serious condition. In February 2002, an IAEA-sponsored search and recovery team found the containers and discovered that each one was previously used in Soviet-era radioisotope thermoelectric generators.

Information on Producers and Distributors of Radioactive Material

This appendix provides information about the major producers and distributors of radioactive material used to manufacture sealed sources. Six countries are the major suppliers of the radioactive material: Argentina, Belgium, Canada, the Netherlands, Russia, and South Africa. Canada is the largest exporter of radioactive material and has provided over half of all radioactive material used in medical applications worldwide. Table 10 lists the major producers and distributors of radioactive material used to manufacture sealed sources.

Table 10: Major Producers and Distributors of Radioactive Material Used to Manufacture Sealed Sources

Country	Major organizations producing and/or distributing sources
Argentina	National Atomic Energy Commission and INVAP S.E.
Australia	Australian Nuclear Science and Technology Organization
Belgium	National Institute for Radio Elements and Belgian Nuclear Research Centre
Brazil	Instituto de Pasquisas Energeticas Nucleares
Bulgaria	Institute for Nuclear Research and Nuclear Energy
Canada	Atomic Energy of Canada, Ltd., and MDS Nordion
China	China Isotope Corporation and Nuclear Power Institute of China
Czech Republic	Nuclear Research Institute
Denmark	Risoe National Laboratory
France	CIS Bio International Commissariat A L'Energie Atomique Centre D'Etudes De Valduc
Germany	AEA Technology QSA, GmbH., Chemotrade, Isotope Products Europe Blaseg, GmbH., and STS—Steuerungstechnik & Strahlesnschutz GmbH
Hungary	Atomic Energy Research Institute and Institute of Isotopes Co., Ltd.
India	Bhabha Atomic Research Centre
Indonesia	National Nuclear Energy Agency
Japan	Japan Atomic Energy Research Institute and Institute for Atomic Energy Rikkyo University
Malaysia	Malaysian Institute for Nuclear Technology Research
Netherlands	I.D.B. Holland B.V.
Russia	Atomenergoexport, Institute of Physics and Power Engineering, Kurchatov Institute, Mayak Production Association, Scientific and Research Institute of Atomic Reactors, and St. Petersburg Institute of Nuclear Physics
South Africa	South African Nuclear Energy Corporation
South Korea	Korea Atomic Energy Research Institute
Sweden	Studsvik AB

(Continued From Previous Page)

Country	Major organizations producing and/or distributing sources
United Kingdom	Ametek Advanced Measurement Technology, Nycomed Amersham, and Reviss Services Limited
United States	Department of Energy
Uzbekistan	Institute of Nuclear Physics

Sources: IAEA and Monterey Institute of International Studies Center for Nonproliferation Studies.

The Nuclear Regulatory Commission's Policy on Exports of Sealed Sources

In most cases, the Nuclear Regulatory Commission grants a general license for the export of sealed sources to all countries containing byproduct material except certain proscribed countries: Cuba, Iran, Iraq, Libya, North Korea, and Sudan. Byproduct material is (1) any radioactive material (except special nuclear material) yielded in, or made radioactive by, exposure to the radiation incident to the process of producing or using special nuclear material (as in a reactor) and (2) the tailings, or wastes produced by the extraction or concentration of uranium or thorium from ore.

According to NRC, limited quantities of sealed sources can also be exported under a general license to "restricted" countries: Afghanistan, Andorra, Angola, Burma, Djibouti, India, Israel, Oman, Pakistan, and Syria. A general license, provided by regulation, grants authority to a person for certain activities, in this case, the export of sealed sources, and is effective without filing an application with NRC or the issuance of a licensing document to the person or organization exporting the sealed source. NRC has placed most sealed sources for export under a general license for several reasons, including the following: (1) subject to NRC or Agreement State[1] oversight, the United States is responsible only for ensuring the safe use and control of radioactive materials used to manufacture sealed sources within U.S. territory; (2) foreign countries have the sovereign responsibility for ensuring appropriate regulatory controls over radioactive material, including such material imported from other countries; and (3) control over radioactive material would not be enhanced by requiring specific licenses for material exported from the United States. A specific license would not ensure that the exported materials would be subject to controls and regulatory oversight in a foreign country because the license does not ensure that the recipient country has adequate regulatory controls over the material that is exported from the United States. Under a specific license, the export request must be reviewed and approved by NRC in consultation with other appropriate agencies, including the Departments of Commerce, State, Defense, and Energy.

NRC officials told us that they are required only to maintain a database of exports of sealed sources that are issued under a specific license and certain other exports of concern, such as americium-241 and neptunium-

[1]A U.S. state that has signed an agreement with NRC under which the state regulates the use of by-product and other materials within that state. Currently, there are 32 U.S. Agreement States.

237. The United States, as a nuclear weapon state, has agreed to report all exports of americium and neptunium to IAEA. With regard to shipments of sealed sources, NRC officials told us that the Department of Homeland Security's Bureau of Customs and Border Protection maintains a database of all transactions, identified by tariff number, including those including sealed sources that are exported under a general license. However, these officials also said that it would be very difficult for the Bureau of Customs and Border Protection to track these specific shipments of sealed sources because the information on manifests is general in nature.

NRC officials told us that they were not aware of any sealed sources that were exported under a general license from the United States that have been used for malicious purposes. They noted that there have been thousands of such exports, most of which involve material in forms or quantities that pose minimal safety or health risks if properly used and controlled. However, there have been a few cases where lax local regulatory oversight over high-risk materials resulted in instances where sealed sources were eventually lost or improperly disposed of, resulting in harmful exposure to individuals.

Specific licenses are required to export radioactive material in waste and tritium for recovery and recycling purposes. This is because a final NRC rule (59 F.R. 48994), effective November 10, 1994, revoked the general license for bulk tritium and alpha-emitting radionuclides having an alpha half-life of 10 days or greater but less than 200 years to conform NRC's regulations to the export control guidelines of the Nuclear Suppliers' Group[2] for nuclear-related, dual-use items. Tritium and reactor-produced alpha-emitting radionuclides are two commodities on the Nuclear Suppliers' Groups dual-use list whose exports are regulated by NRC. In addition, tritium and alpha-emitting radionucliedes are controlled by the Nuclear Suppliers' Group because of their potential application in the production of weapons of mass destruction.

Another final rule on the import and export of radioactive material (60 F.R. 37556), effective August 21, 1995, established specific licensing requirements for the import and export of radioactive material in the form of waste coming into or leaving the United States to conform with NRC's

[2]The Nuclear Suppliers' Group consists of 30 nuclear supplier countries and seeks to control exports of nuclear materials, equipment, and technology, both dual-use and specially designed and prepared.

regulations to the guidelines of the IAEA Code of Practice on the International Transboundary Movement of Radioactive Waste.

In view of increased post-September 11 terrorism concerns, NRC is considering changes to its general license provisions to improve controls over exports. Possible changes include (1) ensuring that the exporter confirm that the customer in the foreign country is authorized by the recipient country to possess the material; (2) requiring prior notification to NRC for risk-significant shipments; and (3) as appropriate, providing national or international source registries with data for risk-significant shipments. Changes under consideration are expected to be implemented in fiscal year 2004 by orders with compensatory measures and in fiscal years 2004-2005 by a rule change as part of a broader NRC plan to improve controls over the imports and exports of sealed sources. Other possible and more restrictive controls for exports include a requirement for a specific export license for high-risk material such as high-activity cobalt-60 sources or imposing a specific prohibition on such exports to countries that do not have acceptable sealed source security, control, and accountability requirements. The United States is coordinating these efforts with other countries that export sealed sources to ensure consistent, adequate controls. In addition, in conjunction with the change of the national threat level to "orange" in March 2003, NRC issued a security advisory to licensees concerning certain quantities of certain high-risk sources, which included exports and imports.

Results of the International Conference on the Security of Radioactive Sources

This appendix provides information concerning several key findings and recommendations from the international conference on the security of radioactive sources held in Vienna, Austria, in March 2003. The conference was sponsored by the governments of the United States and the Russian Federation and hosted by the government of Austria. It was organized by IAEA in cooperation with the European Commission, the World Customs Organization, the International Criminal Police Organization, and the European Police Office. Over 700 delegates from more than 120 countries attended the conference.

The conference produced key findings in the following areas: (1) identifying, searching for, recovering, and securing high-risk radioactive sources; (2) strengthening long-term control over radioactive sources; (3) interdicting illicit trafficking; (4) planning the response to radiological emergencies arising from the malevolent use of radioactive sources; and (5) recognizing the role of the media/public education, communication, and outreach.

Regarding identifying and searching for sources, the conference encouraged countries to

- develop and implement national action plans, on the basis of their own specific conditions, for locating, searching for, recovering, and securing high-risk radioactive sources;
- accelerate the establishment of a coherent and transparent scheme for the categorization of radioactive sources in order to provide for the safety and security of sources; and
- assist other countries, as appropriate, in identifying, searching for, recovering, and securing high-risk sources.

Concerning strengthening long-term control over radioactive sources, the conference encouraged countries to

- formulate and implement national plans for the management of sources throughout their life cycle;
- develop, to the extent practical, standards for the design of sealed sources and associated devices that are less suitable for malevolent use (e.g., alternative technologies and less-dispersible forms of high-risk sources); and

- establish arrangements for the safe and secure disposal of disused high-risk sources, including the development of disposal facilities.

Regarding illicit trafficking, the conference recognized the need for greater international efforts to detect and interdict the illicit trafficking of high-risk sources and to take appropriate enforcement actions. In support of this objective, the conference encouraged countries to

- further develop and strengthen measures to detect, interdict, and respond to the illicit trafficking of high-risk radioactive sources;
- deploy and widely use technologies for detecting high-risk radioactive sources, with emphasis on ensuring the sustainability of monitoring and detection equipment;
- undertake further research on and development of detection technologies for use at borders and elsewhere;
- enhance cooperation between government agencies responsible for preventing, detecting, and responding to illicit trafficking incidents, especially in the fields of information sharing, communications, and training;
- pool resources through, for example, the sharing of monitoring and detection equipment on common borders; and
- continue support for and development of IAEA's illicit trafficking database.

The conference recommended that countries develop comprehensive plans to prepare for and respond to radiological emergencies involving radioactive sources. In support of this recommendation, the conference encouraged countries to, among other things,

- enhance current national and international response arrangements, taking into account the need to respond both proactively and reactively to the new scenarios presented by the possibility of the malevolent use of high-risk radioactive sources and
- consider establishing mechanisms to facilitate effective coordination in the event of a radiological emergency.

Finally, the conference recognized that the public's understanding of the nature and consequences of radiological emergencies will largely determine how the public reacts to such emergencies. As a result, the conference encouraged countries to

- conduct public outreach and awareness programs to foster a better understanding of radiological threats and the appropriate response in the event of a radiological emergency in order to minimize social and economic disruption;
- educate the public regarding the nature of radioactivity, the consequences of the malevolent uses of high-risk radioactive sources, and the procedures for mitigating those consequences in order to reduce the psychological impact of radiological terrorism;
- strengthen their education and training programs as a means to promote confidence building within the public; and
- assume greater responsibility for gaining the trust of the media and informing them about the potential threat of radiological terrorism to help ensure that the media will communicate information accurately in a nonsensational manner to avoid fueling public fear and panic.

Information on IAEA's Revised Categorization of Radioactive Sources

The purpose of IAEA's Categorization of Radioactive Sources is to provide a fundamental and internationally harmonized basis for risk-informed decision making. The draft document provides a categorization for radioactive sources used in industry, medicine, agriculture, research, and education. The principles of the categorization can be equally applied to radioactive sources, such as radioisotope thermoelectric generators that may be under military control. The categorization does not apply to radiation-generating devices such as X-ray machines and particle accelerators, although it may be applied to radioactive sources produced by, or used as, target material in such devices. The revised categorization divides sources into five categories, according to their potential to cause harmful health effects, should the source not be managed safely and securely. The categories are defined as follows:

- Category 1 sources are considered extremely dangerous. If not safely managed safely, the radioactive material would likely cause permanent injury to a person who handled it or were otherwise in contact with it for more than a few minutes. It would probably be fatal to be close to this amount of unshielded material for a period of a few minutes to an hour. Furthermore, the amount of radioactive material, if dispersed by fire or explosion, could possibly—but would be unlikely to—permanently injure persons in the immediate vicinity or be life threatening to them. There would be little or no risk of immediate heath effects to persons beyond a few hundred meters. It would be highly unlikely for a category 1 source to contaminate a public water supply to dangerous levels, even if the radioactive material were highly soluble in water.

- Category 2 sources are also considered personally dangerous. If not safely managed or securely protected, the radioactive material could cause permanent injury to a person who handled it or were otherwise in contact with it for a short time (minutes to hours). It could possibly be fatal to be close to this amount of unshielded radioactive material for a period of hours to days. The amount of radioactive material, if dispersed by fire or explosion, could possibly—but would be very unlikely to—permanently injure or be life threatening to persons in the immediate vicinity. It would be virtually impossible for a category 2 source to contaminate a public water supply to dangerous levels, even if the radioactive material were highly soluble in water.

- Category 3 sources are also considered to be dangerous. If not safely managed or securely protected, the radioactive material could cause permanent injury to a person who handled it or were otherwise in contact with it, for some hours. It could possibly—although it is unlikely—be fatal to be in close contact to this amount of unshielded radioactive material for a period of days to weeks. The amount of radioactive material, if dispersed by fire or explosion, could possibly—but is extremely unlikely to—permanently injure or be life threatening to persons in the immediate vicinity. It would be virtually impossible for a category 3 source to contaminate a public water supply to dangerous levels, even if the radioactive material were highly soluble in water.

- Category 4 sources are unlikely to be dangerous. It is very unlikely that anyone would be permanently injured by this amount of radioactive material. This amount of radioactive material, if dispersed by fire or explosion, could not permanently injure persons.

- Category 5 sources are not considered dangerous. No one could be permanently injured by this amount of radioactive material. Furthermore, this amount of radioactive material, if dispersed by fire or explosion, could not permanently injure persons.

IAEA has developed a list on the basis of practices (such as irradiators, industrial radiography, and teletherapy) as part of its relative ranking of sealed sources. Examples of the most dangerous (category 1) include radioisotope thermoelectric generators, sterilization and food preservation facilities containing cobalt-60 or cesium-137, and medical equipment containing cobalt-60. The least dangerous (category 5) include low-dose-rate brachytherapy devices and lightning detectors containing americium-241.

Countries Participating in IAEA's Model Project Program

Table 11 provides a list of the countries participating in IAEA's model project program and the year they joined the program.

Table 11: Countries Participating in IAEA's Model Project Program

Country	Year joined the program
Albania	1996
Algeria	2002
Angola[a]	2001
Armenia	1996
Azerbaijan	2003
Bangladesh	1996
Belarus[b]	1996
Benin[a]	2003
Bolivia	1996
Bosnia and Herzegovina	1996
Bulgaria	2001
Burkina Faso[a]	2001
Cameroon[a]	1996
Central African Republic[a]	2003
China	2001
Columbia	1998
Costa Rica	1996
Croatia	2001
Cyprus	1996
Democratic Republic of the Congo[a]	1996
Dominican Republic	1996
Ecuador	2000
Egypt	2001
El Salvador	1996
Ethiopia	1996
Estonia	1996
Gabon[a]	1996
Georgia	1997
Ghana	1996
Guatemala	1996
Haiti	1999
Hungary	2001

(Continued From Previous Page)

Country	Year joined the program
Indonesia	2001
Iran	2001
Ivory Coast[a]	1996
Jamaica	1997
Jordan	1997
Kazakhstan	1996
Kenya	2001
Kuwait	2001
Latvia	1996
Lebanon	1996
Libya	2001
Lithuania	1996
Macedonia	1996
Madagascar	1996
Malaysia	2001
Mali[a]	1996
Malta	2001
Mauritius[a]	1996
Moldova	1996
Mongolia	1996
Morocco	2001
Myanmar	1996
Namibia[a]	1996
Nicaragua	1996
Niger[a]	1996
Nigeria[a]	1996
Pakistan	2001
Panama	1996
Paraguay	1996
Philippines	2001
Portugal	2001
Qatar	1996
Romania	2001
Saudi Arabia	1996
Senegal[a]	1996
Sierra Leone[a]	1996
Singapore	2001

(Continued From Previous Page)

Country	Year joined the program
Slovenia	2001
South Africa	2002
Sri Lanka	1996
Sudan	1996
Syria	1997
Tajikistan	2002
Tanzania	2001
Thailand	2001
Tunisia	2001
Turkey	2001
Uganda[a]	1996
United Arab Emirates	1996
Uruguay	2000
Uzbekistan	1996
Venezuela	2002
Vietnam	1996
Yemen	1996
Yugoslavia	2003
Zambia	2002
Zimbabwe[a]	1996

Source: IAEA.

[a]These countries are participating only in milestones 1 and 2 of the model project program.

[b]Belarus completed the program in 2000.

France's System for Controlling Sealed Sources

French officials told us that their system for controlling sealed sources has several key components, including stringent controls on the licensing and tracking of the sources. Distributors of devices containing sealed sources must be authorized to market such devices and must send monthly accounts of the movement of sources to the French government agency responsible for regulating sealed sources. End users must have a license covering each site where the sources are used, and the maximum duration of a license is 5 years. For items such as smoke detectors, the end user is not required to have a license, but the distributor must be licensed. Approximately 30,000 sources in use in France are tracked by the government, and there are nearly 5,000 licensees. This number does not include very small sources like iodine grains used for medical purposes (there are about 80,000 such sources) and smoke detectors (for 400,000 buildings), which are exempt from licensing requirements for end users.

Sealed sources are subject to an annual inspection, and the end user pays for the inspections. The fee is a function of the number of sealed sources owned by the licensee. The inspection is designed to confirm that the sealed sources are properly accounted for, adequately secured, and safely used. In order to renew a license, the licensing agency must be provided with documentation of the annual inspections. If the end user is not inspected, it is subject to fines and may also be fined if the inspection shows that it is not adequately protecting devices containing sealed sources. Fines are based on health and safety infractions—not security violations—and the fines can be as high as about $15,000.

France has also established a system to control orphan sources that has three main components.

- End users are required to remove any source from service not more than 10 years after it was purchased.
- The company supplying the source to the end user is required to include disposal costs within the purchase price.
- All other companies in the supply chain agree contractually to take back the source after 10 years.

Under France's system, the company supplying—or distributing—the sealed source is required to ensure, through a financial guarantee, that funds will be available to pay for the disposal of the source in case the distributor goes out of business or files for bankruptcy. The financial guarantee is made either through an annual fee paid to an association of source distributors or by providing France's national waste management agency with a deposit. The association represents 99 percent of all distributors of devices containing sealed sources in France. About 50 distributors are members of the association. Typically, the distributor makes an initial deposit of about $1,000 and then pays an annual fee on the basis of the total activity of sources it has distributed, the technology that the sealed sources are used for, and the value of the source. French officials responsible for administering the system told us that, initially, distributors did not like it because of the excessive amount of paper work involved. However, companies now see the value of the system.

Distributors also have the option of contracting with France's radioactive waste management agency for disposal of the sources if they do not want to join the association. Typically, the smaller distributors who choose this option do so because they may only supply one or two sources per year and do not want to share the risk of joining the larger association, where costs are spread among many distributors. Distributors who choose this option are required to deposit funds with the agency to guarantee that disposal costs will be covered. The deposit ranges from about $1,000 to several thousand dollars. When a source is returned, the agency returns the deposit (less an administrative fee) to the distributor. According to French officials, only 1 percent of the distributors of sources in France use this option because they believe it is more expensive than belonging to the association, which spreads the financial risk among all of its members. In addition, the cost determined by the waste management agency is based on the entire cost of disposal and takes into account inflation and other economic factors. To date, the waste management agency has not had to use the fund to dispose of any disused sealed sources. The agency has always been able to locate a source's manufacturer to take back the source or find another manufacturer willing to accept it.

According to French officials, when the system was first put into place, it posed a difficulty for distributors, who had to pass the cost of the financial guarantee to the end user. However, now that the system has been in place for many years, the additional costs are accepted, and users are pleased not to have to deal with disposing of the sources on their own. We were told that the process works well and has contributed to the reduction in the number of lost, stolen, or abandoned sealed sources. Currently, about one sealed source per year is orphaned in France.

Comments from the Department of Energy

Department of Energy
National Nuclear Security Administration
Washington, DC 20585

MAY 0 6 2003

Mr. Bob Robinson
Managing Director, Natural Resources
and Environment
General Accounting Office
Washington, DC 20548

Dear Mr. Robinson:

The National Nuclear Security Administration (NNSA) appreciates the opportunity to review the draft report, *Nuclear Nonproliferation: U.S. and International Efforts to Control Sealed Radioactive Sources Need Strengthening* (GAO-03-638). GAO was requested to determine (1) the number of sealed sources worldwide and how many have been reported lost, stolen, or abandoned; (2) the controls, both legislative and regulatory, used by countries that possess sealed sources; and (3) the assistance provided by the Department of Energy and other U.S. Federal agencies to strengthen other countries' control over sealed sources and the extent to which these efforts are believed to be effectively implemented.

NNSA has reviewed the draft report, and disagrees with GAO that "the department has not coordinated its efforts with NRC and the Department of State to ensure that a governmentwide strategy is established." NNSA, however does agree with GAO's recommendations that the program does need strengthening. NNSA further believes that placing the findings of the report in context is extremely important particularly since this program is in its "startup" phase. Therefore, we have enclosed specific technical comments and recommended revisions to the report. The Secretary and NNSA's Administrator are actively involved with the international community to address security of other countries' sealed sources as you recommend in your report.

If you have any questions, please contact Richard Speidel of my staff at 202-586-5009.

Sincerely,

Michael C. Kane
Acting Associate Administrator
for Management and Administration

Enclosure

Printed with soy ink on recycled paper

Comments from the Department of State

United States Department of State

Washington, D.C. 20520

APR 30 2003

Dear Ms. Westin:

We appreciate the opportunity to review your draft report, "NUCLEAR NONPROLIFERATION: U.S. and International Assistance Efforts to Control Sealed Radioactive," GAO-03-638, GAO Job Code 360199.

The enclosed Department of State comments are provided for incorporation with this letter as an appendix to the final report.

If you have any questions concerning this response, please contact Ron Burrows, Bureau of Nonproliferation, at (202) 647-6425.

Sincerely,

Christopher B. Burnham
Assistant Secretary and
Chief Financial Officer

Enclosure:

As stated.

cc: GAO/IAT - Glen Levis
State/OIG - Luther Atkins
State/NP/SC - Warren Stern

Ms. Susan S. Westin,
Managing Director,
International Affairs and Trade,
U.S. General Accounting Office.

Department of State Comments on GAO Draft Report

NUCLEAR NONPROLIFERATION: U.S. and International Assistance Efforts to Control Sealed Radioactive Sources Need Strengthening
(GAO 03-638, GAO Job Code 360199)

The Department of State appreciates the opportunity to comment on the GAO's draft report on U.S. and International Assistance Efforts to Control Sealed Radioactive Sources. Since September 11, 2001, the need to ensure that radioactive material is kept out of the hands of potential terrorists is critical and improving the security of high-risk radioactive sources that could be used in "dirty bombs" is a top priority for our nation.

Overall, we agree with the facts as presented in the report. Despite the early problems with interagency coordination noted in your report, we are currently working cooperatively with the Department of Energy. However, we are concerned that your recommendation to give DOE the responsibility of developing and coordinating a comprehensive U.S. government-wide effort to strengthen international controls over sealed sources could be interpreted as conflicting with our diplomatic responsibilities. The Department of Energy (DOE) is technically qualified and experienced in recovering and securing sealed sources and can assist other countries in achieving the same. However, the State Department is responsible for developing and implementing international strategies.

As noted in your report, the Department of State has been addressing the problem of unsecured sources for some time. For example, for many years, we have nurtured and funded IAEA programs in this regard. This includes aiding in the development of the IAEA Code of Conduct on the Safety and Security of Radioactive Sources and funding so-*called Model Project*, which helps countries to develop legal and regulatory infrastructures to control sources. In addition, despite the limited resources available to us for these purposes, we provided the first funding for DOE and the Nuclear Regulatory Commission efforts to enhance the security of sources (in Georgia and Armenia) through Freedom Support Act funds.

A comprehensive approach to controlling sources, will require a concerted diplomatic effort. It is imperative in this process that this be coordinated with our technical efforts. The security of radioactive sources depends on convincing states to change the fundamental ways that they manage and secure sources. While we can and should secure high-risk sources, we need to recognize that this is only a small part of the problem. We need to ensure those receiving assistance are themselves committed to securing sources as these sources continue to be used widely in commercial activities. Given the overall broader concerns behind this program, the Department of State has a unique perspective that is crucial to its success.

We hope that you will clarify your recommendation to delineate between DOE's technical programmatic responsibilities and State's overall diplomatic role in guiding international strategies for securing radiation sources. Please do not hesitate to contact us if we can be of further assistance.

Comments from the Nuclear Regulatory Commission

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

May 1, 2003

Mr. Bob Robinson
Managing Director, Natural Resources and Environment
United States General Accounting Office
441 G Street, NW
Washington, DC 20548

Dear Mr. Robinson:

I would like to thank you for the opportunity to review and submit comments on the draft report, "NUCLEAR NONPROLIFERATION: U.S. and International Assistance Efforts to Control Sealed Radioactive Sources Need Strengthening" (GAO-03-638). The U.S. Nuclear Regulatory Commission (NRC) appreciates the time and effort that you and your staff have taken to review this important topic.

Overall, this report contains a wealth of information, however, it should have focused more on high-risk radioactive sources, rather than on all radioactive sources. It is important to note that the vast majority of radioactive sources in use in the U.S. and abroad are not useful to a terrorist. Additional security measures are not needed for such sources. Too often in the report very large numbers are used, for example, the number of sources lost in a year or the total number of sources in use in the U.S. or in Europe. Although these numbers are accurate, they can be misleading without the proper context.

The NRC, Department of Energy (DOE), and the International Atomic Energy Agency (IAEA) all recognize the need to focus security efforts on the sources of highest risk, those that would be most useful to a terrorist. In this regard, the NRC and DOE have recently identified the handful of radionuclides that are of greatest concern for potential misuse by terrorists and have identified action levels (activity thresholds) for these radionuclides. The NRC and DOE intend to apply additional security measures, such as national inventory controls and export/import controls, to those high-risk sources above the action thresholds. The NRC and DOE also continue to work aggressively with the IAEA in finalizing the IAEA's revised Code of Conduct on Safety and Security of Radioactive Sources and revised Categorization of Sources (TECDOC-1344). The Commission believes that Category I and Category II sources need to be the focus of additional security measures internationally. The report should make it clear that very few of the sources which are lost or stolen in the U.S. are high-risk sources. A large majority of those reported lost or stolen involve small or short-lived radioactive sources which are not useful as a radiological dispersal device (RDD). In the U.S., only one high-risk source has been lost and not recovered in the last 5 years. However, this source (Iridium-192) would no longer be considered a high-risk source because much of the radioactivity has decayed away since it was reported stolen in 1999. In fact, the combined total of all unrecovered sources over a 5-year time span would barely reach the NRC/DOE threshold for one high-risk radioactive source.

Mr. Bob Robinson 2

We believe that the report should also note that NRC is continuing to move ahead with activities to increase the security of high-risk radioactive sources. For example, on March 17, 2003, as part of Operation Liberty Shield the NRC, with full coordination with the Department of Homeland Security, the Homeland Security Council, and other agencies, sent an advisory to all NRC and Agreement State licensees who were authorized to possess radionuclides of concern above the action levels. This advisory contained additional security measures which these licensees should implement to further protect the high-risk material at their facilities. NRC will soon issue an Order to large panoramic irradiators requiring additional security measures at those facilities. The NRC and Department of Transportation are working together to develop security measures for the transportation of large quantities of radioactive material and, as mentioned above, the NRC and the DOE are working in conjunction with the IAEA to finalize the Code of Conduct and Categorization of Sources documents.

We would also like to note that the report is written retrospectively, and although the recommendations presumably apply to future actions, there is no reference to the need for coordination with the Department of Homeland Security regarding future international activities. We believe that such coordination is important and recommend that the GAO consider integrating this into the report section on Recommendations for Executive Action. The enclosure provides additional specific comments on areas of the report we feel should receive clarification.

Should you have any questions or about the NRC's comments, please contact either Mr. William Dean, at (301) 415-1703, or Ms. Melinda Malloy, at (301) 415-1785, of my staff.

Sincerely,

Carl J. Paperiello for

William D. Travers
Executive Director
for Operations

Enclosure: Specific Comments on Draft Report GAO-03-638

cc: Glen Levis, GAO

GAO Contacts and Staff Acknowledgments

GAO Contact

Gene Aloise (202) 512-3841

Acknowledgments

In addition to the individual named above, Kerry Dugan Hawranek, Preston S. Heard, Glen Levis, Judy K. Pagano, Terry L. Richardson, and Rebecca Shea also made key contributions to this report.

GAO's Mission

The General Accounting Office, the audit, evaluation and investigative arm of Congress, exists to support Congress in meeting its constitutional responsibilities and to help improve the performance and accountability of the federal government for the American people. GAO examines the use of public funds; evaluates federal programs and policies; and provides analyses, recommendations, and other assistance to help Congress make informed oversight, policy, and funding decisions. GAO's commitment to good government is reflected in its core values of accountability, integrity, and reliability.

Obtaining Copies of GAO Reports and Testimony

The fastest and easiest way to obtain copies of GAO documents at no cost is through the Internet. GAO's Web site (www.gao.gov) contains abstracts and full-text files of current reports and testimony and an expanding archive of older products. The Web site features a search engine to help you locate documents using key words and phrases. You can print these documents in their entirety, including charts and other graphics.

Each day, GAO issues a list of newly released reports, testimony, and correspondence. GAO posts this list, known as "Today's Reports," on its Web site daily. The list contains links to the full-text document files. To have GAO e-mail this list to you every afternoon, go to www.gao.gov and select "Subscribe to GAO Mailing Lists" under "Order GAO Products" heading.

Order by Mail or Phone

The first copy of each printed report is free. Additional copies are $2 each. A check or money order should be made out to the Superintendent of Documents. GAO also accepts VISA and Mastercard. Orders for 100 or more copies mailed to a single address are discounted 25 percent. Orders should be sent to:

U.S. General Accounting Office
441 G Street NW, Room LM
Washington, D.C. 20548

To order by Phone:	Voice:	(202) 512-6000
	TDD:	(202) 512-2537
	Fax:	(202) 512-6061

To Report Fraud, Waste, and Abuse in Federal Programs

Contact:

Web site: www.gao.gov/fraudnet/fraudnet.htm
E-mail: fraudnet@gao.gov
Automated answering system: (800) 424-5454 or (202) 512-7470

Public Affairs

Jeff Nelligan, Managing Director, NelliganJ@gao.gov (202) 512-4800
U.S. General Accounting Office, 441 G Street NW, Room 7149
Washington, D.C. 20548

United States
General Accounting Office
Washington, D.C. 20548-0001

Official Business
Penalty for Private Use $300

Address Service Requested

Presorted Standard
Postage & Fees Paid
GAO
Permit No. GI00