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A REVIEW OF U.S. INTERNATIONAL EFFORTS TO SECURE RADIOLOGICAL MATERIALS

HEARING

BEFORE THE

OVERSIGHT OF GOVERNMENT MANAGEMENT, THE FEDERAL WORKFORCE, AND THE DISTRICT OF COLUMBIA SUBCOMMITTEE

OF THE

COMMITTEE ON HOMELAND SECURITY AND GOVERNMENTAL AFFAIRS UNITED STATES SENATE

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A REVIEW OF U.S. INTERNATIONAL EFFORTS TO SECURE RADIOLOGICAL MATERIALS

TUESDAY, MARCH 13, 2007

U.S. SENATE,
SUBCOMMITTEE ON OVERSIGHT OF GOVERNMENT
MANAGEMENT, THE FEDERAL WORKFORCE,
AND THE DISTRICT OF COLUMBIA,
OF THE COMMITTEE ON HOMELAND SECURITY
AND GOVERNMENTAL AFFAIRS,
Washington, DC.

The Subcommittee met, pursuant to notice, at 2:36 p.m., in room SD–342, Dirksen Senate Office Building, Hon. Daniel K. Akaka, Chairman of the Subcommittee, presiding.

Present: Senators Akaka, Carper, and Voinovich.

OPENING STATEMENT OF CHAIRMAN AKAKA

Chairman AKAKA. The Subcommittee on Oversight of Government Management, the Federal Workforce, and the District of Columbia will come to order.

I called this hearing of the Subcommittee on Oversight of Government Management, the Federal Workforce, and the District of Columbia to review the U.S. international efforts to secure radiological materials, and we look forward to examining activities by the Department of Energy and the Nuclear Regulatory Commission to help secure high-risk radioactive sources worldwide, both bilaterally and in cooperation with the International Atomic Energy Agency (IAEA). We will also hear from the Health Physics Society about its work under the Radiation Safety Without Borders program. I would like to request unanimous consent to submit my written statement into the record, and I would also like unanimous consent to submit a written statement provided by the IAEA and an article by the former head of the IAEA's program to secure radioactive sources, Dr. Abel Gonzalez, into the record.[1]

Our hearing seeks to address why funds to control high-risk radioactive sources are being cut out while interest by al Qaeda and other terrorist organizations in stealing them and making them into radiological dispersion devices, commonly known as "dirty bombs," is increasing, not decreasing. I would like to lay out a scenario that illustrates my deep concern about these cuts. On March 28, 2006, the Government Accountability Office testified before the Permanent Subcommittee on Investigations that GAO had con-

[1] The information from IAEA submitted by Senator Akaka appears in the Appendix on page 101.

ducted an undercover operation to purchase two radioactive sources and transport them across two U.S. borders. I was disturbed to learn that GAO was able to use counterfeit documentation modeled after those found on the Internet and counterfeit bills of lading to purchase over the phone one of the most common radioisotopes used in industry.

It was easy for GAO to get enough radioactive source material to manufacture a dirty bomb. These radioactive sources should concern all Americans, but what worries me more is how easy it is and it would be to conduct the very same operation in another country, one with fewer resources than we have to adequately control radioactive sources. What if this was an al Qaeda operative or Chechen rebel trying to obtain a source to use in a dirty bomb in the United States rather than a GAO investigation?

Unfortunately, this is a very real possibility. There are documented efforts of terrorists trying to get these sources. Osama bin Laden has explicitly stated that acquisition of a nuclear weapon is a "religious duty." The IAEA has documented 516 confirmed cases of trafficking or loss of highly radioactive sources. In contrast, the IAEA has documented 224 incidents involving nuclear materials, most of which involve natural or depleted uranium.

A terrorist has three choice targets:

First on the terrorist wish list is plutonium or highly enriched uranium; with this, a terrorist can make a nuclear bomb. Second on his wish list is nuclear material for an improvised nuclear device, or IND. Third is a radioactive source.

The first two are hard to obtain; the third is widely available. It can be found in every hospital in the world with an X-ray machine. This is why I have convened this hearing today, and this is why I have asked GAO to examine this issue four times over the last 4 years. The threat that an al Qaeda operative could steal a radioactive source from a hospital, for example, is very real. This is the bottom line: It is far easier to get a radioactive source than it is to steal highly enriched uranium or plutonium and detonate it in a nuclear weapon or improvised nuclear device. Detection equipment, as the GAO undercover operation revealed, does not deter anyone from acquiring material and transporting it. But detection is the last line of defense, not the first.

And that is why I oppose the Administration's proposed funding cuts to DOE to help ensure that these high-risk sources do not find their way into the United States. Nor has the Administration given the NRC enough funding to help strengthen regulatory control of these sources in other countries. The job is not finished and the threat is growing. Yet funding is being cut. The question is why? The purpose of this hearing is to answer that critical question.

I want to thank our witnesses for being here today to discuss this critical issue.

I will now turn to my good friend, Senator Voinovich, for his statement.

OPENING STATEMENT OF SENATOR VOINOVICH

Senator VOINOVICH. Thank you, Senator Akaka. I thank the witnesses for being here.

Since 2002, over $143 million has been appropriated for the Department of Energy's (DOE's) International Radiological Threat Reduction Program to help other countries, including the Soviet Union, Indonesia, Iraq, and Mexico, secure dangerous radiological sources.

Today we are holding this hearing to ensure that DOE and the other key responsible agencies, including the State Department and the NRC, are adequately performing their roles.

In a tight Federal budget with demands for homeland security funding that far exceed the capacity of this Nation to furnish it, it is discouraging to learn that coordination, both within DOE and with other key agencies, is lacking. Also, it is frustrating to learn that DOE has consistently carried over a large balance of unspent and unobligated funds—that is something that you all ought to be concerned about—while the NRC's biggest challenge has been identifying adequate and reliable funding support from other agencies.

In a report being released at today's hearing, the Government Accountability Office found that DOE did not transfer $5 million from its fiscal year 2004 appropriation to the NRC for strengthening international regulatory controls over radiological sources, despite a Senate Appropriations Committee report directing DOE to get that done.

Now, Senator Akaka and I know that the Nuclear Regulatory Commission is paid for 10 percent by the Federal Government and 90 percent by the people that are in the nuclear industry. So this is an extra task beyond what is in their budget, so this money has got to come over from the DOE.

In addition, gaps in information sharing between DOE and the International Atomic Energy Agency have impeded DOE's ability to target the most vulnerable sites in the International Atomic Energy Agency member States for security improvements. We have to work with the International Atomic Energy Agency.

One of the chief concerns identified by GAO is that many dangerous radiological sources remain unsecured worldwide and that DOE may have focused limited program funding and resources on securing lower-risk, lower-priority facilities. DOE has not given sufficient attention to developing long-term sustainability plans to protect investments in security upgrades, and without such plans, investments to improve the security of radiological sources in many countries may be ineffective.

We have been fortunate that no dirty bombs have been detonated by terrorists to date. However, confirmed reports of illicit trafficking in radiological materials has increased in recent years, as Senator Akaka outlined. Concerns have been raised about the potential for illicit use.

My colleagues know that I have been a consistent advocate for managing risk and setting priorities in our homeland security policy. I have often warned that we cannot secure everything, and we would bankrupt our country if we tried. However, I believe the scenario of terrorist use of a dirty bomb has a sufficiently grave combination of threat, vulnerability, and consequences to justify a serious focus on this issue.

A radiological dirty bomb could result in fatalities and serious health consequences as well as significant economic, psychological, and social disruption associated with the evacuation and subsequent cleanup of the contaminated area. The consequences resulting from a dirty bomb would be no less than that of an anthrax attack like we had 5 years ago that took five lives nationwide, requiring the testing of thousands of mailroom employees throughout the United States, and shuttered buildings around the city for months. Have we forgotten that? It is like it never happened. I remember it well because I was out of my office for about 3 months.

Concerns about Federal agencies having to do a better job of prioritizing and coordinating with each other and securing domestic radiological materials arose soon after the terrorist attacks of September 11. That is why Senator Carper and I, as Chairman and Ranking Member of the Clean Air and Nuclear Safety Subcommittee of the Environment and Public Works Committee, sponsored the nuclear security provisions in the Energy Policy Act of 2005. Among other things, those provisions required the NRC to establish a nationwide mandatory tracking system for the high-risk radioactive sources; two, establish additional controls on the import and export of radioactive sources, including background check requirements for individuals involved in import and exports shipments; and, three, establish a new interagency Task Force on Radiation Source Protection and Security.

Mr. Chairman, perhaps we need to consider expanding some of these provisions, where appropriate, to help responsible agencies do a better job in securing dangerous radiological materials, both domestically and abroad. I am also intrigued by the GAO's recommendation to provide NRC with the authority and direct appropriation to assist foreign regulators in developing regulatory infrastructure in lieu of providing funds from DOE. That is a more direct way of getting it done.

I do understand that the international dimension of this program has added significant challenges, but clearly we cannot and should not do this alone. I would like to better understand the difficulties each agency is having in dealing with your international counterparts, including the IAEA, both in funding and programmatic cooperation.

Thank you, Mr. Chairman, for having this hearing today.

Chairman AKAKA. Thank you very much, my friend and Ranking Member, Senator Voinovich.

And now I welcome our guests. They are Richard Stratford, Director, Office of Nuclear Energy, Safety, and Security, Department of State; Andrew Bieniawski, Associate Deputy Administrator, Office of Global Threat Reduction, National Nuclear Security Administration; Janice Dunn Lee, Director, Office of International Programs, U.S. Nuclear Regulatory Commission; and Eugene Aloise, Director, Natural Resources and Environment, Government Accountability Office.

It is the custom of this Subcommittee to swear in all witnesses, and I would like to ask you all to stand and raise your right hand. Do you solemnly swear that the testimony you are about to give this Subcommittee is the truth, the whole truth, and nothing but the truth, so help you, God?

Mr. STRATFORD. I do.

Mr. BIENIAWSKI. I do.

Ms. DUNN LEE. I do.

Mr. ALOISE. I do.

Chairman AKAKA. Thank you. To all of you, we will include your full statements in the record, and I would like you, Mr. Stratford, to proceed with your statement.

TESTIMONY OF RICHARD J.K. STRATFORD,[1] DIRECTOR, OFFICE OF NUCLEAR ENERGY, SAFETY, AND SECURITY, U.S. DEPARTMENT OF STATE

Mr. STRATFORD. Thank you, Mr. Chairman. Mr. Chairman and Senator Voinovich, thank you for the opportunity to speak to the topic of U.S. international efforts on radiological security and to explain the role of the Department of State in this important area. Radioactive sources are used throughout the world for numerous beneficial purposes, but they can also have malevolent uses. Ensuring access to these valuable technologies, while also ensuring the safe and secure management of radioactive sources, requires a balanced and a multilateral approach.

The principal role of the Department of State in U.S. international efforts to secure radioactive material is the development and direction of U.S. foreign policy and the oversight of U.S. Government activities abroad.

The missions and activities of the Department of Energy and the Nuclear Regulatory Commission are complementary and essential for implementing U.S. policy objectives. DOE has the resources and technical expertise for implementing on-the-ground radiological security work in foreign countries. NRC maintains the technical and legal expertise related to the licensing and control of radioactive sources. And, of course, State provides diplomatic support to the technical agencies, where needed.

The Department of State has also taken a leadership role on developing, strengthening, and building support for international standards and instruments for the management of radioactive sources. The IAEA Code of Conduct on the Safety and Security of Radioactive Sources was revised in 2003 to incorporate post-September 11 security concerns. In 2004, the IAEA Guidance on the Import and Export of Radioactive Sources was developed and approved.

Together, the Code of Conduct and the Guidance now represent the international benchmark for radiation protection authorities.

The Department of State also supports and promotes IAEA programs that help member States evaluate and address gaps in their regulatory infrastructures. The Regulatory Authority Information System (RAIS), is a software platform which enables regulators to track radioactive sources, licenses, and qualifications of authorized users. Since 2003, the State Department has provided $1.4 million to the IAEA for training and for upgrading RAIS software.

Mr. Chairman, I would also like to highlight the U.S. Government's important work in Iraq and Ukraine. Now, if you are following my short written statement, you will see that I am skipping over the phrase "regionally in North America," because I am going to cut that paragraph at the end.

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[1] The prepared statement of Mr. Stratford appears in the Appendix on page 29.

With respect to Iraq, in 2004 the State Department led U.S. efforts to enhance radiological security in Iraq through the establishment of an effective regulatory authority to ensure a native capacity for locating and securing radioactive sources. The rapid standup of the Iraqi Radioactive Source Regulatory Authority, which was made possible by monies from the Department of State, maintained key search and recovery capabilities that were established during the Coalition Provisional Authority. Since that time, hundreds of missions to search for abandoned and vulnerable radioactive sources have been completed, including a recent sweep of Sadr City.

Our Nonproliferation and Disarmament Fund (NDF) has also provided direct support to Ukraine to improve long-term security of high-risk radioactive sources through better accounting, training, and establishment of regional regulatory offices. The State Department considers the Ukraine project a success, and it was accomplished at about a quarter of the originally estimated cost.

In closing, let me say that significant progress has been made by the United States to enhance control over radioactive sources around the world and to reduce the risk of their malicious use. This progress has been achieved through close coordination within the U.S. Government, but there is obviously more to be done. Continued success on international radiological security will require continued close collaboration among the key U.S. Government agencies in partnership with the international community.

Thank you.

Chairman AKAKA. Thank you very much. Mr. Bieniawski.

TESTIMONY OF ANDREW BIENIAWSKI,[1] ASSISTANT DEPUTY ADMINISTRATOR, OFFICE OF GLOBAL THREAT REDUCTION, NATIONAL NUCLEAR SECURITY ADMINISTRATION, U.S. DEPARTMENT OF ENERGY

Mr. BIENIAWSKI. Thank you, Mr. Chairman and Senator Voinovich, for giving me the opportunity to testify on the Department of Energy's efforts to secure and recover vulnerable, high-risk radioactive sources outside the United States. At the very outset, Mr. Chairman, I would like to thank you for your continued interest and leadership on this very important issue of securing vulnerable radiological sources.

I am pleased to report to you that, since the inception of our program back in 2002, the Department of Energy's International Radiological Threat Reduction Program has completed security upgrades at more than 500 sites in over 40 countries around the world. Radioactive sources such as cobalt, cesium, strontium, and americium, which are used worldwide for many legitimate purposes, could be exploited by terrorists to produce a radiological dispersion device, or dirty bomb.

Our program's primary objectives are threefold: First, to implement rapid physical security upgrades at vulnerable sites containing these sources; second, to locate, recover, and consolidate lost or abandoned high-risk sources; and, third, to support the de-

[1] The prepared statement of Mr. Bieniawski appears in the Appendix on page 38.

velopment of the infrastructure necessary to sustain these security enhancements that we are doing.

Now, the intent of terrorists to acquire radioactive materials for use in an RDD does pose a significant risk to the American public and must be addressed. One of the many lessons learned from the attacks of September 11 is that some of the most common tools used in our daily lives, such as commercial airliners, can and will be used by terrorists in an attempt to wreak havoc on the United States. Should terrorists acquire and use these materials in an RDD, the psychological, physical, and economic impact could be significant.

From various reports, we know that al Qaeda is known to be interested in acquiring the materials for a radiological weapon. We would add that in June 2005, Senator Lugar polled dozens of nonproliferation experts around the world, and the Lugar survey concluded that the probability of a radiological attack was twice as high as the probability of other WMD attacks using biological or nuclear materials. Therefore, given the reality of this situation, the Department of Energy, this Administration, and Congress have taken important steps to increase our radiological threat reduction efforts.

So to address this threat, in 2004 the Department of Energy consolidated its radiological threat reduction efforts into a single central office called the Global Threat Reduction Initiative. GTRI is a vital part of the President's National Security Strategy, and GTRI directly addresses and is implementing some of the recommendations of the bipartisan 9/11 Commission.

The DOE and the National Nuclear Security Administration are committed to securing and removing vulnerable sources around the world. Over the past several years, we have significantly accelerated our efforts and secured more than 500 vulnerable radiological sources since 2002. In fact, I think it is very important to note that since our efforts first began back in 2002, we have accelerated these efforts each and every year. So each and every year we are doing more and more to address this very serious radiological threat.

As of January 2007, DOE has spent approximately $120 million to secure these sources. This demonstrates a strong commitment and, from our perspective, a successful program that produces tangible results.

Now, in terms of the GAO report, we are pleased that in the GAO report it was recognized that DOE has achieved noteworthy accomplishments by improving the security of radiological sources at hundreds of sites. The GAO report also highlighted several other key accomplishments under this program, and I would like to recap several of them.

First, it noted that we had removed more than 5,000 curies of radioactive cobalt and cesium from war-torn Chechnya. We have removed nearly 1,000 high-risk sources from Iraq. We have created secure storage facilities in Uzbekistan and Georgia. We have removed or secured, in cooperation with our international partners, more than 30 percent of these high-powered RTGs in Russia. We have improved coordination with the Department of State and with the Nuclear Regulatory Commission. We have improved coordination with the IAEA and several donor States to implement this program. These are excerpts straight out of the GAO report. And we have also developed successful bilateral cooperation.

In closing, I would like to conclude by saying that we welcome this opportunity to focus attention on this very important and pressing issue. Thanks to your support, we have made significant progress to date to reduce the likelihood that terrorists will be able to acquire radiological sources. However, we fully agree, Mr. Chairman, that much work remains to be done, and we look forward to working closely with you in the future to continue to accelerate these efforts. Thank you.

Chairman AKAKA. Thank you very much, Mr. Bieniawski. Ms. Dunn Lee.

TESTIMONY OF JANICE DUNN LEE,[1] DIRECTOR, OFFICE OF INTERNATIONAL PROGRAMS, U.S. NUCLEAR REGULATORY COMMISSION

Ms. DUNN LEE. Thank you, Mr. Chairman and Ranking Member Voinovich. My name is Janice Dunn Lee. I am the Director of the Office of International Programs at the U.S. Nuclear Regulatory Commission. My office oversees and supports the NRC technical staff which participates in international assistance and cooperation activities. A high priority among these activities are efforts to create effective, sustainable regulatory oversight of radioactive sources worldwide.

I would like to join my colleagues in thanking you for giving us this opportunity today to discuss NRC's international efforts to enhance security of risk-significant radioactive sources. As requested, we provided prepared testimony for the record that describes in detail NRC's activities in this area. At this time I will highlight key elements of this testimony, including addressing the recommendations contained in the recently released GAO report, which is the basis for this hearing.

The Commission fully supports the recommendation made in the GAO report that Congress consider providing NRC with a direct appropriation to assist foreign nations in their regulatory oversight of risk-significant radioactive sources. NRC believes that the risk that some radioactive materials might be put to malicious use is still sufficient to warrant continued provision of international assistance.

The NRC can be most effective in supporting the effort to control sources by having appropriated funds to implement its programs and to participate in the combination of bilateral and multilateral regulatory assistance efforts to continue to lower this risk.

With effective planning and project management, continued reductions in risk can be achieved through modest investments in U.S. taxpayer funds. For example, an increase in non-fee-based funding for NRC, estimated at $2 to $3 million per year over the next few years, would allow NRC to expand ongoing efforts to create sustainable, effective national regulatory programs, integrating safety and security controls over these widely used sources.

[1] The prepared statement of Ms. Dunn Lee appears in the Appendix on page 45.

As our written testimony reflects, NRC believes that international efforts to assist foreign nations in controlling risk-significant sources must be based on the Code of Conduct on the Safety and Security of Radioactive Sources. During development of the code, the NRC ensured that it was appropriately risk-informed, effective, realistic, and verifiable. Over a 2-year period, NRC led the world in implementing the code by revising our domestic regulatory programs, establishing a registry to meet the intent of the code, developing a National Source Tracking System, and enhancing import-export restrictions for risk-significant sources.

Our international activities have paralleled those domestic efforts, primarily focusing on helping other countries to adopt and implement the code. Should Congress provide the modest increase in non-fee-based funding needed, these activities could judiciously be expanded.

Specifically in the multilateral arena, NRC would work closely with the International Atomic Energy Agency to identify how best to support IAEA's efforts to assist other countries to implement the code. The NRC could also consider, for example, stationing experts at the IAEA to strengthen and better coordinate regulatory assistance activities and directly funding high-priority IAEA regulatory-strengthening efforts.

In the bilateral area, NRC could expand upon the success achieved and the experience gained working with our regulatory counterparts in Armenia, Georgia, and Kazakhstan. The NRC has reviewed these countries' laws, which now authorize the regulators to implement the guidance of the code and include the ability to enforce regulations. NRC has also provided training for inspectors and assisted in the development of national registries of radioactive sources. With additional funding, NRC could consider work with our regulatory counterparts in the States of the former Soviet Union, similar to the work already achieved in Armenia and ongoing in Georgia and Azerbaijan.

We would continue to devote a significant portion of available funding, typically over 60 percent, to utilize in-country technical expertise and resources needed to implement these projects. More broadly, the NRC would also consider working directly with regulatory authorities of key countries which import U.S.-manufactured sources to ensure that the highest resources are used safely and securely.

Mr. Chairman and Mr. Voinovich, this concludes my statement. I would be happy to answer any questions you may have. Thank you.

Chairman AKAKA. Thank you very much, Ms. Dunn Lee. Mr. Aloise.

TESTIMONY OF GENE ALOISE,[1] DIRECTOR, NATURAL RESOURCES AND ENVIRONMENT, U.S. GOVERNMENT ACCOUNTABILITY OFFICE

Mr. ALOISE. Thank you. Mr. Chairman and Senator Voinovich, I am pleased to be here today to discuss our report, which addresses

[1] The prepared statement of Mr. Aloise appears in the Appendix on page 54.

the progress DOE has made in securing high-risk sources in other countries.

Since the program's start in 2002, DOE has spent over $100 million to secure hundreds of sites in over 40 countries. However, some of the highest-risk and most dangerous sources remain unsecured. Specifically, 16 of 20 nuclear waste storage sites across Russia and Ukraine remain unsecured, and more than 700 portable generators, possibly containing the largest unsecured quantity of radioactivity in the world, remain operational or abandoned in Russia and are vulnerable to theft or misuse.

In 2003, DOE decided to expand the program's scope. In our view, this is where the program detoured from its original mission to secure the highest-risk and most dangerous sources. The program expanded to countries outside the former Soviet Union. It also expanded the types of sites that required security upgrades to include hospitals and oncology clinics. The sources in these medical facilities pose much less of a threat to our national security interests than higher-priority sources such as the portable generators and waste storage facilities. However, as of September 30 of last year, almost 70 percent of all sites DOE secured were medical facilities.

While we understand that many of the portable generators cannot yet be removed, removing as many as possible or securing those that cannot be removed should be a critical component of DOE's program.

DOE has also experienced numerous problems and challenges implementing its program, including: some high-risk countries have been unwilling to cooperate in implementing security upgrades; some security upgrades have been poorly done and required additional funding to fix; and some countries lack adequately trained and equipped guard forces to respond to site alarms.

Furthermore, DOE has not developed a long-term plan to sustain the upgrades it has installed. In fact, program officials told us that they believed upgrades would only be sustained in about 25 percent of the countries receiving assistance.

Regarding coordination, although it has improved among DOE, NRC, and the State Department, it has been inconsistent and there is no comprehensive governmentwide approach to securing sources overseas. In addition, we found that DOE needs to better coordinate program activities within this program, as well as with other related DOE programs, to leverage financial resources.

We believe that DOE's reorganization of its nuclear and radiological threat reduction efforts is a step in the right direction. However, there are still significant management issues that need to be resolved and addressed. Our report makes several recommendations designed to improve the DOE's program.

Mr. Chairman, that concludes my remarks. I would be happy to respond to any questions you or Senator Voinovich might have.

Chairman AKAKA. Thank you very much, Mr. Aloise.

Mr. Bieniawski, you mentioned in your statement that there have been 500 sites DOE secured, which of those could be considered high priority?

Mr. BIENIAWSKI. Yes, Mr. Chairman. All the sites that we have secured are considered high priority and contain vulnerable sources. Some of those are the high-powered RTGs in the Russian Federation. Some of those are medical sources that are vulnerable and exceed our minimum threshold of 1,000 curies. We believe you have to have a comprehensive approach and secure a range of sources, but all of those that we have secured to date are the highest priority.

Chairman AKAKA. Mr. Bieniawski, DOE claims a number of successes in securing, as you have said, radioactive sources throughout the world. But as you know, there remain countless sites with sources that have not been secured, and terrorists are even more eager to steal them.

Why then has DOE steadily reduced funding for this activity?

Mr. BIENIAWSKI. Mr. Chairman, each and every year under this program, as I said in my oral testimony, we have accelerated our efforts. The first year, back in 2003, we just did eight sites. Then we did an additional 61 sites, then an additional 174 sites, and then last year an additional 257 sites. So we have been accelerating the program, and in order to continue the program, you are absolutely right, we need funds to make sure that we can accelerate.

What I would like to note is that, regarding the fiscal year 2008 budget request, in addition to the $6 million that we requested in 2008, there is currently a supplemental request before Congress for a fiscal year 2008 supplemental for $20 million specifically for this program.

In terms of what that will buy if Congress authorized an additional $20 million for our program, we will directly implement several of the recommendations from the GAO that you just heard about. We will recover an additional 45 of these high-powered RTGs in Russia. We will secure up to 10 radiological sites in China. We will secure an additional seven radiological sites in Pakistan. We will secure five vulnerable sites in Lebanon, three additional sites in Egypt, 10 sites in Turkey, and three additional sites in Kenya.

So if the supplemental is funded, that would bring our funding level up in fiscal year 2008 to a total of $26 million for this program and enable us to secure at least an additional 85 vulnerable sources.

Chairman AKAKA. Thank you.

Mr. Aloise, will the recent reorganization of DOE's program have a positive impact on DOE efforts to assist other countries to secure radiological sources? And if not, why not?

Mr. ALOISE. Well, we think it is a step in the right direction, but it is too early to tell. We think the proof of whether it will be or not is if the program refocuses on securing the highest-priority sources, not just numbers of sources but the highest-priority sources, and not just numbers of sites but the highest-priority sites. Those include the generators we have talked about and waste storage sites.

Chairman AKAKA. Mr. Bieniawski, would you please explain your rationale for not providing NRC with the $5 million as directed by the Senate Appropriations Committee report?

Mr. BIENIAWSKI. Yes, sir. The detail on that situation is that back in fiscal year 2004—this was the fiscal year 2004 budget process—the $5 million proposed transfer was only in the Senate report. There was no mention of this $5 million transfer in the House report, so, therefore, it was an issue that had to be resolved in the conference negotiations for the final fiscal year 2004 budget process.

During the conference negotiations, the House did not support the Senate position, and the Senate receded to the House. And, therefore, this was not in the final report. The Senate gave up on their initial request and, therefore, we were specifically directed not to transfer the $5 million to NRC. We checked at that time with our appropriators, and they confirmed that because this was not, as you know, in the final report, there was no requirement to transfer those funds and, therefore, we did not do so.

Chairman AKAKA. I understand, Mr. Bieniawski, the rationale you have provided. However, I understand that DOE and the NRC had initially come to an agreement on providing the funding to NRC. Do you know why the agreement was not implemented?

Mr. BIENIAWSKI. To clarify, NRC and DOE did have discussions regarding the possible transfer of DOE funds to NRC for international radiological security cooperation. However, no final agreement was reached with NRC due to the fact that since the specific NRC-related activities would be periodic and intermittent in nature, NRC could not dedicate full-time staff to support this effort and therefore it was mutually agreed not to continue further discussions on this matter.

Chairman AKAKA. Ms. Dunn Lee, would you like to comment on that?

Ms. DUNN LEE. I would be pleased to, Mr. Chairman.

DOE and NRC have a mutual common goal of securing radioactive sources from potential theft and diversion. However, we come at these goals with different approaches. And when you put money in one agency to manage a program, I think there is a natural tendency to use money to support that agency's approach.

When funds are limited to begin with, the pot of money there really needs to be managed very carefully. And while we had a very good dialogue going on with DOE at the time, it was not workable because of the small streams of money that came in and that came in very prescriptively. We were asked to support work with specific tasks in specific countries, given specific time frames, with very little flexibility, and it is very inconsistent with our regulatory approach. And, therefore, we were unable to support some of the items that DOE had come up with, so it was a little bit unfortunate in that regard that we were not able to work out a mutual program to support our mutual goal, which is to secure these radioactive sources.

Chairman AKAKA. Thank you.

Mr. Aloise, GAO found that DOE does not have a strategy for sustaining its security upgrades. Did you determine why this is the case?

Mr. ALOISE. Well, they have a 3-year warranty on their upgrades, and DOE has talked about that a lot. But as we got more into the program, we found out they had nothing beyond that to sustain these upgrades. And a lot of these sites that they have upgraded are private hospitals or oncology clinics. Moreover, many of these sites are in countries that are very strapped for cash, and it is not clear that the countries are going to be able to sustain the upgrades. So it is important that DOE develop a plan to do that, and as of yet, a long-term plan has not been developed.

Chairman AKAKA. Mr. Bieniawski, would you want to comment on that?

Mr. BIENIAWSKI. Yes, sir. As Mr. Aloise said, we do have a short-term sustainability plan for 3 years where we provide maintenance over a 3-year period. We fully agree that we need to devote more attention to the long-term sustainability. Part of this is that if additional funds are made available through the supplemental, some of those funds can also be used to help us work to sustain this work in other countries.

As a result of the GAO recommendation, we have set up an internal task force to look at the long-term sustainability. One of the things we do not want to do is just reinvent the wheel, and there is a lot of work that some of the other DOE programs have already done under our Material Protection Control and Accounting Program. So as part of this task force, we will be looking at what they have done, what can be applied to our upgrades, and we will be devoting more attention to this in the future.

Chairman AKAKA. Well, thank you very much for your responses. I would like to ask Senator Voinovich for his questions.

Senator VOINOVICH. Do you all agree that, based on threat assessment, this is a problem that we should be very concerned about relative to some other things? Everybody is nodding their head. [Laughter.]

If it is, why aren't we doing a better job? For example, Mr. Bieniawski, the GAO report cites a comment by senior DOE official who believed that there is still a significant amount of work to be done to secure radiological sources in the United States. What is DOE's current estimate of the number of high-risk sources in this country that still need to be located and secured? If you can respond without disclosing sensitive information. And how does that compare with the number of sources outside of the United States?

Mr. BIENIAWSKI. My program, GTRI, has several sub-elements. It has both an international program, which is the focus of the GAO report, and then also a domestic program.

To answer the last part of your question first, in terms of additional sources outside the United States that need to be secured, we estimate that there are approximately 3,300 high-risk sources in other than high income economy countries that meet this minimum curie level of at least 1,000 curies that are near important U.S. strategic interests that need to be secured. So that is a number that we have surveyed, that we have good confidence in that number.

In terms of the United States, what I would comment on and then see if the NRC would have additional comments, one of the programs we have under GTRI is securing what is called excess and unwanted sources here in the United States. These are sources that are no longer needed by industry. To date, we have recovered 14,000 of those sources.

To answer your question specifically, we estimate that each year we need to recover around 2,000 to 2,500 that become excess each year and are no longer needed by industry. And what we do under this program, which is our domestic radiological program, is we go and remove them and secure them at Los Alamos.

So that is how I would answer that, but NRC might have some additional information.

Senator VOINOVICH. Well, Ms. Dunn Lee, one of the security provisions in the Energy Policy Act of 2005 that I cosponsored requires the NRC to develop a National Source Tracking System to help secure high-risk radiological sources in the country. What is the status of this program? You were just talking about looking at it, but how are you coordinating? Are you using DOE's information or are you using NRC's information? How does that work?

Ms. DUNN LEE. Senator Voinovich, yes, the NRC has a responsibility for developing the National Source Tracking System, and we have met the deadline in the Energy Policy Act to promulgate regulations. The final rule, which requires licensees to report inventories and transactions of Category 1 and 2 materials, was issued in November 2006.

We expect the National Source Tracking System to be up and running—it is a big data system—by the end of 2008. In the meantime, we continue to use an interim database to meet its obligations for the registry under the requirements of the Code of Conduct.

With regard to the recovery of orphan sources——

Senator VOINOVICH. Is that the Code of Conduct of the International Atomic Energy Agency?

Ms. DUNN LEE. Correct, yes, which recommends that each country have a national registry of these radioactive sources.

With regard to the recovery of orphan sources, it is primarily a DOE program, and we work together in this effort, but I would have to defer to the Department of Energy with respect to the data on the numbers of orphan sources around. The National Source Tracking System tells you what sources are under the jurisdiction of licensees. These are the known sources. It does not really account for the abandoned and orphan sources.

Senator VOINOVICH. OK. Are the abandoned and orphan sources the result of activity of people that have been regulated by the Nuclear Regulatory Commission?

Mr. BIENIAWSKI. Yes, the sources that are excess and unwanted are no longer needed by those licensees, and they go to a secure database, and they basically say that these sources are no longer needed and please have these sources removed because they are one step away from basically being orphaned or abandoned.

Senator VOINOVICH. Your job is, as part of your Department, that when you have sources like this that are not used anymore——

Mr. BIENIAWSKI. Correct.

Senator VOINOVICH [continuing]. Your job is to get rid of them?

Mr. BIENIAWSKI. Yes, sir.

Senator VOINOVICH. I was just thinking about something that I have written to Secretary Bodman about. We have the tailings of uranium at the Piketon facility in Ohio, USEC does, so that is just laying out there.

Mr. BIENIAWSKI. Yes, sir.

Senator VOINOVICH. And one of the things we want to do is see if DOE would be interested in removing the uranium from those tailings, which would make more uranium available and make it more likely that you could then get rid of it.

Mr. BIENIAWSKI. Yes, sir. These sources that we recover are what we call sealed sources that are no longer needed. They are not the in-use ones, but they are actually sealed sources that we can then pick up and remove to Los Alamos or our Nevada test site.

Senator VOINOVICH. You are talking about nuclear materials, what about radiological sources in hospitals?

Mr. BIENIAWSKI. Well, some of these are from hospitals, but most of these are just licensed facilities that no longer need them.

I think what you are getting at is what about all the sources that are still in use that are being used by hospitals, whether they are cobalt and cesium, and that is under the auspices of the NRC, to in-use sources.

Senator VOINOVICH. GAO recommended Congress to authorize the NRC with direct authority, and a direct appropriation to help other countries develop regulatory infrastructure in lieu of providing funds to DOE and the State Department and then have these agencies reimburse NRC. I know from Ms. Lee's testimony that NRC supports this recommendation. I would like to get the State Department's and DOE's positions on this proposal.

Would this step enhance or further complicate policy efforts and coordination?

Mr. STRATFORD. Senator, I do not have specific guidance on that issue, but I do have a view. Thirty years ago, when I was a junior lawyer, I was a legal assistant to one of the first NRC commissioners for 3 years, from 1975 to 1978. I was very impressed then with what the NRC could do, and 30 years later, today they are the premier nuclear regulatory organization in the world. They have a lot to offer in terms of boosting safety culture overseas and making life safer and more secure for all of us.

In my judgment, it is passing strange for the NRC to have to go from agency to agency with a tin cup asking for donations so that they can do the very things that the State Department would like them to do.

So in my personal judgment, yes, I think it would make sense for the NRC to have an appropriation that they could use to help boost safety and security around the world.

Senator VOINOVICH. So they would not have to rely on money coming from DOE. They would have the money there to do it either by a direct appropriation or a charge-back. I suspect they would rather have the money than the charge-back.

Mr. STRATFORD. Just as a matter of personal management, some bureaus maintain all funds in the front office, and if you are an office director and you want something, you have to go ask for it.

Our bureau does not do it that way. I have a budget. I have a travel budget. I have a training budget. And it is allotted to me, and it is my job to figure out how to get the job done within what they give me.

So, from my point of view, it makes more sense to have NRC have a budget that they know what they can do with instead of having to go begging for money whenever something makes sense for them to do it.

Senator VOINOVICH. So they would have the money to do the identification and do the tracking that they supposedly do here and work with other countries that do it.

Mr. STRATFORD. And provide training.

Senator VOINOVICH. And provide training on how to handle the stuff.

Mr. STRATFORD. That is right.

Senator VOINOVICH. And in this country, DOE would have the responsibility to take care of disposing of the stuff that is not being used anymore, basically. I mean, in those countries where we have radiological materials which need to be disposed of, they get information from the NRC or from the International Atomic Energy Agency about how to do that?

Mr. STRATFORD. Well, when you talk about sustainability, what you are talking about is a country's ability to run a regulatory program, to run its own national registry, and to know how to go and pick things up safely and dispose of them safely. That is a matter of training, and nobody knows how to do that better in this country than the NRC.

So should they go explain to other people how to have a successful program? In my judgment, yes, they should. Should they have the resources to do that? In my judgment, yes, they should.

Senator VOINOVICH. Thank you.

Chairman AKAKA. Thank you very much.

Mr. Stratford, in recognition of the lower level of safety in the design and operation of Soviet-designed nuclear power plants and later the need to secure radioactive sources in the former Soviet Union, the State Department created a stand-alone office to provide policy guidance to DOE and NRC in their assistance efforts to these countries. However, over the last year or so, that stand-alone office was folded back into your office.

What are you doing to ensure that the profile of these efforts to secure high-risk radioactive sources remains high?

Mr. STRATFORD. Originally, the Department created a Senior Coordinator for Reactor Safety Assistance whose job it was to work with the DOE and the NRC to be sure that their activities in the safety assistance area were fully coordinated. That later evolved into what you described, which is a Senior Coordinator for Safety with an office to handle a number of different safety issues, including sources.

In the last reorganization, which combined the Arms Control Bureau and the Nonproliferation Bureau, that office was handed over to me and combined with my office, I suppose because management felt that all of the peaceful nuclear issues, including safety, should be handled under the same management.

I have inherited all of those people, with the exception of the former office director, who is now working in Vienna for the IAEA. The person who was deputy director I have left in charge of all the people that she brought with her. I have canceled no slots. I am letting them devote the amount of time they need to the radioactive source issue, which is three people full-time and two people part-time. I do not plan to change that. I may look at the situation in terms of workloads in another year or so. But right now I think from a management point of view, the most important thing is to make those people feel comfortable, that they have not been relegated, that they have not been forgotten, that they still have a job to do and they are doing it for the person they were working for before.

I think it is important to make them feel comfortable, I think it is important to let them do their job, and they are very highly qualified people, most of whom are Ph.D.s in hard science, which is a relatively rarity in the State Department.

Chairman AKAKA. Let me finally ask you, Mr. Aloise, for your view on the State Department organization.

Mr. ALOISE. Mr. Chairman, we really have not looked at that issue closely, so I cannot comment on that.

Chairman AKAKA. Well, I want to thank you. I have further questions that I will submit for the record, but I want to thank you so much. You have been helpful, and we are all trying to do the same thing. It is to help our country do the best we can to secure our Nation. And I want to thank all of you very much for your part in doing this, and I look forward to working with all of you in the future.

Thank you.

I would like to ask our second panel of witnesses to come forward. Testifying are Dr. Charles Ferguson, Science and Technology Fellow at the Council on Foreign Relations; Dr. Brian Dodd, President, Health Physics Society; and Joel Lubenau, a Certified Health Physicist and former adviser to NRC Commissioner Greta Dicus.

As you know, it is the custom of this Subcommittee to swear in all witnesses, so I ask all of you to raise your right hand. Do you swear that the testimony you are about to give to this Subcommittee is the truth, the whole truth, and nothing but the truth, so help you, God?

Mr. DODD. I do.

Mr. FERGUSON. I do.

Mr. LUBENAU. I do.

Chairman AKAKA. Thank you. Mr. Dodd, will you please begin.

TESTIMONY OF BRIAN DODD,[1] PRESIDENT, HEALTH PHYSICS SOCIETY

Mr. DODD. Good afternoon. My name is Brian Dodd. I work as a consultant under BDConsulting, and I am also the President of the Health Physics Society. I want to thank you for holding this hearing and providing me with the opportunity to testify both personally and as the President of the Health Physics Society.

Information about the society as well as my background and experience with the IAEA and as a consultant are detailed in my written testimony. However, I do need to clarify that I cannot speak for the IAEA and that I am still bound by my confidentiality agreement with them.

Having been involved in the field of safety and security of sources before, during, and after September 11, I feel that we have achieved a great deal in the years since. As Americans, I believe

[1] The prepared statement of Mr. Dodd appears in the Appendix on page 69.

we can be proud of our involvement in helping to secure dangerous sources around the world. I have no doubt that we are safer and securer now than we were then. That being said, there is still much to be done.

Our initial efforts have focused on the high-risk sources, but as these are being dealt with and as we begin to address those with lower risks, the problems grow because their numbers increase by orders of magnitude. The first phase has largely been characterized by short-term outside assistance. We now need to transition to the point where local internal controls take over.

The issue of self-reliance and sustainability has always been a basic objective of the IAEA. Programs that help countries develop their laws and regulations to implement the Code of Conduct contribute significantly in this regard. However, there are some fundamental difficulties that are often overlooked.

First is the issue of priority. Bluntly, these countries do not see themselves as targets of terrorist activity using radioactive sources and have much more basic human needs to focus on. Should the government of a poor country spend its limited resources on source problems or provide running water and sanitation to a village? It is not that they do not care about RDDs, but they are pretty far down their list. To a certain extent, what we are trying to do is to impose our priorities and values on other countries. Sometimes we can gain short-term external conformance with our carrots and sticks, but clearly it is better that they have an internal will to address the issues.

Second, there is the problem of personnel. The IAEA has been attempting to grow national expertise as part of its sustainability effort. However, it seems that it is taking much longer than anyone would have predicted. One of the major reasons is that as soon as a person becomes trained, he or she then leaves for a "better" position—often in another country where salaries and living conditions are much more desirable. It requires a high degree of self-actualization for a highly qualified person to continue to work in appalling conditions with little official government support.

I believe that these issues of priority and personnel are the major impediment to building the national infrastructure and sustainability necessary to achieve the ongoing level of safety and security that we desire. However, we should not stop trying.

In fact, one of the Health Physics Society's efforts to address the personnel problem is our Radiation Safety Without Borders program. As a society of professionals, I think the best thing we can do to help build infrastructure and sustainability is to help our peers in developing countries. In the revitalized RSWB program, a Health Physics Society chapter links itself to a country, much like the sister city approach—for life. The chapter members will get to know the HPs in that country and how best to support them.

The countries we are pairing with are those without a professional radiation safety society, with the ultimate objective of helping them develop their own. This will then become affiliated with the International Radiation Protection Association, perhaps via the stepping stone of forming a foreign HPS chapter. The desire is to help our fellow HPs get the same level of support that we receive from belonging to a high-quality professional organization.

This program has the full support of the IAEA, the IRPA, and has the full knowledge of the State Department.

It would be remiss of me not to mention the fact that the HPS has a position paper on radioactive source control. In particular, I would like to point out our recommendations regarding sufficient funding, No. 8, and making it an administrative mission to recover sources abroad, No. 16, instead of it being an ad hoc process.

I hope you find these remarks helpful, and once again, I thank you for the opportunity to provide them in this hearing. I shall be pleased to answer questions as you desire.

Chairman AKAKA. Thank you very much, Mr. Dodd. Mr. Ferguson.

TESTIMONY OF CHARLES D. FERGUSON,[1] FELLOW FOR SCIENCE AND TECHNOLOGY, COUNCIL ON FOREIGN RELATIONS

Mr. FERGUSON. Thank you, Mr. Chairman.

Several observations follow from an analysis of the radiological terrorism threat. First, we have to learn to live with a certain level of risk. We cannot and should not try to make the risk of radiological terrorism zero. Millions of people have derived great benefits from the use of radioactive sources. We have to learn to use radioactive sources more smartly, safely, and securely to reduce the risk as low as possible.

Developing a safety and security culture takes many years. That is why we need a long-term sustainability plan that involves all countries. Governments, the radioactive source industry, and users of radioactive sources need to take ownership of the safety and security problems. This endeavor will require long-term concentrated effort to educate users, establish regulatory infrastructures where needed, improve existing regulatory agencies, and create public-private partnerships with industry. A public-private partnership would work toward finding alternatives to potent radioactive sources and replacing easily dispersible radioactive materials with hard-to-disperse materials.

Users should have the opportunity to make an informed decision about whether to buy a non-radioactive alternative product or radioactive source. The purchase decision should include an assessment of the safety and security cost as well as the efficacy of the alternative product as compared to traditional radioactive sources.

A number of applications have already substituted in non-radioactive alternatives, but more could be done in this area. The National Nuclear Security Administration, in particular, has a major role to play here. NNSA already has established a precedent in the nuclear security program to replace nuclear-weapons-usable highly enriched uranium with non-weapons-usable low-enriched uranium in research reactors. Similarly, I recommend that NNSA be given the mission and mandate to work with industry to identify, research, and develop suitable alternative replacement products for potent radioactive sources as well as to research, develop, and make available less dispersible radioactive materials in the marketplace.

[1] The prepared statement of Mr. Ferguson appears in the Appendix on page 74.

Unlike the several-billion-dollar nuclear security program the United States is funding along with international partners, a multi-billion-dollar program is not required to significantly reduce the radiological terrorism threat. With relatively modest amounts of funding over the past 4 to 5 years, NNSA has accomplished a substantial amount of security work, with much of that work being done in Russia as well as in 40 more countries.

The NNSA program has provided the needed jump-start for many countries to improve their radioactive source security. What is needed now is development of a long-term sustainable program which can come about only with the full participation of all countries. For starters, I would recommend that the G–8 countries begin to identify how much money is required over the coming years to develop a sustainable program. Similar to what the United States did in 2002 at the G–8 Summit in starting the Global Partnership to deal with nuclear security and other weapons of mass destruction, I believe we have the opportunity to have a parallel program with radioactive source security. It will cost far less money, but I think we have yet to establish such a program among the G–8 countries, who are the major manufacturers of radioactive sources.

I would like to just briefly touch on in my remaining time some of the other recommendations from my written testimony.

Congress should require NNSA, the NRC, and other relevant government agencies to perform an urgent, comprehensive risk assessment of all types of radioactive sources. This assessment should be updated at least every 2 years and should evaluate the dynamical nature of the terrorism threat.

A global problem requires a global solution. I commend Congress for giving NNSA, in October 2006, the mandate to seek and obtain international, monetary, and other contributions to counter the radiological threat. But as I said a little while ago, I think the United States can do more and should leverage international donations to help create a long-term sustainable program. Other countries should not continue to look to the United States to provide the bulk of these resources and money to develop these programs. It is everyone's responsibility.

The United States and partner governments should form public-private partnerships within industry to work vigorously toward phasing our production and use of easily dispersible radioactive materials.

The radioactive source industry and the user community should internalize as many of the safety, security, and disposal costs in the price of commercial radioactive sources.

And, finally, the Nuclear Regulatory Commission and regulatory agencies in other countries should encourage users to make an informed decision about whether to purchase a radioactive source or a non-radioactive alternative product. Such a decision should factor in all relevant costs, including security.

Thank you, Mr. Chairman, for the opportunity to offer guidance on this important issue.

Chairman AKAKA. Thank you very much, Mr. Ferguson. Mr. Lubenau.

TESTIMONY OF JOEL O. LUBENAU,[1] CERTIFIED HEALTH PHYSICIST

Mr. LUBENAU. Mr. Chairman, thank you for your continuing interest in this subject, and also thank you for the opportunity to offer comments on this subject. My submitted testimony includes a brief historical overview of radioactive source safety and security in the submittal, and it should be noted that, with respect to history, concerns about accountability and control of radioactive sources pre-September 11. The submittal also discusses the setting of priorities and the need for long-term measures. With these considerations as background, the following recommendations are offered:

One, the radioisotope thermal generators, the RTGs, in the former Soviet Union that are disused, have been abandoned, or lack security and continue to need priority attention. Priority attention also needs to be given to locating and securing mobile seed irradiators in the former Soviet Union. That said, other high-risk and lower-risk sources will also need attention.

Two, improving security of radioactive waste repositories should receive priority attention. To not do so simply continues the risk when recovered radioactive sources are transferred to an unsecured waste repository.

Three, DOE's program to recover domestic radioactive sources posing safety and security risks is greatly needed. Over 14,000 sources have been recovered in the United States to date. Another 31,000 are projected to need recovery between now and 2021. Funding shortfalls have historically impacted this important program that does not include an overseas mission as well. Future competing, non-predictable priorities within the DOE should not be allowed to adversely affect this program, either domestically or internationally.

Four, development of national regulatory infrastructures must include development of adequate continuing funding sources to sustain them. The NRC's experience and that of the agreement States is a resource that should be utilized. To this end, neither NRC license fees nor interagency fund transfers should be utilized. Instead, Congress should directly fund NRC work in this area using general revenues.

Last, long-term measures must become an integral part of national and international programs to improve radioactive source security. The lack of viable, affordable disposal paths for unused and unwanted sources has led to unplanned storage that increases their vulnerability to loss and theft. In the short-term, programs such as the DOE off-site source recovery program help to address this. In the long term, better solutions must be found for low-level radioactive waste disposal.

We need to use radioactive sources more wisely than in the past. The IAEA, the National Academy of Sciences, the National Council on Radiation Protection and Measurements, the Health Physics Society, and numerous experts recommend developing and using safer chemical and physical forms of radioactive material in sources and alternatives to radioactive sources. These measures should be vig-

[1] The prepared statement of Mr. Lubenau appears in the Appendix on page 80.

orously pursued. Public-private partnerships should be explored to advance these measures.

Mr. Chairman, again, thank you for the opportunity to testify on this important subject. I will be glad to answer any questions that you and the Subcommittee Members may have.

Chairman AKAKA. Thank you very much, Mr. Lubenau. I am so glad to see my friend Senator Carper here joining me, and I will ask three questions, and then I will call on you.

I also note that Mr. Bieniawski has remained here, and I want to commend you for spending the time here.

Dr. Dodd, you have testified that you are working to revitalize the Radiation Safety Without Borders program. How has this program been funded in the past and how do you plan to fund it in the future?

Mr. DODD. Yes, Mr. Chairman, we had some funds from the Department of Justice. However, the emphasis on the program was more related to nonproliferation objectives, very much more of a review of some of the various countries' Radiation Safety Regulatory programs. In my mind, the program was more determined by those considerations rather than the professional-to-professional considerations. My view is now that we need to help the people, the things that we were trying to do are better done by a government and government agencies. As a professional society, I believe the best thing we can do is help the people in a peer-to-peer type relationship with other professionals.

It does not require a lot of funding. Frankly, we do not have nor asked for any additional funding from anyone to do this program. The idea is that each of the chapters will pair with the countries, and determine how best they can help that country. It might just be at the end of a phone call to provide some advice. Many of the chapters have a few thousand dollars perhaps to bring one of the key members of the regulatory agency from that country to the United States to a Health Physics Society meeting to see how to do professional society business.

Certainly if we had some funding, we could do more country-to-country visits, but I think almost everything else we can do without additional funding. A lot of it can be done electronically, through telephone and e-mail.

Chairman AKAKA. Mr. Dodd, GAO has found that hundreds of radioisotope thermal generators remain unsecured in Russia.

Mr. DODD. Yes.

Chairman AKAKA. To your knowledge, has the IAEA been involved in securing such large, dangerous sources? And if so, why do you think so many of them remain unsecured?

Mr. DODD. Well, the reason that we have RTGs is to provide electrical power in remote regions where there is none. So to start off with, they are in places in the world which are very remote. There are approximately 900 of them along the northern navigation route along the Arctic Circle north of Russia and so on. So they are in very remote, inhospitable places in the first place because that is what they do well. They provide power for such things as navigation beacons.

The agency has certainly been working with many countries to improve the situation with regard to RTGs. In particular, Norway and Canada have helped. Norway, I believe, has helped recover probably on the order of several dozen RTGs back to MAYAK for reprocessing.

Chairman AKAKA. Thank you. Let me call on Senator Carper for a statement or questions that he has.

OPENING STATEMENT OF SENATOR CARPER

Senator CARPER. What I would like to ask you to do is just—I do not care who goes first, second, or third, but I would like for each of you to respond to a couple of questions.

I think a couple of you cited sustainability as one of the major problems with securing radioactive sources in other countries. For example, poor countries have to choose between some basic needs—health care—as opposed to protecting radioactive sources. And, in addition, some poor countries have problems retaining personnel that have been trained to secure radioactive sources because they leave, I guess, for better positions once they are trained.

What do you see as possible solutions that the United States alone and in conjunction with the international community could engage in to address these problems? I think you have spoken to this already in your testimonies, but I am going to ask you to take another shot at it, if you would, please.

Whoever wants to go first. But I would appreciate a response from each of you.

Mr. LUBENAU. Senator, thank you. I referred in my testimony to using the agreement States as a resource in this area.

Senator CARPER. I am sorry. Say that again?

Mr. LUBENAU. In my testimony, I suggest that using the agreement States—these are the States that have agreements with the NRC to regulate radioactive material—as a model because they have had funding problems in the past. And they are also smaller in size and thus more comparable to many of these countries. They have more in the way of shared experience in this area.

But one common theme that has helped the States has been the collection of user fees, which is a large part of the support of the NRC program. And this would go a long way, I think, to solving funding problems. As Dr. Dodd and others have commented, we cannot keep handing out goodies. They have got to develop their own resources, not only in terms of training people but also retaining them. That takes providing decent salaries, and to that you need to have a fund available that can be depended upon to pay the salaries and also pay for the equipment and so on that will be required.

Senator CARPER. Thank you. Dr. Ferguson.

Mr. FERGUSON. Yes, Senator. I think my answer is threefold.

I think we can draw on the IAEA's program, the model project that has been around since the mid-1990s. They have worked with, I think, close to almost 100 countries now trying to improve the regulatory infrastructure. As I said in my oral remarks, it takes many years to develop a safety and security culture. You cannot turn around on a dime. But I think much more work can be done there. The IAEA has been cash-strapped. The U.S. Government and other governments have had a policy to keep the IAEA funding pretty much flat, and I think we need to—those countries that benefit the most from using radioactive sources and nuclear technology should contribute the most to the IAEA's efforts to control those technologies. So that is one part of the answer.

I think we also need to think through future use of radioactive sources. I said in my oral remarks that we need to think about alternatives to radioactive sources, and this is not any kind of antinuclear statement. There have been many applications—and Mr. Lubenau knows this much better than I do—that many applications have substituted in nonradioactive products that do the same job, but they do not have the safety and security risk that radioactive materials have. I do not think we can do this across the board. We need to think very carefully about applications and which ones can use substitutes. I think much more work can be done in research and development of those substitutes, and I would recommend that the Department of Energy and NNSA have a major role to play here. They have a lot of technical expertise at the National Laboratories, and I think they can be given the mission and the mandate to focus on the R&D question like they have been doing in terms of converting research reactors into using nonweapons-usable type of uranium. They have not had that mandate yet, and I would recommend that they get that.

And then, finally, I want to just second what Mr. Lubenau said about user fees. The United States has been assessing user fees to try to take account of some of these costs, and I think we need to encourage other countries to continue to develop user fees as well.

Senator CARPER. My time has expired, but, Dr. Dodd, would you just take a minute as well and respond to the question? Thank you.

Mr. DODD. Yes. Very quickly, priorities—they are both big, difficult issues, which is why I raised them in the first place. It is interesting that the countries which have had an accident with a radioactive source, priorities are not a problem. It is nationally embarrassing for them to be seen as deficient, and they have put the resources into it.

I hate to say that we should have an accident in every country, but that solves the problem to a certain extent.

One of the issues, I think, is getting countries committed to the Code of Conduct because then that gives them the national impetus and desire to make that international commitment.

When I was at the IAEA, one of the things we tried to do was to make it legally binding for that very purpose so that it would not be an option, that they would have to prioritize is. That, too, I think helps the personnel problem, that if the people have the backing and the will from the government to deal with the issue, then there is a certain amount of pride and respect that goes into doing that. And that is part of what our Radiation Safety Without Borders program is trying to do, too, is to provide the status to the professional to deal with the issue.

But the personnel one is a very difficult one that has been ongoing for many years in lots of areas the agency is working on. I do not have any easy solutions, I am afraid.

Senator CARPER. All right. Thank you, sir. Thank you all.

Thanks, Mr. Chairman.

Chairman AKAKA. Thank you. If you do not mind, we will go into a second round here.

Dr. Ferguson, do you believe that DHS is taking the RDD threat seriously?

Mr. FERGUSON. Mr. Chairman, if you are referring to the Department of Homeland Security, particularly their Domestic Nuclear Detection Office program, my concern is they have competing priorities. I think they are trying to do too much for the technologies they have right now. They are trying to solve the nuclear bomb problem and the dirty bomb problem. My understanding as a physicist, as a scientist, looking at the radiation detection capability today that they have, I would recommend to them to prioritize the dirty bomb problem. It is far more likely—I agree with everything you said in your opening statement, sir, that it is far more likely that a dirty bomb would occur, even though it is not nearly as damaging as a nuclear bomb. But the thing with our technologies now is we can detect the highly radioactive materials, and it is very difficult to detect the nuclear materials that would go into an actual nuclear weapon. So I would recommend shifting priorities at DHS in that program.

Chairman AKAKA. Dr. Ferguson, what, in your opinion, is a greater threat to the United States: A terrorist organization acquiring highly enriched uranium or plutonium, or stealing a radioactive source?

Mr. FERGUSON. Mr. Chairman, it is really hard to decide between the two. In my written comments, I said experts agree in terms of the likelihood and the consequences, and I think there is this tension right now—we see it being played out in the government—how we should devote our resources to dealing with these two very important threats.

I do not think it is either/or. I think we need to try to find a way to tackle both of these threats. Fortunately, the dirty bomb threat requires far less money to deal with than the nuclear bomb threat.

Chairman AKAKA. Yes. Do you believe that the threat of a dirty bomb attack in the United States is greater or lower than the time just after the September 11 attack?

Mr. FERGUSON. Mr. Chairman, I think a dirty bomb threat is, I think, greater post-September 11 than it was pre-September 11, although we did see evidence from al Qaeda pre-September 11 that they were trying to get their hands on material for a nuclear bomb or a dirty bomb. But I think we have seen just a recent upsurge of criminal and terrorist interest in the radiological terrorism threat.

Chairman AKAKA. Mr. Lubenau, based on your knowledge of the Nuclear Regulatory Commission, do you believe that the NRC has adequate resources to help secure radioactive sources internationally?

Mr. LUBENAU. Mr. Chairman, the resources may involve funding. Resources include staffing. It also involves the ability to engage in travel if NCR is going to do international work.

I think the NRC has done its best to obtain the necessary resources. That has been my experience when I was there. But they are also very mindful of overall Federal budget constraints. They are also mindful of the fact that work in this area does not directly relate to the regulation of the users, and the users' fees to a large part in the past have had to be used for this purpose.

That is why, for example, the direct funding of additional work by the NRC using general revenues presumably is a better alternative than either using the user fees or seeking those funds from other agencies. To me that is the key issue. Once the funding is made available, then it is a matter of deciding where to apportion the funding for the resources that are needed.

Chairman AKAKA. I was asking about international funding. Do you believe the NRC has been effective in securing sources internationally?

Mr. LUBENAU. The NRC is not directly involved in that. What they have done and continue to do is to work with the IAEA, the State Department, and the DOE to support programs—the IAEA programs, the DOE programs—to recover and secure radioactive sources. But the NRC does not directly go out and recover the sources, nor does it operate or provide equipment, for example, to secure the repositories where the sources are taken to. That is a responsibility that lies with the host governments. But in terms of direct engagement, that is not an NRC function—at least in my experience when I was there.

Chairman AKAKA. Mr. Lubenau, do you believe that the NRC has been effective—I have asked you that. Do you believe that the NRC is well suited to help other countries strengthen control over sources?

Mr. LUBENAU. I think the testimony before by Mr. Stratford that the NRC is recognized as the premier regulatory agency in the world, I would agree with that assessment. And it does serve as a model for other countries, and I think they are well positioned to provide assistance or advice to other countries in developing their programs.

Chairman AKAKA. Do you believe that the Commission has made this initiative a priority and afforded it adequate resources?

Mr. LUBENAU. To the extent—and I realize I am throwing this back to the Congress—to the extent that funds have been made available by Congress, my answer would be yes.

Chairman AKAKA. Well, I thank you all for your responses. Especially I thank those who have traveled from out of town to come here for this hearing.

Mr. LUBENAU. I do not travel as far as you, though. [Laughter.]

Chairman AKAKA. Your testimony, again, has been very informative and in a sense somewhat disturbing. It has also served to remind all of us that the threat of dirty bombs has not gone away. This is the disturbing part. These sources were not adequately secured, as you know, continue to be a risk to the safety and security of this country, and also to the rest of the world. It is inexcusable that sufficient funding for DOE and NRC activities to secure radioactive sources internationally is not being made available. Al Qaeda's desire to acquire a radioactive source and to fashion it into a dirty bomb to inflict destruction upon the American people, or the people of any country, has not waned and has not dissipated. In response, our efforts cannot wane. Attention to these critical efforts cannot be diverted either.

It is, therefore, my intention, as a member of the Energy Committee as well as Chair of this Subcommittee, to press for sufficient funding for both DOE and NRC to continue their valuable efforts to help other countries secure radioactive sources. I will also continue to highlight the need to secure these sources both here in the United States and around the world.

Again, I thank you very much for being here and for providing the information you have. The hearing record will be open for 1 week for additional statements or questions that other Members may have.

Again, thank you very much, and this hearing is adjourned.

[Whereupon, at 4:12 p.m., the Subcommittee was adjourned.]

APPENDIX

TESTIMONY OF RICHARD J. K. STRATFORD

DIRECTOR, OFFICE OF NUCLEAR ENERGY, SAFETY AND SECURITY

BUREAU OF INTERNATIONAL SECURITY AND NONPROLIFERATION

U.S. DEPARTMENT OF STATE

BEFORE THE

UNITED STATES SENATE HOMELAND SECURITY AND GOVERNMENT AFFAIRS COMMITTEE

SUBCOMMITTEE ON OVERSIGHT OF GOVERNMENT MANAGEMENT, THE FEDERAL WORKFORCE, AND THE DISTRICT OF COLUMBIA

13 MARCH 2007

INTRODUCTION

Mr. Chairman, Mr. Ranking Member, and members of the Committee, I want to thank you for the opportunity to speak to the topic of U.S. international efforts on radiological security and to explain the role of the Department of State in this important area. The Government Accountability Office is issuing a report reviewing the work of the Department of Energy and other agencies, including the Department of State, to enhance security of radioactive sources abroad. This is a challenging and important task. Radioactive sources are used throughout the world and across the public sector for numerous beneficial purposes, including cancer treatment, sterilization of medical equipment, food preservation, inspection of pipelines and other critical infrastructure, and oil exploration. Ensuring access to these valuable, often lifesaving, technologies while also ensuring the safe and secure management of radioactive sources requires a balanced, harmonized, and multilateral approach.

Following the events of September 11, 2001, governments and international organizations have taken steps to enhance security for radioactive sources, particularly those that could be used in a radiological dispersal device or "dirty bomb." The United States has led the world on radiological security through our proactive engagement on multilateral undertakings and the provision of bilateral assistance.

WHAT IS THE ROLE OF THE DEPARTMENT OF STATE?

The principal role of the Department of State in U.S. international efforts to secure radioactive material is the development and provision of U.S. international policy direction on source security and oversight of U.S. government activities abroad.

The Department of State has taken a leadership role in the international arena on strengthening existing and developing new international standards and instruments for the management of radioactive sources. The Department provides leadership in the development of unified U.S. government (USG) policy positions, in consultation with the Department of Energy (DOE), the Nuclear Regulatory Commission (NRC) and other technical agencies, related to radiological security. The Department of State also coordinates USG efforts abroad to ensure that these activities are consistent with overall U.S. foreign policy and do not negatively affect foreign relations. The State Department roles in international radiological security include:

- Leading U.S. efforts to promote radiological security agenda within international organizations and high-level political fora, including the International Atomic Energy Agency (IAEA), Group of Eight major industrialized nations (G-8), , Asia-Pacific Economic Cooperation (APEC), and Organization for Security Cooperation in Europe (OSCE)

- Coordinating U.S. activities related to radiological security under presidential-level initiatives, including the U.S.-Canada–Mexico trilateral Security and Prosperity Partnership of North America (SPP) and the G-8 Action Plan on the Security of Radioactive Sources;

- Establishing U.S. policy positions on international radiological security policies and activities, including co-chairing (with DOE) the interagency Subcommittee on Nuclear Security;

- Leading and coordinating U.S. participation at IAEA consultancies and technical meetings for the development and revision of key Agency guidance documents and multilateral frameworks pertaining to radiological security;

- Contributing to funding for and promoting IAEA programs and activities that enhance global radiological security;

Providing general oversight of U.S. international radiological security assistance to prevent overlap, optimize effectiveness, and ensure consistency with U.S. policy objectives.

- In conducting its work, the Department works closely with the technical agencies, including DOE and the NRC. As the missions and activities of DOE and NRC are complementary, both are essential for implementing U.S. policy and meeting U.S. radiological security objectives, and the Department relies heavily on the technical expertise of each.

WHAT HAS THE DEPARTMENT OF STATE DONE TO ENHANCE GLOBAL SECURITY OF RADIOACTIVE SOURCES?

The Department of State promotes the establishment and strengthening of lifecycle controls for radioactive sources.

To encourage and help countries enhance the safe and secure management of radioactive sources and materials throughout their entire lifecycle, the Department of State has pursued a strategy comprised of three important elements: the development and strengthening of international standards for ensuring the safe and secure management of radioactive sources; participating in revising and strengthening IAEA assistance programs to help countries implement these standards; and providing support for services to help countries evaluate their progress toward sustainable and effective management of radioactive sources.

Department of State led the U.S. delegations and coordinated interagency activities in efforts to gain broad international support at the highest levels for strengthening the control of radioactive sources throughout their entire lifecycle. This included in 2003 the successful revision of the IAEA Code of Conduct on the Safety and Security of Radioactive Sources (Code of Conduct) to incorporate post-9/11 security concerns and in 2004 the development of the first international framework for the import and export of radioactive sources, now published as a supplement to the Code of Conduct as the IAEA Guidance on the Import and Export of Radioactive Sources (Guidance).

Through Department of State leadership, the United States also succeeded in gaining strong international endorsements for the Code of Conduct and Guidance at the IAEA Board of Governors and the General Conference and by leaders at G-8, U.S. - EU, APEC, and OSCE summits. As a result of this high-level support, the Code of Conduct and Guidance now represent the broadly accepted international guidance for effective national radiation protection infrastructures and international harmonization of import/export practices for radioactive sources. Furthermore, such international engagement has led to the establishment of a formalized review mechanism to begin in 2007 that includes regular international meetings to review progress achieved and challenges faced by implementing countries. To date, 88 countries have made a political commitment to the Code of Conduct, an action encouraged by Secretary Powell in a February 2004 letter sent to capitals worldwide, and 39 countries have made a similar commitment to the import/export Guidance. In spite of their non-binding status, IAEA legal experts have commented that such widely recognized guidance documents could prove more effective than a legally binding approach for the control of radioactive sources, which are in wide-use throughout the world in medical, industrial, commercial, and academic settings.

The success of the United States in these international endeavors would not have been possible without the technical and legal input of the NRC and DOE during the revision of the Code of Conduct and development of the import/export Guidance. Of equal significance has been the commitment of both agencies to implement the guidance contained in the Code of Conduct and Guidance. As a notable example, provisions of the Energy Policy Act of 2005 regarding radiation source protection incorporated key provisions of the Code of Conduct and Guidance, and NRC rules implementing export controls for high-activity radioactive sources became effective December 28, 2005. As a result, the U.S. became the first country to put into place new export controls for radioactive sources, fulfilling G-8 commitments and enabling the U.S. to lead by example.

The Department of State supports and promotes IAEA programs that provide technical and regulatory assistance for the development and strengthening of national infrastructures for the life-cycle management of radioactive sources. These include the Model Project on Upgrading Radiation Protection Infrastructures (Model Project) and the Regulatory Authority Information System (RAIS). RAIS provides regulators with the capability to track radioactive sources, licenses, qualifications of authorized users, and occupational dose records. RAIS offers developing nations an established platform that can be tailored to individual needs; is supported by IAEA training and technical assistance; is available in multiple languages; and is currently being adapted for internet-based use. Since 2003, State has provided $1.14 million to the IAEA for upgrading RAIS software and training.

The Department of State also supports and promotes IAEA services that help Member States evaluate their current status and identify gaps in meeting international benchmarks for radiation protection infrastructures and the safe and secure management of radioactive sources. The Department encouraged the revision of the Agency's existing Radiation Safety Infrastructure Appraisal (RaSIA) program to extend its scope to security of radioactive sources. The resulting Radiation Safety and Security of Radioactive Sources Infrastructure Appraisal (RaSSIA) protocol provides countries with much needed missions led by the IAEA to assess the adequacy of regulatory infrastructures applicable to the security of sources. Department of State, along with Department of Energy support, have helped the IAEA conduct in excess of 60 such missions to Member and Non-Member States since 2004.

The Department of State monitors illicit trafficking of radioactive materials and serves as the official U.S. point of contact for the IAEA Illicit Trafficking Database.

One way to gauge the effectiveness of efforts to secure radioactive materials is through the evaluation of reports of illicit trafficking. The Department leads an interagency effort to track and coordinate responses to nuclear and radiological trafficking. The group reviews information reported in a number channels, and one unique source of data on radioactive materials outside legitimate control is the IAEA Illicit Trafficking Database Program (ITDB). The Department, which is the USG point of contact for the program, is working with the interagency to make the ITDP a more robust and effective tool for reporting illicit-trafficking related information so that governments can better identify the potential threats associated with nuclear and radioactive materials outside legitimate control.

The ITDB also provides a useful information source to direct U.S. radiological assistance programs. Overall, incidents confirmed to the ITDP show an increase in radioactive sources outside legitimate control. However, with the increase in deployed radiation detection equipment worldwide and greater participation in the ITDP, it remains to be seen if this increase is real or an artifact of better reporting and tracking of radioactive sources.

The Department of State provides leadership for establishing U.S. policy on IAEA radiological security guidance and programs.

Department of State oversees IAEA activities on radioactive source security and employs two mechanisms to influence IAEA activities in this area. State co-chairs, with DOE, the standing Subcommittee on Nuclear Security that feeds directly into the IAEA Advisory Group on Nuclear Security (AdSec). State also coordinates the development of U.S. policy positions on guidance documents. U.S. government policy positions are transmitted through the U.S. Mission in Vienna via formal delegation guidance, letters, and other communications.

As an example of this work, the Subcommittee on Nuclear Security, through the U.S. Mission in Vienna, pressed for the IAEA to accelerate its efforts on source security and develop a formal process for the preparation of IAEA security documents. As a result, the Agency has since proposed as part of its Nuclear Security Program for 2006 - 2009 a new Nuclear Security Series and review process for the preparation of publications to provide IAEA Member States with recommendations and guidance on best practices for developing, implementing and maintaining effective programs for providing security for radioactive materials. State has worked closely with DOE, NRC, and other technical agencies to ensure that documents produced as part of IAEA Nuclear Security Series are consistent with existing legal and policy instruments of the international nuclear security regime, including the Convention on the Physical Protection of Nuclear Material, the United Nations Security Council Resolution 1540, and the Code of Conduct on the Safety and Security of Radioactive Sources.

The Department of State coordinates all U.S. funding provided to the IAEA for radiological security related work.

The Department of State has the lead for coordinating all U.S. funding provided to the IAEA, the primary international organization for coordinating multilateral radiological security activities. The Department of State, in close collaboration with DOE, has urged the IAEA to improve coordination of security related activities and funding from donor countries. The U.S. is now seeing results from this effort in the form of tangible improvements in IAEA coordination.

Notably, at two Major Donor meetings in 2006, the U.S. and others urged the IAEA to set priorities for its Nuclear Security Plan (NSP), establish metrics to gauge progress, and assume a greater coordination role for physical protection activities. As a result of these efforts, the IAEA is now creating a country-by-country matrix of activities being conducted by each Member State, the European Commission, and the IAEA. This information exchange will enable Donors to the IAEA Nuclear Security Fund to better utilize and leverage activities and resources. In keeping with this progress, the next

Major Donor meeting will focus on priorities for activities, including radiological security efforts, conducted under the NSP.

The Department of State provides diplomatic support to and oversight of technical agencies when conducting radiological security work in foreign countries.

While State maintains a central role in setting a consistent, long-range, and sustainable course through multilateral instruments and international programs, the technical agencies clearly have the lead for implementation and day-to-day oversight of assistance projects. DOE has the resources and technical expertise for implementing on-the-ground radiological security work in foreign countries. NRC, as the domestic U.S. nuclear regulatory authority, maintains the technical and legal expertise related to the licensing and control of radioactive sources.

However, State provides diplomatic support to the technical agencies, if requested and needed, to facilitate international radiological security efforts. In terms of oversight, State also monitors official U.S. travel and maintains close contact with DOE and other agencies to ensure that USG actions abroad are informed by U.S. foreign policy and consideration of sensitivities associated with a specific country. State also provides input to DOE for the prioritization of work by country and region on a number of projects. As part of this collaboration, DOE provides briefings to State's country desks and regional offices to update the Department and its embassies and missions on ongoing and planned activities in countries and regions of interest. In support of State's efforts, DOE also has offered to call attention to the Code of Conduct and import/export Guidance during assistance missions to countries that have not made a political commitment to implement these international guidelines.

The Department of State provides bilateral assistance to countries for the establishment or enhancement of a sustainable infrastructure for the safe and secure management of radioactive sources.

The Department of State Bureau of International Security and Nonproliferation manages the Nonproliferation and Disarmament Fund (NDF) to conduct the development, execution and implementation worldwide of carefully selected projects to advance proliferation threat reduction and disarmament goals. The NDF has funded projects that enhance security for high-risk sources in Iraq and Ukraine.

Strengthening Radiological Security in Iraq

In September 2005, GAO published a report entitled Radiological Sources in Iraq [GAO-05-672], which describes in detail U.S. efforts to enhance radiological security in Iraq through the establishment of an effective regulatory authority to ensure a native capacity for locating, recovering, and securing radioactive sources that remain outside of regulatory control. This program continues to represent a model for interagency cooperation. This work also represents a success story resulting from the establishment of a functional independent government agency in Iraq.

A project funded by the NDF has provided training and equipment essential for the establishment of a regulatory authority in Iraq to provide for the safe and secure management of radioactive sources. The rapid standup of the Iraqi Radioactive Source Regulatory Authority (IRSRA) immediately following the June 2004 transfer of authority allowed for preservation of search and recovery capabilities established under the Coalition Provisional Authority using staff from the Iraq Ministry of Science and Technology (MoST). From the inception of IRSRA, DOE has also provided equipment and training in Jordan and elsewhere. DOE has provided extensive security related training to Iraqi personnel. DOE has also trained and equipped border control personnel to screen vehicles for radioactive materials at the twenty major Iraq border control points. NRC and DOE experts, in cooperation with the IAEA, have provided guidance and direction to IRSRA with respect to development of regulations in line with international standards.

As a result of State Department led efforts, Iraqi engagement on radioactive source control has been exemplary, with an early and notable political commitment to the IAEA Code of Conduct. IRSRA and MoST report that hundreds of missions to search for abandoned and vulnerable radioactive sources have been conducted by the MoST teams, including a recent sweep of Sadr City. As an example of ongoing progress, during the week of 12 March, the Chairman of IRSRA and the Director General of MoST (the agency managing the radioactive source field survey teams) will be in Washington., D.C., to meet with personnel from State, DOE, NRC, and the IAEA to plan future work. During the week, the Chairman of IRSRA also plans to meet with NRC Commissioners.

Improving Regulatory Control of Radioactive Sources in Ukraine

State Department has provided direct support for the strengthening of regulatory infrastructures in support of radiological security to the Government of Ukraine through the Nonproliferation and Disarmament Fund (NDF). On November 17, 2003, the Under Secretary of State for Arms Control and International Security authorized NDF funding for the execution of a project (NDF Project 188) to establish key elements of a Ukrainian national system to improve long-term security of high-risk radioactive sources. This work was conducted in a manner that leveraged to the maximum extent prior U.S. and international assistance to the IAEA for promoting radioactive source controls. The project was formulated in consideration of foreign policy objectives and is consistent with the overall policy direction of the Department.

The Department considers the Ukraine project a success, both in terms of the execution and end result. The Ukrainian regulator is the ultimate customer for the project deliverables, i.e., a regulatory information system, training, and equipment for regional offices. Accordingly, State pursued an approach placing the responsibility for performance in the hands of the Ukrainian regulator, the State Nuclear Regulatory Committee of Ukraine (SNRCU), including the development of a mutually agreed action plan. This was done in close partnership with the DOE Attache in Kyiv, who agreed to work with the SNRCU in project implementation. As another example of interagency cooperation, the DOE Attache provided in-country oversight of project implementation to ensure project objectives were met. The fact that the regulatory authority assumed full ownership of the project increases the likelihood that the tangible products of the project, regulatory tools and training, will be supported, maintained and utilized.

A key objective of the NDF project was to leverage U.S. support for related existing IAEA programs to the maximum extent possible. In this regard, Ukraine is using the IAEA Regulatory Authority Information System (RAIS) system for its regulatory tracking and management of radioactive sources along with other regulatory functions. As mentioned earlier, the U.S. has provided substantial support, including voluntary funds, to the IAEA for recent enhancements and upgrades of the RAIS system. The project is essentially complete, with only $250,000 provided to the Ukraine regulator.

Initial RAIS training for Ukrainian staff is complete and all regional offices are equipped with furniture, computers, and software. All of this has been accomplished by the Ukrainians themselves.

The Department of State coordinates U.S. radiological security efforts under the President's Security and Prosperity Partnership initiative.

On March 23, 2005, President Bush, President Fox and Prime Minister Martin launched the trilateral Security and Prosperity Partnership of North America (SPP) to establish a common security strategy to better protect critical infrastructures and secure borders, among other things. Strengthening radiological security is one component of this cooperation. The Department of State coordinates radiological security efforts and works closely with the DOE, NRC, and the Department of Homeland Security (DHS) to take advantage of the SPP umbrella to advance common security interests and to minimize negative impacts on existing programs and relationships. I conclude with this example because it exemplifies the close and mutually beneficial cooperation among State, DOE, and NRC.

During the initial development of the SPP implementation plan, Department of State brought in DOE and NRC to help identify attainable and concrete radiological security goals in North America that would benefit from presidential-level commitments and greater cooperation with Canada and Mexico. Building on existing working-level relationships between DOE and NRC with counterparts in Canada and Mexico, State was able to engage Canadian and Mexican authorities on a bilateral basis to examine these mutual goals and discuss avenues for furthering them. Significantly, such discussions led to an offer by Mexico to host the first trilateral SPP meeting on nuclear and radiological security later this month. Thus, through close interagency cooperation, by leveraging a Presidential-level initiative, and cultivating DOE and NRC expertise and working-level relationships, the U.S. is successfully cooperating on a regional basis to advance and accelerate our mutual radiological security goals for North America.

CLOSING

Effective U.S. action to strengthen lifecycle control and increase security over radioactive sources requires extensive coordination here at home with our interagency colleagues and abroad with partner nations, the IAEA, and other international organizations. The Department of State therefore serves a central role ensuring that U.S. international efforts on radiological security are consistent with and informed by U.S. foreign policy and relations. The Department also provides leadership on a number of multilateral efforts that provide international benchmarks for national regulatory and legal infrastructures required for sustainable and effective control of radioactive sources throughout their entire lifecycle. The Department also supports key IAEA programs, services, and tools to evaluate progress and determine gaps in national infrastructures and to fill those gaps in order to meet international standards for ensuring the safe and secure management of radioactive sources. In doing so, the Department of State relies heavily on the resources, expertise, and experience of the Department of Energy, the Nuclear Regulatory Commission, and other U.S. agencies.

Significant progress has been made by the United States to enhance control over radioactive sources around the world and to thereby reduce the risk of a radiological dispersal device being used against our nation or our interests. This progress has been achieved through action at all levels, from high-level political and diplomatic efforts to on-the-ground security work conducted in foreign lands. Given the scale and importance of the task at hand, U.S. international efforts to strengthen radiological source security has required and resulted in greater coordination within the U.S. government, with each agency providing complementary and essential capabilities. Continued success on international radiological security will, accordingly, require continued close collaboration among the key U.S. government agencies in partnership with the international community.

**STATEMENT OF ANDREW BIENIAWSKI
ASSISTANT DEPUTY ADMINISTRATOR
OFFICE OF GLOBAL THREAT REDUCTION
NATIONAL NUCLEAR SECURITY ADMINISTRATION
U.S. DEPARTMENT OF ENERGY
BEFORE THE
UNITED STATES SENATE HOMELAND SECURITY AND GOVERNMENT AFFAIRS COMMITTEE SUBCOMMITTEE ON OVERSIGHT OF GOVERNMENT MANAGEMENT, THE FEDERAL WORKFORCE, AND THE DISTRICT OF COLUMBIA**

MARCH 13, 2007

INTRODUCTION

Thank you, Mr. Chairman and members of the Committee, for giving me the opportunity to testify on the Department of Energy's (DOE) efforts to secure and recover vulnerable, high-risk radioactive sources outside the United States that pose a security risk to U.S. strategic assets at home and around the world. We very much appreciate the Committee's continued interest and leadership on the issue of securing vulnerable radiological sources both domestically and internationally.

I am pleased to report that, since its inception in 2002, the DOE International Radiological Threat Reduction program has completed security upgrades at more than 500 sites in over forty countries around the world. Radioactive materials such as cobalt-60, Cesium-137, Strontium-90, and Americium-241, which are used worldwide for many legitimate purposes, could be exploited by terrorists to produce a radiological dispersion device (RDD), or dirty bomb. The program's primary objectives are to (1) implement rapid physical security upgrades at vulnerable sites containing radioactive sources; (2) locate, recover and consolidate lost or abandoned high-risk radioactive sources; and (3) support the development of the infrastructure necessary to sustain security enhancements, including the development of regional partnerships to leverage international resources.

THE RADIOLOGICAL THREAT

Before I describe our progress in responding to the recommendations within the recent Government Accountability Office (GAO) report on our work in this area, I would like to address the radiological threat and why we are accelerating and expanding our efforts. The intent of terrorists to acquire radioactive materials for use in an RDD poses a significant risk to the American public and needs to be addressed. One of the many lessons learned from the attacks of September 11, 2001 is that some of the most common tools used in our daily lives, such as commercial airliners, can and will be used by terrorists in an attempt to wreak havoc on the U.S. and other democratic governments around the world. Radioactive materials, in particular, are used routinely for a variety of medical, industrial and educational purposes. Commonly used sources available in sufficient quantities for an attractive RDD capable of causing harm of national significance include Cobalt-60, Cesium-137, Iridium-192, and Radium-226. Should terrorists acquire and use these materials in an RDD, the physical, psychological and economic impact could be significant.

Since September 11, we have witnessed several large-scale sophisticated terrorist attacks around the world. The terrorist attacks in Russia, Spain, Indonesia, Iraq and UK have all been well planned with no regard for the well being of innocent civilians. A terrorist act using an explosive RDD could result in a few immediate radiation induced-deaths, over the longer-term increased cancer induced deaths; and, substantial near and long-term economic losses due to the costs associated with environmental decontamination and the serious psychological impact upon the general population. Unlike a nuclear weapon, the explosion of an RDD would likely result in instant deaths only in the immediate vicinity of the explosion. However, the economic consequences of such an explosion could be severe, perhaps in the billions of dollars.

From various reports, Al Qaeda is known to be interested in acquiring the materials for a radiological weapon. In June 2005, Senator Lugar, polled dozens of nonproliferation experts around the world; the *Lugar Survey on Proliferation Threats and Responses* concluded that "the probability of a radiological attack…was twice as high as…" other potential WMD attacks such as biological and nuclear. Given the reality of this situation, the Department, this Administration, and Congress have taken important steps to increase radiological threat reduction efforts.

GLOBAL THREAT REDUCTION INITIATIVE

In order to more effectively address the risk of terrorist use of an RDD, in 2004 DOE consolidated its radiological threat reduction efforts into the Global Threat Reduction Initiative (GTRI). The program's primary approach to reducing the risk posed by vulnerable high-activity radiation sources abroad is to: (1) implement rapid physical security upgrades at vulnerable sites containing radioactive sources; (2) locate, recover and consolidate, into secure facilities, lost or abandoned high-risk radioactive sources; and (3) support the development of the infrastructure necessary to sustain enhanced security systems, including through the development of regional partnerships leveraging international resources. GTRI works with international partners to enhance security of vulnerable radiological material located at civilian sites worldwide that, if stolen or diverted, could be used in a RDD. GTRI is a vital part of the President's *National Security Strategy of the Untied States of America* and the President's July 2006 *Global Initiative to Combat Nuclear Terrorism* aimed at strengthening international cooperation to secure nuclear and radiological materials and to prevent the use of these materials in terrorist acts. In addition, GTRI directly addresses recommendations of the bipartisan 9/11 Commission.

DOE and the National Nuclear Security Administration (NNSA) are committed to securing and removing vulnerable radiological sources around the world. Over the past several years, DOE and NNSA have significantly accelerated efforts to secure vulnerable sources. To date, DOE/NNSA has secured more than 500 vulnerable radiological sources worldwide since 2002. In fact, since we began our efforts to first secure sources internationally in 2002, we have accelerated these efforts each and every year. As of January 2007, DOE has spent approximately $120 million to secure vulnerable radiological sources under its International Radiological Threat Reduction Program. This demonstrates both a strong commitment and a successful program that produces tangible results and reduces the risks that these vulnerable sources could be acquired by terrorists to make a "dirty bomb".

I am also pleased to note that this Committee, and the U.S. Congress as a whole, have provided critical support to DOE's radiological threat reduction efforts both domestically and internationally. I applaud the numerous Congressional actions that have helped make our efforts possible, including the establishment of legal authority for DOE to collect high-activity and high-risk radioactive sources (Greater-Than-Class-C) within the United States via the Low-Level Radioactive Waste Policy Amendments Act, the provision of emergency appropriations after the terrorists acts of "9/11" for the accelerated domestic recovery of radioactive sources; authorization and appropriations to carry out dirty bomb threat reduction efforts internationally; and emergency supplemental funding for DOE to carry out radiological threat reduction work in Iraq, resulting in the successful removal of nearly 1,000 high-risk radioactive sources from that country.

GAO RECOMMENDATIONS AND DOE ACTIONS

I would also like to recognize GAO for conducting a comprehensive assessment of our efforts to secure and recover vulnerable high risk radioactive sources at various sites around the world. Their efforts and recommendations have helped us make adjustments to improve the effectiveness of the program.

We are pleased that the GAO report recognizes that "DOE has achieved noteworthy accomplishments in improving the security of radiological sources at hundreds of sites in more than 40 countries..." The GAO report also highlighted several notable DOE accomplishments, including the fact that DOE:

- secured or recovered radioactive sources at over 500 facilities in 43 countries under this program since 2002;
- removed more than 5,000 curies of radioactive Cobalt-60 and Cesium-137 from war-torn Chechnya;
- improved security in Greece prior to the 2004 Olympics;
- created secure storage facilities in Uzbekistan, Moldova, Tajikistan, and Georgia;

- removed or secured, in cooperation with our international partners, more than 30% of the radioisotope thermoelectric generators (RTGs) located in Russia;

- negotiated an agreement to obtain international funding (e.g. Government of Canada) to accelerate RTG security efforts in Russia;

- improved coordination with Department of State (DOS) and Nuclear Regulatory Commission (NRC) to secure radiological sources worldwide (the most prominent example is the cooperation and radiological sources in Iraq);

- improved cooperation and coordination with the International Atomic Energy Agency (IAEA) and several Key Donor States to the IAEA's Nuclear Security Fund to avoid duplication of effort; and,

- developed successful bilateral and multilateral partnerships to enhance physical protection of vulnerable radioactive material at various sites around the world.

As GAO notes, radioactive sources provide substantial medical, industrial, and agriculture benefits. Because radioactive materials are in widespread commercial use throughout the world, the GAO report acknowledged that we face a considerable challenge in securing other countries' most dangerous radiological sources given the number of these sources and how widely they are employed. While we believe that we have achieved a great deal of threat reduction in a short period of time, there remains an enormous amount of dangerous material left to secure or eliminate.

In their study, GAO identified areas that it believes need to be further addressed by DOE – prioritization, quality assurance/sustainability, coordination, and transportation. It is important to note that we already have in place substantial measures to address each of these areas. For example, during the past several months GTRI undertook a major program assessment aimed at establishing new prioritization guidelines for securing and recovering vulnerable nuclear and other radioactive material around the world. GTRI has further improved coordination by organizing the program regionally.

Regarding GAO's belief that we need to further address <u>prioritization</u>, we note that:

- NNSA and its international partners have made substantial progress by securing 742 sites. All of these sites are of the highest priority and contain vulnerable radiological sources. Specifically NNSA or its partners have completed:
    - 374 of 1,062 (35%) of the RTGs
    - 30 of 69 (43%) of the waste repositories
    - 82 of 229 (36%) of the research institutes and commercial/industrial sites
    - 256 of 1,951 (13%) of the medical facilities

- Total curies of radioactivity is just one of several critical factors that the program uses to determine priority. The others are (1) known terrorist threat in the country/region, (2) current level of security at the site, and (3) the proximity of the site in relationship to potential strategic targets of U.S. interest. The first factor, terrorist threat, is significant because the majority of large scale attacks to date have been at U.S. assets (embassies, military bases/ships, etc) or western hotels and transportation systems in Africa, Middle East, Asia, and Europe using locally purchases/stolen materials to minimize the risk of detection prior to the attack.

- Because of this, specific types of medical sources are highly attractive to would-be terrorists. GAO's report highlights a 1,400 curie medical source in Brazil that, in an accident not a premeditated, planned attack, killed 4 people, caused widespread panic, and resulted in $36 million in decontamination costs.

- Recent research conducted by Sandia National Laboratories that we shared with the GAO investigators, documents the ease with which a medical source could be stolen and helps to validate the significance of this risk.

- As GAO states, it is the small size, portability and potential value of sealed radiological sources make them vulnerable to misuse. At the same time, as GAO recommends, NNSA will continue to accelerate RTG recoveries but the program must also address these additional high priority medical and other radioactive sources.

Regarding the GAO's recommendations on quality assurance/sustainability, we note that:

Our standard protection upgrade implementation practice ensures quality assurance. This is accomplished by (1) having the development of a protection upgrade design reviewed and approved by NNSA physical protection experts prior to payment for the contracted design document; (2) insisting the approved design document is a precondition to proceeding with procurement of protection equipment and installation; (3) conducting post-installation visits by our technical experts for the purpose of assuring all equipment and systems are installed as agreed upon in the design document (if installations are performed incorrectly, payments are withheld until corrections are made). We are further investigating this process to identify and implement additional improvements.

- GTRI already has been implementing a short-term sustainability program that includes a 3-year warranty as well preventative maintenance contracts and training on newly installed equipment for operational staff at the sites. In order to ensure effective long-term security upgrades at facilities around the world, we agree with GAO's recommendation to expand this into a long- term sustainability plan of the security measures. We agree that additional work needs to be done to develop a **long-term** sustainability plan and we are in the process of developing this plan. We are currently re-examining our sustainability policies and procedures to assure ourselves that security upgrades can and will function effectively over the long term, especially in those countries that lack reliable communications and electric power systems.

Regarding GAO's recommendation to further address coordination, we note that NNSA is closely cooperating with other offices within the DOE, other Government Agencies, and international partners. In fact, the GAO report notes that DOE has improved coordination with the State Department and the Nuclear Regulatory Commission (NRC) to secure sources in other countries. The GAO report also acknowledges that DOE has involved State and NRC in its international radiological threat reduction activities more often and has increased information sharing with the agencies since GAO last reported on this matter in 2003. Additional examples of coordination include:

- Working closely with the U.S. Nuclear Regulatory Commission (NRC) and the Massachusetts Department of Public Health's (MDPH) Radiation Control Program in removing radioactive materials from Massachusetts in December 2006;

- Teaming with DOE's Office of Nonproliferation and International Security to secure and recover large quantities of orphaned nuclear materials and radioactive materials in Iraq under Project Maximus in 2004;

- Continuing to work closely with the Department of State and NRC to develop and implement physical protection programs internationally;

- Closely cooperating and coordinating with the International Atomic Energy's (IAEA). Specific programs include: successful Tripartite Initiative with the IAEA and the Government of the Russian Federation to identify, locate and secure disused and orphaned sources in the Former Soviet Republics, including the recovery of a large quantity of vulnerable radioactive sources from Chechnya this past year; teaming with the Department of State to assist the IAEA in development and implementation of a major upgrade to its Radiological Authority Information System (RAIS), and teaming with NRC and DOS to develop IAEA consensus guidance for use by member states;

- Providing technical experts to support the IAEA's Office of Nuclear Security's programs to assist countries in the areas of regulatory infrastructure support, physical protection training and inspections; providing technical experts to assist the IAEA in the recovery of vulnerable at risk radioactive sources, and providing technical experts to IAEA missions to assess the status of radiological security in member states;

- Working with select donor countries to assist the IAEA in addressing the most significant challenges to source security first.

- Teaming with the IAEA and the Government of South Africa to recover and disposition sixty-eight (68) disused or orphaned sources from other African countries to mitigate security concerns; assisting the IAEA and the Nuclear Energy Corporation of South Africa (NECSA) in development of a mobile Spent High Activity Radioactive Source (SHARS) conditioning facility to aid in the recovery of vulnerable, high-risk orphaned and disused sources around the world. This system is scheduled to be used to recover several high activity sources in Africa during the fourth quarter of FY2007;

- Teaming with the Government of Australia and the IAEA in developing the infrastructure to support increased source security in Southeast Asia , that complements GTRI's bi-lateral physical security upgrade work

- As an indication of the importance and effectiveness of our RTG security and recovery program, the Government of Canada is preparing to provide NNSA approximately $2 million to augment the work currently being done by GTRI to secure and recover RTG's in Russia.

Regarding the GAO's recommendation to further address transportation, we note that:

- NNSA staff and technical experts from our national laboratories have been working with the U.S. Department of Transportation, the IAEA's Office of Nuclear Security, and key IAEA Donor States to strengthen transport security regulations and procedures to mitigate the risks of theft or diversion of nuclear and other radioactive materials in transit.

- We have also been working bilaterally with the Government of the Russian Federation to enhance the security of radioactive materials during their transport from the end-user's site to a location of final material disposition. Because the vast majority of all waste shipments within the Russian RADON system are handled by the RADONs located at Sergev Posad and Moscow, most of the funds we provided to upgrade transport security within Russia, including cargo trucks and escort vehicles, were in support of shipments to and from these two sites.

We appreciate the efforts made by the GAO report to reinforce the importance of DOE nuclear and radiological security programs in support of U.S. national security. GAO's independent validation of our successes and recommendations for further strengthening of our efforts is very helpful.

In conclusion, we welcome this opportunity to focus attention on the very urgent and pressing issue of securing vulnerable radiological sources around the world. Thanks to your support, we have made significant progress to reduce the likelihood that terrorists will be able to acquire radiological sources for use in a dirty bomb. However, much work remains to be done and we look forward to working closely with Congress to continue to accelerate these efforts in the outyears.

STATEMENT SUBMITTED

BY THE

UNITED STATES NUCLEAR REGULATORY COMMISSION

TO THE

COMMITTEE ON HOMELAND SECURITY AND GOVERNMENTAL AFFAIRS

SUBCOMMITTEE ON OVERSIGHT OF GOVERNMENT MANAGEMENT, THE FEDERAL

WORKFORCE, AND THE DISTRICT OF COLUMBIA

UNITED STATES SENATE

CONCERNING

INTERNATIONAL EFFORTS TO SECURE THE HIGHEST PRIORITY RADIOLOGICAL

SOURCES THROUGH REGULATORY STRENGTHENING

PRESENTED BY

JANICE DUNN LEE
DIRECTOR
OFFICE OF INTERNATIONAL PROGRAMS

SUBMITTED: MARCH 13, 2007

INTRODUCTION

Mr. Chairman and Members of the Subcommittee, thank you for inviting the U.S. Nuclear Regulatory Commission (NRC) to discuss the vital role that it plays in international efforts to enhance security of risk-significant radioactive sources. As requested, we will discuss the recently released Government Accountability Office (GAO) Report GAO-07-282 "The Department of Energy's International Radiological Threat Reduction Program Needs to Focus Future Efforts on Securing the Highest Priority Radiological Sources," and NRC's relationship with the work of the International Atomic Energy Agency (IAEA) and the Department of Energy's National Nuclear Security Administration (DOE/NNSA) in this area.

At the outset, I would like to highlight that the Commission fully supports the suggestion made in the GAO Report that Congress consider providing NRC with the authority and a direct appropriation to conduct international regulatory development activities to improve security over radioactive sources. NRC estimates that a modest increase – estimated at $2 to $3 million per year in non-fee-based funding – would allow us to continue this successful effort to create sustainable national regulatory programs integrating safety and security controls over these widely used sources.

The NRC's current assistance program has contributed significantly to the overall U.S. effort to strengthen control of sources around the world. The success of the NRC assistance program derives from our 32 years of experience as the U.S. regulator of civilian uses of radioactive material, including radioactive sources. We seek to create effective, sustainable national regulatory infrastructures by paying close attention to regional needs and cultures as well as coordinating our efforts with other federal agencies' and international efforts.

The best way to demonstrate how NRC has cooperated with other Federal agencies and the IAEA to enhance security of risk-significant sources globally is to discuss NRC's specific activities in these areas. I will briefly describe NRC's participation in the development and implementation of the IAEA's Code of Conduct on the Safety and Security of Radioactive Sources, a successful ongoing pilot project started by NRC in 2002 in Armenia, and work begun in 2006 to support the Iraqi nuclear regulator.

RECENT DEVELOPMENTS

A. The IAEA Code of Conduct on the Safety and Security of Radioactive Sources

The NRC, and Departments of Energy and State, all played key roles in developing the IAEA Code of Conduct on the Safety and Security of Radioactive Sources. The Code was adopted by the IAEA in September 2003, endorsed by the Group of Eight Industrial Nations in 2004, and, with the associated Guidance, was fully implemented by the NRC in December 2005. So far, 88 nations have made a commitment to implementing the code. The Code provides a reinforcing framework of sound international export controls on radioactive materials that could be used to construct devices for malicious purposes. The NRC was also active in developing the categorization of sources, upon which the Code was based, using its technical expertise, and work being done to support our domestic program. Further, the enactment of the Energy Policy Act of 2005 codified certain of the Code's import-export restrictions for risk-significant sources. The NRC has used the Code as the underlying principle for the security enhancements of licensees possessing risk-significant sources.

The U.S. has worked to promote the Code's implementation worldwide. As the government agency responsible for import-export licensing of radioactive sources, the NRC has coordinated extensively with its international regulatory counterparts to assist them in understanding both changes in U.S. regulations and the responsibilities associated with implementing the Code in their countries. In this effort, the NRC has partnered with the regulatory authorities of the United Kingdom, Canada, and Australia, among others, on projects to secure, protect, and monitor radioactive sources.

The NRC staff maintains a close partnership with the IAEA on other source-related issues, participating regularly in international meetings to develop safety and security guidance documents. NRC staff, and senior staff from Agreement State programs, have also participated in Radiation Safety and Security Infrastructure Appraisal (RaSSIA) missions, which assess the effectiveness of individual nation's regulatory infrastructure for the safety and security of radioactive sources.

Our success in controlling high-risk radioactive sources internationally is by large measure dependent on our success in controlling them domestically. Some examples of NRC efforts include the plan to implement the National Source Tracking System; our issuance, together with the Agreement States, of legally-binding requirements for increased security of high-risk sources to nearly 3,000 licensees; the Radiation Source Protection and Security Task Force; our Rulemaking on Secure Transfer; and NRC's partnership with Customs and Border Patrol to validate the authenticity of radioactive material shipments.

B. Pilot Program in Armenia

In early 2002 NRC performed an assessment to identify regions of the world within which an attack using radioactive materials might be conducted, or that might have risk-significant radioactive sources that could be used for such devices. This assessment drew on NRC's knowledge and experience working with its regulatory counterparts throughout the world, country-specific information regarding the existence -- or the lack thereof -- of national nuclear regulatory authorities, in-country availability of radioactive sources in quantities of concern, known incidents or events involving radioactive sources and country-specific security, threat, illicit trafficking and other intelligence-related information. NRC staff also consulted with the Departments of State and Energy to ensure that its assessment did not duplicate any activities underway by those agencies.

NRC's focus turned to a number of the newly independent states of the former Soviet Union, especially countries in the Caucasus and Central Asian regions, as likely areas of high risk for either experiencing a Radiological Dispersal Device or Radiological Exposure Device attack, or for being the source of radioactive material that might be put to malicious use elsewhere. NRC sought to utilize over a decade's worth of assistance activities relating to strengthening national regulatory authorities in the region as part of the U.S. Government's nuclear safety initiatives.

With the support of the State Department's Office of the Coordinator for Assistance to Europe and Eurasia, NRC expanded the use of State Department-provided Freedom Support Act (FSA) funds to include development of a pilot project to strengthen the capabilities of the Armenian Nuclear Regulatory Authority (ANRA) to exercise effective nuclear safety and security regulatory oversight of radioactive sources. The project focused on two of the principal measures identified in the IAEA-sponsored Code of Conduct, to establish a national registry of radioactive sources, and to develop and implement legislation and regulations that prescribe and assign government responsibilities for the safe and secure use of radioactive sources.

Since mid-2003 this project has produced a stream of significant, measurable results. ANRA became one of the first regulatory authorities in the Caucasus region, if not the world, to successfully complete development and implementation of a national radioactive source registry. ANRA now has current information on the type, owner and use of the approximately 1,200 radioactive sources in over 275 sites in Armenia. Disposition of these sources has been verified by ANRA through on-site inspections. Periodic updates of the radioactive source registry ensure its accuracy. ANRA adopted several new radioactive source-related safety and security regulatory requirements and procedures to license users of radioactive sources. Workshops were conducted to familiarize users with the new safety and security requirements. ANRA's legal authority was also significantly strengthened when amendments to Armenia's basic nuclear law were adopted in late 2005.

The effectiveness of this project was independently assessed in mid-2005 by an IAEA-sponsored RaSSIA mission. The mission highlighted how the legislative and statutory framework enhancements "fully addresses the radiation safety principles set out in international standards." The RaSSIA mission also positively noted how ANRA had developed its own registry of radioactive sources. Further, the new regulatory controls in Armenia support NRC's ability to make positive licensing decisions when evaluating applications to export Category 1 and 2 radioactive sources under the revised U.S. controls consistent with the Code of Conduct.

These results were achieved at a total cost to the U.S. taxpayer of around $500,000 over 3 years, using FSA funds. NRC utilizes a significant portion of available funding, typically over 60%, to utilize in-country technical expertise and resources needed for project implementation. This results in the use of technical expertise comparable to that available in the United States at one-twentieth the cost. This also ensures both short-term and long-term sustainability of assistance results, as the expertise resides in-country even after U.S.-funded assistance efforts have been completed.

C. Support for the Iraqi Radioactive Source Regulatory Authority

In 2004, the Departments of State and Energy began work with the Iraqi government to secure nuclear materials, to catalog sources and their whereabouts, to secure sources of concern, and to create an Iraqi regulatory authority with responsibility for radioactive materials. Iraq has several thousand sources primarily used in the oil industry and medical applications. Identifying, tracking and securing sources has been a top priority for the newly-formed Iraqi Radioactive Source Regulatory Authority.

In support of these U.S. Government initiatives, the NRC is providing regulatory assistance on the review of the country's national legal structure and is helping to develop regulations for disposal of low-level radioactive waste and storage of unwanted sources.

CHALLENGES

NRC is now receiving requests for similar support from regulatory authorities of other countries in or near the Caucasus and Central Asian regions, including, but not limited to, Georgia, Azerbaijan, Ukraine, Moldova, Kazakhstan, Uzbekistan, Tajikistan and Kyrgyzstan. The State Department's Office of the Coordinator for Assistance to Europe and Eurasia has determined that limited FSA funding is only available to support similar radioactive source-related regulatory assistance in Georgia and Kazakhstan, due to budget constraints.

As detailed in the GAO Report, NRC is seeking to identify potential sources of funding that could support provision of radioactive source-related regulatory assistance to these Caucasus countries, as well as other areas of the world. While we have not been successful to date in obtaining this funding, NRC remains committed to assisting its international counterparts in developing, implementing and sustaining the security-related regulatory infrastructure needed to ensure both the short-term and long-term safe and secure use of risk significant radioactive sources.

Receiving direct appropriations from Congress for assistance-related activities, as recommended by GAO, is the only viable mechanism for providing the stable, predictable funding needed to effectively implement these activities. This approach would produce a resource saving for NRC, as approximately one-quarter of NRC's assistance-related staff time focuses on identifying, obtaining, and accounting for funding from other U.S. Government agencies. And, as noted in the GAO report, our efforts are often unsuccessful.

An increase of $2 to $3 million per year in non-fee-based funding appropriated directly to NRC would provide the basis for a stable, sustainable assistance program. NRC believes the conclusions reached in its 2002 assessment are still valid, and direct funding would enable us to expand ongoing or planned radioactive source-related regulatory strengthening activities. NRC would work in parallel with other parties in the U.S. and the international community, such as the IAEA and the European Commission, to identify other countries that could benefit from regulatory strengthening assistance. NRC would also work closely with the regulatory authorities of key countries to which U.S.-manufactured radioactive sources are exported to ensure that the U.S.-origin radioactive sources of highest concern are used safely and securely.

CONCLUSION

NRC is uniquely qualified to assist its international counterparts in developing, implementing and sustaining the security-related regulatory infrastructure needed to ensure both the short-term and long-term safe and secure use of radioactive sources of highest concern. Congressional authorization and appropriation of an increase of $2 to $3 million per year in non-fee-based funding appropriated directly to NRC will help reduce the likelihood of radioactive sources falling into the wrong hands and supports creating an enduring infrastructure to enhance global security.

We appreciate the opportunity to testify today and look forward to working with you on this important topic.

United States Government Accountability Office

GAO

Testimony

Before the Subcommittee on Oversight of Government Management, the Federal Workforce, and the District of Columbia, Committee on Homeland Security and Governmental Affairs, U.S. Senate

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NUCLEAR NONPROLIFERATION

Focusing on the Highest Priority Radiological Sources Could Improve DOE's Efforts to Secure Sources in Foreign Countries

Statement of Gene Aloise, Director
Natural Resources and Environment

GAO
Accountability * Integrity * Reliability

GAO-07-580T

March 13, 2007

GAO Accountability · Integrity · Reliability

Highlights

Highlights of GAO-07-580T, a testimony to the Subcommittee on Oversight of Government Management, the Federal Workforce, and the District of Columbia, Committee on Homeland Security and Governmental Affairs, U.S. Senate

Why GAO Did This Study

Following the terrorist attacks of September 11, 2001, U.S. and international experts raised concerns that unsecured radiological sources posed a significant security threat to the United States and the international community. If certain types of these sources were obtained by terrorists, they could be used to produce a radiological dispersion device, or dirty bomb. In response, the Department of Energy (DOE) established the International Radiological Threat Reduction Program to identify, recover, and secure vulnerable, high-risk radiological sources.

GAO was asked to (1) assess DOE's progress in securing sources in foreign countries, (2) identify DOE's current and planned program costs, and (3) determine the extent to which DOE has coordinated its efforts with other federal agencies and with international organizations, such as the International Atomic Energy Agency (IAEA). In January 2007, GAO issued a report— *Nuclear Nonproliferation: DOE's International Radiological Threat Reduction Program Needs to Focus Future Efforts on Securing the Highest Priority Radiological Sources*, (GAO-07-282)—that addressed these matters.

To carry out its work, GAO reviewed DOE policies, plans and budgets; observed installed physical security upgrades; and interviewed senior DOE, Department of State (State), and Nuclear Regulatory Commission (NRC) officials.

www.gao.gov/cgi-bin/getrpt?GAO-07-580T.

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

NUCLEAR NONPROLIFERATION

Focusing on the Highest Priority Radiological Sources Could Improve DOE's Efforts to Secure Sources in Foreign Countries

What GAO Found

While DOE has improved the security of hundreds of sites that contain radiological sources in more than 40 countries, many of the highest-risk sources remain unsecured. For example, more than 700 radioisotope thermoelectric generators (RTG) remain operational or abandoned across Russia, representing the largest unsecured quantity of radioactivity in the world. Each of these devices has activity levels ranging from 25,000 to 250,000 curies of strontium-90—similar to the amount of such material released from the Chernobyl nuclear reactor accident. In addition, only 4 of 20 waste storage facilities in Russia and Ukraine have been secured.

In 2003, when DOE decided to broaden the scope of the program beyond the former Soviet Union, it also expanded the types of sites that required security upgrades to include hospitals and oncology clinics. In contrast to higher priority sources, such as RTGs, these facilities operate teletherapy machines that generally contain a single cobalt-60 source ranging from about 1,000 to 10,000 curies. As of September 30, 2006, almost 70 percent of all sites secured by DOE's program were hospitals and oncology clinics. Moreover, DOE has not developed a plan to ensure that countries receiving security upgrades will be able to sustain them over the long-term.

Since 2002, DOE has spent about $108 million to implement its program. Funding for the program has steadily declined as DOE has placed a higher priority on securing special nuclear material, such as plutonium and highly enriched uranium.

Finally, although DOE has improved coordination with State and NRC, these efforts have been inconsistent. For example, DOE chose not to transfer $5 million of its fiscal year 2004 appropriation to NRC for international regulatory activities, causing friction between the agencies. In addition, GAO found that critical gaps in information-sharing between DOE and IAEA have impeded DOE's ability to target the most vulnerable sites in IAEA member states for security improvements.

In its recent report, GAO made recommendations to the Secretary of Energy and the Administrator of the National Nuclear Security Administration to (1) limit the number of hospitals and clinics containing radiological sources that receive security upgrades to only those deemed the highest risk; (2) accelerate efforts to remove as many RTGs in Russia as practicable; and (3) develop a long-term sustainability plan for security upgrades. In addition, GAO asked Congress to consider providing NRC with authority and a direct appropriation to conduct regulatory development activities to help improve other countries' security over sources. DOE said that our recommendations were helpful and would further strengthen its program. NRC said it would work closely with relevant executive branch agencies and IAEA if Congress acts upon GAO's matter for consideration.

Mr. Chairman and Members of the Subcommittee:

I am pleased to be here today to discuss our work on the actions the Department of Energy (DOE) has taken to secure radiological sources in foreign countries. Specifically, my remarks are based on the report we are issuing today—*Nuclear Nonproliferation: DOE's International Radiological Threat Reduction Program Needs to Focus Future Efforts on Securing the Highest Priority Radiological Sources*, which was prepared at the request of this subcommittee.[1]

Following the terrorist attacks of September 11, 2001, U.S. and international experts raised concerns that unsecured radiological sources were vulnerable to theft and posed a significant security threat to the United States and the international community. If certain types of these sources were obtained by terrorists, they could be used to produce a simple and crude but potentially dangerous weapon—known as a radiological dispersion device, or dirty bomb.

In 2001, a congressional report directed DOE to address the threat posed by dirty bombs. In response, the National Nuclear Security Administration (NNSA)[2] established the Radiological Threat Reduction Task Force to identify, recover, and secure vulnerable, high-risk radiological sources. This effort was focused in countries of the former Soviet Union (FSU) because DOE determined this region had the greatest number of vulnerable sources. In 2003, at the direction of the Secretary of Energy, DOE expanded the scope of the program to secure sealed sources worldwide, ultimately establishing the International Radiological Threat Reduction (IRTR) Program. The program's primary objective is to protect U.S. national security interests by (1) implementing rapid physical security upgrades at vulnerable sites containing radioactive sources; (2) locating, recovering, and consolidating lost or abandoned high-risk radioactive sources; and (3) supporting the development of the infrastructure necessary to sustain security enhancements and supporting regulatory controls, including the development of regional partnerships to leverage international resources.

[1]GAO-07-282.

[2]NNSA is a separately organized agency within DOE that was created by the National Defense Authorization Act for Fiscal Year 2000, Pub. L. No. 106-65 (2000), with responsibility for the nation's nuclear weapons, nonproliferation, and naval reactors programs.

The Department of State (State) and the Nuclear Regulatory Commission (NRC) also fund efforts to secure radiological sources in other countries, though on a much smaller scale than DOE. State, among other things, provides the International Atomic Energy Agency (IAEA) with funds to conduct training, workshops, and advisory missions to improve member states' radiological source security practices and procedures. NRC has provided guidance on the development of programs in Armenia, Georgia, and Kazakhstan to improve nuclear regulatory controls over radiological sources, including establishing radiological source inventories and promoting the development of laws, rules, and regulations governing controls over this material.

In this context, you asked us to (1) assess the progress DOE has made in implementing its program to help other countries secure their sealed radiological sources, (2) identify DOE's current and planned program costs, and (3) determine the extent to which DOE has coordinated its efforts with other federal agencies and with international organizations, such as IAEA and the European Commission. In conducting our review, we analyzed DOE's IRTR program documentation, including project work plans for each country and program activity; strategic plans; and internal briefings. We supplemented the documentation with interviews with senior level DOE officials responsible for implementing the IRTR program. We also visited four countries—Russia, Lithuania, Poland and Georgia—representing about 35 percent of overall DOE program expenditures, observed physical security upgrades implemented by DOE's program, and met with host government officials in each country. We reviewed budget documents detailing IRTR program expenditures and determined the program's total carryover of unspent and unobligated funds. Finally, we met with senior officials at State, NRC, IAEA and the European Commission. We performed our review in Washington, D.C., and other locations, from November 2005 to December 2006 in accordance with generally accepted government auditing standards.

In summary

DOE has improved the security of hundreds of sites that contain radiological sources in more than 40 countries and achieved some noteworthy accomplishments, including the removal of cobalt-60 and cesium-137 sources from a poorly protected nuclear waste repository in Chechnya. However, many of the highest-risk and most dangerous sources remain unsecured. For example, hundreds of large devices known as radioisotope thermoelectric generators (RTG) remain operational or abandoned in Russia. Each of these devices has activity levels ranging from 25,000 to 250,000 curies of strontium-90—similar to the amount of strontium-90 released from the Chernobyl nuclear reactor accident in 1986.[3] In addition, security upgrades at a majority of waste storage facilities—which can individually store up to 3 million curies of material—located primarily in Russia and Ukraine, have not been completed. Moreover, in 2003, when DOE decided to broaden the program's scope beyond the former Soviet Union, it also expanded the types of sites that required security upgrades to include medical facilities operating teletherapy machines which are used to provide radiation treatment to cancer patients. These machines generally contain a single cobalt-60 radiological source ranging from about 1,000 to 10,000 curies. As a result, as of September 2006, almost 70 percent of all sites secured were hospitals and oncology clinics. In the view of several DOE national laboratory and security specialists responsible for implementing the program, DOE installed security upgrades at so many of these facilities primarily because the upgrades are relatively modest in scope and cost.

In addition, DOE has also experienced a number of challenges, such as, problems with foreign contractor performance and lack of adequate physical infrastructure to support security upgrades, which impeded program implementation; caused project delays; and in some extreme cases, prevented DOE from initiating projects at all. Finally, DOE has not developed a plan to ensure that countries receiving security upgrades will be able to sustain them over the long term. This is particularly problematic, since we identified numerous problems with the maintenance of DOE-funded security equipment and storage facilities during our site visits.

Regarding program costs, as of August 31, 2006, DOE had spent approximately $108 million to secure radiological sources worldwide. A majority of this money—$68 million—was spent to (1) physically secure sites; (2) locate, recover, and dispose of lost or abandoned sources; and (3) help countries draft laws and regulations to increase security and accounting of sources. In addition, DOE provided $13.5 million to IAEA to support activities to strengthen controls over radiological sources in IAEA member states and spent $26.5 million on program planning activities such as, developing program guidance documents, hiring private consultants, and conducting studies. DOE officials told us that securing radiological

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

sources in other countries is a lower priority than securing more dangerous nuclear materials, such as plutonium and highly enriched uranium (HEU). As a result, recent budget allotments for radiological security activities were reduced. Consequently, DOE program officials are concerned that the agency may be unable to meet outstanding contractual commitments to maintain the more than $40 million in security upgrades already installed.

Concerning coordination between DOE, State and NRC, efforts have improved since we reported on this matter in 2003.[4] Specifically, DOE has involved State and NRC in its international radiological threat reduction activities more often and has increased information-sharing with the agencies. However, DOE has not always integrated its nuclear regulatory infrastructure development efforts with these agencies efficiently. For example, DOE and NRC disagreed about whether, as directed by the Senate Appropriations Committee, DOE should have transferred $5 million from its fiscal year 2004 appropriation to NRC for the purpose of strengthening international regulatory controls over radiological sources. Ultimately, DOE did not transfer the funds, causing friction between the agencies. Finally, DOE has improved coordination with IAEA to strengthen controls over other countries' radiological sources and has developed bilateral and multilateral partnerships with IAEA member states to improve their regulatory infrastructures. However, significant gaps in information-sharing between DOE and IAEA have impeded DOE's ability to target the most vulnerable sites for security improvements.

To help ensure that DOE's future efforts focus on securing the highest priority sources, our report recommends that the Secretary of Energy and the Administrator of the NNSA, among other things, (1) limit the number of hospitals and clinics containing radiological sources that receive security upgrades to only those deemed the highest risk; (2) accelerate efforts to remove as many RTGs in Russia as practicable; and (3) develop a long-term sustainability plan for security upgrades that includes, among other things, future resources required to implement such a plan. Additionally, we asked that the Congress consider providing NRC with the authority and a direct appropriation to conduct international regulatory infrastructure development activities. DOE said that our recommendations

[4]GAO, *Nuclear Nonproliferation: U.S. and International Assistance Efforts to Control Sealed Radiological Sources Need Strengthening*, GAO-03-638 (Washington, D.C.: May 16, 2003).

were helpful and would further strengthen its program. NRC said it would work closely with relevant executive branch agencies and IAEA if Congress acts upon our matter for consideration.

Background

The small size, portability and potential value of sealed radiological sources make them vulnerable to misuse, improper disposal and theft. According to IAEA, the confirmed reports of illicit trafficking in radiological materials have increased since 2002. For example, in 2004, about 60 percent of the cases involved radiological materials, some of which are considered by U.S. government and IAEA as attractive for the development of a dirty bomb. Although experts generally believe that a dirty bomb could result in a limited number of deaths, it could, however, have severe economic consequences. Depending on the type, amount, and form, the dispersed radiological material could cause radiation sickness for people nearby and produce serious economic, psychological and social disruption associated with the evacuation and subsequent cleanup of the contaminated area. Although no dirty bombs have been detonated, in the mid-1990s, Chechen separatists placed a canister containing cesium-137 in a Moscow park. While the device was not detonated and no radiological material was dispersed, the incident demonstrated that terrorists have the capability and willingness to use radiological sources as weapons of terror.

A 2004 study by the National Defense University noted that the economic impact on a major populated area from a successful dirty bomb attack is likely to equal and perhaps exceed that of the September 11, 2001, attacks on New York City and Washington, D.C. According to another study, the economic consequences of detonating a series of dirty bombs at U.S. ports, for example, would result in an estimated $58 billion in losses to the U.S. economy. The potential impacts of a dirty bomb attack could also produce significant health consequences. In 2002, the Federation of American Scientists concluded that an americium radiological source combined with one pound of explosives would result in medical supervision and monitoring required for the entire population of an area 10 times larger than the initial blast.

DOE Has Installed Physical Security Upgrades at Hundreds of Sites Worldwide, but Many Dangerous Radiological Sources Have Not Been Secured

As of September 30, 2006, DOE had secured 368 sites that contained radiological sources in more than 40 countries. The agency's efforts included the removal of cobalt-60 and cesium-137 sources from a poorly protected nuclear waste repository in Chechnya; construction of storage facilities in Uzbekistan, Moldova, Tajikistan, and Georgia in order to consolidate sources and strengthen their long-term protection; and the installation of physical security upgrades at 21 sites containing radiological sources in Greece prior to the 2004 Olympics. However, despite these achievements, a majority of sites secured do not represent the highest-risk or the most vulnerable sources, and many of the most dangerous sources remain unsecured, particularly in Russia.

In 2003, when DOE decided to broaden the program beyond the former Soviet Union, it expanded the types of sites that required security upgrades to include medical facilities that contained lower priority sources. For example, of the total sites completed, 256—or about 70 percent—were hospitals and oncology clinics operating teletherapy machines which generally contain a single cobalt-60 source ranging from about 1,000 to 10,000 curies. In contrast, only 4 of 20 waste storage sites across Russia and Ukraine have been secured. According to DOE, these waste storage facilities are the most vulnerable in the world and pose a significant risk, because of the large quantities of radioactive sources currently housed at each site.

Officials from three of the four recipient countries we visited raised concerns about DOE's focus on securing so many medical facilities and Russian officials told us that radiological sources in hospitals did not pose a risk comparable to that of RTGs or lost or abandoned sources. In addition, several national laboratory officials and security specialists responsible for implementing DOE's program told us that although progress had been made in securing radiological sources, the agency had focused too much attention on securing medical facilities at the expense of other higher-priority sites, such as waste storage facilities and RTGs. In their view, DOE installed security upgrades at so many of these facilities primarily because the upgrades were relatively modest in scope and cost. For example, a typical suite of security upgrades at a medical facility costs between $10,000 and $20,000, depending on the size of the site, whereas the average cost to remove and replace an RTG in the Far East region of Russia is about $72,000 in 2006 dollars.

To track program progress, DOE has relied upon an indicator that uses as its primary metric, the number of sites that have been upgraded, or "sites secured." Although DOE has compiled and tracked accomplishments such as the amount of curies secured, the number of countries to receive regulatory assistance, and the number of orphan sources recovered, multiple national laboratory officials and security specialists told us that completing upgrades at medical facilities served to demonstrate rapid program progress because the upgrades are completed relatively quickly. DOE's program director said that the number of sites completed demonstrated conclusively that work has been done and represented the best available measurement. However, Pacific Northwest National Laboratory and Sandia National Laboratory officials told us that this particular measurement did not demonstrate how the program is reducing threats posed to U.S. national security interests. In their view, this measurement is one-dimensional and does not adequately distinguish lower-priority sites from higher-priority sites.

Furthermore, although numerous medical facilities have been secured, more than 700 RTGs remain operational or abandoned in Russia, representing several million curies of unsecured radioactive material. Almost 100 of these are located along the Baltic coastal line and, according to Russian officials, should be removed as soon as possible because of their accessibility and proximity to large population centers. As of September 30, 2006, DOE had funded the removal of about 13 percent of all RTGs located in Russia's inventory.

According to DOE and Russian officials, RTG removal is complex and DOE has faced a number of challenges. First, no comprehensive inventory of RTGs exists, and, as a result, the actual number of these devices is unknown. Second, RTGs contain sources with high levels of radioactivity, and their removal requires specialized containers for their transport and facilities with adequate storage capacity. Finally, future RTG removal efforts will depend on finding a viable, alternative energy source to replace power supplied by radiological sources contained in RTGs. DOE has equipped a select number of RTGs with alarm systems that are remotely monitored as an interim measure to help reduce the risk posed by RTGs that have not yet been removed.

Additionally, although IAEA officials told us that transportation of high-risk radiological sources is the most vulnerable part of the nuclear and radiological supply chain, DOE determined that source transport is generally outside the scope of the program and did not pursue transportation security-related projects with the majority of countries participating in the IRTR program. However, in every country we visited, host country officials identified the transportation of sources as a critical vulnerability and a priority for security upgrades.

DOE also experienced numerous challenges that impeded program implementation, specifically problems with foreign contractor performance and inadequate physical infrastructure. Some examples we found of poor contactor performance included

- steel security doors to a room containing radiological sources installed with the hinges on the outside,
- security manuals and procedures for newly installed equipment provided in English instead of the native language, and
- hospital staff that had not been trained by the contractor on operation of the alarm systems.

In terms of physical infrastructure, some countries lacked reliable electricity, a backup power source, or telecommunications at sites containing radiological sources. As a result, frequent power outages diminished the detection capability of security alarms installed, and backup sources of power were unavailable to operate the security alarms and security lighting. DOE officials said that various combinations of these and other impediments resulted in delays implementing security upgrades in about 75 percent of all countries participating in the program.

Finally, we were especially concerned to find that DOE had not developed a plan to ensure that countries receiving security upgrades will be able to sustain them over the long term, particularly in light of the number of problems with the maintenance of DOE-funded security equipment and storage facilities we identified during our site visits. For example, we visited an oncology clinic and observed that the security cable used to secure a teletherapy machine's cobalt-60 source had been broken for almost a month. This cable, according to a DOE physical protection specialist, was the most important security feature because it triggered an alarm directly connected to the teletherapy machine's "head," which contains the radiological source. We also observed a storage facility containing RTGs and a seed irradiator— which has thousands of curies of a cesium-137 source—with several large openings in the roof and a broken motion detection device at a research facility containing a 22,000 curie irradiator. According to the foreign contractor, because of the high level of radioactivity present, the device had been disabled at least three times since the equipment was installed about a year earlier.

DOE's current sustainability plan consists of a 3-year warranty on newly installed security equipment and preventative maintenance contracts, as well as providing training on newly installed equipment for operational staff at the sites. However, DOE has not formulated a long-term plan that identifies, among other things, how host countries will financially continue maintenance of upgrades following DOE warranty expiration. DOE officials responsible for program implementation said that they were uncertain that security upgrades installed would be sustained by countries once DOE assistance was no longer available. In fact, our analysis showed that these officials had confidence that the security upgrades would be sustained in only 25 percent of the countries.

DOE Has Spent about $108 Million to Secure Radiological Sources Worldwide, but Future Program Funding Is Uncertain

As of August 31, 2006, DOE had spent about $108 million to implement the IRTR program. The majority of program expenditures—$68 million—was spent to (1) physically secure sites containing radiological sources; (2) locate, recover, and dispose of lost or abandoned sources; and (3) help countries draft laws and regulations to increase security and accounting of sources. DOE also provided $13.5 million to IAEA to support activities to strengthen controls over radiological sources in IAEA member states. However, one-fourth of the total budget—about $26.5 million—was spent on program planning activities not directly attributed to a specific country. DOE also carried over almost $23 million in unspent or unobligated funds for the IRTR program from previous years. Moreover, the program consistently carried over a substantial uncosted balance each fiscal year throughout the life of the program. Specifically, for fiscal years 2003 through 2005, the program carried over uncosted funds totaling $27.4 million, $34.1 million, and $22.4 million, respectively.

Physical security upgrades accounted for DOE's largest program expenditure—almost $43 million. The majority of these upgrades were installed at hospitals and oncology clinics. DOE also funded upgrades at other types of facilities that utilize or store radiological sources and materials, including waste storage facilities, commercial and industrial facilities, and other research institutes. The types of upgrades installed varied, but standard equipment packages consisted mostly of hardened windows and doors; motion sensors and alarms; access control systems, such as coded keypads or swipe card entry; security cameras; and video monitoring. Costs of physical security upgrades also included 3-year warranty contracts that covered maintenance costs, such as the cost of remote monitoring and spare parts.

DOE also spent $23 million to provide countries with radiation detection equipment and training to locate and recover lost or abandoned radiological sources and secure them in interim or permanent storage facilities. More than 80 percent of these expenditures were spent in Russia—about $19 million. These funds were spent primarily to provide countries with (1) standard packages of equipment, such as hand-held radiation detection monitors and characterization instruments to properly identify recovered sources; (2) training workshops on the appropriate use of the equipment; and (3) physical security upgrades at some facilities storing recovered or disposed sources.

While DOE assistance was spread among 49 countries, Russia received the largest amount, $33 million, nearly one-third of total program expenditures. The 13 other former Soviet Union countries received a total of about $11 million. By comparison, DOE spent significantly less outside the former Soviet Union, and expenditures in these countries were both modest by comparison and disproportionately spent in the United States by DOE's national laboratories for labor, travel, equipment and overhead costs.[5] For example, the 35 non-FSU countries participating in DOE's program received a total of about $17 million, or just 28 percent of total country-specific expenditures.[6] Furthermore, two-thirds of funds allocated for activities in these countries were spent in the United States.

Since 2003, DOE has significantly decreased IRTR program funding and according to a senior DOE official, future funding will be redirected to, among other things, securing special nuclear material, such as plutonium and highly enriched uranium. Future anticipated reductions in funding for the IRTR program will have significant implications for the amount of sources that can be secured in other countries and may jeopardize DOE's ability to meet outstanding contractual commitments for the more than $40 million in security upgrades already installed. Additionally, according to DOE officials, the agency plans to seek international contributions to secure radiological sources in other countries to offset anticipated shortfalls in funding.

[5]DOE noted that some of the FSU countries that received DOE assistance had comparatively larger infrastructure problems than that of several non-FSU countries and, in some cases, higher labor rates; and therefore, project implementation costs in the FSU countries were proportionally higher.

[6]Of the $107.7 million in total program expenditures, $61.7 million could be traced to specific country-related expenditures.

Coordination with State and NRC Has Improved, but Coordination Problems Worldwide Have Impacted DOE's Ability to Target the Most Vulnerable Sites for Security Improvements

In recent years, DOE has improved coordination with State and NRC to secure radiological sources worldwide, involved State and NRC in its international radiological threat reduction activities more often, and increased information-sharing with the agencies. For example, these agencies worked together successfully to implement a State-led effort to create the Iraq Radiological Source Regulatory Authority. This effort included providing equipment, training, technical assistance, and funding to help the new agency assume increased responsibility for establishing radiological source regulations and procedures consistent with international standards.[7]

However, DOE has not always integrated its efforts efficiently, and coordinated efforts among the agencies have been inconsistent. In particular, DOE, State, and NRC have differed on funding and implementation of regulatory infrastructure development activities in other countries. For example, in May 2003, NRC's Office of International Programs sought $5 million in appropriated funds to assist its regulatory counterparts in countries of the Former Soviet Union and central and eastern Europe to, among other things, enhance existing laws, rules, and regulations governing the use of radiological sources. NRC officials noted they made the request in part because the biggest challenge the agency has faced has been identifying adequate, reliable, and predictable funding to support international assistance activities. In July 2003, the Senate Appropriations Committee directed DOE to make $5 million out of certain amounts appropriated to NNSA available to NRC for bilateral and international efforts to strengthen regulatory controls over radioactive sources that are at the greatest risk of being used in a dirty bomb attack. However, DOE did not do so because, according to DOE officials, the provision directing them to transfer the funds did not appear in the final conference report and was not included in the appropriation legislation.

In addition, within the agency, DOE has not adequately coordinated the activities of multiple programs responsible for securing radiological and nuclear materials in other countries, which, at times, has resulted in conflicting or overlapping efforts. Specifically, we found

[7]For more information on U.S. efforts to secure radiological sources in Iraq, see *Radiological Sources in Iraq: DOD Should Evaluate Its Source Recovery Efforts and Apply Lessons Learned to Future Recovery Missions*, GAO-05-672 (Washington, D.C.: Sept. 7, 2005).

- a lack of effective integration between different programs addressing multiple threat reduction activities at the same sites,
- confusion among host country officials because of multiple visits to the same country by different components of the same program, and
- limited information-sharing between international source security and recovery of U.S.-origin sources in order to better leverage DOE resources.

With respect to international organizations, DOE has improved coordination with IAEA to strengthen controls over other countries' radiological sources and has developed bilateral and multilateral partnerships with IAEA member states to improve their regulatory infrastructures. However, significant gaps in information-sharing between DOE and IAEA have impacted DOE's ability to target the most vulnerable sites for security improvements. For example, IAEA has not shared with DOE the countries that IAEA considers the most in need of security assistance. In addition, although DOE funds IAEA appraisal missions to assess the weaknesses in radioactive source security in IAEA member states, IAEA does not provide DOE with the findings of these missions because member state information is considered country-sensitive and confidential.

Finally, we found that little coordination exists between DOE and the European Commission. Although, the Commission has coordinated with IAEA to provide assistance to selected European countries to improve control over radiological sources, Commission officials told us that no formal communication exists with the United States on matters related to radioactive source security assistance. As a result, each the United States and the Commission are largely unaware of the specific sites and locations the other is securing, and whether recipient countries are receiving too little or too much assistance.

Mr. Chairman, this concludes my prepared statement. I would be happy to respond to any questions that you or other Members of the Subcommittee may have.

GAO Contact and Staff Acknowledgments

For further information about this testimony, please contact me at (202) 512-3841 or at aloisee@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this statement. Erika D. Carter, Nancy Crothers, Glen Levis, Mehrunisa Qayyum, and Jim Shafer also made key contributions to this statement.

HEALTH PHYSICS SOCIETY

Specialists in Radiation Safety

Testimony to the
Subcommittee on Oversight of Government Management, the Federal Workforce, and the District of Columbia

Committee on Homeland Security and Governmental Affairs

U.S. Senate

presented by

Brian Dodd, Ph.D
President, Health Physics Society

at the hearing entitled

A Review of U.S. International Efforts to Secure Radiological Materials

held in Room 342
of the Dirksen Senate Office Building

on

March 13, 2007

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Good afternoon. My name is Brian Dodd. I work as a consultant under BDConsulting and am also the President of the Health Physics Society. I want to thank the Subcommittee on Oversight of Government Management, the Federal Workforce, and the District of Columbia for holding this hearing and for providing me with the opportunity to testify on behalf of the members of the Health Physics Society as well as a person with experience in the subject area[1].

Introduction

For those not familiar with the Health Physics Society[2] (HPS) it is an independent scientific organization whose members are professionals in the field of radiation safety. The Society's mission is excellence in the science and practice of radiation safety. HPS activities include encouraging research in radiation science, developing standards, and disseminating radiation safety information.

Between September 1998 and February 2004, I worked at the International Atomic Energy Agency (IAEA) in Vienna. During the last three years I was head of the IAEA's Radiation Source Safety and Security Unit and was responsible for developing the revised Code of Conduct on the Safety and Security of Radioactive Sources[3], the revised Categorization of Radioactive Sources[4], the IAEA's Security of Radioactive Sources[5] interim guidance as well as documents on illicit trafficking[6,7,8] and regaining control over orphan radioactive sources[9]. My unit was also responsible for the Tripartite (IAEA - Russian Federation ROSATOM - USDOE) Initiative on the Securing and Managing of Radioactive Sources.

Since retiring from the IAEA, I have retained an interest in the subject and under BDConsulting I have worked with the National Nuclear Security Administration's International Radiological Threat Reduction Program, drafting Model Regulations for the Security of Radioactive Sources for potential use by IAEA Member States as well as revising the protocol used by the IAEA for Radiation Safety, and Security of Radioactive Sources, Infrastructure Appraisals (RaSSIA). I chaired an IAEA Technical Meeting on Investigation of Radioactive Source Designs to Minimize the Consequences of Malicious Use and have provided input on the IAEA's revision to the Security of Radioactive Sources guidance document. I have written several articles about radioactive source safety and security particularly as they relate to radiological terrorism[10,11,12,13].

Before going further, I wish to clarify that I cannot speak for the IAEA, and that I am still bound by my confidentiality agreement with them.

Status Appraisal

Having been involved in the field of radioactive source safety and security before, during, and after September 11, 2001, I first have to state that I think we have achieved a great deal in the years since. In addition, as Americans I believe that we can be proud of our involvement in helping to secure dangerous radioactive sources around the world. I have no doubt that we are safer and securer now than we were then. However, having said that, there is still much to be done.

The IAEA's specific work with radioactive sources, particularly orphan sources, started in earnest with the recommendations from its Dijon Conference on the Safety and Security of Radioactive Sources in 1998[14]. It took on new direction and impetus following 9/11. The basic structure of the effort was to a) remediate past problems, and b) prevent future problems. Remediating past problems had three main aspects: 1) collecting and disposing of known disused sources; 2) securing vulnerable sources, especially high-risk sources; and, 3) searching for, recovering and disposing of orphan or vulnerable sources. Preventing future problems focused on: 1) improving the legal and regulatory infrastructure; 2) revising and implementing the Code of Conduct; 3) increasing import/export controls on high-risk sources; 4) strengthening source control with the development of national strategies; 5) increasing the security of sources as needed; and 6) involving manufacturers and distributors with issues such as source redesign, and return of sources.

There were many specific actions taken in each of these areas both by the IAEA, and by other countries such as the United States. There are success stories in each area too, and the IAEA and others can give data relating to the hundreds of sources and the hundreds of thousands of curies that have now been collected, disposed of, and secured as well as the number of missions to countries to help them in the preventive aspects such as self-appraisals and increased regulatory control. Naturally, the initial efforts have been focused on the highest activity and most vulnerable sources. There are relatively few high-risk sources (Category 1 and 2 in the IAEA Categorization of Radioactive Sources[4]) but as these are dealt with and we begin to address the sources with lower risk, that is, IAEA Category 3 and lesser sources, the problems grow because the number of sources increases by orders of magnitude.

So, as I said, we have much to be proud of, but much left to do. As many have identified, including the most recent Government Accountability Office (GAO) report, we are now moving from the initial, high priority phase where the biggest problems are identified and fixed, to a phase where the issue of more routine, on-going sustainability is important. The first phase has largely been characterized by short-term 'outside' assistance to address the high-risk sources. We now need to transition to the phase where local, internal controls can continue to work on the lower priority sources over a much longer time (as well as maintain the high-risk source controls). One can say that the big fire has been put out, but now the other buildings need to have sprinklers installed, the burnable trash removed and have routine fire safety inspections.

Sustainability

The issue of sustainability is continuously discussed at the IAEA and is always their goal. It does not want to be the Santa Claus handing out goodies or a guardian angel protecting people, but would much rather help Member States learn how to take care of the problem themselves. Certainly some of the programs, such as those in the IAEA and the International Radiological Threat Reduction Program, that help countries develop their laws and regulations can contribute significantly in this regard. However, there are some fundamental difficulties that are often overlooked that I wish to highlight today.

First, with many countries there is the issue of priority. Bluntly, they do not see themselves as targets of terrorist activity using radioactive sources and have much more basic human needs to focus on. Should the government of a poor country spend its limited resources on radioactive source problems or provide running water and sanitation to a village? The basic needs of nutrition, health and housing appropriately take priority. It is not that they don't care about radiological dispersal devices (RDDs), but it is pretty far down the list. To a certain extent, what we, the United States, are trying to do is to impose our priorities and values on other countries. Sometimes we have some success because of our carrots or sticks, but in reality it is more externally imposed conformance rather than internally inherent.

Second, there is the problem of personnel. The IAEA has for many years provided good training courses for Member States, including train-the-trainer courses in an attempt to grow national expertise as part of the sustainability effort. However, it seems that it is taking much longer than anyone would have predicted to achieve a steady state of national competence. One of the major reasons is that as soon as a person becomes trained, educated and well qualified, he or she then leaves for a 'better' position – often in another country where salaries and living conditions are more desirable. It requires a high degree of self-actualization for a highly qualified person to continue to work in appalling conditions with little official government support (because of the priority issue discussed earlier). One of the reasons why we at the IAEA wanted to make the Code of Conduct a legally binding document was to give radiation safety regulators and managers the leverage to force their government to support their efforts.

I see these two issues of priority and personnel as the major impediment to building the national infrastructure and sustainability necessary to achieve the ongoing level of safety and security that we desire. However, I don't believe that we, or the IAEA, should stop trying.

The Health Physics Society's Role

In fact, one of the efforts that the Health Physics Society has been engaged in for several years, and that I am attempting to revitalize and refocus during my Presidency, is our Radiation Safety Without Borders (RSWB) program. The HPS is a society of *professionals* and I think the best thing we can do to help build infrastructure and sustainability is to help our peer professionals in developing countries in a person-to-person, relationship based way. In the revitalized RSWB program, an HPS chapter will link itself to a country 'for life'...much like the sister city approach. The chapter members over a number of years would get to know the professional health physicists (HPs) in that country, as well as their culture and their regulations, and how to best support them in their work.

The countries we are choosing to pair with are those without a professional radiation safety society. The ultimate objective would be to help the people in the country eventually develop their own professional society that would become affiliated with the International Radiation Protection Association (IRPA). A stepping stone to getting to that point would be for the domestic HPS chapter to help them form a foreign HPS chapter, which over time (years probably) and with support from their U.S. colleagues, could grow to become an independent national society. They would then formally disaffiliate with the HPS (but maintain personal ties), then apply for IRPA Associate Society status.

I should note that the RSWB program has the full support of the IAEA and IRPA and we have kept the U.S. Department of State fully informed of our efforts.

I also have to be clear that the RSWB is not a big brother program. There is absolutely no intention of the HPS wanting to take over, or control other countries, but rather it is a desire to help fellow HPs get the same sort of support that we receive from belonging to a high-quality professional organization. We are helping and supporting each other for mutual benefit, much as we do within the Society now. We are just removing the borders of the HPS family network.

It would be remise of me not to mention the fact that the HPS has a history of calling for greater source security since before 9/11 and early last year revised its Position Paper entitled "Continued Federal and State Action is Needed for Better Control of Radioactive Sources"[15]. In particular, I would like to point out our position about sufficient funding (Recommendation 8) and making it an administration mission to recover sources abroad (Recommendation 16) instead of having it be an ad-hoc process.

I hope that you find these remarks helpful, and once again, I thank you for the opportunity to provide them in this hearing. I shall be pleased to answer any questions.

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[1] http://www.BDodd.com/

[2] http://www.hps.org/

[3] International Atomic Energy Agency. The Code of Conduct on the Safety and Security of Radioactive Sources. Vienna: IAEA; IAEA/CODEOC/2001

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[12] B. Dodd, International Efforts in Countering Radiological Terrorism, *Health Physics*, 89, 556-565, (2005)

[13] B. Dodd, Mustard to Wine...Aspects of the IAEA's Recent Work on the Control of Radioactive Sources, *Operational Radiation Safety*, Supplement to *Health Physics,* 90, No. 2, S12-S17, (2006)

[14] International Atomic Energy Agency. Proceedings of an International Conference on the Safety of Radiation Sources and Security of Radioactive Materials. Vienna: IAEA; STI/PUB/1042; 1999

[15] http://hps.org/documents/sourcecontrol_ps021-0.pdf

Testimony for "A Review of U.S. International Efforts to Secure Radiological Materials"
Presented to the Subcommittee on Oversight of Government Management, the Federal Workforce and the District of Columbia, Committee on Homeland Security and Governmental Affairs

Charles D. Ferguson
Fellow for Science and Technology
Council on Foreign Relations

March 13, 2007

Mr. Chairman, I appreciate the opportunity to testify at this important hearing concerning the United States' international efforts to secure high-risk radioactive materials in more than 40 countries. To provide context for my testimony and recommendations, I will begin by briefly discussing relevant work I have done with the U.S. government and other organizations in helping to improve the security of radioactive materials that could fuel potent radiological dispersal devices (RDDs), one type of which is commonly called a "dirty bomb." My involvement in this work dates back to September 12, 2001, when I was asked to write a memorandum to then-Secretary of State Colin Powell about the threat of radiological terrorism. In March 2002, I left the State Department to work as a scientist-in-residence at the Monterey Institute's Center for Nonproliferation Studies (CNS), where I continued my work on this issue.

In January 2003, CNS published "Commercial Radioactive Sources: Surveying the Security Risks," one of the first in-depth post-9/11 reports on the radiological terrorism threat. I was the lead author of that report, which attracted attention in the U.S. government, the Sandia National Laboratories, the International Atomic Energy Agency (IAEA), and the Health Physics Society, which awarded me the 2003 Robert S. Landaurer Memorial Lecturer Award in recognition for work on the CNS report. The report led to officials at the National Nuclear Security Administration (NNSA) hiring me as a non-governmental consultant to help them develop their action plan to secure the highest risk radioactive sources. This consultancy took place during the month of April 2003 and contributed to the NNSA action plan of July 2003. This action plan has partially formed the basis of NNSA's current program to secure the highest risk international radioactive sources.

The CNS report also resulted in the Sandia National Laboratories hiring me as a scientific consultant on a study investigating the security of research and blood irradiators, which are highly radioactive sources used in scientific and medical applications in thousands of locations throughout the world. As part of that study, I helped organize site visits to several places in the United States containing these sources. My research team also identified several hundred of these sources in dozens of countries.

In other work on radioactive materials security, I have written or co-written articles for the *Bulletin* of the IAEA, the journal *Issues in Science and Technology*, as well as other publications, such as the chapters on radiological terrorism in the book *The Four Faces of Nuclear Terrorism*, and I have briefed commissioners at the Nuclear Regulatory Commission (NRC). I have also had discussions with officials and analysts with the Government Accountability Office (GAO) during the research phase of some of GAO's reports on radioactive materials security. Most recently, in October 2006, I helped train border guards and customs officials from Tajikistan about nuclear and radiological security. That training workshop was funded by the State Department. Also in October 2006, I participated in the NATO-Russia workshop, held in Bratislava, Slovakia, on the social and psychological effects of radiological terrorism.

What is the Nature of the Radiological Terrorism Threat?

Mr. Chairman, practically all nuclear and radiological security analysts agree that the probability of a dirty bomb attack is much greater than the probability of a nuclear bomb attack from a terrorist group. There is also broad agreement that the consequences of a nuclear bomb attack are far greater than the damage from a dirty bomb attack. Many analysts, including myself, have said that it is all but inevitable that the United States or some other country will experience a radiological attack. The question is, though: Why hasn't such an attack already happened?

To answer this question, it helps to think like a detective. As any competent detective knows, for a crime to occur, there are three essential ingredients: motive, means, and opportunity. Similarly, for a particular act of terror to happen, a terrorist group must be highly motivated to carry out that act, must identify the appropriate means, and must find the right opportunity to acquire these means and to launch the attack. The government has considerable leverage in controlling means and opportunity and far less leverage in influencing terrorists' motivations. Nonetheless, the government should work to develop a greater understanding of the dynamical nature of terrorists' motivations as well as the motivations of those people who have access to radioactive materials and who may want to abet terrorists either intentionally or unintentionally.

While most terrorist groups have expressed little or no interest in radiological terrorism, the current trend line is not encouraging. Prior to the past year, many of the reported incidents of terrorist interest in radiological attacks appeared amateurish, for example, the reported activities of José Padilla and Dhiren Barot. However, some terrorists and criminals appear to be climbing a learning curve. In September 2006, for example, Abu Hamza al-Muhajir, who was then the leader of al-Qaeda-in-Iraq, called for nuclear scientists and explosive experts to help his organization in making biological and "dirty radioactive weapons. Later that year, former Russian spy Alexander Litvinenko was murdered in London with tiny amounts (micrograms) of radioactive polonium-210. Investigators are still trying to narrow down where this particular polonium material came from, but it is well known that Russia is the major global producer of polonium used in civilian applications. Although the perpetrators do not appear to have been motivated to instill terror in a large population, traces of polonium were found in several locations. This contamination was too little to cause health effects in many people; nonetheless, the relatively high-level of expertise shown in acquiring and using this rare radioactive material has increased concern that criminals and terrorists' capabilities to use radioactive materials have increased.

These two recent incidents also illustrate the international nature of the threat. The Litvinenko case, in particular, underscores the need for better regulatory controls over radioactive materials. Whether in Great Britain, Russia, or some other country where the polonium was located, the regulatory system did not prevent misuse of this material. The continuing illicit trafficking of radioactive materials, as documented by the IAEA, also underscores the need for improved regulatory controls in more than one hundred countries.

The means for producing radiological weapons are found in practically all countries of the world. Millions of radioactive sources are used around the globe. While only a small fraction of those sources pose high safety and security risks, this fraction includes at least several thousand high risk sources. NNSA, the NRC, and the IAEA have focused their security efforts on about ten radioactive isotopes that are contained in the most prevalently used high risk sources. While polonium-210 was listed in a May 2003 NRC-NNSA report, this isotope had not attracted significant national and international attention until the Litvinenko murder. This murder points to the need for continual reassessments of the radioactive isotopes and radioactive sources that could cause harm to human heath as well as damage to valuable property.

The high-risk source categorization system developed by the IAEA and followed by the NRC and NNSA primarily categorizes radioactive sources based on the harm that a source could do to human health. While this is a vitally important consideration, a comprehensive assessment would have to factor in the economic damage that could result from the contamination from sources that would not pose an immediate threat to health but could disrupt use of valuable property. Moreover, a thorough security assessment would consider the portability of a source and the dispersibility of the radioactive material in a source. Those sources that are easy to access and carry, have relatively large amounts of radioactive material, and contain material that is relatively easy to disperse should receive the greatest security attention.

What improvements are needed for U.S. government, other governments, and industry's efforts to secure the highest risk radioactive sources?

I have recently reviewed the NNSA's Global Threat Reduction Initiative (GTRI) unclassified risk profile system for assessing radioactive sources. I found it to be a sound system based on prioritization criteria that factor in: nuclear and radioactive material attractiveness, external threat environment within the country, internal site vulnerability condition, and proximity to strategic interests. I have also reviewed GAO's recent report on NNSA's international radiological threat reduction program. The overall impression that emerges from these reviews is that NNSA has made significant accomplishments in this program, especially in the area of physical security efforts. Physical security has traditionally been one of NNSA's strengths. NNSA has transferred the lessons learned in providing for physical security of nuclear explosive materials into the area of enhancing physical protection of commercial radioactive materials. But more attention is needed to address security of radioactive sources that are used daily and to enhance the regulatory infrastructure in dozens of countries.

Uses of nuclear explosive materials and commercial radioactive materials differ. In contrast to nuclear explosive materials, commercial radioactive materials are designed to be used on a daily basis in a variety of settings, many of which are accessible to the public. For instance, potent radioactive materials are used in hospitals and universities. Also unlike nuclear explosive materials, many radioactive sources are accessible to numerous workers, such as hospital doctors, nurses, and technicians. Simply locking up radioactive sources that are still in use is not adequate. NNSA has recognized this situation and thus, has made improving safety and security culture, including regulatory infrastructure a crucial pillar of its action plan. Moreover, NNSA has recognized that it has limited capability in this area of work and has been leveraging cooperative activities with the IAEA, which has a Model Project to help countries in need of regulatory assistance. However, more worked is needed in this area including developing a long-term sustainability plan.

Sustainability depends fundamentally on all countries taking responsibility for ensuring safety and security of their radioactive sources. The NNSA program, I believe, works best when it provides a jumpstart to countries in serious need of security assistance. The program also importantly can serve as a bridge on the way toward having countries pick up the costs of sustainable security solutions. As the NNSA program heads into its fifth year of operations, it is transitioning into that bridging period for many of the countries that received security assistance in 2002 and 2003. Russia, in particular, is now in a better position, especially with money earned from oil revenues, to fund its radioactive source program with gaps covered by some international resources. With terrorist activity within its borders and interest expressed by some Chechen rebels in radioactive materials, Russia has a clear vested interest in significantly improving its own security efforts. Nevertheless, with strategic assets abroad and the possibility that terrorists could transport radioactive materials to the U.S. homeland, the United States continues to have a strong interest in securing the highest risk international radioactive sources.

Congress should be commended for delegating authority in October 2006 to NNSA to accept international monetary and other resource commitments for the radioactive source security program. NNSA has been seeking contributions from international donors. If it is not already doing so or if it has not already intended to do so, the United States should use the G8 and other international forums to raise money to create a sustainable radioactive source security program. The Bush administration could draw on the precedent it established in 2002 at the G8 summit to start the Global Partnership Against the Spread of Weapons and Materials of Mass Destruction in which the United States pledged $10 billion over ten years and requested matching $10 billion from the G8 and other countries. While this partnership has yet to reach its goal pledges of $20 billion, it has reenergized efforts to secure and eliminate nuclear, chemical, and biological weapons and the materials to make those weapons. A similar partnership to address radioactive materials would cost far less than the partnership focused on weapons of mass destruction. One of the first priorities of a global partnership to improve the security of radioactive materials would be to do a comprehensive analysis of the near and long term costs. This partnership should also recognize that a radiological attack anywhere is a radiological attack everywhere. Thus, it is every country's responsibility to enhance the security of its radioactive materials.

The radioactive source industry and the users of commercial radioactive sources also have fundamental roles to play. A major terrorist attack using commercial radioactive sources could have a chilling effect on the industry. Thus, industry and the community of radioactive source users have a vested interest in ensuring rigorous security. They should internalize as many of the external security costs as possible in the costs of radioactive sources. A security fee could be assessed to help cover those costs. Governments should not have to subsidize this industry.

It is my understanding the U.S. government has done some work with the radioactive source industry to encourage greater security efforts. But the U.S. and other governments should do more. In particular, they should form a public-private partnership that would work vigorously to phase out production and use of radioactive materials that can be easily dispersed. The community of radioactive source users should also be able to make an informed decision about whether to buy a radioactive source or a non-radioactive alternative product. The Nuclear Regulatory Commission has resisted asking users to consider alternatives to radioactive sources. The point is not to second guess users or to dictate what type of product they should use. Instead, to uphold high standards of safety and security, users should be made aware of the full portfolio of product choices in their purchasing decisions, which would include security costs. For example, one of the impediments to removing many of the very potent radioisotope thermoelectric generators (RTGs) in Russia is developing suitable alternatives. Reducing the use of dispersible radioactive materials and substituting alternatives to radioactive sources where appropriate would significantly result in permanent risk reduction. Such a strategy would fit within the mission of NNSA's GTRI, which is "to seek permanent threat reduction."

Summary of Major Recommendations

- Congress should require NNSA, NRC, and other relevant government agencies to perform an urgent, comprehensive risk assessment of all types of radioactive sources. This assessment should be updated at least every two years and should include an evaluation of the dynamical nature of the terrorist threat.

- A global problem requires a global solution. The United States should leverage international donations to help create a long-term sustainable plan to develop safety and security culture. The United States should use the G8 and other appropriate international forums to seek and obtain substantial international contributions to create a radioactive source security fund. This international radioactive source security partnership should first estimate what are the near- and long-term costs to create a sustainable security system.

- The United States and partner governments should form public-private partnerships with industry to work vigorously toward phasing out production and use of easily dispersible radioactive materials.
- The radioactive source industry and the user community should internalize as many of the safety, security, and disposal costs in the price of commercial radioactive sources.
- The U.S. Nuclear Regulatory Commission and regulatory agencies in other countries should encourage users to make an informed decision about whether to purchase a radioactive source or a non-radioactive alternative product. Such a decision should factor in all relevant costs, including security.

Mr. Chairman, thank you for the opportunity to offer guidance on improving the security of radioactive sources.

Testimony of
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Presented before the Senate Committee
on Homeland Security and Governmental Affairs
Subcommittee on Oversight of Governmental Management,
the Federal Workforce and the District of Columbia

Hearing on
A Review of U.S. International Efforts to Secure Radiological Materials

March 13, 2007
Washington, DC

Introduction

Mr. Chairman, I appreciate the opportunity to offer comments on the subject of international safety and security of radioactive sources. In 1961, I accepted a Commission in the U.S. Public Health Service (USPHS) and began a career as a health physicist. Later, I joined the Pennsylvania radiation control program becoming chief of the Division of Radiation Control. Following another tour of duty with the USPHS, I joined the Atomic Energy Commission. For many years I managed the Nuclear Regulatory Commission's (NRC) Agreement State Program. Beginning in 1992, I served as a Technical Assistant to Nuclear Regulatory Commission Commissioner E. Gail de Planque and later as Senior Assistant to Chairman Greta Joy Dicus retiring from government service in 1999. Presently, I am a consultant.

Since 1984 when the Mexican contaminated steel incident occurred, I have been involved in safety issues caused by orphan sources. In 1995 and 1998 James Yusko and I wrote review articles for the *Health Physics* journal on orphan sources in metal scrap destined for recycling (1,2). In 1998, I presented an historical overview of radioactive source accountability and control to the International Atomic Energy Agency (IAEA) international conference on safety and security of radioactive source held in Dijon, France, later published in the *IAEA Bulletin* (3). Two months after 9/11, Dr. Brian Dodd asked if I was willing to take on the task of updating the IAEA draft safety guide on safety and security of radioactive sources to reflect the new concerns about security. Early in 2002, I was pleased to assist Dr. Peter Zimmerman, then Senior Scientist on the staff of the Senate Foreign Relations Committee, in the preparations for the committee's 2002 hearing on nuclear and radiological terrorism. In August 2002, *Health Physics* published a paper by Dr. Daniel Strom and me, "Safety and Security of Radioactive Sources in the Aftermath of 11 September 2001" (4). In 2003, Dr. Ferguson and I collaborated on an article, "Securing U.S. Radioactive Sources," published in *Issues in Science and Technology* (5).

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I am pleased to note that the Health Physics Society has issued several position papers and reports advocating improvements in safety, accountability, and security of radioactive sources (6-9). The Conference of Radiation Control Directors and Organization of Agreement States have advocated improvements *since 1981* (10).

Historical Overview

Mr. Chairman, losses and thefts of radioactive sources and injuries and damages that result are not new news. In 1913, only 15 years after the discovery of radium, a radium source was reported lost (3). In a 1968 study of NY Times reports, the USPHS identified 286 news reports of lost and stolen radium sources between 1913 and 1964 (3). Given that there were no regulatory requirements at the time for such reports, the actual number was undoubtedly larger. In the 1940s, a 5 gram radium source used for industrial radiography was stolen from a Pennsylvania foundry (11). Police later found it in a bureau drawer in a residence. Orphan source incidents causing injuries of members of the public occurred. In 1979, a 28 Ci iridium-192 radiography source was mishandled and lost at a job site at a U.S. plant (12). The source was found and picked up by a plant worker who then pocketed it. He later showed it to other curious workers. Several received serious radiation burns. NRC Commissioner Dicus noted in 1999 that between 1992 and 1999, unshielded radioactive sources were found in the public domain in the U.S. 13 times, one of them a 40 Ci iridium-192 source that had been stolen (13). In 9 of the cases, the sources were found in metal scrap yards and steel mills.

Orphan sources have been a recurring problem for the U.S. metal scrap and steel industries. In our 1998 review paper, Mr. Yusko and I reported that between 1983 and 1997 NRC regulated radioactive material was found in U.S. and Canadian metal scrap on 119 occasions. Since 1983, US steel mills have accidentally melted radioactive sources that were mixed with scrap metal on 24 occasions.[2] Many occurred despite installation of radiation detectors to monitor scrap. Collectively, these 24 events cost US steel mill operators *over a quarter billion* dollars in clean up and mill shutdown costs, a cost incurred because of the negligence of others and ineffective regulatory requirements for control and accountability of radioactive sources.

Metal scrap is an internationally traded commodity. In 1998, a Spanish steel mill unknowingly melted a cesium-137 source, initially estimated to be between 8 and 80 Ci, that was in recycled metal scrap (14). Its presence in the scrap used by the mill had not been detected by radiation monitors installed for this purpose. Some of the cesium escaped through the plant stack. Environmental radiation monitors operated in France detected the airborne radioactivity. The discovery initially raised concerns that there had been an unknown nuclear power plant accident. It cost the Spanish mill operator US$ 26 million to clean up the mill. Most of the mill's metal scrap is imported.

[2] Data on these and other incidents involving mills accidentally melting radioactive sources are in a database maintained by James G. Yusko, Pennsylvania Bureau of Radiation Protection, Southwest Regional Office, 400 Waterfront Drive, Pittsburgh, PA 15222-4745, U.S. In addition to the 24 U.S. steel mill cases, the database includes 12 U.S. incidents involving other metals (aluminum, gold, lead, zinc) and 60 foreign cases.

The first known incident of a steel mill accidentally melting a source was reported in 1983 (15). A New York steel mill melted a 25 Ci cobalt-60 source contaminating the steel mill and the mill product. The metal scrap used by the mill was a mix of domestic and imported scrap, the latter from Canada. The origin of the source was never determined.

The following year, U.S. and Mexican authorities discovered that Mexican steel mills and foundries melted metal scrap accidentally contaminated by 400 Ci of cobalt-60 (16). Some of their contaminated products, rebar and cast iron furniture, were exported to the U.S. The cobalt came from a teletherapy unit that had been legally exported from the U.S. to a Mexican clinic that then stored it. However, Mexican authorities were uninformed that the source was in Mexico. The stored teletherapy unit was stolen, broken apart and sold for scrap. The source capsule that contained 6000 pellets of Co-60 was breached releasing the pellets in the scrap yard. A number of Mexican nationals received serious overexposures. The contaminated ferrous products that had been exported to the U.S. were, for the most part, recovered and returned to Mexico.

Three years later in Goiânia, Brazil, another incident involving the destruction of an unused teletherapy unit for scrap occurred (17, 18). Again, the source capsule was breached. At least four people died and several more were seriously injured. Radioactive contamination was widespread. The social impact was enormous; because of public fears of being exposed to contamination carried by Goiânians, they were ostracized when they traveled to other parts of Brazil.

In both these cases, and some later ones, a contributing factor was that persons who gained access to the devices containing the sources, either did not recognize the radiation caution propeller symbol on the device label as a warning or were confronted with warning labels in a language other than their own.

Worldwide, more incidents involving the loss or theft of large radioactive sources resulting in deaths and injuries occurred leading to growing concerns in the international community (19-22). Thefts of radioactive sources from inadequately secured waste repositories have occurred (19). Recognizing this trend, the IAEA in 1998 convened the first-ever international conference on safety and security of radiation sources in Dijon, France. This conference led to an IAEA action plan approved by the 1999 IAEA General Conference to improve radioactive source safety and security. The plan incorporated a variety of approaches including developing a source categorization system, drafting a Code of Conduct for member countries, and taking steps to improve regulatory infrastructures of member countries.

All of this was accomplished before 9/11.

The aftermath of 9/11 elevated concerns about security of radioactive sources that might be used in a radiological dispersion device (RDD). Security has always been part and parcel of radiation protection but, as Dr. Abel Gonzalez of the IAEA frequently noted, security requirements on account of safety have not been as stringent as those to prevent malicious use. Because of their inherent hazard, radioactive sources were considered self-protecting, a paradigm that changed given the prospect of persons accessing and using radioactive sources for malicious purposes without regard to their personal safety.

Though rare, deliberate malicious use of radioactive material was not unknown. In Texas, a radioactive source was deliberately used to injure a boy (4). In the U.S., there have been several incidents where radioactive material was used to deliberately contaminate persons and property.[3] More recently, Chechen rebels demonstrated their capability to make a RDD when they left a RDD device in a Moscow park to be discovered (4). The recent Litvenenko case represents another kind of malicious – and deadly – use of radioactive material. That case is notable for the international movement of the polonium-210 used for the assassination and subsequent spread of contamination. Also notable is the public anxiety over possible exposure to the contamination, an effect seen earlier in the Goiânia, Brazil accident.

The IAEA, because of its prior work to improve radioactive source safety and security, was well positioned to respond quickly to the post-9/11 security concerns. The source categorization system issued in 2000 readily served as the basis for a revised version (23). Similarly, work began that led to revision of the Code of Conduct in 2004 (24). Concurrently, existing initiatives to improve member country regulatory infrastructures were expanded and accelerated.

Setting Priorities

In the U.S. the Department of Energy's (DOE) Off-site Source Recovery Program (OSRP) recovers and places into secure storage orphan and unwanted sources. To date, the program has recovered 14,000 sources.[4] By 2021, projections are that another 31,000 sources will need to be recovered. In 2003, the Government Accountability Office (GAO) found that the program suffered from budgetary shortfalls (25). The program was moved to National Nuclear Security Administration (NNSA) and incorporated into the Global Radiological Threat Reduction Initiative. It's responsibilities were expanded to recover U.S. origin sources outside the country. However, in 2007, the program's domestic goal for source recovery was reduced because of reprogramming of program funds for security upgrades at DOE facilities. NNSA plans call for significant budget increases for 2008 and beyond. Future competing, non-predictable priorities within the DOE, however, cannot be ruled out. They should not be allowed to adversely affect the program again.

Regardless of cause – accidental or malicious intent – radiation safety and the avoidance of deterministic effects is the first and foremost concern following a radiological incident.

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[3] See, for example, NRC SECY-97-023 and SECY-97-045, both available at the NRC web site, http://www.nrc.gov/reading-rm/doc-collections/commission/combined/.
[4] NNSA Fact Sheet, "NNSA: Working to Prevent Nuclear Terrorism," January 2007.

Categorization of radioactive sources by the IAEA is based on this premise (23).[5] Non-radiological effects – economic damage and social anxiety – also result and, in many scenarios, will be the major consequence (26). The consequences, albeit on a smaller scale, extend to lower priority sources. For this reason, steps to improve accountability and security of radioactive sources should not be limited to Category 1 and 2 sources. The IAEA has published for comment interim guidance to improve security for categories utilizing a graded approach (27). In 2006, NRC directed staff to take steps towards enhancing controls over lower priority sources.[6]

Prioritization of radioactive sources for recovery and actions to enhance security should into account additional factors that include their accessibility, mobility, physical and chemical form, vulnerability, threat assessments, and proximity to and consideration of impacts upon critical infrastructures. Taking into account these factors, the radioisotope thermal generators (RTGs) in the Former Soviet Union (FSU) that are no longer in use, have been abandoned, or are unsecured should receive high priority. Another group of large sources deserving priority attention are Russian made seed irradiators, *Gamma Kolos* units (18, 28). These are *mobile* units containing several kilocuries of cesium-137 or more.[7] The exact number made is unknown; estimates range from 100 to 1,000. They were widely distributed to various countries in the FSU. Many are unaccounted for.

Long-term Measures

The lack of viable, affordable disposal paths for unused and unwanted sources has led to unplanned storage that increases their vulnerability to loss whether accidentally or purposefully. This is also an issue in the U.S. It is entirely possible that in some cases sources have been "dumped" to avoid disposal costs and storage. In the short-term, programs such as the DOE Off-site Source Recovery Program are needed to recover and securely store unwanted and orphan sources, both domestically and internationally. In the long-term, better solutions to low-level radioactive waste disposal must be found.

Reviews of international accidents indicated another matter needed international attention. Because of language barriers or lack of literacy, standard warning labels on radioactive devices intended to alert individuals to the radiation hazard are not always understood. Also, the radiation warning propeller is not as well recognized as other internationally used symbols. Recognizing this, the IAEA initiated work to address this. The result, recently announced by the NRC in a public notice, is approval of an

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[5] Economic and social consequences were recognized by the IAEA in its original (2000) and revised (2005) source categorization systems but the IAEA noted that they are difficult to quantify.
[6] See NRC SECY-06-0094, "Tracking or Providing Enhanced Controls for Category 3 Sources," the accompanying Staff Requirements Memorandum, and the Commissioners' voting record, available at the NRC web site, http://www.nrc.gov/reading-rm/doc-collections/commission.
[7] *Gamma Kolos* irradiators were intended to be transported, usually by trucks. Transportation of radioactive sources is, itself, a vulnerable activity.

internationally proved sign to supplement the current standard warnings[8]. Its use needs to be required for higher risk sources.

Reports issued by the IAEA, the National Academy of Sciences, the National Council on Radiation Protection and Measurements, the Health Physics Society and many experts have recommended development and wider utilization of alternative chemical and physical forms of radioactive material in sources and of alternative technologies to replace radioactive sources (28, 29). Alternative technologies are being utilized by the U.S. steel industry (5). Private-public partnerships may provide a mechanism for advancing the measures.

Conclusions

Dr. Ferguson has pointed out the production, fabrication and utilization of radioactive sources *is an international enterprise* (30).

The historical record of past incidents shows that the consequences of radiological incidents *do not respect boundaries.*

The historical record shows that while radiation injuries and deaths may occur, the severity of the economic damage and social anxiety that result from incidents *often exceeds the health effects.*

The historical record shows that the IAEA, the states and numerous radiation safety experts identified source safety and security as a concern *prior to 9/11.*

Developing solutions radioactive source safety and security issues will require approaches that

- are international in scope,
- retain an appropriate level of attention to domestic needs,
- consider all of the impacts of accidental and malicious use of radioactive material, and
- incorporate both long-term and short-term solutions.

Recommendations

Given this background, the following recommendations are offered:

1. The radioisotope thermal generators (RTGs) in the FSU are a concern because of the very large quantities of radioactive material in the devices. RTGs that are disused, have been abandoned or are unsecured *need priority attention.* Priority attention should also be given to locating and securing mobile seed irradiators in the FSU.

[8] U.S. Nuclear Regulatory Commission, "NRC Regulatory Issue Summary 2007-03 Ionizing Radiation Warning Symbol," ML070600495 (March 1, 2007).

2. Improving security at radioactive waste repositories should receive priority attention: *The transfer of recovered radioactive sources that are at risk to an unsecured waste repository simply continues the risk.*
3. The DOE's program to recover *domestic* radioactive sources posing safety and security risks *is greatly needed.* Over 14,000 sources have been recovered in the U.S. to date and another 31,000 are projected to need recovery between now and 2021. The program has been expanded to recover U.S. origin sources outside the country. Future competing, non-predictable priorities within the DOE *should not be allowed to adversely affect the program.*
4. A key to success of international radiological security efforts to development of national regulatory infrastructures is finding reliable funding sources *to sustain them.* The NRC's experience (and that of the Agreement States) in developing and sustaining regulatory programs is a resource that should be utilized. To this end, neither NRC licensee fees nor interagency fund transfers should be utilized. Instead, *Congress should directly fund NRC work in this area using general revenues.*
5. Long-term measures must become an integral part of a program to improve radioactive source security:
   - The lack of viable, affordable disposal paths for unused and unwanted sources has led to unplanned storage that increased their vulnerability to loss and theft. In the short-term, programs such as the DOE Off-site Source Recovery Program help address this. *In the long-term, better solutions to low-level radioactive waste disposal must be found.*
   - The IAEA, the National Academy of Sciences, the National Council on Radiation Protection and Measurements, the Health Physics Society and numerous experts have recommended *development and wider utilization of alternative chemical and physical forms of radioactive material in sources and of alternative technologies to replace radioactive sources.* This should be vigorously pursued. Private-public partnerships should be explored as a mechanism for advancing these measures.
   - Because of language barriers or lack of literacy, warning labels on radioactive devices intended to alert individuals to the radiation hazard are not always understood. The use of internationally approved supplementary signage for this purpose *should be required for higher risk sources.*

Mr. Chairman, again thank you for the opportunity to provide testimony on this important subject. I will be glad to answer any questions that you and committee members may have.

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BRIEFING MEMORANDUM

BACKGROUND

Following the terrorist attacks of September 11, 2001, U.S. and international experts raised concerns that unsecured radiological sources were vulnerable to theft and that, in the wrong hands, could be used to create a radiological dispersion device (RDD), or a "dirty bomb."

On February 11, 2004, President Bush stated in a speech at the National Defense University that the greatest risk to the United States is the possibility of a terrorist attack using a nuclear weapon or radiological materials. According to a report of the National Commission on Terrorist Attacks Upon the United States (also known as the 9/11 Commission) more than two dozen terrorist groups, including al Qaeda, are pursuing chemical, biological, radiological, and nuclear materials.

Radioactive sources are abundant and are extensively used around the world in a wide range of medical, industrial, agricultural and research applications. Some sources contain relatively large amounts of radioactive material that could potentially be used for malevolent purposes. For example, radioactive material in a source could be used for an RDD or, if the material is easily dispersible, may be spread by breaking open the seal and releasing the material to the environment. Such actions could conceivably contaminate large areas of an urban environment with minor but measurable amounts of radioactive material. Any potential health effects would be moderated owing to the dispersion of the radioactive contamination; however, anxiety, panic and social disruption could follow such an event. The awareness that terrorists might attempt to use radioactive materials for such purposes has raised questions about the adequacy of the security of radioactive sources.

Many radioactive sources are not subject to tight security measures; such measures have traditionally been limited to preventing accidental access or petty theft. Traditional security measures aim to prevent unauthorized access to radioactive sources; such access is facilitated when sources are misplaced, forgotten, lost or insecurely stored. Consideration should be given to what additional security measures may be required to prevent the potential use of radioactive sources by terrorists.

While the vast majority of radioactive sources around the world are under the control of governmental regulatory authorities, there are some sources that have never been subject to regulatory control. Other sources have been regulated, but have nevertheless been abandoned, lost, misplaced, stolen or otherwise removed without authorization; these are termed 'orphan sources.' Because of their availability and lack of control, such orphan sources may pose a security risk.

RADIOACTIVE DISPERSION DEVICE (RDD) OR "DIRTY BOMB"

An RDD is an unconventional weapon. An RDD combines a conventional explosive device—such as a bomb—with radioactive material. It is designed to scatter dangerous and sub-lethal amounts of radioactive material over a general area. The radioactivity in an RDD can be distributed passively (nonexplosively), such as through spraying or spreading by hand. Alternately, a radiological exposure device (RED would involve placing a radioactive source in a public area to expose passersby, as was done by Chechen rebels when they placed a radioactive source in a Moscow park.

Potential terrorist use of an RDD—often called "dirty bomb"—is considered by many to be more likely than the use of a nuclear explosive device because of the number of sources used internationally and the perceived lack of security. RDDs may appeal to terrorists because they require limited technical knowledge to build and deploy compared to a nuclear device. Further, the radioactive materials in RDDs are widely used in medicine, agriculture, industry, and research, and are easier to obtain than weapons grade uranium or plutonium.

The primary purpose of terrorist use of an RDD would be to cause psychological fear and economic disruption. While some devices could cause fatalities from exposure to radioactive materials, the number of deaths and injuries resulting from an RDD might not be substantially greater than from a conventional bomb explosion. Casualties would depend on the speed at which the area of the RDD detonation was evacuated or how successful people were at sheltering-in-place.

The size of the affected area and the level of destruction caused by an RDD would depend on the sophistication and size of the conventional bomb, the type of radioactive material used, the quality and quantity of the radioactive material, and the local meteorological conditions—primarily wind and precipitation. The area affected could be placed off-limits to the public for several months during cleanup efforts.

THE ROLE OF THE DEPARTMENT OF ENERGY NATIONAL NUCLEAR SECURITY ADMINISTRATION (NNSA)

The Department of Energy National Nuclear Security Administration (NNSA) operates the Off-Site Source Recovery Project (OSRP), a program that was created in the late 1990's by the Department of Energy (DOE) under the Office of Environmental Management. The OSRP was initially tasked with recovering the known backlog of excess, abandoned, orphan, and unwanted radioactive sealed sources from licensees across the U.S. to meet a congressional mandate of 5,000 sources recovered by April 2004.[1] This included sources from the commercial sector and sources from state agencies.

The OSRP works to recover and manage unwanted radioactive sealed sources and other radioactive material presenting disposal difficulties. It recovers materials that present a risk to public health and safety as well as radioactive materials that present a potential loss of control by NRC or agreement states. In addition it collects excess and unwanted radioactive materials or sources that DOE owns or has responsibility for under Public Law 99-240.

Because of post-9/11 concerns about the security of excess radioactive material, Congress provided the OSRP with additional federal funding in September 2002 to step up its efforts to dispose of radioactive sources. In October 2003, responsibility for the project was transferred to the NNSA as part of the Global Threat Reduction Initiative (GTRI), expanding its scope of isotopes of concern to be consistent with international efforts to reduce threat from radiological sources. This transition expanded the scope of isotopes of concern to include beta-and gamma-emitting sources.

On May 26, 2004, NNSA established the Global Threat Reduction Initiative (GTRI) to identify, secure, remove and/or facilitate the disposition of high risk vulnerable nuclear and radiological materials around the world, that pose a threat to the United States.

The GTRI is intended to build international support for national programs to identify, secure, recover and/or facilitate the disposition of vulnerable, high-risk nuclear and other radioactive materials around the world that pose a threat to the international community.

To mitigate the potential threat of terrorists acquiring high-risk radioactive materials, the International Radiological Threat Reduction (IRTR) program under GTRI works in cooperation with foreign counterparts and international agencies to locate, identify, recover, consolidate, and enhance the security of such materials. IRTR promotes the sustainability of training and equipment provided to specialized teams and law enforcement personnel in partner countries by encouraging improvements in regulatory infrastructure.

THE NUCLEAR REGULATORY COMMISSION

The U.S. Nuclear Regulatory Commission (NRC) ensures safeguards and security of nuclear and radioactive material by regulating licensees' (a) accounting systems for special nuclear and source materials and (b) security programs and contingency plans. This includes responsibility for licensing domestic users and import and export licensing.

Sections 3(c) and (e) of the Atomic Energy Act of 1954, as revised, and Section 204(b)(1) of the Energy Reorganization Act of 1974 give NRC the responsibility for ensuring that the peaceful uses of nuclear energy "make the maximum contribution to the common defense and security and the national welfare, and [...] provide continued assurance of the Government's ability to enter into and enforce agreements with nations or groups of nations for the control of special nuclear material."

In recent years, federal agencies like the NRC have reviewed their programs and policies to improve the security of radioactive sources against theft, diversion, and use in radiological terrorism.

Title 10 of the Code of Federal Regulations, Part 110, provides specific NRC export/import licensing requirements of radiation sources. For each license, amendment or renewal application, applicants must identify all foreign and domestic locations where exports or imports will be handled, sorted, repackaged and/or processed in any way. In addition, they must provide information on quantities, forms, and other characteristics of the radioactive materials, sealed sources, nuclear facilities and equipment to be exported or imported and indicate how they will be used by each of the parties listed.

Even before the terrorist attack of September 11, 2001, NRC had begun to tighten controls on general-licensed radioactive sources, in particular those used in manufacturing and other settings, because disused sources were sometimes being found mixed with scrap metal. After September 11, the NRC requested that licensees undertake more stringent interim security measures. These security improvements were meant to increase security mainly at locations containing very highly radioactive material.

Current U.S. regulations allow the import and export (except to the embargoed countries of Cuba, Iran, Iraq, Libya, North Korea, and Sudan) of most high-risk radioactive sources under a general license, meaning that the government is not required to conduct a detailed review of the credentials of the sender and recipient.

On July 20, 2006, NRC proposed development of a National Source Tracking System. That system, expected to be in full operation by mid-2007, will allow radioactive sources in quantities of concern to be closely tracked.

NRC has also developed an Interim Inventory of Radioactive Sources, established to address international requirements on source tracking. This inventory was used to ensure the safety of radiation sources following Hurricanes Katrina, Rita and Wilma. U.S. Customs and Border Protection agents are able to get nearly immediate validation of NRC licenses associated with materials coming into the U.S.

To be ready in the event of a radiological or nuclear-related terrorist event, the NRC and other federal agencies have drafted guidance for officials to use for response and long-term recovery planning. The NRC coordinated with the Department of Homeland Security (DHS), the Environmental Protection Agency (EPA), the Department of Defense, DOE and others to develop the guidance. Agencies relied upon existing standards such as EPA's Superfund and NRC's standards for decontamination and decommissioning nuclear power plants. The guidelines are flexible in order to address the broad range of scenarios that could occur.

The NRC works with its Agreement States, DHS, DOE, the FBI, and the International Atomic Energy Agency, as well as manufacturers and distributors of nuclear materials, to protect certain radioactive material from theft or diversion.

The Energy Policy Act of 2005 directed the NRC to strengthen requirements for fingerprinting and background checks of plant employees, and in January 2006, the NRC entered into an agreement with the federal government's Terrorist Screening Center to review records of individuals with unescorted access to nuclear power reactor facilities in an effort to automate and streamline the collection information used to determine the trustworthiness of individuals who have unescorted access to certain vital areas of nuclear power plants.

In the international arena, the NRC's Office of International Programs began a small-scale program of regulatory assistance to a number of counterpart organizations in the Caucasus region in 2002. In countries such as Armenia, NRC succeeded in creating an inventory of radioactive sources and provided guidance to the nuclear regulatory authority to better control sources and improve day-to-day oversight of sources by creating two regional offices. Similar efforts were undertaken in Kazakhstan, Georgia and Azerbaijan.

INTERNATIONAL ATOMIC ENERGY AGENCY

The International Atomic Energy Agency (IAEA) is an independent international organization related to the United Nations system. The Agency works with Member States and multiple partners worldwide to promote safe and secure nuclear technologies, protect people and the environment from harmful radiation exposure, and assist countries in upgrading nuclear safety in accordance with international conventions, standards, and guidance.

The IAEA Department of Nuclear Safety and Security is the organizational hub for this pillar of the IAEA's work. Two sets of activities target priorities:

- In the safety area, they cover nuclear installations, radioactive sources, radioactive materials in transport, and radioactive waste. A core element is setting and promoting the application of international safety standards for the management and regulation of activities involving nuclear and radioactive materials.

- In the security area, they cover nuclear and radioactive materials, as well as nuclear installations. The focus is on helping States prevent, detect, and respond to terrorist or other malicious acts - such as illegal possession, use, transfer, and trafficking - and to protect nuclear installations and transport against sabotage.

The IAEA's work has set the framework for cooperative efforts to build and strengthen an international safety and security regime. This framework includes advisory international standards, codes, and guides; binding international conventions; international peer reviews to evaluate national operations, capabilities, and infrastructures; and an international system of emergency preparedness and response.

In March 2001, the Board of Governors of the IAEA approved a Code of Conduct on the Safety and Security of Radioactive Source. It was revised in September 2003 to reflect findings produced by the *International Conference on Security of Radioactive Sources* held in Vienna in March 2003 (the Hofburg Conference). The Code of Conduct marked the culmination of developments and efforts spanning several years.

Following approval of the revised Code by the Board of Governors, the General Conference urged each State to write to the Director General stating that it fully supports and endorses the IAEA's efforts to enhance the safety and security of radioactive sources; and that it was working towards following the guidance contained in the revised Code. The Code was published by IAEA in January 2004 and many countries have written to the Director General, expressing their support for the Code.

The Secretariat has been working with Member States to develop practical guidance on how to comply with the Code - in particular, the text of Guidance on the Import and Export of Radioactive Sources was approved by the IAEA Board of Governors in September 2004.

G-8 ACTIVITIES TO CONTROL RADIOACTIVE SOURCES

The G-8 annual summit held in Evian, France, in June 2003 issued a statement on "non-proliferation of weapons of mass destruction — securing radioactive sources" in which it encouraged all countries to strengthen controls on radioactive sources and observe the IAEA Code of Conduct.

At the summit, the G-8 pledged its support to improve the security of radioactive materials. Recognizing that radioactive sources are found in everyday life and have beneficial applications in medicine, agriculture, research, and industry, the G-8 also acknowledged that certain poorly protected sources pose a threat because they may be subject to manipulation by terrorists. The G-8 committed to employing high standards to reduce the vulnerability of radioactive sources to acquisition by terrorists. They urged all countries to take measures to strengthen regulatory control of high-risk sources within their territories.

The G-8 accepted the findings of the 2003 Conference on Security of Radioactive Sources, and recognized the essential role of the IAEA in combating radiological terrorism and endorsed its efforts to establish international standards that ensure the long term security and control of high-risk radioactive sources. The G-8 agreed to reinforce and complement the IAEA's activities as well as to ensure the unavailability of radioactive sources to terrorists.

In 2005, in Gleneagles, Scotland, the G-8 once again pledged its support in the area of non-proliferation. They acknowledged, as they did at Evian, that the proliferation of weapons of mass destruction (WMD) and their delivery means, together with international terrorism, remained the pre-eminent threats to international peace and security and called for redoubling efforts to combat it. The G-8 commended the more than 70 countries that had committed to implementing the IAEA Code of Conduct on the Safety and Security of Radioactive Sources and urge all other states to adopt the Code. In a statement issued by the G-8, they pledged to work towards having effective controls applied by the end of 2005, in a harmonized and consistent manner, and to strengthen their cooperation to improve the security of radioactive sources world wide.

GAO'S FINDINGS

The hearing will focus on a January 2007 report drafted at Senator Akaka's request, "*DOE's International Radiological Threat Reduction Program Needs to Focus Future Efforts on Securing the Highest Priority Radiological Sources*."[2] The report assesses the progress DOE has made in implementing its program to help other countries secure their sealed radiological sources, identifies DOE's current and planned program costs, and describes DOE's coordination with other U.S. agencies and international organizations to secure radiological sources in other countries.

The report indicates that the small size and portability of sealed radiological sources make them susceptible to misuse, improper disposal, and theft. The report notes that sealed sources could be used as crude, but potentially dangerous, radiological weapons.

GAO asserts that DOE has made limited progress securing many high-risk sources located in waste storage facilities in Russia, had not yet developed a long-term plan to ensure that security upgrades will be adequately sustained once installed, and that, while interagency cooperation with NRC and State has improved, gaps remain.

The GAO report acknowledges the success of DOE in improving the security of radiological sources at hundreds of sites in more than 40 countries, but notes that when DOE decided to expand its program beyond securing sites in Russia and the FSU, it diverted a significant portion of its limited program funding away from securing the highest priority and most dangerous radiological sources.

GAO asserts that instead of focusing increased attention on the highest priority threats, such as waste storage facilities in Russia, DOE allocated significant program funding resources to securing lower risk medical facilities.

In addition, GAO advises that the security equipment and upgraded storage facilities funded by DOE will require a long-term commitment by recipient countries to ensure their continued use and operation. Without a comprehensive sustainability plan that adequately addresses a country's ability to reliably install and maintain upgrades and provide adequate oversight for source security, investments to improve the security of radiological sources may be ineffective.

GAO also noted that while the budget for radiological source security activities increased between 2002-2004, it has been reduced in subsequent years and future funding and commitment is uncertain. The reduction is, in part, a reflection of the greater priority given to activities devoted to securing nuclear materials such as highly enriched uranium.

BACKGROUND SUMMARY OF PREVIOUS GAO REPORTS

GAO's most recent report updates previous work on this matter. In 2003, GAO issued three reports at Senator Akaka's request focusing on U.S. and international efforts to secure sealed radiological sources.

In the April 2003 report, entitled "DOE Action Needed to Ensure Continuous Recovery of Unwanted Sealed Radioactive Sources,"[3] GAO focused on potentially dangerous sealed sources containing greater-than-Class-C radioactive material which pose a threat to national security because terrorists could use them to make "dirty bombs." Public Law 99-240 requires the Department of Energy (DOE) provide a facility for disposing of unwanted sources. Because DOE has no disposal facility for these sources, its Off-Site Source Recovery Project is recovering and temporarily storing them at Los Alamos, New Mexico. GAO was asked to determine (1) the number of unwanted sealed sources that DOE plans to recover through 2010 and the estimated cost, (2) the status of recovery efforts and any problems that DOE faced, and (3) the status of DOE's efforts to provide a disposal facility for these sealed sources.

GAO recommended that the Secretary of Energy (1) determine whether the priority given to the project is commensurate with the threat these sources pose; (2) ensure adequate resources are devoted to the project; (3) take immediate action to provide space to store sealed sources containing plutonium-239, strontium-90, and cesium-137; (4) initiate the process to develop a permanent disposal facility for greater-than-Class-C radioactive waste; and (5) develop a plan to ensure the continued recovery of greater-than-Class-C waste until a disposal facility is available.

A May 2003 GAO report entitled, "U.S. and International Assistance Efforts to Control Sealed Radioactive Sources Need Strengthening,"[4] focused on sealed radioactive sources, radioactive material encapsulated in stainless steel or other metal, are used worldwide in medicine, industry, and research. As previously stated, 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 were believed to be effectively implemented.

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

Finally, in August 2003, the GAO issued a third report entitled, "Federal and State Action Needed to Improve Security of Sealed Radioactive Sources,"[5] which also focused on sealed radioactive sources, and radioactive material encapsulated in stainless steel or other metal. In addition to focusing on numbers accounted for and lost, the report also reviewed the Nuclear Regulatory Commission (NRC) and state efforts since September 11, 2001, to strengthen security of sealed sources.

GAO recommended that NRC (1) collaborate with states to determine availability of highest risk sealed sources, (2) determine if owners of certain devices should apply for licenses, (3) modify NRC's licensing process so sealed sources cannot be purchased until NRC verifies their intended use, (4) ensure that NRC's evaluation of federal and state programs assess security of sealed sources, and (5) determine how states can participate in implementing additional security measures.

LEGISLATION:

National Nuclear Security Act of 2000
www.nnsa.doe.gov/docs/statguidance/2004-03-11-Title_XXXII.pdf

Title 10, Part 110
http://www.nrc.gov/reading-rm/doc-collections/cfr/part110/

NRC Nuclear Non–Proliferation and Export Licensing Statutes

- Nuclear Non–Proliferation Act of 1978 (P.L. 95–242)
- International Atomic Energy Agency Participation Act of 1957 (P.L. 85–177) and the Statute of the International Atomic Energy Agency
- International Security Assistance and Arms Export Control Act of 1976 (P.L. 94–329)
- International Security and Development Cooperation Act of 1980 (P.L. 96–533)
- International Security and Development Cooperation Act of 1981 (P.L. 97–113)
- Convention on the Physical Protection of Nuclear Material Implementation Act of 1982 (P.L. 97–351)
- Iraq Sanctions Act of 1990 (P.L. 101–513)
- Iran–Iraq Arms Non–Proliferation Act of 1992
- Subtitle B–North Korea Threat Reduction (P.L. 106–113)
- Iran Non–Proliferation Act of 2000 (P.L. 106–178)

ADDITIONAL INFORMATION/RESOURCES:

Human Health Fact Sheet - www.ead.anl.gov/pub/doc/rdd.pdf

National Nuclear Security Administration Fact Sheet -
www.nnsa.doe.gov/docs/factsheets/2006/NA-06-FS04.pdf

Press Release - Department Refocuses Threat Reduction Efforts to Return Nuclear Research Reactor Fuel http://www.energy.gov/news/1321.htm

NRC Backgrounder - Nuclear Security – Five Years After 9/11
http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/security-enhancements.html

IEAE: Reducing the Threat of Nuclear Theft and Sabotage
www.ieae.or/NewsCenter/Features/Nuclear_Terrorism

IEAE: Trafficking in Nuclear and Radioactive Material in 2005
http://www.iaea.org/NewsCenter/News/2006/traffickingstats2005.html

Code of Conduct on the Safety and Security of Radioactive Source
http://www-pub.iaea.org/MTCD/publications/PDF/Code-2004_web.pdf

Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management
http://www.iaea.org/Publications/Documents/Infcircs/1997/infcirc546.pdf

The G8 2003 Statement on Non Proliferation
http://www.g8.fr/evian/english/navigation/2003_g8_summit/summit_documents/non_proliferation_of_weapons_of_mass_destruction_securing_radioactive_sources_-_a_g8_action_plan.html

The G8 2005 Statement on Non Proliferation
http://www.fco.gov.uk/Files/kfile/PostG8_Gleneagles_CounterProliferation.pdf

Report: Partnership Against the Spread of Weapons and Materials of Mass Destruction
www.cissm.umd.edu/papers/files/**globalpartnership**.pdf

GAO Report: IAEA Safeguards and Other Measures to Halt the Spread of Nuclear Weapons and Material, September 2006
www.**gao**.gov/new.items/d061128t.pdf

GAO Report: Nuclear Nonproliferation: DOE Action Needed to Ensure Continued Recovery of Unwanted Sealed Radioactive Sources, GAO-03-483, April 15, 2003

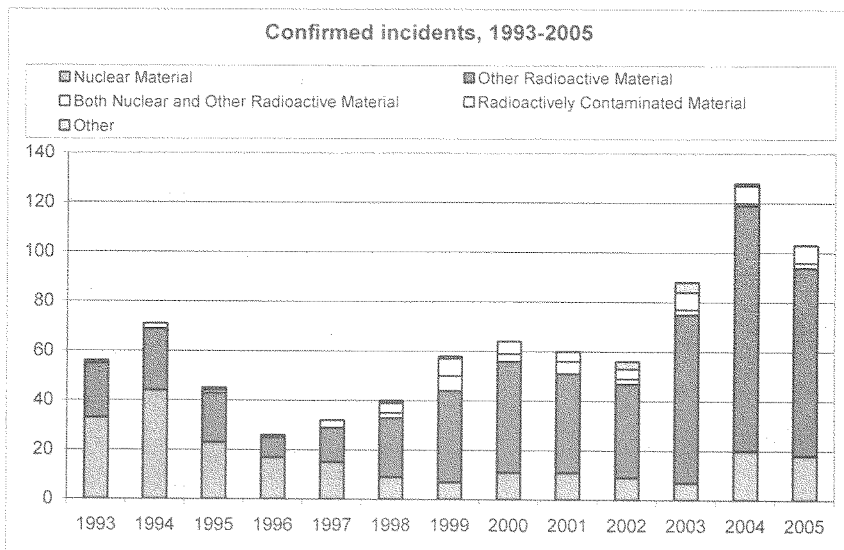
GAO Report: Nuclear Nonproliferation: U.S. and International Assistance Efforts to Control Sealed Radioactive Sources Need Strengthening, GAO-03-638, May 16, 2003

GAO Report: Nuclear Security: Federal and State Action Needed to Improve Security of Sealed Radioactive Sources, GAO-03-804, August 6, 2003

CRS: Issues Brief for Congress – Non Proliferation
www.iwar.org.uk/news-archive/**crs**/12396.pdf

IAEA ILLICIT TRAFFICKING DATABASE (ITDB)

IAEA information system on illicit trafficking and other unauthorized activities involving nuclear and radioactive materials



IAEA Efforts to secure high risk radioactive sources in Member States, to strengthen their regulatory infrastructure and to track cases of illicit trafficking in radioactive materials

The International Atomic Energy Agency (IAEA) is an independent intergovernmental organization governed by its Statute and by the decisions of its 143 Member States, acting through duly constituted policy making organs of the IAEA. In March 2002, the IAEA Board of Governors approved the IAEA's first comprehensive programme to combat the risk of nuclear terrorism by assisting States in strengthening their nuclear security. The Board also approved the creation of a voluntary funding mechanism, the Nuclear Security Fund (NSF), to which Member States were called upon to contribute. In September 2005, the Board of Governors considered and approved a new Nuclear Security Plan (NSP) covering the period 2006–2009. The new Plan builds upon the accomplishments of the first Plan, reviews the threat picture as it has evolved since the configuration of the priorities and approach set in 2002, and promotes implementation of strengthened international instruments to combat nuclear terrorism. It covers three activity areas: Needs Assessment, Analysis and Coordination; Prevention; and Detection and Response.

The following highlights some of the areas in which the Department of Energy National Nuclear Security Administration's (NNSA) Office of Global Threat Reduction (GTR) programs have provided significant support to the IAEA's NSP during the past few years.

Background

Radioactive sources provide great benefit to humanity primarily through their utilization in agriculture, industry, medicine and research. Nonetheless, control over thousands of these sources has been lost, sometimes resulting in serious consequences. As a result, the Agency assists States in preventing radioactive material from falling into the hands of criminals and non-State actors and, accordingly, helps States to strengthen their nuclear security as well as to meet international commitment including those accepted under international binding and non-binding international legal instruments.

The precise number of radioactive sources in worldwide use or storage is not known, but it is estimated that there are probably well in excess of 100,000 Category 1 and 2 sources[1] and more than 1,000,000 Category 3 sources. In all, there may be over 3,000,000 high-activity sources worldwide. If not well controlled and protected, these sources may fall into the hands of non-state actors and be used for malicious purposes.

The Code of Conduct on the Safety and Security of Radioactive Sources (the Code) is one example of the global trend toward increased security on radioactive sources. The Code was revised in 2003 to include stronger security principles in light of the events of 11 September 2001. Additionally, several important international conferences have been convened on this topic and concluded that the security of radioactive sources should be a global priority and that efforts should increase to combat the illicit trafficking of radioactive sources.

Considerable effort is being made by the IAEA in assisting States (over 100) in implementing the guidance given in the Code and its Guidance on Import and Export of Radioactive Sources.

The NSP is another example of the trend toward greater security of radioactive sources, and provides a compilation of programmes and activities that contribute to enhancing the security of radioactive material worldwide and a plan for their implementation.

These programs and activities include:

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[1] The Safety Standard 'Categorization of Radioactive Sources' (RS-G-1.9) provides a ranking of radioactive sources in terms of their potential to cause early harmful health effects if the source is not safely managed or securely protected. Sources are classified into five categories: Category 1 sources are potentially the most dangerous and Category 5 are the most unlikely to be dangerous.

- Providing *legislative and regulatory assistance* to enable States to adhere to international binding and non-binding legal instruments relevant to nuclear security;
- Support in strengthening *States' systems for registry accounting for and controlling radioactive material (nuclear material and other radioactive material)* including through a State's system for register radioactive sources (RAIS);
- Supporting States in the implementation *of high standards of physical protection of radioactive material and related facilities, transport and storage and waste sites.*
- Supporting States in the *removal and repatriation of radioactive sources.*
- Support for States' efforts to *upgrade border controls, in order to enhance the capability to detect the illicit trafficking of radioactive material including nuclear material.*

Actions carried out in support of these activities

Guidance Documents

The IAEA is working, together with its Member States, for the development and publishing of a series of guidance documents on nuclear security with *recommendations* and *implementing guides* containing practical advice on how States can implement international obligations that are relevant to strengthening nuclear security.

The consistent implementation of the *Code of Conduct* and *Supplementary Guidance* and the guidance on the security of radioactive sources and radioactive waste, on transport security, on nuclear security culture, on nuclear security at major public events and on combating, and detecting and responding to, the illicit trafficking of radioactive material supports States in securing high-risk radioactive sources and reacting to situations where the control of radioactive material has failed and the material may be used for malicious ends.

The process leading to the production of IAEA documentation includes consultation with IAEA Member States. The U.S. DOE/NNSA as well as the NRC have contributed expertise in the development, consultation and review of nuclear security guidance documents. Their contribution to this process has significantly facilitated the production of documents in the Nuclear Security Series.

Evaluation and Assessment Services

To further assist States in their efforts to implement their nuclear security commitments, the IAEA offers and carries out *evaluation and assessment services* to help States evaluate their nuclear security systems and identify what needs to be improved. Since 2003, some one hundred such peer-based review missions have been carried out by the IAEA. Other services include the assessment of security at specific locations or for sources in industrial and medical use.

RaSSIA Missions assess the effectiveness of a State's existing national regulatory infrastructures for radiation safety and security of radioactive sources against established international radiation safety standards and Code of Conduct and its Guidance for the Export and Import. The hosting State receives, for its endorsement, a comprehensive and objective assessment of the current status of the regulatory infrastructure together with an action plan, if appropriate, designed to bring the regulatory infrastructure up to international standards and those specified in the Code of Conduct. Between June 2005 and June 2006, RaSSIA Missions were performed in 62 States 15 of which were funded from the NSF. The IAEA may provide assistance in implementing the recommendations for improvement that were prepared during the RaSSIA Missions. Such assistance has included training packages on authorisation and inspection of radiation sources and the provision of some essential tools for the control of radioactive sources (e.g. provision of basic inspection equipment and RAIS).

Source Security Missions survey the needs for the recovery, conditioning and secure storage of disused radioactive sources and/or repatriation to the country of origin. The IAEA carried out six such missions in 2006 with a further 15 such Missions planned for 2007.

National Strategy Missions support the development of national strategies and advise States on methodologies for searching for and locating orphan sources. The IAEA has carried out more than 15 National Strategy Missions since 2002 and in certain cases has provided instruments and tools to conduct search and recovery.

INSServ Missions evaluated the range of nuclear security capabilities and needs, including those related to the security of radioactive sources, in Member States. The IAEA carried out five INSServ Missions in 2006, bringing the total number of INSServ Missions to 27.

IPPAS Missions focus on the physical protection of nuclear material and complement efforts to enhance the security of locations and facilities housing radioactive sources. To date, the IAEA has conducted 37 IPPAS Missions.

Capacity building

The IAEA assists States with their human resource development by offering a comprehensive *education and training programme*, with a large variety of education and training events, including technical and scientific visits and on the job training in the fields of physical protection of nuclear and other radioactive material and facilities and combating illicit trafficking in radioactive material. Since 2003, about 150 training events have been carried out with more than 3000 participants from more than 100 States. Non-IAEA Member States were also among the recipients of this training.

Education and Training for security radioactive material

10 Regional and National courses on **Security of sources** undertaken since 2004

314 participants from 62 States (including 2 non members) sent participants,

Lecturers from IAEA, USA (DOE), EU States and other Member States

10 hosting States (Namibia, Algeria, Australia, South Africa, Argentina, Pakistan - national, Slovenia, India, Tunisia, Syria)

5 more training events scheduled for 2007 (Kazakhstan, Nigeria, Spain – National, China – national, and Estonia) with additional 150 participants

33 International, Regional and National training courses on **Nuclear security Issues and combating illicit trafficking**
Target audience: Policy makers, Nuclear Regulators, Facility Operators, Legislators, Emergency responders, Police, Customs, Border forces, Military, Intelligence

To strengthen security arrangements for radioactive sources, attention has been given to the physical protection and control of radioactive sources throughout their life cycle. A training course devoted to the "Physical Protection of Radioactive Sources", developed in cooperation with the US National Nuclear Security Administration (NNSA), was first held in Australia (August 2005). This training is now regularly provided for regional audiences, recently in South Africa (March 2006), Argentina (April 2006, in Spanish), Slovenia (June 2006), India (October 2006), Tunisia (November 2006) and Syria (February 2007). In addition, two national training courses on the security of sources were held in Pakistan in 2006. In 2007, similar regional courses are scheduled for Estonia, Kazakhstan Nigeria and national courses in China and Spain.

The IAEA has also responded to some States' physical protection needs by providing upgrades and technical support for improved physical protection of radioactive material and associated facilities, transports and storage and waste sites.

For capacity building in the area of detection of radioactive material in illicit trafficking, including at border-crossing points, more than 1000 detection instruments have been provided to some 20 States.

The IAEA, together with GTR, helped support nuclear security at the 2004 Olympic Games in Greece, including through the provision of radiation detection instruments.

Locating and securing abandoned, vulnerable sources

Risk reduction is achieved by locating and securing abandoned, vulnerable sources that may never have been under regulatory control or that have been abandoned, lost, misplaced, stolen or otherwise transferred without proper authorization because the level of control was weak. The IAEA supports the development of national strategies and provides advice to States on methodologies for searching for and locating orphan sources

Source recovery

Tripartite Initiative, which was established in 2002 between the IAEA, the Russian Federation and the United States and completed in 2005, was a collaborative effort to secure high risk radioactive sources in States of the former Soviet Union. Under this Initiative, the IAEA facilitated the dismantlement and transport into safe and secure storage of high activity vulnerable radioactive sources with a total activity of 2120 TBq (57251 Ci). In addition, the US Department of Energy team completed security upgrading work on operating sources or provided storage facilities in thirteen States.

In 2006, the IAEA worked in close partnership with DOE/NNSA and the Nuclear Energy Corporation of South Africa in the recovery and disposition of 67 vulnerable, high risk radioactive sources from other African countries. The IAEA is currently working with DOE/NNSA technical experts to recover similar sources from South America and other locations around the world. During 2006, the IAEA worked in close cooperation with DOE/NNSA to recover disused and vulnerable sources in Panama, Sudan, Nigeria, and Tanzania.

As part of a systematic programme of support for States in recovering, repatriating and/or securely storing sources, the IAEA has carried out a number of projects for the recovery and conditioning of high-activity and neutron sources. More than 100 sources, including high-activity Category 1 sources, have been recovered. The sources were collected for repatriation, with 72 of them repatriated to their suppliers or to another storage place.

The IAEA has developed a mobile unit which will allow spent high activity radioactive sources to be conditioned prior to shipment to secure storage. During the week of 12 March 2007, the IAEA will conduct a demonstration recovery of radioactive materials with the newly constructed Spent High Activity Recovery System (SHARS) at the Nuclear Energy Corporation of South Africa. This development was facilitated through financial and technical support from DOE/NNSA.

Partnerships

The IAEA has worked with DOE/NNSA and Partner Countries such as Australia, India and South Africa to address security of high risk nuclear and other radioactive materials in vulnerable locations around the world. This partnership has facilitated DOE/NNSA bilateral work for enhanced security at over 500 sites in more than 40 countries under the Global Threat Reduction Initiative.

The Radiological Security Partnership (RSP) has become an important mechanism to deal with risk-reduction activities and focusing on the security of vulnerable, high-risk radioactive sources. The RSP was initiated by the US Department of Energy to address "the potential threats from under-secured high-risk radioactive sources". Such Regional RSPs have been established with: Australia and the USA for increasing awareness on the security of sources and human resource development in Southeast Asia, with activities including training, technical advice, recovery of unsecured or disused sources and the security of research reactors; India and the USA for the provision of training, instrumentation, technical support and awareness building in and between States in the South Asia region, with modalities of regional cooperation being outlined and activities including education and training; and South Africa and the USA for recovering and securing disused, high-activity sources, with activities include training and technical development.

Illicit Trafficking Database

The IAEA maintains the Illicit Trafficking Database (ITDB) which is the principal international mechanism for the exchange of authoritative information on incidents of illicit trafficking and other unauthorized activities involving nuclear and radioactive materials. 95 States participate in the ITDB program. Since 1993, States have reported to the ITDB around 100 incidents involving Category 1-3 'dangerous' radioactive sources, as per the IAEA Categorization of Radioactive Sources (IAEA Safety Guide No. RS-G-1.9). In nearly 50% of these incidents, the 'dangerous' sources were reported lost or stolen; about half of them have not been recovered. The second largest group of cases involved the finding of uncontrolled, or orphan, "dangerous' sources, which had not been previously reported as lost or stolen.

Cooperation and Coordination

The IAEA's activities in the area of nuclear security are funded almost exclusively from extra-budgetary funds. In addition, significant "in-kind" contributions are received from Member States. The cost of all activities carried out in 2006 under the NSP was US $20 million.

The US is the largest single donor to the NSF and by the end of 2006 had contributed US $33 million. The GTR has provided more than $12 million to address a broad spectrum of issues related to the security of radioactive sources, many of which cannot be directly addressed by the U.S. Government. In addition to the financial contribution, the GTR has provided a full time Cost Free Expert to the IAEA's Office of Nuclear Security to assist in the development and implementation of IAEA programs, including those supported by the GTR.

The IAEA is working actively to expand its coordination and cooperation with the DOE/NNSA and other Member States in order to reduce duplication and avoid gaps in the assistance. The IAEA believes that such coordination and cooperation is vital in order to avoid duplication of efforts: both national and of other multilateral nuclear security initiatives and to take advantage of the IAEA's global reach and impartiality. The IAEA is seeking to take advantage of practical experience and information gained through its nuclear security cooperation with States to identify urgent problems, to prioritize needs and to formulate new projects for preventing the malicious use of high-activity radioactive sources. The IAEA will continue to work with the DOE/NNSA assistance to coordinating the bilateral application of available resources to nuclear security needs identified in recipient States, including via Integrated Nuclear Security Support Plans.

Special Submission

LAURISTON S. TAYLOR LECTURE: RADIATION PROTECTION IN THE AFTERMATH OF A TERRORIST ATTACK INVOLVING EXPOSURE TO IONIZING RADIATION

Abel J. González*

Abstract—**I would like to start this Twenty-Eighth Lauriston S. Taylor Lecture by expressing my gratitude to the National Council on Radiation Protection and Measurements (NCRP) for this unique occasion. I feel particularly honored for this opportunity to address a highly specialized and qualified audience of professionals who are specifically interested in what appears to be a forthcoming worldwide challenge, namely radiological terrorism and managing its potential radiological consequences.**

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INTRODUCTION

It seems natural that NCRP continues to be interested in this field as it was the scientific body who presented to the world the exclusive scoop of the first report on the management of terrorist events involving radioactive material (NCRP 2001). Time will reveal whether the current concerns on the possibility of radiological terrorism are just a transitory paranoia arising from the troublesome period of human history we are transiting or whether they will become a permanent factor of our future lives. I am a stubborn optimist who believes in the ultimate success of decency over wickedness, and, therefore, I am inclined to favor the former possibility. I nevertheless also believe that the radiation protection profession has a particular responsibility these days. It should be able and willing to respond to the current demands for protection against potential malevolent events involving radiation exposure. I have therefore accepted with pleasure the NCRP suggestion to focus my lecture on this topic of terrorism, which I hope will be of transitory importance. My desire would obviously have been to devote this renowned lecture to a subject of expected long standing transcendence for radiation protection, but I am happy to accept that this topic reflects the needs of these times.

This Lauriston S. Taylor Lecture, therefore, will mainly address radiation protection in the event of a terrorist attack involving exposure to ionizing radiation. In preparing the lecture, I have benefited from the perceptive work of a Task Group of the International Commission on Radiological Protection (ICRP), which I have been given the honor to chair (ICRP 2005). I have furthermore profited from the vast amount of activities on security of radioactive sources that were carried out by the International Atomic Energy Agency (IAEA) in the Division that is currently under my responsibility and supervision. These IAEA activities have been intense even before radiological terrorism became an issue for many countries in the repercussion of the events of 11 September 2001.

Following a general introduction, my lecture will start with a tutorial (but, hopefully, not pedantic) discussion on the misuse of language to describe our problem and the consequent confusion it produces. It will continue with a rather speculative description of the potential scenarios we might confront. Then, I will try to summarize the international recommendations on radiation protection adapting them to the protection of both responders and members of the public who might be involved in a terrorist event of the type we have speculated. I will conclude with an outlook that will attempt to answer a perhaps unanswerable question: "Could we prevent such a malevolent event and its consequences?" followed by an epilogue of personal thoughts.

Speculations of nuclear terrorist attacks have increased after the devastating events of September 11th. Assumptions on the possible scenarios include the explosion of improvised nuclear devices (IND), attacks to nuclear installations, and the malevolent use of radiation

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sources containing radioactive materials. While the terrorist use of nuclear weapons (whether improvised or not) would certainly be catastrophic, and a well-planned sabotage of a nuclear installation can also cause devastating effects, radioactive sources do not contain the nuclear materials that are used in nuclear installations and would allow someone to build a nuclear bomb and trigger a destructive explosion. The security of radioactive sources has nonetheless become a subject of serious public concern. These sources, so commonly used in medicine and industry, contain radioactive materials that could kill or damage the health of people coming into close contact with them. However, there is an increasing apprehension that radioactive sources could be turned into terrorist tools characterized by the media with the expression "dirty bomb," a term used to describe a radioactive source shrouded by a conventional explosive built with malevolent intent of dispersing into the environment the radioactive materials constituting the source. In fact, if detonated in a public domain, this ensemble may cause widespread dispersion of radioactive particles, and for this reason it is also known as a radiological dispersal device (RDD). While such a weapon would not produce a nuclear reaction and explosion, with its feared mushroom bringing calcinating heat, devastating shock waves, and large amounts of radioactive fallout, there have been unfounded suggestions that an RDD explosion would kill thousands and render full cities uninhabitable. These catastrophic scenarios, however, are wildly exaggerated: as it will be derived from this lecture, if such an attack actually occurs, the device would probably just scatter some mild-by-comparison radioactive contamination. Possibly, merely a small area of a few city blocks would be involved and casualties would be low, limited largely to the perpetrators who will be hurt by the direct radiation exposure caused by the manipulation of the source. However, even if the device would not injure a lot of people, it could certainly cause a lot of terror and psychological harm. As the media properly reported, terror, indeed, appears to be an RDD's greatest attraction: the image of moon-suited cleaning crews with Geiger counters in a big city downtown is bound to cause panic.

The RDD scenario is certainly not unique in the menu of nuclear terror. Nuclear installations with large radioactivity inventories, such as nuclear power plants and radioactive waste depositories, can certainly be attacked and their radioactive materials dispersed. In the worst nightmare scenario, a nuclear weapon can reach terrorist hands, and the detonation of a nuclear device with even a small nuclear yield in a major metropolitan area will certainly have devastating effects. However, mainly the odds of an RDD being used by malevolent hands are those that have triggered a particular public anxiety, perhaps because the likelihood is perceived to be higher. As a consequence, there has been a wide request to increase the *security* of radioactive sources.

The need for securing radioactive sources is not new. Internationally, source security was always presumed or specifically required for preventing radioactive materials getting lost and going astray, and, as a result, causing harm to people. Over the years, the ICRP recommendations (ICRP 1959, 1964, 1966, 1977, 1991) have presumed that, as a precondition for proper radiological protection, sources of radiation exposure have to be subject to proper measures of control. This presumption was reflected in the IAEA sponsored global radiation safety norm, the *International Basic Safety Standards for Protection Against Ionizing Radiation and for the Safety of Radiation Sources*, usually referred to as the Basic Safety Standards, or BSS (IAEA 1996a), which established requirements on radiological security in 1996 by requiring that the control of sources shall not be relinquished under any circumstances as a precondition for radiological safety. In fact, the IAEA has always had the security of radioactive sources as an important component of its radiation safety program. Already in mid-1999, the *IAEA Bulletin* (IAEA 1999) dedicated a full issue to address the problem and describe the IAEA response. However, under the new challenges put forward by the recent terrorist attacks, a new dimension of security seems to be developing: deterring the diversion of radioactive materials from legal into illegal and criminal uses—such as terrorist violence. Not surprisingly, the international community is adjusting its response to this new and somehow remarkable reality.

COMMON UNDERSTANDING

Since Aristotle all philosophers and scientists recognized that words should be used properly for intelligible understanding, particularly on scientific issues, a fundamental principle our generation seems to have forgotten. In the words of the logistician Abbe de Condillac, "we think only through the medium of words. . . [and]. . . the art of reasoning is nothing more than a language well arranged." Because, as properly recognized in Ludwig Wittgenstein's *Tractatus Logico-philosophicus*, "the limits of my language mean the limits of my world," or, as more prosaically expressed by U.S. President William Clinton in his 1998 evidence before a Grand Jury, ". . . it depends on what the meaning of . . . 'is'. . . is." The common understanding of the problem of radiological terrorism is at the root of its possible solution.

The public apprehension generated by the new issue of radiological terrorism is parallel with (and perhaps enhanced by) a terminological confusion mainly caused by the loose usage of technical vocabulary and exacerbated by translation. In fact, in today's insecure world, the confusion seems to be increased by the inaccurate language employed by many. The magical expression used (and misused) *ad nausea* is "security" or, more precisely, "security" *against* "terrorism." These days, people seem to appreciate this concept more than any other attribute, and politicians duly follow suit and promise it for all. Few, however, seem to wonder what "terrorism" and "security" really mean.

Terrorism

Giving the magnificent historical analysis of terrorism, presented at this meeting by John W. Poston in his Warren K. Sinclair Keynote Address, I will not attempt to examine deeply the confusing international perceptions on the notion of terrorism. However, I cannot escape from making a few reflections into this crucial concept. The idea of terror made its political debut as "*la terreur*," the French Revolution's Reign of Terror in 1793. It was then sympathetically appreciated by many and hypocritically defined by Robespierre as "nothing other than justice, prompt, severe, inflexible... an emanation of virtue." Albert Camus described terror as "the urge that draws people to the violent certainties of totalitarianism where rebellion hardens into ideology." But terror and its subsidiary concept "terrorism" switched in the past century from violence by government into violence against authority. Not only the concept but also the terminology changed into "freedom fighting" or equivalent notions. Various groups, from the anti-nazis "maquis" to the Latin American "liberation movements," were seen with sympathy by the same North Atlantic cultural alliance that today seems to be obsessed with this technique of power struggle that they have applauded (if not facilitated) over the years. It should not be surprising, therefore, that in spite of the current political noise, the international community could not yet reach agreement on an acceptable (ergo: legally binding) definition of either terror or terrorism! It seems that our start is not very auspicious: we will lecture on international recommendations related to a subject area that we could not define properly in international terms.

Security

The concept of "security" also presents problems of common understanding. It is surprising that few have tried to make a differential analysis between the concept of "security" and its more widely used kin: "safety." Safety and security—*sûreté* and *sécurité*—are two distinct terms in English and French; in many other major languages, a common word is used for these two concepts. Not surprisingly, therefore, many people wonder what the distinction is between safety and security. If they reached for their dictionaries, they would perhaps be none the wiser, because one of the definitions of *security* is *safety* and vice versa.

Within the context of this lecture, the comparative meaning of safety and security becomes even more cryptic: What do radiological safety and radiological security really mean? Both concepts are used to denote a combination of administrative, technical and managerial features, for two different purposes that usually coincide but sometimes collide. "Radiological safety" (e.g., of a practice involving radiation exposure) covers the features that diminish the likelihood of radiological accidents, as a result of which people may be injured, as well as those that may mitigate the consequences of such mishaps. Distinctly, "radiological security" (e.g., of a radiation source) refers to the features that prevent any unauthorized possession, e.g., of a radiation source, and any nonpermitted action with it. Radiological security is achieved by ensuring control is not relinquished and improperly acquired on any device capable of delivering radiation exposure. Thus, while safety is used to convey the concept of preventing and restricting harm attributable to radiation exposure, international radiation safety standards have made use of the concept of security over years to mean the prevention and inhibition of the unauthorized possession and unlawful use of radiation sources. So described, security is a basic safety requirement that was condensed in the expression "control of radiation sources shall not be relinquished." Therefore, in international radiation-related parlance, today's popular term "radiological *security*" expresses a concept that has always been an integral part of "radiological *safety*." This is because of simple logic: while a radioactive source that is *secure* (namely kept under proper control, physically protected), is not necessarily automatically *safe* (namely, unlikely to produce harm); a radioactive source cannot be *safe* if it is not *secure*. It follows that: "radiological security" is a necessary (but not sufficient) condition for "radiological safety" and, consequently, that radiological security should be *subsidiary* to radiological safety.

It should be noted that, while *safety* is of relevance to all types of radiation sources, either nonradioactive or radioactive sources, *security* is usually limited to radioactive sources alone. Radiation generators, such as x-ray machines and accelerators, are less likely to be a security threat because the use of such equipment for malevolent purposes is not evident. Moreover, it should also be noted that sometimes *safety* and *security* appear to oppose each other: for instance, the clear marking of radioactive sources is imposed on *safety* grounds, but it makes radioactive sources more vulnerable to *security* breaches. The dichotomy has become evident during recent international discussions on the controversial issue of transporting radioactive sources by sea: while many coastal States request that transporting States provide comprehensive information on the sources being transported near their shore because of *safety* concerns, the latter prefer to keep information restricted because of *security* concerns.

Security and terrorism

There is not an unequivocal link between radiological security and terrorism. The security of radiation sources is a requirement to be respected whether or not there is a terrorist menace. In fact, while many radiation safety breaches produced by security violations have been the cause of serious radiological accidents; none of them however were caused by "terrorist" actions but rather by what can be considered criminal, although nonmalevolent, violations of the law. People causing these security breaches were unaware of the radiological consequences that such violations will create.

In fact, secured sources can, and have, become unsecured through a variety of circumstances, not necessarily malevolent ones. Historically, in the most common cases, control over the source has usually been relinquished inadvertently, the source being misused without any premeditated malevolent intent. In other cases, many sources have been found *orphaned* of any control and were therefore completely unsecured. A relatively large number of radiological accidents have occurred because of these unintentional breaches in source security or because an orphan source was inadvertently found. The detailed causes and consequences of some of these accidents have been reported by the IAEA (1988, 1996b, 1998a, 2000a, 2000b, 2000c). The recent discovery by Western societies that so-called terrorists may make use of radioactive substances for malevolent purposes has not changed the fundamental concept of radiological security as established in international standards over years, but just reinforced its justifications and recognized the myopia of many national regulations that ignored this international basic requirement.

These are conclusions difficult to digest for the new species of "security" moguls who, after the worldwide terrorist menaces, have proliferated like mushrooms after the rain. They claim that radiological security should have an overriding priority over radiological safety. As they are nonprofessionals in the radiation field, they fail to understand that in this area safety and security are intrinsically intertwined and are inseparable. The conclusions are, however, very important for the radiation safety community in general, and for NCRP in particular because it is in the United States where the confusion seems to be bigger. A substantial fraction of the financial resources being dedicated to combat radiological terrorism come from U.S. sources, and the lack of respect for the above described fundamental hierarchical principle has resulted in nonprofessional decision makers attempting to resolve issues that they do not fully understand resulting in an enormous waste of resources.

All the reasoning heretofore does not apply to the security measures that are needed for avoiding the diversion of nuclear materials into, for instance, the construction of nuclear weapons. In this field (which is usually termed "safeguards") it should be a real new concern that was not properly covered by international nonproliferation undertakings. The confusion between radiological security (i.e., the proper control of radioactive materials in order to prevent a safety case) and nuclear security (i.e., the proper control of nuclear materials in order to prevent their diversion into atomic weapons) has produced enormous harm and waste of resources. The culprit is not the professional ignorance of prefabricated "security experts" who were given the management of vast amount of resources and wasted most of them in the pursuit of a "holistic" unfocused security; but rather those who gave such power to them.

Dangerousness

Within the above understanding of security, terrorism, and their relationship in relation to radiation, another important issue of communication is to have full clarity about the meaning of (radiological) *"dangerousness,"* whether it be the *"dangerousness of a radiation dose,"* or the *"dangerousness of a radioactive source."* For describing quantitatively these dangerousness qualities, the international radiation protection quantities will be used.†

† Radiological attacks will likely result in dispersion of radioactive substances. *Radioactivity* is the term used to describe the phenomenon of radiation emission, which is quantified in terms of the *activity* of the emitting source. Activity is a quantity assessed in units termed *bequerel* (the term *curie* was and still is widely used). One bequerel represents an extremely small amount of activity (conversely, 1 Ci represents a significant amount of activity; as it equates to 37,000 million bequerels). Both individual members of the public and rescuers coming to their help may be exposed to the radiation emitted by the radioactive substances. Depending on the amount of exposure, whether it is from outside the body (external) or from inhaled or ingested radioactive substances (internal), various health effects can occur. The amount of radiation exposure is measured in terms of the radiation *dose* incurred by the affected people. The relevant quantity is termed *absorbed dose* and is assessed in units called *gray* (in the past the unit *rad* was used). The types of radiation that can be emitted by the radioactive materials expected to be used in an RDD include: the so-called alpha particles, which portray high linear-energy transfer properties but low penetrability into tissue (and therefore are only relevant if the emitting substance is incorporated into the body); the so-called beta particles, which are able to penetrate relatively thin tissues, such as the skin; and, fundamentally, the so-called gamma radiation, which can penetrate the full body. In case of INDs, neutrons will also contribute to the radiation field. Different types of radiation have different effectiveness to induce damage. Besides, different

Dangerousness of radiation doses. The dangerousness of radiation doses can be objectively judged taking account of the international consensus about the attributability of radiation health effects to a given radiation dose. The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), a committee of the United Nations General Assembly (UNGA), is the body that formulates this international consensus. Since the middle of the last century, UNSCEAR has annually assembled leading radiation specialists to provide the most plausible estimates of the health risks attributable to radiation exposure. UNSCEAR presents its findings to UNGA, where representatives of more than 190 countries acknowledge the UNSCEAR reports as the best available understanding of the topic. The extremely detailed reports regularly submitted by UNSCEAR to UNGA, the latest being the 2000 Report (UNSCEAR 2000a, 2000b), are a synthesis of thousands of peer-reviewed references. While it is certainly unfeasible to summarize accurately such a vast amount of information, nearly a decade ago I did a brief account of UNSCEAR estimates aimed at a broad audience (González 1994). I will now try to summarize even further UNSCEAR's position into two simple (in fact, simplistic) figures.

Fig. 1 summarizes the attributability of radiation health effects at various radiation doses.

At high doses, health effects are *determined* to occur (i.e., the likelihood of occurrence approach 100%). These *deterministic effects*, which include tissue burns, organ impairments, and could lead to death, cannot occur below a dose threshold that varies for different organs but is above some thousands of millisieverts. Below these high doses still remains a probability of occurrence of long-term effects, the so-called *stochastic effects*, mainly cancer and hereditable effects. The probability is exceedingly small as can be appreciated in Fig. 2. Above the prevalent background dose, any increment in dose would induce an increment in the probability of incurring cancer in the long term of approximately 0.005% per millisievert. The risk of hereditable effects in the descendants of the exposed person is one order of magnitude smaller.

On this basis and with some assumptions, we are able to quantify the dangerousness of various radiation doses. A plausible assumption is that in a large variety of the anticipated potential scenarios of radiological terrorism (particularly in RDD scenarios), the expected doses to be incurred by the majority of victims will probably be

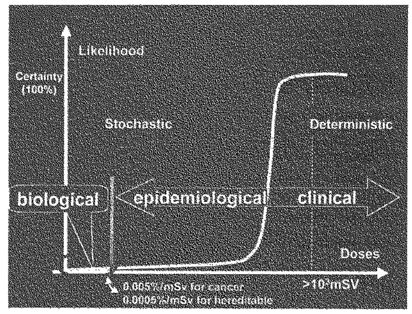

Fig. 1. Radiation health effects at various dose levels.

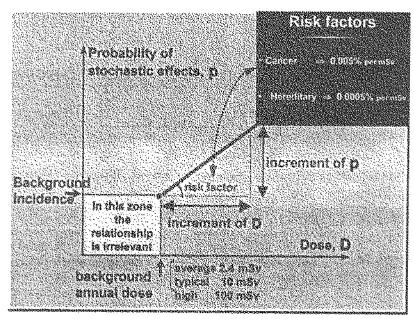

Fig. 2. Risk of stochastic health effects as a function of radiation dose.

organs and tissues have different sensitivity to radiation exposure. Therefore, the absorbed dose has to be weighted to take account of these differences. The quantities resulting from the absorbed-dose weighting for effectiveness and sensitiveness are termed *equivalent dose* and *effective dose*, respectively, and are measured in a unit termed *sievert* (in the past the unit *rem* was used). The *equivalent dose*, which is used to express tissue and organ doses, and the *effective dose*, which is used for assessing the whole-body implications, can only be employed for "normal" radiation protection purposes, i.e., for situations causing relatively low doses that may merely induce low-probability and delayed health effects. Formally, these quantities cannot be used to express the high doses that may result from a radiological attack, which are able to cause serious and early pathological effects. Moreover, for radiation with high linear-energy transfer properties (such as alpha radiation), the relative biological effectiveness varies depending upon the type of radiation injury, the organ irradiated, and the time over which the irradiation is delivered, which will require separate considerations. However, for reasons of simplification, this paper only uses the quantities *equivalent dose* and *effective dose* and, for units, a submultiple of the sievert termed *millisievert* (*mSv*), which is equal to a thousandth of a sievert (1 mSv equates 100 thousandths of rem or 100 millirem). In order to put these quantities into perspective, it should be noted that the level of effective dose that is unavoidably incurred from natural radiation exposure by people living for 1 y in an area of low background radiation is around 1 mSv (the global average effective dose from natural background radiation is 2.4 mSv per annum, and high background levels are typically around 10 mSv per annum; in a few areas of the world the background levels can be even higher than 100 mSv per annum).

low, e.g., of the order of tens of millisieverts or less. As indicated above, while low radiation doses have the potential for inducing delayed "stochastic" health effects, such as cancer and hereditable effects, the probability of occurrence of these effects is very small though it increases with dose. Conversely, at high doses, e.g., of the order of thousands of millisieverts, early "deterministic" health effects are almost certain to occur, affecting the function of tissues and organs with a severity that increases with dose and, in severe cases, even leading to the death of the exposed individuals. In radiological attacks with RDDs, the perpetrators and victims closer to the event may incur such high doses if substantial activity is involved. People affected by the detonation of an IND or by the radiological consequences of a sabotage leading to a catastrophic nuclear accident are more likely to be subject to high doses than those affected by an RDD scenario. The levels of danger, i.e., the biological effects of different radiation doses and the likelihood of observable consequences, are summarized in Table 1.

Dangerousness of radioactive sources. Another important (and related) notion that needs a common understanding is the concept of "dangerousness of radioactive sources," i.e., a radioactive source that because of its characteristics can be judged as particularly dangerous from a radiation safety viewpoint. Globally, the concept of a dangerous source had been addressed in international safety standards (IAEA 2002a). These define dangerous sources as follows: a source that could, if not under control, give rise to exposure sufficient to cause severe deterministic effects, i.e., effects that are fatal or life threatening or result in a permanent injury that decreases the quality of life. Recognizing this definition and the need for a graded approach to the regulatory control of radiation sources, IAEA developed a preliminary categorization system (IAEA 2000d) that branded a limited range of practices in three categories. Subsequently, the IAEA reviewed how the categorization system was being used and found a number of limitations. It has, therefore, recently developed a revised categorization system (IAEA 2003a) that provides a numerical relative ranking of radioactive sources and practices, and assigns them into one of five categories. The system is based on a logical and transparent methodology that provides the flexibility for it to be applied to a wider range of uses than the original categorization and an internationally harmonized fundamental basis for decision makers. This new international categorization is based on radionuclide-specific activity levels that had been developed by IAEA for the purposes of emergency planning and response (IAEA 2003b). These levels, referred to as the "D values," are given in terms of an activity above which a radioactive source is considered to be "a dangerous source" (IAEA 2002a) because it will have a significant potential to cause severe deterministic effects if not managed safely and securely. Since the new categorization of sources is also based upon the potential for sources to cause deterministic health effects, the D values were considered to be compatible normalizing factors for the purpose of generating a numerical relative ranking of sources and practices. A list of some significant radionuclide-specific D values, the more restrictive of which was used as the normalizing factor, are given in Table 2.

As the categorization system is based on the potential for sources to cause deterministic effects and uses the D values as normalizing factors, in practice, sources with an activity greater than D have the potential to cause severe deterministic effects. The activity ratio of A/D = 1 is, therefore, considered to be a logical category-dividing line, resulting in two categories. However, the large number and the diversity of applications above and below this line confirmed that further categories are

Table 1. Biological effects as a function of radiation dose.

Expected dose	Biological effect	Likely outcome of epidemiological follow-up
Very low dose: Below ~10 mSv (effective dose)	No acute effects; potentially, extremely small long-term enhanced risk of incurring cancer.	Effects likely not to be detected, even if the number of exposed people is large.
Low dose: Towards ~100 mSv (effective dose)	No acute effects, subsequent long-term enhanced risk of incurring cancer of about 0.5%.	Possible detection of effects if the exposed population is large (e.g., >100,000 people).
Moderate dose: Towards ~1,000 mSv (acute whole-body dose)	Nausea, vomiting possible, mild bone-marrow depression; subsequent long-term enhanced risk of incurring cancer of about 10%.	Likely detection of effects for populations more than a few 100 people.
High dose: Above ~1,000 mSv (acute whole-body dose)	Certain nausea, likely bone-marrow syndrome, medical evaluation, and treatment requirement; subsequent long-term enhanced risk of incurring cancer of about 10% per 1,000 mSv.	50% lethality at about 4,000 mSv of acute whole-body dose without medical treatment.

Table 2. Classification of radionuclides in terms of health risks.

Radionuclide (examples)	Dangerous activity TBq	Ci
^{60}Co	3×10^{-2}	0.8
^{137}Cs	1×10^{-1}	3
^{192}Ir	8×10^{-2}	2
^{241}Am	6×10^{-2}	2

needed. Since a source activity 10 times greater could give rise to a life-threatening exposure in a relatively short period of time, a category dividing line is drawn at A/D = 10. This, however, would leave some of the very high activity sources in the same category as sources with significantly lower activities (e.g., high dose-rate brachytherapy). It was therefore decided to use operational experience, professional judgment, and lessons learned from accidents to separate these practices, which resulted in a further dividing line at A/D = 1,000. As there were a large range of practices and source activities below A/D = 1, a further category dividing line was needed. Operational experience, professional judgment, and lessons learned from accidents were, therefore, used to draw a dividing line at A/D = 0.01, with a lower cut-off for this category set at the activity of a radionuclide that is considered to be "exempt" from regulatory control divided by the relevant D value.[‡] Radionuclide-specific exemption levels for radioactive sources are given in Schedule 1 of the BSS. Examples of the categorization are given in Table 3.

POTENTIAL SCENARIOS (CERTAINTY VIS-À-VIS IMPOSSIBILITY)

In radiological terrorism, what are plausible scenarios for some become incredible speculations for others. There are therefore not objective ways of defining a potential scenario against which we have to formulate radiation protection criteria. I have decided therefore to follow Tertullian's dictum (from AD c.160), *"certum est quia impossibile est"* (it is certain because it is impossible) and to consider for the purpose of this lecture that the quasi-impossible will in fact occur. On this basis I would try to hypothesize what to do to protect people *post facto*.

My definitions hereinafter will therefore be subjective in nature. They will reflect professional judgment on the scenarios that the radiation protection community ought to consider in planning radiation protection for potential rescuers and for the general public. The potential scenarios are as follows: detonating IND; sabotaging nuclear facilities; misusing radioactive materials, which may include RDDs, specific irradiation of individuals, specific radioactive contamination of sites or food and water supplies; and threats and thefts.

Commonality

There is a commonality among all these scenarios. They are completely different in threat, genesis, and likelihood, but they are also rather similar in their ultimate radiological consequence, namely, unexpected situations of uncontrolled public radiation exposure and radioactive contamination of the environment. In fact, whether or not an "attack" is the trigger of a situation of radiological concern, the aftermath of either intended or unintended events of this type are, in fact, very similar, namely, the potential for unexpected exposure of people to radiation. The intent that caused the radiological condition may be different, but the outcome and the needed response actions are essentially the same. However, it should be noted, there are differences between an emergency that may arise from an unintended accident and those associated with a radiological attack. If a radiological attack were to occur, authorities and radiological protection experts could be faced with a situation where radiation and/or radioactive material are in a place where it was not expected or explicitly planned to be. Whatever the scenario, the final objectives should be to protect people in unpredictable exposure situations, to minimize the impact, and to quickly restore the situation to normal. When this fact is realized, the response must essentially identify and then characterize the emergency situation, provide medical care to the victims, quickly attempt to avoid further exposures, gain control of the situation, prevent the spread of radioactive materials, provide accurate and timely information to the public, and begin the process of returning to normality.

Benchmarking

It is dangerous and probably wrong to postulate the likelihood of scenarios of nuclear terror. It is perhaps wise to recall Thomas H. Huxley's dictum: "the scientific imagination should always restrain itself within the limits of probability" (Huxley 1907). And the probabilistic assessment of security breaches leading to terrorist events is certainly not a simple issue. A more objective alternative than speculating on the scenario and its probability is benchmarking it. This is what I will try to do now.

The improvised nuclear device scenario

An extreme but possible scenario is the diversion of nuclear materials, particularly special fissionable materials, such as ^{235}U and ^{239}Pu, and the development, construction, and use of a crude nuclear weapon, an IND.

[‡] Although low activity sources will not lead to severe deterministic effects, the "D" values were used as normalizing factors for all sources to ensure consistency across all categories.

Table 3. Categorization of radioactive sources.

Category	Practice	Activity ratio (A/D)
1	Radioisotope thermoelectric generators; irradiators; teletherapy; gamma knife	A/D ≥ 1,000
2	Gamma radiography; brachytherapy (high/medium dose rate)	1,000 > A/D ≥ 10
3	Fixed industrial gauges (e.g., level, dredger, conveyor gauges); well logging	10 > A/D ≥ 1
4	Brachytherapy (low-dose rate except eye plaques and permanent implants); thickness/fill-level gauges; portable gauges, static eliminators, bone densitometers	1 > A/D ≥ 0.01
5	Brachytherapy (eye plaques and permanent implants); x-ray fluorescence devices; electron capture devices	0.01 > A/D ≥ exempt/D

This scenario is considered by some the less plausible of the potential scenarios of nuclear terror, and it is also the more difficult to benchmark. Obviously, the blast would have devastating consequences even if the IND yield were low. Moreover, the event will certainly scatter massive amounts of radioactive fission products into the environment. Significantly, a low-yield IND will disperse the unburned fissile material. Furthermore, health effects following an IND event present some special characteristics as far as the health consequences are concerned. The extreme blast and thermal effects significantly amplify the health treatment issues, and necessitate triage to place resources where they can be useful. This is exacerbated by the likely loss of most or all infrastructure capability to deal with health issues in the immediate vicinity of the detonation. For those who survive the attack, the presence of fission neutrons must be considered in addition to the gamma radiation and contamination. It has long been recognized that fission neutrons have greater biological effectiveness than gamma rays.[§] Notwithstanding the above (and surprisingly for many), the objective analysis would indicate that the use of an IND would be, *from a radiological viewpoint*, less catastrophic than usually assumed.

Benchmarking: Hiroshima. While military organizations have surely made numerous potential scenarios of consequences of a nuclear blast, the only factual civilian experience still is the bombing of Hiroshima and Nagasaki. The rough, cold numbers of this human catastrophe are well known: 320,081 inhabitants in the affected area; 122,358 deaths (accounted, 118,661; missing, 3,677); 79,130 injured; 118,613 uninjured. The nuclear blast generated a cohort of around 82,000 survivors exposed to radiation who have been studied extensively and who provide the main source of data for our knowledge on the attributability of health effects to radiation exposure. I would like to make two observations on this benchmarking. First, as it can be shown in Fig. 3, the immediate victims mainly died not because of radiation doses but because of the blast and the heat. The dark shaded area in the center of the figure shows the area of Hiroshima City that was incinerated and destroyed by heat and pressure generated by the nuclear blast. The solid circle within this area shows the theoretical border for doses that would have been able to induce sudden radiation death. It is obvious from this figure that nobody would have survived the blast and calcinating heat to be able to die of radiation exposure.

Second, from the more than 80,000 that survived and were studied, less than 500 have until now suffered cancers attributable to radiation exposure, as Fig. 4 clearly shows. They are, however, epidemiologically detectable as the standard deviation is around 4.7 sigma.

Attacking nuclear facilities

An important scenario is an attack on, or sabotage of, safety-related systems at nuclear facilities holding large inventories of radioactive materials, including nuclear fission and activation products and radioactive wastes. A well-planned attack on these types of facilities, which encompass nuclear power plants, research reactors, nuclear-fuel reprocessing plants and radioactive

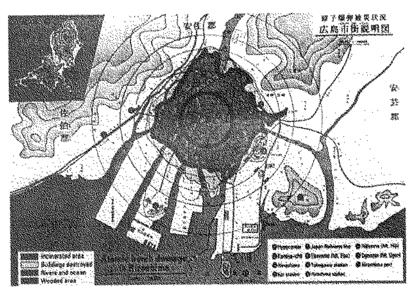

Fig. 3. Areas of severe life-threatening and lethal health effects associated with the Hiroshima atomic-bomb detonation.

[§] ICRP recommends the use of energy-dependent radiation weighting factors for cancer risk based upon incident neutron energy.

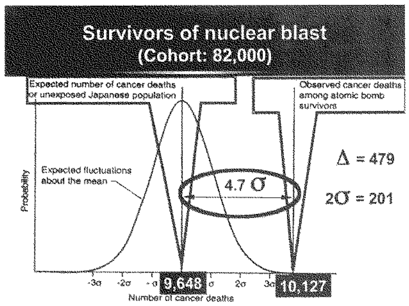

Fig. 4. Cancer incidence among survivors of the Hiroshima atomic-bomb detonation.

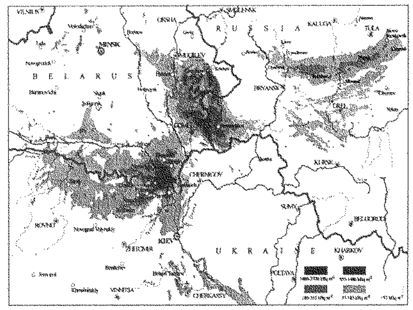

Fig. 5. Radioactive contamination in areas surrounding or near the site of the Chernobyl reactor accident.

waste management installations, may conceivably result in significant discharges of radioactive materials into the environment. Moreover, if the attack disrupts a facility that is able to sustain a nuclear reaction, an uncontrolled release of energy could conceivably occur, which could lead to significant discharges of fission products. It should be noted, however, that sophisticated safety systems are usually in place at these facilities to prevent radioactive discharges into the environment even in case of serious accidents. In particular, nuclear power and research reactors as well as other fuel cycle facilities used in civilian applications usually have emergency systems in place to prevent radioactive discharges during an accident, which can greatly reduce the potential for radioactive effluents to be released outside the facility in case of an attack.

Benchmarking: Chernobyl. One of the best available examples for benchmarking this potential event is the accident at the Chernobyl Nuclear Power Plant in the former Soviet Union. The consequences of this accident, which were studied extensively by the United Nations (UN) system, particularly by UNSCEAR and the IAEA, can be used as a maximizing hypothesis of the order of magnitude of consequences that can occur in a successful terrorist attack on a nuclear power plant. A summary of the UNSCEAR assessment follows.

The total radioactivity released from Chernobyl was 2×10^{19} Bq, of which 3×10^{18} Bq were of ^{131}I, 4×10^{17} Bq of ^{134,137}Cs, and 7×10^{18} Bq of noble gases. The release contaminated vast territories of what today are Belarus, Russian Federation, and Ukraine (Fig. 5).

Three main areas of contamination, which were defined as those with ^{137}Cs deposition density greater than 37 kBq m^{-2} (1 Ci km^{-2}), are in Belarus, the Russian Federation, and Ukraine; they have been designated the Central, Gomel-Mogilev-Bryansk, and Kaluga-Tula-Orel areas. The Central area is within about 100 km of the reactor, predominantly to the west and northwest. The Gomel-Mogilev-Bryansk contamination area is centered 200 km to the north-northeast of the reactor at the boundary of the Gomel and Mogilev regions of Belarus and of the Bryansk region of the Russian Federation. The Kaluga-Tula-Orel area is located in the Russian Federation, about 500 km to the northeast of the reactor. Altogether, territories with an area of approximately 150,000 km^2 were contaminated in the former Soviet Union. About five million people reside in those territories. Outside the former Soviet Union, there were many areas in northern and eastern Europe with ^{137}Cs deposition density in the range 37–200 kBq m^{-2}. These regions represent an area of 45,000 km^2, or about one-third of the contaminated areas found in the former Soviet Union.

Approximately 600 emergency workers who were on the site of the Chernobyl power plant during the night of the accident received the highest doses. Twenty-eight (28) of these workers died for reasons attributable to their radiation exposure. Two more workers died during the first days as a result of severe combined injuries (trauma plus thermal burns plus irradiation). The most important exposures were due to external irradiation, as the intake of radionuclides through inhalation was relatively small in most cases. Acute radiation sickness was confirmed for 134 of those emergency workers. Forty-one (41) of these patients received whole-body doses from external irradiation of less than 2.1 Gy. Ninety-three (93) patients received higher doses and had more severe acute radiation sickness: 50 persons with doses between 2.2 and 4.1 Gy; 22 between 4.2 and 6.4 Gy; and 21 between 6.5 and 16 Gy. The skin doses from beta exposures evaluated for eight patients with acute radiation sickness ranged from 10–30 times the whole-body doses from external irradiation. This was a complicating factor and the presence of severe and extensive beta-radiation skin injuries in 58 patients aggravated the course of the sickness in 19 of the 28 who died.

From the point of view of dose incurred by the public, the significant radionuclides were only ^{131}I and ^{137}Cs (Fig. 6). This is the plausible scenario if an attack to a nuclear power plant would be successful. Iodine-131 was the main contributor to the thyroid doses, received mainly via internal irradiation within a few weeks after the accident, while ^{137}Cs was (and remains) the main contributor to the doses to organs and tissues other than the thyroid, from either internal or external irradiation, which will continue to be received at low-dose rates during several decades.

It should be noted that with the exception of the dose incurred by children who, because of the lack of elementary countermeasures, ingested milk contaminated with ^{131}I, the doses of the residents (mainly due to ^{137}Cs) were relatively mild. Within a few weeks after the accident, approximately 116,000 persons were evacuated from the most contaminated areas of Ukraine and Belarus. The thyroid doses received by the evacuees varied according to their age, place of residence, and date of evacuation. For example, for the residents of Pripyat, who were evacuated essentially within 48 h after the accident, the

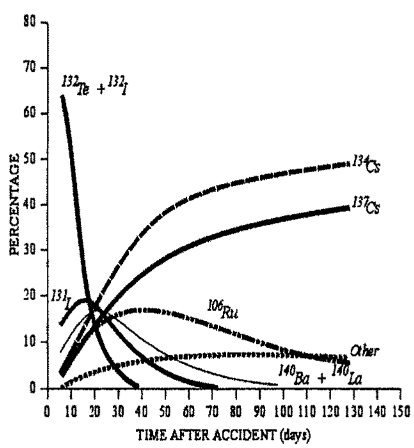

Fig. 6. Relative amounts of radionuclides released in the Chernobyl accident.

population-weighted average thyroid dose is estimated to be 0.17 Gy and to range from 0.07 Gy for adults to 2 Gy for infants. For the entire population of evacuees, the population-weighted average thyroid dose is estimated to be 0.47 Gy. Doses to organs and tissues other than the thyroid were, on average, much smaller. Thyroid doses have also been estimated for residents of the contaminated areas who were not evacuated. In each of the three republics, thyroid doses exceeding 1 Gy were estimated for the most exposed infants. For residents of a given locality, thyroid doses to adults were smaller than those to infants by a factor of about 10. The average thyroid dose received by the population of the three republics is estimated to be 7 mGy. Since 1987, the doses received by the populations of the contaminated areas have resulted essentially from external exposure from ^{134}Cs and ^{137}Cs deposited on the ground and internal exposure due to contamination of foodstuffs by ^{134}Cs and ^{137}Cs. Other, usually minor, contributions to the long-term radiation exposures include the consumption of foodstuffs contaminated with ^{90}Sr and the inhalation of aerosols containing isotopes of plutonium. Both external and internal irradiation due to ^{134}Cs and ^{137}Cs result in relatively uniform doses in all organs and tissues of the body. The average effective doses from ^{134}Cs and ^{137}Cs that were received during the first 10 y after the accident by the residents of contaminated areas are estimated to be about 10 mSv. The median effective dose was about 4 mSv and about 10,000 people are estimated to have received effective doses greater than 100 mSv. The lifetime effective doses are expected to be about 40% greater than the doses received during the first 10 y following the accident. Again, this is the most plausible dosimetric scenario if an attack on a nuclear power plant would be successful.

There has been a remarkable increase in the reported incidence of thyroid cancer in Belarus, in Bryansk and Orel oblasts of the Russian Federation, and Ukraine since the Chernobyl accident. The increase, which started some 4–5 y after the accident and has continued to manifest itself to the present day, is much more substantial in those exposed as young people (under the age of 20 y) than those exposed at older ages, in whom the increase is much smaller, or nonexistent. However, except for the increase in thyroid cancers, no increased risk of leukemia or other cancers linked to ionizing radiation has so far been confirmed in children, in recovery operation workers, or in the general population of the former Soviet Union or other areas with measurable amounts of contamination from the Chernobyl accident. Increases in a number of nonspecific detrimental health effects other than cancer in recovery operation workers and in residents of contaminated areas have been reported. It is difficult to interpret these findings without referring to a known baseline or background incidence. Because health data obtained from official statistical sources, such as mortality or cancer incidence statistics, are often passively recorded and are not always complete, it is not appropriate to compare them with data for the exposed populations, who undergo much more intensive and active health follow-up than the general population (Cardis et al. 2005).

I would like to finalize this benchmarking of the scenario of successful sabotage to a nuclear power plant by noting the following: the international community presumes that any operating nuclear installation has in place both (1) strict security measures that would make a successful radiological attack unlikely, and (2) radiation emergency arrangements based on ICRP recommendations (ICRP 1993a). The technicalities of the radiation emergency at such facilities may not differ substantially from that expected and planned for as part of their existing emergency response.

The radiological dispersal device scenario

It seems to be obvious that the RDD scenario has a subjective element of plausibility that is absent in the other scenarios. For that reason, I would like to assess it more extensively, as there are a number of certainties about radioactive sources that are interesting to explore.

Extensive prevalence. Firstly, the world has plenty of radioactive sources, which are widespread all around the globe. Radioactive sources are extensively and commonly used in a broad range of medical, industrial, agricultural, and research applications. They vary widely in physical size and properties, their amount of radioactivity, and ease of access.

In medicine, radiation sources are used for both diagnostic and therapeutic purposes. Radiodiagnosis techniques commonly employ nonradioactive radiation sources, usually x-ray machines, which therefore do not present a security threat. When radioactive materials are used for diagnostic purposes, notably in nuclear medicine procedures, the amount of radioactivity used is small and again does not present a security threat. Radiation sources used in diagnostic medicine, therefore, can be generally excluded from security considerations. Conversely, in radiotherapy, radioactive sources containing large amounts of radioactive materials are common. There are two main radiotherapeutic techniques, namely, the irradiation of tumors with a radiation beam external to the body (usually termed teletheraphy) and the intracavitary use of radiation sources (a technique usually called brachytherapy). Many medical sources are mainly made of the radioactive element termed ^{60}Co, which is a metal and has a half-life of around 5 y. Less frequently, the radioactive element ^{137}Cs, with a half-life of around 30 y, is employed. Many cesium sources were manufactured using the compound cesium chloride, a salt whose physical form is a highly dispersible powder similar to talc in its spreading properties. More than ten thousand teletherapy sources containing a capsule of ^{60}Co are in use worldwide. Each source has a radioactivity of around a hundred trillion becquerels, or 10^{14} Bq, which is equivalent to around 3,000 Ci. Cobalt, being a solid metal, is not easy to disperse. But the capsules usually contain around 1,000 pellets, each pellet having a radioactive content of around 10^{11} Bq or several curies. The available information on external beam therapy sources containing the radioactive element ^{137}Cs is scarcer. These sources were used when this type of therapy first started but their use was abandoned in favor of ^{60}Co. The number of sources still in service is estimated to be low, mainly in developing countries that could not afford the changeover to ^{60}Co units. The amount of radioactivity of each source is similar to the ^{60}Co sources, i.e., around 10^{14} Bq. The difference, however, is the high dispersibility of the cesium compound, which makes them particularly tailored to any malevolent intent to contaminate a public environment. Brachytherapy sources are more abundant than teletherapy sources but their individual radioactivity is orders of magnitude lower. The technique is commonly performed manually with sources of ^{226}Ra, ^{137}Cs, and ^{192}Ir, with a radioactivity content of around 10^8–10^9 Bq ($\sim$0.01 Ci) per source, and sometimes using the method known as remote after-loading.

Many more radioactive sources are used in industry through applications such as irradiation of products, radiography, and gauges. Around the world there are a large number of *industrial irradiators*. These are huge installations containing large amounts of radioactivity; they are usually employed for sterilizing medical products, such as syringes, and for preserving food. Their number approaches around 300 major facilities worldwide. Their radioactivity content is so high that it is difficult to express it in becquerels; they range from 10 to 1 million curies per facility. In addition, there are a few thousand smaller self-contained units, each with radioactivity of around a hundred trillion becquerels, or a few thousand curies. The radioactive element used in industrial irradiators is mainly metallic ^{60}Co, with numerous "rods" containing thousands of pellets of ^{60}Co composing the source. It should be noted, however, that some facilities are still equipped with sources of ^{137}Cs. The radioactive source of industrial irradiators could pose a serious security hazard; but they are not easy to steal, as thieves would most likely die almost instantaneously from overexposure. Numerous radioactive sources are used for purposes of industrial radiography. The number of sources used in this practice is estimated to be of several ten of thousands. Eighty percent (80%) of the sources contain the radioactive element ^{192}Ir; the remainder are sources of ^{60}Co, ^{75}Se, and ^{169}Yb. The typical activity is around 50–100 Ci each or around three trillion becquerels. Their physical form is usually encapsulated metal, which makes them robust to disaggregation. While these sources are therefore unlikely to pose a serious contamination hazard, they can produce significant injuries to individuals in contact with the source. It is relatively easy to steal an industrial radiography source, but difficult to accumulate a larger number as they are usually stored at different industrial locations. Currently, around 10,000 ^{192}Ir industrial radiography sources are supplied annually and replaced approximately every 6 mo. Their activity is around 1–300 Ci, but typically 50 or 100 Ci. Their physical form is a metal pellet. The supply of ^{60}Co sources is approximately 200 per year with 1,000–2,000 in circulation. Their activity is around 10–500 Ci, but mostly about 100 Ci. In addition, around 1,000 sources of ^{75}Se and ^{169}Yb are supplied annually; their activity range is 10–30 Ci. Finally, millions of sources having a relatively low radioactive content are used as industrial gauges and in other applications. In the United States alone near two million sources are registered under the system of "general license," a lighter control mechanism. They usually contain ^{60}Co, ^{137}Cs, or ^{241}Am, and their typical activity is of a few curies each. They come in many physical forms and their regulatory control is particularly light in many countries. They pose a minor risk, but could lead to small scale but easily measurable contamination.

Powerful sources orphaned of any control. While, in general, competent governmental regulatory authorities around the world exercise control over the vast majority of radioactive sources, many radioactive sources are not under any sort of regulatory control. Regulatory authorities usually subject the sources to a system of registration, licensing, authorization, and regular inspection. As the sources reach the end of their expected working lives, the users no longer need them and sometimes they are discarded by relinquishing their control. Thus, radiation sources became "orphaned" of any control. Thus, these so-called *orphan sources* are those that may never have been subject to regulatory control or, initially regulated, but eventually abandoned, lost or misplaced, stolen or removed without authorization. Hundreds of industrial and medical radioactive sources are abandoned, lost, or stolen worldwide each year and become orphan sources. It is not clear how many orphan sources are in the world, and their location is largely unknown.

Some orphaned sources are unconventional and powerful. There have been reports of incidents involving these dangerous sources. A notable case is the thermoelectric generators containing huge amounts of the radioactive element ^{90}Sr (the amount of radioactivity per source is similar to the release of this radioactive element from the Chernobyl accident). A number of these devices were found uncontrolled in some of the now independent States of the former Soviet Union and it appears that many were manufactured. The IAEA has been reporting incidents involving orphan sources, notably in Georgia.

Light security. Often, no tight security measures are applied to radioactive sources. Traditionally, the security aim has been confined to prevent accidental access to the sources or petty theft (such as stolen shielding materials). There are no sophisticated antiterrorist security measures for radioactive sources. In fact, even well-regulated radioactive sources could be stolen and diverted with relative ease. Potentially, the control of regulated sources can be simply relinquished by the user and, as a result, they could be easily taken away. Obviously, orphan sources are even easier to divert. Thus, both noncontrolled regulated sources and orphan sources are prone to fall into malevolent hands. An embezzled source can be transferred without difficulty. It can be easily removed and concealed in a truck or can fit into a suitcase, and used with malevolence, *particularly if the perpetrator is willing to disregard his or her personal safety.* By shrouding a radioactive source with explosives, and detonating it in an appropriate manner, radioactive contamination could be spread in the environment and public terror easily created.

It is to be noted, however, that robbers of sources have not traditionally had malevolent criminal intent; rather they took away the sources for economical benefit or simply out of curiosity or ignorance. In fact there is no record of a radioactive source being stolen for sabotage or terrorist activities, except for a couple of cases related to the Republic of Chechnya in the Russian Federation. (According to Russian press reports, 6 y ago, a Chechen used a canister containing the radioactive element cesium to scare shoppers in a Moscow marketplace and, in 1998, officials in the Republic defused a booby-trapped explosive attached to a container of radioactive material.)

Benchmarking: Goiânia. Serious radiological consequences from noncriminal security breaches with radioactive sources have already occurred. These cases, which as referred to before have been reported by the IAEA, could be used as benchmarks for estimating the consequences of terrorist use of radioactive material. For instance, around a decade ago, in the large city of

Goiânia in Brazil, a security breach occurred leading to a radiological accident that can be considered as a yardstick of what could happen in a terrorist act involving a radioactive source. A private radiotherapy institute moved to new premises and left in place a ^{137}Cs teletherapy unit without notifying the licensing authority. The former premises were subsequently partly demolished and the ^{137}Cs source became insecure. Two scavengers entered the premises and, not knowing what the unit was but thinking it might have scrap value, removed the source assembly from the radiation head of the machine. They took it home and tried to dismantle it. In the attempt the source capsule was ruptured. Contamination of the environment ensued. As result of this event, 14 people were overexposed and four died within 4 wk. Around 112,000 people had to be monitored and 249 were found contaminated. Hundreds of houses had to be monitored, 85 were found to be contaminated, and hundreds of people had to be evacuated. The full operation of decontamination produced 5,000 m^3 of radioactive waste. The social impact was such that the village suburban to Goiânia, where the waste repository was installed, has incorporated the three-foil symbol of radioactivity into the village flag.

This was not the only case of security breaches intensively studied and reported by the IAEA. For instance, in the Estonian village of Tammiku, in 1995, there was one fatality and many injured after someone found a tiny radioactive metal fragment in a nearby field and put it in a kitchen drawer. The fragment, whose origins are unknown, poisoned the family over several weeks. In another example, in Samut Prakarn, Thailand, in 2000, a group of scrap-metal workers cut through the shiny metal innards of an abandoned cancer treatment machine and removed the ^{60}Co radioactive source. Three of the workers died and 11 others suffered severe radiation injuries. Investigators found two more stolen cancer treatment machines awaiting the scrap dealers in a suburban Bangkok parking lot.**

Distinctiveness: The "attack" scenario vis-à-vis the "normal" emergency scenario

As William Shakespeare put it in *Much Ado about Nothing* (1599), "comparisons are odorous." However, it is important to address the distinctiveness between "normal" accidents, caused by innocent breaching in security or any other safety failure, and potential malevolent events. These two scenarios are distinct because of their different elements of preparedness, the potential for diverse consequences and their dissimilar aftermath.

The preparedness is different because, in the case of a terrorist attack, there is an element of fictitious planning. Moreover, the terrorist characteristic of suicidal approach introduces a new and unforeseeable ingredient for preparedness. There is, nonetheless, a positive element that distinguishes the terrorist attack: the possibility of advance warning.

Diverse consequences could be anticipated in case of a terrorist attack. Firstly, there should be expected damage in infrastructure that will affect the response. Potentially, there is a possibility of concurrency with other hazards, with the natural consequences of enhanced health effects inter alia due to synergism with biological and chemical agents. Psychological effects could also be expected, caused by distress, misattribution of illness, and fear of radiation-induced cancer.

There will also be a dissimilar aftermath. Firstly, it should be considered that in case of a terrorist attack there will be forensic investigation and the area will be declared a crime scene. The public behavior will also be different: there will be solidarity that will perhaps make the response less effective.

An example of distinctiveness is the modeling of releases and dispersion from a nuclear installation, which are usually located in a rural environment, vis-à-vis the modeling of RDDs, which are expected to be detonated in an urban environment. Over the years, Gaussian models have been used for modeling releases of nuclear installations. In urban environments, however, these models can produce serious mistakes. A relatively recent testimony (Kelly 2002) used Gaussian models to assess the potential long-term contamination that would be produced by a medical cesium gauge shrouding an explosive detonated in downtown Washington, DC (Fig. 7).††

However, the use of Gaussian models in this type of city assessment can be extremely fictitious. Conversely,

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

†† Similar assessments were done for the expected long-term contamination that a single piece of radioactive cobalt from a food irradiation plant shrouding an explosive would produce in downtown New York City, including a comparison with the Chernobyl contamination, and the long-term consequences that would be caused by a typical americium source used in oil-well surveying that is detonated with one pound of TNT, also in New York City.

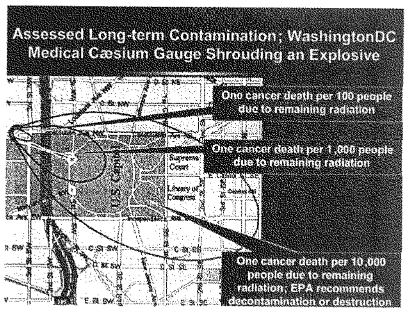

Fig. 7. Model of radiation levels in Washington, DC, after explosion of a cesium source.

a more realistic consequence-estimation of an RDD blasting in a city can be done by application of three-dimensional, dynamic models,[‡‡] which are based on the solution of Navier-Stocks formulae and energy equations and allow for the simulation of contamination spreading in a wide range of Reynolds and Relay numbers, for both laminar and turbulent flows, and for complex geometries. Fig. 8 shows the dramatic differences in results from both models in an urban environment.

In summary, therefore, although many aspects of emergency scenarios resulting from a radiological attack may be similar to emergencies arising from radiological accidents, it should be recognized that these two types of emergencies differ in many aspects. One difference is that a radiological attack would most likely occur in a public area, possibly an urban location, where the presence of radiation or radioactive material is not expected and there may be no preparedness for responding with radiological protection measures. As seen before, the nonurban environmental dispersion conditions commonly assumed for planning emergencies in nuclear facilities are not applicable in this case. The characterization of the radiation source and its impact would probably be different as well. In addition, particular issues associated with a malevolent attack, such as the criminal investigation that is likely to follow it, will have influence on the emergency planning and response.

[‡‡] A three-dimensional model and code for modeling heat and mass transfer dynamics of low compressible fluids in complex geometry with a wide range of boundary conditions. (See Oleg Pavlovski and Vladimir Tchudanov, Nuclear Safety Institute RAN, Moscow, Russia; http://www.ibrae.ac.ru/english/index_eng.html.)

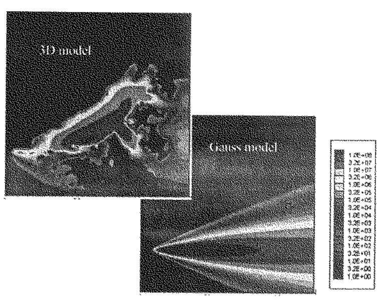

Fig. 8. Comparison of Gaussian and three dimensional transport models of radionuclide dispersion following detonation of a radioactive source.

RADIATION PROTECTION

Should a radiological attack ever occur, it will be proper to follow Benjamin Disraeli's dogma: "protection is not a principle, but an expedient" (Disraeli 1843). Measures, means, methods, and devices will be needed for protecting not only the public at large, for whom the attack is intended, but also those who will rush to the scene to protect them, namely the first responders.

The discussion hereinafter is conceptually applicable to the wide range of conceivable attacks discussed before, namely the malevolent uses of radioactive materials, such as employing RDDs, sabotaging nuclear facilities to cause a nuclear accident or, in extreme cases, detonating INDs. However, since as indicated before the two latter scenarios are perceived to present a wider range of potential health hazards, to be less accessible, and perhaps to be more unlikely than those involving commonly used radioactive materials, the arguments in the discussion are intended to be tailored to radiological attacks with RDDs in particular.

Planning

Planning for radiological protection in the aftermath of a radiological attack requires the establishment of appropriate programs at both the local and national level. These programs need to ensure that first responders and rescuers are adequately trained and have the proper equipment to identify the presence of radiation and radioactive contamination, and that radiation protection specialists are available to advise local and other relevant authorities. It may be prudent to assume that any attack involves radiological, chemical, and/or biological agents until proven otherwise. This calls for the adoption of the so-called "all-hazard approach" to the response, which is based on universal precautions combined with a prompt capability to identify all hazards present. This approach usually requires extensive coordination and cooperation of the responsible institutions, as well as experts in the fields of biological, chemical, and radiological threats and their associated risks.

Response phases

The relationship between exposure routes, protective actions, and response phases are expected to vary depending on the unique circumstances of the specific radiological attack. In Table 4, which is of a qualitative nature, an attempt was made by the ICRP to identify some of the potential scenarios that can be anticipated at various phases during the response. The table illustrates emergency phases, exposure routes, and protective actions following a malevolent attack.

Protection aims

Following an attack, the aim of radiological protection actions must be to prevent deterministic effects and restrict the likelihood of stochastic effects. In addition to protecting people against the unpredictable exposure

Table 4. Phases of response to a radiological terrorism event.

	Rescue	Recovery	Restoration
EXPOSURE ROUTE			
Direct from source/fragments/facility	✱ —		
External from deposited contamination	✱ —	—	—
External from contaminated skin/clothes	✱ —	—	—
Plume (internal/external)	✱ —		
Inhalation of resuspended material	✱ —	—	—
Inadvertent ingestion of contamination	✱ —	—	—
Ingestion of contaminated food/water	✱ —	—	—
ACTIONS			
Evacuation	✱ —		
Sheltering	✱ —		
Control of access by the public	✱ —	—	—
Administration of prophylactics	✱ —	—	
Decontamination of persons	✱ —	—	—
Decontamination of land and property	✱	—	—
Relocation	✱	—	—
Food controls	✱ —	—	—
Water controls	✱	—	—
Livestock and animal protection	✱ —	—	—
Waste control	✱ —	—	—
Refinement of access control	✱	—	—
Release of personal property	✱ —	—	—
Release of land and buildings	✱	—	—
Re-entry of nonemergency workforce	✱	—	—
Re-entry to homes	✱	—	—

situations that will be created by the attack, the objectives include minimizing the overall radiological impact in terms of environmental contamination and general disruption and attempting to restore normality quickly. The response must essentially be to identify and characterize the emergency situation, to provide medical care for the victims, to attempt to avoid further exposures, to gain control of the situation, to prevent the spread of radioactive materials, to provide accurate and timely information to the public, and to institute a process for returning to normality, while dealing with psychological issues, such as distress and misattribution and fear of illness, which will be a major concern. In the immediate response phase, exclusion distances used in relation to explosions are a good starting point for controlling the site for radiation levels, and typical precautions at medical facilities for infectious agents are sufficient as a starting point for handling persons that may be contaminated with radioactive material. ICRP has emphasized that taking actions to avert exposures is much more effective than medical treatment after exposure has occurred. Treatment after an exposure is liable to reduce the health effects by only a factor of a few (e.g., by a factor of two to three); by comparison, interventions with protective actions to avert the exposure occurring is likely to reduce health effects by up to several orders of magnitude (e.g., by factors of 10–1,000).

Protecting rescuers

The earliest radiological protection consideration will be to protect the first responders. These will be the police, firefighters, and paramedics and eventually other support and intervention services personnel who will be the first to arrive on the scene of a radiological attack. They may have to exercise their duties with little knowledge of the actual hazards present, and will need to use an all-hazards approach and assume biological, chemical, and radiological hazards may be present. In most situations it would be likely that the radiation dose will be due to external exposure, inhalation in the plume for a fire or explosion, or inadvertent ingestion. The initial radiation protection of first responders can be accomplished, in most cases, without monitoring, by taking some basic precautions that also apply when responding to emergencies involving other types of hazardous material. These involve restricting the proximity to, and limiting time near suspicious objects, avoiding inadvertent ingestion, using respiratory protection, and staying out of smoke. If a radiological hazard is suspected, provisions are usually made to provide the first responders with alarming dosimeters with preset levels that allow a rapid field dose evaluation. The first responders should have received basic guidance on how to recognize a potential radiological emergency, the initial actions to take, and how to obtain timely radiological assessment support. They are expected to be provided with some basic radiation monitoring equipment.

The ICRP, in its latest recommendations (ICRP 1991) and in its recommended general principles for the radiation protection of workers (ICRP 1997a), had already made general recommendations on the limitation of occupational exposure in "emergencies." More detailed and specific recommendations for protection of workers who, as responders, are involved in intervention following an accident were addressed in the ICRP principles for intervention for protection of the public in a radiological emergency (ICRP 1993a). Following these ICRP recommendations, international occupational protection requirements have been established in the BSS, which include protection conditions for workers undertaking emergencies. As the BSS are cosponsored by the International Labour Organisation, which within the UN system is the specialized agency dealing with labor conditions, where governments, labor unions, and employers are equally represented in a tripartite partnership, their acceptance by the workers' representatives is secured.

This international approach for protecting responders can be summarized as follows:

1. For first responders undertaking emergency work, other than life-saving actions, all reasonable efforts should be made to keep effective doses below 100 mSv, and, in any case, every effort should be made to keep effective doses below 500 mSv. Except for life-saving actions (see below), the maximum acute whole-body dose to first responders shall be kept below 1,000 mSv so as to avoid serious deterministic health effects. In all cases, every effort should also be made to keep the equivalent doses to the responder's skin below 5,000 mSv. (These criteria leave a margin for error in avoiding deterministic effects, given the possible difficulty in establishing the exact exposure conditions immediately after an attack and the possibility that the worker may not have the level of training or experience usually required for dealing with radiological attacks.)
2. For life saving actions, higher doses may be justified, but only when the benefit to others clearly outweighs the rescuer's own risk.
3. For actions undertaken by workers engaged in recovery operations, the doses received should be treated as part of normal occupational exposure and normal occupational dose limits should apply, namely effective doses of 20 mSv y^{-1}, averaged over 5 y, and of 50 mSv in any 1 y, and equivalent dose to the skin of 500 mSv.

4. Those rescuers undertaking actions in which the effective dose may exceed 50 mSv, in addition to being volunteers, should be well prepared for dealing with the aftermath of the radiological attack, i.e., they should be clearly and comprehensively informed in advance of the associated health risk and, to the extent feasible, be trained in the actions that may be required. (This may be difficult to achieve because of the greater uncertainties in predicting the precise nature of a radiological attack.)
5. Taking account of the unavoidable uncertainties surrounding first response measures and the specific protection measures recommended for female workers who may be pregnant or nursing an infant, it is strongly advocated that female workers in those conditions should not be employed as first responders (i.e., for undertaking life-saving or other urgent actions at the site of a radiological attack).

The dose guidance values for occupational exposure of responders to a radiological attack are summarized in Table 5.

Protecting the public

The protection of the public in the case of a radiological attack has the added difficulty that a current international radiation protection approach has not been conceived for such situations. There is an international system of radiological protection, which is recommended by ICRP and has been converted into international standards by the IAEA in the BSS. This system is based on the concepts of "practices" and "interventions." Regulated activities that increase the overall exposure of people to radiation are termed *practices*. Exposures already existing, *de facto*, in human habitats can be subject to protective actions through a process termed *intervention*, which is intended to decrease the overall exposure of people. Many exposures are *controllable*. Exposures that are essentially uncontrollable (for instance the exposure to natural radionuclides with metabolic roles in the human body), or unamenable to control (for instance exposure to cosmic radiation), are generally *excluded* from the scope of regulations on radiological protection. Due to the lack of familiarity with the international system of radiological protection that sometimes seems to be apparent in U.S. audiences, I have decided to provide a short summary of it hereinafter.

Practices. The principles of the System of Radiological Protection for practices are the *justification of the practice*, the *optimization of radiological protection*, with regard to any source within the practice, and the *limitation of individual doses* attributable to the practice. These principles are applied prospectively, at the planning stage of any practice, to the design, operation, and decommissioning of the practice and its radiation sources. Before the introduction of a practice, an extant annual dose will exist in the human habitat where the practice takes place. After its introduction this extant annual dose will be increased by an additional dose attributable to the practice. The principles are applicable to the control of this attributable additional annual dose and not to the existing annual dose. Under certain conditions, sources used in justified practices can be exempted from regulatory requirements if the individual additional annual doses attributable to the source are below 0.01 mSv y^{-1}.

Justification of a practice requires that all relevant long-term factors be considered prior to the adoption of the practice. Pertinent factors will include the anticipated additional annual doses, both individual and collective, and the benefits expected from the practice.

Optimization of protection requires the selection of the best radiological protection option for any source, under the prevailing social and economic circumstances. This optimum option will be expected to deliver the "as low as reasonably achievable" (ALARA) doses, taking into account economic and social factors. The optimization process may be carried out using the techniques recommended by the ICRP (1983, 1989).

Table 5. Radiation dose guidance for emergency responders in a radiological terrorism event.

Type of emergency operations		Dose guidance value: Dose	Dose guidance value: Skin equivalent dose[a]
Rescue operations (excepting female workers that may be pregnant or nursing)	Life-saving actions	In principle, no dose restrictions are recommended if, and ONLY IF, the benefit to others clearly outweighs the rescuer's own risk	
	Other immediate and urgent actions at the site	<1,000 mSv (of acute whole-body dose) Making every effort not to exceed 500 mSv and all reasonable efforts not to exceed 100 mSv (of effective dose)	<5,000 mSv
Recovery and restoration operations		<20 mSv y^{-1} (averaged over 5 y) and <50 mSv in any 1 y (of effective dose)	<500 mSv y^{-1}

[a] Average dose over 1 cm^2 of the most highly irradiated area of the skin.

Application of the justification and optimization principles to practices may introduce individual inequities. Inequities are caused by the possibly wide spatial distribution of exposures, which may involve people who are not direct beneficiaries of the practice. They can also be attributed to the potentially long-term temporal distribution of exposure, which may affect future generations. In order to limit these inequities and to allow for exposures to multiple sources, stringent individual dose restrictions shall be applied to the exposure to be delivered by individual sources and to the exposures to be aggregated by all regulated practices. The exposure restrictions to sources are termed "dose constraints;" the exposure restrictions to practices are termed "dose limits." The maximum value of the dose constraint to be used in the optimization of radiological protection for a single source should be less than 1 mSv y^{-1}, and a value of no more than about 0.3 mSv y^{-1} would be appropriate. Considerations should be given to exposure situations where a build up over time of exposures from a source could occur. It would be prudent to restrict the prolonged component of the individual dose from a source with a dose constraint of the order of 0.1 mSv in any given year during the operational lifetime of the source. Furthermore, the exposures from all regulated practices should be restricted to a dose limit of 1 mSv y^{-1}.

Intervention. The principles of the system of radiological protection for interventions are the *justification of intervention* and the *optimization of the protective actions*. These principles should be applied to any *de facto* exposure situations involving controllable exposure where annual dose exists and part of it can be averted through appropriate countermeasures.

The justification of intervention should be assessed by means of a *decision-aiding process* requiring a positive balance of all relevant long-term attributes related to radiological protection. (In addition to the avertable annual doses, both individual and collective, other attributes include the following: the expected reduction in the anxiety caused by the situation, the reassurance to be provided by the intervention, and the social cost, harm, and disruption that may be caused by the implementation of the protective actions.) The results of such a decision-aiding process should be used as an input into a *decision-making process*, which may encompass other considerations and may involve relevant stakeholders.

The optimization of protective actions can be performed following the general approach to optimization of protection recommended by the ICRP in the context of practices. The optimum form, scale, and duration of the protective actions should be selected from the justified options of intervention. For some situations the restricted use of human habitats can be the outcome of the optimization process.

National authorities (and as appropriate relevant international organizations) predetermine *specific reference levels* (such as *intervention levels, action levels*, and *intervention exemption levels*) for particular exposure situations amenable to intervention. They can be conveniently expressed in terms of the avertable annual dose, or a related subsidiary quantity. The use of predetermined specific reference levels can facilitate timely decisions on interventions and the effective deployment of resources; however, an improper use may lead to inconsistencies with the principles of justification and optimization.

The ICRP also recommends the use of *generic reference levels* for intervention (ICRP 1999). These levels can conveniently be expressed in terms of the existing annual dose. The ICRP, however, warns to use generic reference levels with extreme caution. If some controllable components of the existing annual dose are clearly dominant, the use of the generic reference levels should not prevent taking protective actions to reduce these dominant components. Either specific reference levels or case-by-case decisions following the requirements of the system of radiological protection for interventions can trigger these actions. Nor should the use of the generic reference levels encourage a "trade-off" of protective actions among the various components of the existing annual dose. A low level of existing annual dose does not necessarily imply that protective actions should not be applied to any of its components; conversely, a high level of existing annual dose does not necessarily require intervention. With these provisos, it can be considered that an existing annual dose approaching about a few millisieverts may be used as a generic reference level below which intervention is not likely to be justifiable. Below this level, protective actions to reduce a dominant component of the existing annual dose are still optional and might be justifiable. In such cases, action levels specific to particular components can be established on the basis of appropriate fractions of the few millisievert used as a generic reference level. Above such level, intervention may be necessary and should be justified on a case-by-case basis.

Radiological terrorism: a "practice" or an "intervention?"

The issue before us is how to manage a terrorist attack within the international system described heretofore. Should such an event be considered a (malevolent) *practice* or should it be handled as an *intervention*? It is obvious that once the terrorist attack has occurred, the radiological aftermath can be considered a *de facto* situation where an extant dose exists and should be reduced, i.e., a clear situation of intervention. However, a problem can be envisaged: members of the public will ask why in such a situation, where they are expecting the maximum efforts from the authorities to protect them, the protection levels may be higher doses than the authorities will normally accept from a "practice." My discussion hereinafter will keep in mind this dilemma of an impossible straightforward solution.

Public protection phases

The immediate countermeasures to protect the public in the rescue phase include control of access, caring for people with traumatic injuries, and respiratory protection measures. This should be supported by triage dose assessments and physiological triage and disposition. Urgent actions in this phase include personal decontamination, sheltering, iodine prophylaxis (if radioiodines are involved), and temporary evacuation. In the recovery phase, definitive relocation and resettlement may be needed in extreme cases. The ICRP has recommended levels of avertable doses at which the protection of the public afforded by these countermeasures would be generically optimized, which are summarized in Table 6.

The recovery phase may require restoration and cleanup, the safe management of the radioactive waste remaining from these operations, management of corpses containing significant amounts of radioactive substances, and dealing with long-term prolonged exposure situations caused by remaining radioactive residues. In the latter case, the ICRP recommended that generic criteria for justifying intervention with radiation protection measures are those recommended for general interventions in prolonged exposure situations (Table 7).

Contamination of bulk amounts of materials

Large amounts of material can remain contaminated in the event of a radiological attack. While a fraction of this amount could be contaminated so much as requiring being treated as radioactive waste, most likely a large quantity will be just mildly contaminated. However, these could not be recycled into civilian use unless sufficient protection could be ensured. Until recently, there were no international criteria for dealing with bulk amounts of materials and other commodities containing small amounts of radioactivity. One year before September 11th, however, the IAEA General Conference developed a "... radiological criteria for long-lived radionuclides in commodities, particularly foodstuffs and wood" (IAEA 2000e). A few weeks after this lecture, the IAEA Commission on Safety Standards, following approval by the IAEA Radiation Safety Standards Committee, in which the specialized agencies of the UN that cosponsor the BSS are invited to participate, and the IAEA Waste Safety Standards Committee, in the light of extensive consultations held with Member States and with the IAEA Transport Safety Standards Committee, endorsed the publication of a safety guide entitled *Application of the Concepts of Exclusion, Exemption and Clearance* (IAEA 2004a). This Safety Guide would establish the activity concentration values for radionuclides in bulk amounts of materials that can be excluded from radiation protection considerations, as presented in Table 8.[§§]

Table 6. Optimizing countermeasures to a radiological terrorism event.

Countermeasure	Avertable dose (for which the countermeasure is generically optimized)
Sheltering	~10 mSv in 2 d (of effective dose)
Temporary evacuation	~100 mSv in 2 wk (of effective dose)
Iodine prophylaxis (if radioiodine is present)	~100 mSv (of equivalent dose to the thyroid)
Relocation	~1,000 mSv lifetime or ~100 mSv first year (of effective dose)

Generic activity levels for intervention on foodstuffs

Foodstuffs may remain contaminated after a radiological attack, and one of the big challenges for the protectionists will be to determine what food is acceptable for general consumption. It should be noted, however, that the deliberate act to contaminate food or water supplies with radioactive materials is unlikely to lead to the significant internal contamination of a large number of people due to the enormous quantities of radioactive material that would be required to reach high levels of contamination in mass-produced or distributed supplies. Following recommendations of the Food and Agriculture Organization/World Health Organization (WHO) Codex Alimentarius Commission*** (CAC), guidance levels of activity that may trigger some intervention measures for contaminated foodstuffs were established in the BSS (see Table V-1 in IAEA 1996a) within the context of a nuclear accident. In order to widen this context, IAEA

§§ These levels, which are expected to be endorsed by the IAEA Board of Governors in September 2004, are to be used for guidance in fulfilling requirements of the BSS for radionuclides of artificial and natural origin in bulk amounts of materials that relate to: *exclusion* (BSS, paragraph 1.4); *exemption* [BSS, paragraphs 2.17 and 2.18, and Schedule I, particularly sentence (d) in footnote 36]; and *clearance* (BSS, paragraph 2.19). A graded approach consistent with the requirements of optimization of protection established in the BSS should be applied (reference should also be made to BSS paragraph 2.8) in the event of values exceeding the levels prescribed in the table.

*** The CAC is a body of the Food and Agriculture Organization (FAO) of the UN and the WHO charged with developing the *Codex Alimentarius*, or the food code, which has become the seminal global reference point for consumers, food producers and processors, national food control agencies, and the international food trade. Both FAO and WHO cosponsor the BSS. The Codex Alimentarius provides the basis for the BSS generic action levels of radioactivity for foodstuffs.

recently requested the CAC to broaden the existing guideline levels for radionuclides in foods following accidental nuclear contamination for use in international trade,[†††] which are those established in the BSS, to other radionuclides and to consider the establishment of guideline levels for radionuclides for long-term use. The 50th Session of the CAC's Executive Committee, in June 2002, considered the request and referred the issue to the Codex Committee on Food Additives and Contaminants (CCFAC) for consideration along with further input from the IAEA. The 35th Session of the CCFAC (in March 2003) agreed to request the IAEA to prepare a revised version of the Codex guideline levels for circulation, comment and further consideration at its 36th Session. (The 26th Session of the CAC had approved the revision as new work for the CCFAC.) In response to this request, in January 2004, the IAEA convened a meeting of a high-level group of experts to advise on the revision, which was chaired by the Chairman of the ICRP and was attended by the Secretary of UNSCEAR, the Director of the State Research Centre of the Russian Federation Institute of Biophysics, the Chairman of the (Hiroshima) Radiation Effects Research Foundation, and representatives of the European Commission and the Food and Agriculture Organization.[‡‡‡] Once the CAC formally adopts these levels as a revised and final Codex text, which are given in Table 9, they may be applied for long-term use in lieu of the generic action levels for foodstuffs given in Table V-1 of the BSS.

Additionally, WHO, in collaboration with the IAEA, has developed specific guidance levels for radionuclides in drinking water. The levels have been accepted by the WHO's task force for the finalization of the *Guidelines for Drinking-Water Quality*, third edition. WHO (2004) issued these Guidelines in September 2004. (Publication has been embargoed by WHO until they are officially launched and officially put on the WHO Web site.) Once WHO formally issues these levels they may be applied in lieu of the generic action levels for drinking water established in BSS Table V-1.

Table 7. Intervention criteria in aftermath of radiological terrorism event.

Intervention	Criteria (extant annual effective dose in mSv y^{-1})
Almost always justifiable	Towards 100
May be justifiable	> ~10
Unlikely to be justifiable	< ~10

Radioactive waste management

The management of *radioactive waste* that will be created by a terrorist attack is an important component in the planning of restoration activities. Account must be taken of the volume of waste, the total activity content that will have to be disposed, and presence of long-lived and alpha-emitting materials, depending on the source of the event. National authorities will have to plan for disposal of radioactive waste and consider whether the normal arrangements are acceptable. The arrangements will include decisions on the conditioning (i.e., packing and stabilization) of the waste in preparation for storage and disposal, and whether existing disposal sites can be utilized. One of the factors that an authority will have to decide is whether the waste is treated simply in accordance with the normal radioactive waste regulations, or whether some special provisions are made because of the volume or costs in an optimization of the overall remediation effort. In a radiological attack, the volumes could be much greater than usually expected, and severely burden the normal capacity available. The ICRP has issued recommendations on radiological protection policy for the disposal of radioactive waste, and radiation protection recommendations as applied to the disposal of long-lived solid radioactive waste (ICRP 1998a, 1998b). While these recommendations were obviously issued for a different intention, they are applicable to radioactive wastes that may result from a radiological attack. The IAEA program of waste safety standards has a number of publications providing guidance for handling specifically this type of waste.

Finally, a *Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management* (the Joint Convention) was adopted in September 1997. This Convention establishes the international legally binding obligations for managing the radioactive waste that may be created in a terrorist attack (IAEA 2003c). Following the adoption of the Joint Convention, the IAEA organized (IAEA 2000f) the International Conference on the Safety of Radioactive Waste Management that took place in Cordoba, Spain, in

[†††] In Geneva in 1989, the CAC adopted *Guideline Levels for Radionuclides in Foods Following Accidental Nuclear Contamination for Use in International Trade* (CAC 1989) applicable for six radionuclides (^{90}Sr, ^{131}I, ^{137}Cs, ^{134}Cs, ^{239}Pu, and ^{241}Am), which were incorporated into the BSS as generic action levels for foodstuffs to be used in interventions. The Guideline Levels were designed to be applicable for 1 y following a nuclear accident. Since that time, the need to establish guideline levels for more than six radionuclides and for a longer time period than 1 y after a major nuclear or radiological event or due to routine radionuclide discharge to the environment has been recognized. In addition, and as presented in the companion *Scientific Justification for Proposed Draft Guideline Levels for Radionuclides in Foods*, significant improvements in the assessment of radiation doses resulting from the human intake of radioactive substances have become available.

[‡‡‡] The CCFAC, at its 36th session, held from 22–26 March 2004, approved the revised Guideline Levels; see ALINORM 04/27/12, Appendix XXII (CAC 2004).

Table 8. Criteria for unregulated levels of radionuclides in bulk amounts of materials.

Radionuclides	Level (Bq g^{-1})
^{129}I	0.01
^{22}N, ^{46}Sc, ^{54}Mn, ^{56}Co, ^{60}Co, ^{65}Zn, ^{94}Nb, ^{106}Ru, ^{110m}Ag, ^{125}Sb, ^{134}Cs, ^{137}Cs, ^{152}Eu, ^{154}Eu, ^{182}Ta, ^{207}Bi, ^{229}Th, ^{232}U, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{242}Pu, ^{244}Pu, ^{241}Am, ^{242m}Am, ^{243}Am, ^{245}Cm, ^{246}Cm, ^{247}Cm, ^{248}Cm, ^{249}Cf, ^{251}Cf, ^{254}Es	0.1
^{14}C, ^{24}Na, ^{36}Cl, ^{48}Sc, ^{48}V, ^{52}Mn, ^{59}Fe, ^{57}Co, ^{58}Co, ^{75}Se, ^{82}Br, ^{85}Sr, ^{90}Sr, ^{95}Zr, ^{95}Nb, ^{96}Tc, ^{99}Tc, ^{103}Ru, ^{105}Ag, ^{109}Cd, ^{113}Sn, ^{124}Sb, ^{123m}Te, ^{132}Te, ^{136}Cs, ^{140}Ba, ^{140}La, ^{139}Ce, ^{155}Eu, ^{160}Tb, ^{181}Hf, ^{185}Os, ^{190}Ir, ^{192}Ir, ^{204}Tl, ^{206}Bi, ^{232}Th^{a}, ^{233}U, ^{235}U^{b}, ^{238}U^{c}, ^{237}Np, ^{236}Pu, ^{243}Cm, ^{244}Cm, ^{248}Cf, ^{250}Cf, ^{252}Cf, ^{254}Cf	1
^{7}Be, ^{18}F, ^{38}Cl, ^{40}K, ^{43}K, ^{47}Ca, ^{51}Mn, ^{52m}Mn, ^{56}Mn, ^{52}Fe, ^{55}Co, ^{62m}Co, ^{65}Ni, ^{69m}Zn, ^{72}Ga, ^{74}As, ^{76}As, ^{91}Sr, ^{92}Sr, ^{93}Zr, ^{97}Zr, ^{93m}Nb, ^{97}Nb, ^{98}Nb, ^{90}Mo, ^{93}Mo, ^{99}Mo, ^{101}Mo, ^{97}Tc, ^{97}Ru, ^{105}Ru, ^{115}Cd, ^{111}In, ^{114m}In, ^{125}Sn, ^{122}Sb, ^{127m}Te, ^{129m}Te, ^{131m}Te, ^{133}Te, ^{133m}Te, ^{134}Te, ^{126}I, ^{130}I, ^{131}I, ^{132}I, ^{133}I, ^{134}I, ^{135}I, ^{129}Cs, ^{132}Cs, ^{138}Cs, ^{131}Ba, ^{143}Ce, ^{144}Ce, ^{153}Gd, ^{181}W, ^{187}W, ^{191}Pt, ^{198}Au, ^{203}Hg, ^{200}Tl, ^{202}Tl, ^{203}Pb, ^{203}Po, ^{205}Po, ^{207}Po, ^{225}Ra, ^{230}Pa, ^{233}Pa, ^{230}U, ^{236}U, ^{240}Np, ^{241}Pu, ^{242}Cm, ^{254m}Es	10
^{3}H, ^{35}S, ^{42}K, ^{45}Ca, ^{47}Sc, ^{51}Cr, ^{53}Mn, ^{61}Co, ^{59}Ni, ^{63}Ni, ^{64}Cu, ^{86}Rb, ^{85m}Sr, ^{87m}Sr, ^{91}Y, ^{91m}Y, ^{92}Y, ^{93}Y, ^{97m}Tc, ^{99m}Tc, ^{105}Rh, ^{109}Pd, ^{111}Ag, ^{115m}Cd, ^{113m}In, ^{115m}In, ^{129}Te, ^{131}Te, ^{123}I, ^{125}I, ^{135}Cs, ^{141}Ce, ^{142}Pr, ^{147}Nd, ^{149}Nd, ^{153}Sm, ^{152m}Eu, ^{159}Gd, ^{166}Dy, ^{166}Ho, ^{171}Er, ^{170}Tm, ^{175}Yb, ^{177}Lu, ^{188}Re, ^{191}Os, ^{193}Os, ^{194}Ir, ^{197m}Pt, ^{199}Au, ^{197}Hg, ^{197m}Hg, ^{201}Tl, ^{227}Ra, ^{231}U, ^{237}U, ^{239}U, ^{240}U, ^{239}Np, ^{234}Pu, ^{235}Pu, ^{237}Pu, ^{249}Bk, ^{253}Cf, ^{253}Es, ^{255}Fm	100
^{31}Si, ^{32}P, ^{33}P, ^{55}Fe, ^{60m}Co, ^{69}Zn, ^{73}As, ^{77}As, ^{89}Sr, ^{90}Y, ^{96m}Tc, ^{103}Pd, ^{125m}Te, ^{127}Te, ^{131}Cs, ^{134m}Cs, ^{143}Pr, ^{147}Pm, ^{149}Pm, ^{151}Sm, ^{165}Dy, ^{169}Er, ^{171}Tm, ^{185}W, ^{186}Re, ^{191m}Os, ^{193m}Pt, ^{197}Pt, ^{211}At, ^{226}Th, ^{243}Pu, ^{242}Am, ^{246}Cf	1,000
^{58m}Co, ^{71}Ge, ^{103m}Rh, ^{254}Fm	10,000

[a] The thorium series, headed by ^{232}Th and constituted by ^{228}Ra, ^{228}Ac, ^{228}Th, ^{224}Ra, ^{220}Rn, ^{216}Po, ^{212}Pb, ^{212}Bi, ^{212}Po, ^{208}Tl, and ^{208}Pb.
[b] The actinium series, headed by ^{235}U and constituted by ^{231}Th, ^{231}Pa, ^{227}Ac, ^{227}Th, ^{223}Fr, ^{223}Ra, ^{219}Rn, ^{215}Po, ^{211}Pb, ^{211}Bi, ^{207}Tl, and ^{207}Pb.
[c] The uranium series, headed by ^{238}U and constituted by ^{234}Th, ^{234m}Pa, ^{234}U, ^{230}Th, ^{226}Ra, ^{222}Rn, ^{218}Po, ^{214}Pb, ^{214}Bi, ^{214}Po, ^{210}Pb, ^{210}Bi, ^{210}Po, and ^{206}Pb.

March 2000 (the Cordoba Conference), which was subsequently followed by the International Conference on Issues and Trends in Radioactive Waste Management that took place in Vienna in December 2002 (the Vienna Conference). Following the Cordoba Conference, the IAEA launched the implementation of seven actions for enhancing the safety of radioactive waste management (IAEA 2001). The list of actions was subsequently updated in the light of the deliberations of the Vienna Conference, resulting in an international Action Plan on the Safety of Radioactive Waste Management consisting of nine actions that are currently under implementation (IAEA 2003d, 2003e). These actions, which deal with the safety of radioactive waste management in general, are applicable to the waste that could be generated in a terrorist attack.

A difficult problem: *hot* particles

In some scenarios, it can be imagined that radioactive residues may become very sparsely distributed in the environment, usually as "hot particles," giving rise to situations where there is the potential, but not the certainty, that an exposure will actually occur. The ICRP and the IAEA have issued recommendations for dealing with potential exposure situations (IAEA 1990; ICRP 1993b, 1997b). Protection in situations involving hot particles is not a new international issue (IAEA 1998b). For these situations, it is recommended that criteria be derived on the basis of the unconditional probability that members of the public would develop fatal stochastic health effects attributable to the exposure situation. Such a probability should be assessed by combining the following probabilities: the probability of being exposed to the hot particles, the probability of incorporating a hot particle into the body as a result of such exposure, the incurred average equivalent dose as a result of such incorporation, and, the probability of developing a fatal stochastic effect from that dose. These probabilities should be integrated over the entire range of situations and possible doses. In establishing such criteria, consideration should be given to the possibility that localized deterministic effects may also occur as a result of the incorporation of hot particles.

Word of caution

The quantitative recommendations given in the foregoing tables cannot always be used directly. Rather, they should be used as the basis for development (at the planning stage) of *operational intervention levels* expressed in directly measurable quantities. Moreover, the recommended guidance is based solely on radiological protection considerations and should be seen purely as a *decision-aiding* tool aimed at helping the responsible authorities deal with the aftermath of a radiological attack. They are expected to serve as an input to a final, and usually wider, decision-making process that may include other societal concerns, other hazards that may be present, consideration of lessons learned in the past

Table 9. Guideline levels for radionuclides in foods.

Radionuclides in foods	Guideline level (Bq kg^{-1})
^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Am	1
^{90}Sr, ^{106}Ru, ^{129}I, ^{131}I, ^{235}U	100
^{35}S, ^{60}Co, ^{89}Sr, ^{103}Ru, ^{134}Cs, ^{137}Cs, ^{144}Ce, ^{192}Ir	1,000
^{3}H,[a] ^{14}C, ^{99}Tc	10,000

[a] This represents the most conservative value for tritium (organically bound).

from other events, and the participation of relevant stakeholders.

The process of radiological protection intervention measures in the aftermath of a radiological attack should result in a systematic and flexible approach to the response, taking into account the conditions present and invoking protective actions as warranted by the circumstances. It is helpful to understand that there are recommendations that are always applicable, others are often applicable, and others are only applicable in the most severe circumstances (for instance, as many potential scenarios clearly cannot induce immediate severe radiation injuries, recommendations on these effects are not always applicable). In order to prevent overreaction, it is essential that radiological protection decisions are proportional to the magnitude of the radiological attack.

OUTLOOK: MAKING THE THREAT LESS LIKELY

Can we prevent a radiological attack? Absolute prevention could be impossible, but a common effort by the international community is making the threat less likely. It should be noted that these multilateral actions started before the events of September 11th.

International undertakings

As indicated before, strengthening the security of radioactive sources is not a new challenge for the international community. The IAEA, which has been labeled by the media as *the UN nuclear watchdog*, has an international mandate for protection against radiation exposure that may be caused by security breaches and it is stressed again that the BSS, set up jointly with other specialized agencies within the UN system, established requirements on the security of radioactive sources much before the September 11th events. In order to provide for the application of these international standards, the IAEA has been using a variety of mechanisms, including the performance of peer-review appraisals of the security situation in a requesting State, the provision of technical cooperation and education and training, and the fostering of information exchange. The IAEA also has a mandate in the implementation of relevant obligations undertaken by States through international "conventions," notably conventions of notification of radiological emergencies and of emergency assistance that are applicable should a crises involving a terrorist attack occur, and the above mentioned Joint Convention on Radioactive Waste.

International conferences

The Dijon Conference. While the IAEA security requirements established in the BSS can be traced back to 1992, not until 1998 did governments become fully informed of the international dimensions of the security threat associated with radioactive sources. In that year, the IAEA (jointly with Interpol, the World Custom Organization, and the European Commission) organized the first international conference on the issue, in Dijon, France. In the Dijon Conference, hundreds of specialists and governmental representatives from member States of these organizations discussed the problem for the first time and produced concrete recommendations. Following suit, the IAEA General Conference decided to implement an international Action Plan that included measures to strengthen the global security of radioactive sources.

The Buenos Aires Conference. In December 2000, just 9 mo before the fateful September 11th, another topical international conference was convened by the IAEA, this time assembling national authorities regulating the security of radioactive sources, in Buenos Aires, Argentina.[§§§] The Buenos Aires Conference recommended updating and strengthening of the Action Plan and therefore, at its March 2001 session, the IAEA Board of Governors requested adjustments to the Action Plan. The Board and the IAEA General Conference approved a revised Action Plan in September 2001.

A new dimension

The September 11th attacks demonstrated a new kind of malevolence, identified by the perpetrators' intent to induce widespread panic and harm among the

[§§§] The *International Conference of National Regulatory Authorities with Competence in the Safety of Radiation Sources and the Security of Radioactive Materials* was organized by the IAEA in cooperation with Argentina's Nuclear Regulatory Authority, and hosted by the Government of Argentina in Buenos Aires, in December 2000. The so-called Buenos Aires Conference was attended by 89 representatives of regulatory bodies of the following IAEA Member States: Angola, Argentina, Australia, Bolivia, Brazil, Canada, Chile, China, Costa Rica, Croatia, Cuba, the Czech Republic, the Dominican Republic, Ecuador, Estonia, Ethiopia, France, Georgia, Germany, Ghana, Hungary, India, Indonesia, Iraq, Ireland, Italy, Japan, Jordan, the Republic of Korea, Latvia, Madagascar, Mongolia, Namibia, Norway, Pakistan, Panama, Peru, Philippines, Portugal, Romania, the Russian Federation, Slovakia, Slovenia, Spain, Sudan, Sweden, the Syrian Arab Republic, the Former Yugoslav Republic of Macedonia, Turkey, Uganda, Ukraine, the United Kingdom, the United Republic of Tanzania, the United States of America, Vietnam, Yemen, and Yugoslavia.

civilian population, the ability to work with modern technologies, and a suicidal approach. These characteristics opened up new dimensions to the problem of securing potentially harmful substances in general, including radioactive sources. Tight security measures for chemical or biological products were rare and, as indicated before, radioactive sources were not an exception.

The Hofburg Conference. In the light of the new concerns emerging, the IAEA convened at the Hofburg Palace in Vienna, Austria, in March 2003, an international conference to raise further governmental and public awareness of key issues relating to the security of high-risk radioactive sources and, in particular, to foster a better understanding of the measures necessary to improve the security of such sources and enhance preparedness for radiological emergencies.

The international action plan for the safety and security of radiation sources

The Hofburg Conference provided two main directions for international actions on radioactive source security, namely: to locate, recover, and secure those sources still at large; and to ensure their global and sustainable control in the future. Following suit, in September 2003, the IAEA Board of Governors approved a new International Action Plan for the Safety and Security of Radiation Sources (the Action Plan), which is now being implemented. Some activities included in the Action Plan are described below:

- In February 2004, the document IAEA-TECDOC-1388 (IAEA 2004b), titled *Strengthening Control Over Radioactive Sources in Authorized Use and Regaining Control Over Orphan Sources, National Strategies,* was issued;
- The IAEA has continued to work with source manufacturers on strengthening the safety and security of radioactive sources through design and manufacturing improvements;
- The IAEA has continued supporting research and development work on disposal options for spent radioactive sources,**** including the development of standards and safety assessment methods and the demonstration of the feasibility of the borehole disposal concept;
- Assistance and advice have been provided by the IAEA to its developing Member States that need to deal with disused high-activity sources. In that connection, it is supporting the development of a shipping container design for the safe return of disused high-activity sources and for their subsequent long-term storage;
- Under an initiative on securing and managing radioactive sources among the IAEA, MINATOM of Russia, and the U.S. Department of Energy (the so-called Tripartite Initiative), fact-finding missions to six countries (Armenia, Azerbaijan, Belarus, Kazakhstan, Moldova, and Tajikistan) have resulted in comprehensive assessments of the situation regarding the most significant radioactive sources in those countries and the identification of options for increasing their security. Follow-up activities include the procurement of services for the dismantling and transport of disused sources to safe and secure storage facilities;
- Following directions given by the Hofburg Conference and the guidance given in IAEA-TECDOC-1388 (IAEA 2004b), the IAEA is organizing missions to Member States for the purpose of helping them to develop national strategies and associated action plans. So far, missions to 15 countries have been carried out, and in the case of two countries (the Philippines and Tanzania) follow-up procurement activities are taking place;
- Regional workshops have been organized on the development of national strategies in Argentina, Bulgaria, India, and Vietnam;
- Activities related to emergency response are being carried out within the framework of an International Action Plan for Strengthening the International Preparedness and Response System for Nuclear and Radiological Emergencies (see below);
- Significant progress is being made in the development of a new warning sign to be used in conjunction with the trefoil for dangerous radiation sources. The International Organization for Standardization (ISO) has approved a new warning sign development project, including a testing methodology, proposed by the IAEA. The preselection of signs has been completed, and the preselected signs will be tested in 10 countries constituting a broad cultural cross-section. On the basis of the test results, a new warning sign for dangerous radiation sources is expected to be proposed to ISO by April 2005;†††† and

**** The international *Action Plan on the Safety of Radioactive Waste Management* contains an activity to explore international mechanisms for facilitating the management of spent sealed radioactive sources through: the return of such sources to their suppliers, the development of regional repositories for the disposal of such sources, and studies on the feasibility and safety of the borehole disposal concept. A safety guide covering the design and operation of borehole disposal facilities is being developed. A first draft was discussed in March 2004 at an IAEA Waste Safety Standards Committee meeting, where it was agreed that the safety guide should focus on intermediate-depth narrow-diameter boreholes intended primarily for the disposal of disused sealed sources. The draft is being revised accordingly. A complementary safety report on the generic safety assessment of borehole disposal facilities is also being developed.

†††† Once the sign is adopted by ISO, the IAEA will update para 1.23 (c) of the BSS.

- Notwithstanding the above, one of the most relevant actions in the Action Plan was the development of a *Code of Conduct on the Safety and Security of Radioactive Sources* (the Code of Conduct); this will be described below.

The Code of Conduct on the Safety and Security of Radioactive Sources

On 8 September 2003, the Board of Governors approved the *Revision of the Code of Conduct on the Safety and Security of Radioactive Sources* (IAEA 2003f). This decision had been strongly supported by the Summit of the G8 Group of countries that met in Evian (France), in June 2003. Subsequently, on 19 September 2003, the IAEA General Conference welcomed the Board's approval of the Code of Conduct and urged each State "to write to the Director General that it fully supports and endorses the IAEA's efforts to enhance the safety and security of radioactive sources, and is working toward following the guidance contained in the IAEA Code of Conduct on the Safety and Security of Radioactive Sources, and encourages other countries to do the same" and requested that the IAEA "... compile, maintain and publish a list of States that have made a political commitment" (IAEA 2003g). The IAEA Secretariat issued the Code of Conduct (IAEA 2003g) and, in order to define its scope, issued the Categorization of Radioactive Sources referred to earlier (IAEA 2003a). Further, by *Note Verbale* dated 22 January 2004, it encouraged States to make the commitment to the Code of Conduct referred to in the General Conference resolution. Support for the Code of Conduct has been remarkable: by April 2004, 61 States (including two that are not IAEA Member States) had made a political commitment to supporting the Code, and some States—notably the United States, and the European Union—have taken steps to promote the Code.‡‡‡‡

Guidance on the import and export of radioactive sources. When the IAEA Board of Governors approved the Code of Conduct, summing up the Board's discussion, the Chairperson stated, inter alia, that there still were concerns regarding the import and export of radioactive sources and that the matter needed to be further explored and some guidance developed.§§§§ Moreover, in anticipation of the need to facilitate the implementation of the Code of Conduct and of concerns regarding the import and export of radioactive sources, the Action Plan called for the development of internationally agreed procedures for importing and exporting radioactive sources. A meeting of technical and legal experts, held in July 2004, attended by 68 experts from 40 Member States, reached a consensus on an international *Guidance on the Import and Export of Radioactive Sources* that would eventually be approved by the IAEA Board.

International preparedness and response

Under the Convention on Early Notification of a Nuclear Accident (the Early Notification Convention) and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (the Assistance Convention), the IAEA performs a number of functions concerned with preparedness for and response to nuclear and radiological emergencies that are applicable to the aftermath of a terrorist attack. Also, in fulfilling its statutory responsibilities, it develops and provides for the application of safety standards relevant to emergency preparedness and response. The necessary activities are carried out primarily through the IAEA Emergency Response System and implement arrangements described in the IAEA *Emergency Notification and Assistance Technical Operations Manual.******

In September 2002, the IAEA General Conference (IAEA 2002b) recognized "the need for enhanced efforts by the Secretariat in coordinating and facilitating international preparedness and response and thereby making it more consistent and coherent," requested "to seek ways

‡‡‡‡ The list of countries that have made a political commitment is as follows: Albania, Argentina, Australia, Austria, Belarus, Belgium, Bolivia, Bulgaria, Burkina Faso, Canada, Chad, Chile, China, Croatia, Cuba, Czech Republic, Denmark, Estonia, Ethiopia, Finland, France, Germany, Ghana, Greece, Hungary, India, Ireland, Israel, Italy, Japan, Korea (Republic of), Lithuania, Luxembourg, Malta, Mexico, Morocco, Namibia, Netherlands, Norway, Pakistan, Paraguay, Philippines, Portugal, Romania, Russian Federation, Serbia and Montenegro, Slovakia, Slovenia, Spain, Sweden, Syrian Arab Republic, the Former Yugoslav Republic of Macedonia, Turkey, Turkmenistan, Ukraine, United Kingdom, United States of America, Uruguay, Uzbekistan, Venezuela, and Yemen; it is also available on the IAEA Web site: http://www-rasanet.iaea.org/downloads/meetings/code-conduct-signatories.pdf.

§§§§ See IAEA-TECDOC-1076 para. 61. Communications on nuclear, radiation, transport and waste safety. P. Wieland, Nuclear Installation Safety/NSNI; April 1999.

***** During the last biennium, reports to the IAEA of 53 events resulted in the IAEA Emergency Response System taking action to verify, provide information or advice, and/or offer its assistance. In eight cases, some involving unsecured sources, assistance was provided in response to requests made under the Assistance Convention: Bolivia, July 2002—medical examinations of and dose assessments for a small group of members of the public who may have been seriously overexposed; Tanzania, November 2002—analysis of confiscated nuclear material; Nigeria, February 2003—technical advice following the theft of two americium-beryllium sources; Qatar, March 2003—recovery of buried orphan sources; Ecuador, May 2003—technical advice following the theft of five ^{192}Ir sources from a private company and the loss of a similar source; Georgia, July 2003—long-term specialized medical treatment for two victims of the incident at Lilo, Georgia; Albania, December 2003—securing of ^{60}Co source stuck in an oncology machine; and Russia, January 2004—urgent provision of specialized medicine for the treatment of a victim of the incident at Lia, Georgia.

of facilitating cooperation and coordination among Parties to the Early Notification Convention and the Assistance Convention to ensure adequate implementation and consider institutionalizing the Competent Authorities' Meeting,"[†††††] and "to continue to evaluate and, if necessary, improve the capability of the IAEA Emergency Response System to fulfill its role as coordinator and facilitator of international emergency preparedness and response and to ensure sustainability of the System." In September 2003, the General Conference requested (IAEA 2003e) "to continue to seek ways of facilitating cooperation and coordination among Parties to the Early Notification Convention and the Assistance Convention to ensure adequate implementation, and to consider institutionalizing the Competent Authorities' Meeting," requested the Director General "to continue to evaluate and, if necessary, improve the capability of the IAEA Emergency Response System to fulfill its role as coordinator and facilitator of international emergency preparedness and response and to ensure sustainability of the System," and supported the development of a plan of action for enhancing the international emergency response system (IAEA 2003h).

Thus a plan of action for enhancing the international emergency response system was developed. The International Action Plan for Strengthening the International Preparedness and Response System for Nuclear and Radiological Emergencies was approved by the Board in June 2004.[‡‡‡‡‡]

Security during international transport

In March 2004, the IAEA Board of Governors approved an international *Action Plan for the Safety of Transport of Radioactive Material,*[§§§§§] which provides directions in the field of radioactive material transport safety and security.

Promoting effective and sustainable national regulatory infrastructures for the control of radiation sources

In the Preamble to the BSS, it is stated that the international standards are based on the presumption "that a national infrastructure is in place enabling the Government to discharge its responsibilities for radiation protection and safety." (In addition to the BSS, relevant to the issue of promoting effective and sustainable national regulatory infrastructures for the control of radioactive sources are, inter alia, the Action Plan and the Code of Conduct.) Following the BSS, the IAEA launched a number of initiatives for helping Member States to establish regulatory infrastructures where they do not exist or to strengthen their existing infrastructures. These initiatives include the so-called technical cooperation Model Projects on Upgrading Radiation Protection Infrastructure (the Model Projects), in which 92 Member States are now participating, and international initiatives launched within the framework of IAEA's regular program, as part of the Action Plan, to encourage and assist governments in their efforts to establish national radiation safety and security infrastructures. They also include extra budgetary initiatives (IAEA 2003i).******

The Rabat Conference. In order to review progress in the implementation of the various IAEA initiatives and to identify ways in which the current approach should be adjusted in the light of new developments, the IAEA organized the *International Conference on National Infrastructures for Radiation Safety: Towards Effective and Sustainable Systems* that was held in Rabat, Morocco, in September 2003 (the Rabat Conference) (IAEA 2004c). The IAEA General Conference noted the findings of the Rabat Conference and the progress of the Model Projects, welcomed the Board's approval of the Code of Conduct, and recognized the need for adjustments to the Model Projects in the light of the findings of the Rabat Conference and the guidance contained in the Code of Conduct (IAEA 2003j). As a result, proposals for actions to be taken in response to the findings of the Rabat Conference were developed (IAEA 2003k). These include actions aimed at further enhancing effective and sustainable regulatory infrastructures that would eventually be approved by the IAEA Board. The vision is to achieve effective and sustainable national regulatory infrastructures for the control of radioactive sources in all IAEA Member States. This will require a strategy for providing for the systematic strengthening and acceleration of ongoing work. While the IAEA's assistance is critical for the development of such infrastructures, it is Members States themselves which have the ultimate responsibility for ensuring that adequate regulatory oversight is in place to protect public health against the effects attributable to radiation exposure, for providing adequate safety and security for radioactive sources, and for ensuring that they have regulatory requirements compatible with the BSS, the Code of Conduct, and

[†††††] Competent Authorities' Meeting—Meeting of Representatives of National Competent Authorities identified under the Early Notification and Assistance Conventions, attended by representatives of national competent authorities both of States Parties to the Early Notification Convention and the Assistance Convention and of IAEA Member States that are not Parties to the two conventions.

[‡‡‡‡‡] It was before the Board in Annex 1 to document GOV/2004/40 (corrected) and is now available on the IAEA Web site: http://www-ns.iaea.orgtech-areas/emergency/ers.htm.

[§§§§§] It was contained in the Annex 2 document GOV/2004/2.

****** See IAEA document GOV/INF/2004/1 *Measures to Protect Against Nuclear Terrorism* (Activity Area IV).

related documents. The IAEA will, through its regular and technical cooperation programs, continue its proactive approach to assisting its Member States. It will do so by providing all relevant stakeholders with clear and accurate information about the IAEA programs and activities, by bringing about a common understanding of the baselines or starting-points and by ensuring frequent communication of the measured progress towards the achievement of project objectives. It is expected that this proactive approach will lead to more consistent, reliable, predictable, and timely decision making and will minimize the duplication of efforts within the IAEA and in Member States. In this regard, the IAEA will encourage Members States to play a more active role in the implementation of strategies that will help to enhance the control of radiation sources. For the next IAEA technical cooperation cycle, it is proposed that for each region of the world there be a number of national and regional projects, based on requests from and on the needs identified in Member States, to promote effective and sustained national regulatory infrastructures for the control of radiation sources. These projects will focus on key elements such as encouraging Member States to engage in periodic appraisals and self-assessments (using, for example, the IAEA "Radiation Safety Infrastructure Appraisal" methodology); strengthening the education and training of regulatory staff; and encouraging stakeholder involvement, networking and information exchange. By expanding regional cooperation, self-reliance, and networking, and further promoting the "train-the-trainer" approach, the success and sustainability of infrastructures for the control of radiation sources should be greatly enhanced. Compliance with relevant national laws and regulations based on the BSS and the Code of Conduct will help to ensure the achievement of this sustainability. The IAEA will seek to ensure effective oversight and coordination across all relevant organizational units as regards the implementation of radiation safety and security infrastructure projects for the control of radiation sources. In the case of non-Member States, based on previous decisions of the IAEA Board and subject to the availability of extra budgetary funds and to the conditions regarding IAEA assistance to non-Member States,[††††††] assistance will be provided through extension of the administrative and program management arrangements already in place and through the new arrangements to be created, in order to ensure coherence and consistency of approach for all States.

Among the new actions, it is expected that the IAEA will incorporate additional regulatory requirements and guidance contained in the Code of Conduct and in the Categorization of Radioactive Sources into its future assistance projects. It is proposed that the additional requirements and guidance include:

- The establishment of national registries/inventories, including the prompt development of a standard registry/inventory format and of tagging and tracking systems, in cooperation with manufacturers;
- The life-cycle management and appropriate disposal of radioactive sources ("cradle-to-grave" oversight by regulatory authorities);
- The development of national strategies for locating, identifying, and regaining regulatory control over orphan sources;
- Strengthened control over the import and export of radioactive sources;
- Measures to avoid or minimize the likelihood of malicious acts;
- Emergency actions for responding to malicious acts involving radioactive sources;[‡‡‡‡‡‡] and
- Actions to be taken in proven cases of illicit trafficking in, and malicious acts involving, radioactive sources (including theft).

It is also expected that the IAEA will:

- Substantially strengthen and accelerate its activities for promoting regulatory infrastructures in Member States and non-Member States (the objective being to establish, in the medium term, in all countries receiving IAEA assistance a regulatory framework[§§§§§§] augmented by the elements mentioned above);
- While taking due account of confidentiality issues, develop and implement a mechanism for making optimum use of the information in its Country Radiation and Waste Safety Profiles,[*******] which indicate, inter alia, the status of national regulatory control of radioactive sources;
- Foster bilateral, regional, and interregional regulatory partnerships for enhancing national regulatory control infrastructures (including encouraging States to enhance exchanges of experience in the establishment of infrastructures for the regulatory control of radioactive sources between relevant governmental agencies and

†††††† Which are set out in the IAEA document GOV/1999/14.

‡‡‡‡‡‡ See, in this connection, the International Action for Strengthening the International Preparedness and Response System for Nuclear and Radiological Emergencies contained in Annex 1 to IAEA document GOV/2004/40 (corrected).

§§§§§§ "The establishment of a regulatory framework" involves the drafting and promulgation of radiation protection laws and regulations, the designation and empowerment of a national regulatory authority and the establishment of a system for the notification, authorization, inspection, and enforcement related to radiation sources (including the preparation of an inventory of radiation sources and installations).

******* The Country Radiation and Waste Safety Profiles cover, inter alia, all legal, regulatory, and other matters relevant to the safety of radioactive sources.

the provision of guidance on interdepartmental coordination, on the conduct of joint exercises for the interdiction of illicit trafficking, on joint planning for radiological emergencies, etc.);
- Working through regional partnerships with Member States, make available an upgraded version of the IAEA Regulatory Authority Information System (also ensuring that the upgraded system is operational in all official languages of the IAEA and that a program is established for ensuring that the software is maintained and regularly upgraded by regional centers and that sufficient training is provided to the users);
- Support the development of networks aimed at promoting effective and sustainable national regulatory infrastructures, including networks based on regional structures and devoted to specific radiation safety and security topics;
- With guidance from its Education and Training Steering Committee, strengthen its strategic approach to education and training in radiation and waste safety by (1) further promoting the "train-the-trainers" approach as a means of achieving national and regional sustainability in the field of education and training, and (2) continuing to help Member States to organize Postgraduate Educational Courses in Radiation Protection and the Safety of Radiation Sources leading to a diploma in radiation safety;
- Launch a training program designed to produce regulatory inspectors at the national level qualified to carry out inspections of national regulatory authorities in the area of radioactive source safety and security; and
- Develop "tool kits" for informing news media staff, the general public, and particularly concerned stakeholders about radiological hazards, radiation protection, radioactive waste safety, the security of radioactive materials, and radiological emergency response and make them available to Member States, and seek to harmonize the terminology used by various international organizations relating to the regulatory control of radioactive sources by making available the draft IAEA Safety Glossary (Terminology used in Nuclear, Radiation, Radioactive Waste and Transport Safety) in all official IAEA languages.

EPILOGUE

While I agree with Shakespeare that "if it be true that good wine needs no bush, it is true that a good play needs no epilogue," I would like to end this lecture with a number of considerations that are an integral part of the international thinking on the problem before us.

There are a number of reasons why radiation is of unique concern in relation to malevolent events. On the negative side, radiation is perceived as a mysterious pollutant, and past experience with radiation emergencies has shown that there are problems in dealing with it. The public will have exaggerated fears because radiation is invisible and odorless and its effects may only be apparent hours, days, weeks, or even many years after exposure. Radiological attacks are more likely than other malevolent events to give rise to psychological problems among members of the public, public officials, and professionals in other fields because of the fear of radiation and a misunderstanding of its consequences. The perceived risk is a major contributor to the anxiety and fear that may be induced by a malevolent act, an extra dimension presenting additional challenges to those who will have to manage the health consequences of such an event. There will be difficulties in responding to a radiological attack because those who handle the situation at an early stage will share much of the anxiety and fear about radiation and they will probably have little experience in dealing with such an emergency.

Relatively low levels of radiation exposure, such as those that may remain after a radiological attack, are often viewed as a substantial hazard and this is the main element in the creation of anxiety and fear. Radiation is actually a weak carcinogen in contrast to public perception. At levels of radiation exposure similar in magnitude to those arising from natural sources of radiation, and to which people experience in daily life without concern, the risks of cancer are very low—so low that any potential effect is, in fact, undetectable. In spite of this, radiation protection professionals should, however, do whatever they reasonably can to constrain unjustified public exposure, because the prevalent scientific opinion is that a small but definite risk of deleterious effects should be attributed to radiation exposure even at low levels, although these effects are in fact undetectable at low doses. Unfortunately, justifiable radiation protection efforts can themselves become a contributor to anxiety and fear as people can misinterpret them as an indication that they are subject to a high risk.

On the positive side, in comparison with biological or chemical attacks, the area over which contamination occurs can be readily delineated if radiation measurement instruments are available (with the possible exception of contamination due to some alpha-emitting radioisotopes). Moreover, radiation (including its carcinogenic potential) is one of the most studied agents in toxicology and human clinics, and therefore many sources of information on the health effects of radiation are available. As a result of these studies, sound criteria for conventional radiological emergencies have already been developed that are relevant to and can be applied quickly in the event of a radiological attack. Furthermore, it is generally recognized that many more people would survive a radiological attack compared with the number of immediate fatalities that may be caused by biological or chemical agents, or simply by an explosive blast.

We have a difficult dilemma in radiological security. We should not overreact, but the danger seems to be real and we have to work responsibly and *multilaterally* to ensure that *all over the world* control over radioactive sources is not relinquished under any circumstance. Because, as the IAEA has repeatedly indicated: "a global threat requires global action." A monumental security agenda lies ahead for national governments, for the IAEA, and, last but not least, for the health physics community. The challenge will be to address the problem effectively weighing up its relative importance vis-à-vis the larger-scale threat of terrorist use of chemical and biological agents.

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Questions for the Record Submitted to
Mr. Richard Stratford by
Senator Daniel K. Akaka (#1)
Senate Committee on Homeland Security and Governmental Affairs
March 13, 2007

Question:

The GAO has found that there is little coordination between DOE and the European Commission (EC). Does the Department of State play a role in helping DOE coordinate with the EC?

Answer:

It is the view of the Department of State that the IAEA is the major focal point for coordination of international activities on radiological security. As such, we encourage DOE to coordinate its activities with other entities, such as the EC, through the IAEA. We believe such an approach will help minimize redundancies and inefficiencies in radiological security efforts.

In light of IAEA's central role in coordinating radiological security activities, State and DOE have been pressing the IAEA to further improve its coordination and prioritization of activities. For example, since June 2006, we have been working with DOE's Office of Global Threat Reduction (GTR), the IAEA's Office of Nuclear Security, the European Commission (EC), and representatives of seven other major donor states (four of which are EC members) to the IAEA's Nuclear Security Fund (NSF) to establish a mechanism to better coordinate projects undertaken to secure radioactive materials around the world. We believe that this initiative, undertaken at the behest of GTR, appears to be paying off. We anticipate this initiative will play a major role in eliminating any unnecessary duplication of efforts by the IAEA and its key donor States.

During the past few years, DOE has funded the majority of radiological security activities under the IAEA's NSF. The EC contributed a small percentage of funds to the NSF, and was not a significant player, making the need for coordination less critical. However, in the last two years, the EC significantly increased its funding to the NSF and last year surpassed DOE's contribution. State and DOE efforts to improve IAEA coordination, described above, have kept pace with this increasing role of other donor States and the accompanying need for overall coordination.

Questions for the Record Submitted to
Mr. Richard Stratford by
Senator Daniel K. Akaka (#2)
Senate Committee on Homeland Security and Governmental Affairs
March 13, 2007

Question:

At its 2003 meeting at Evian, the G8 [G-8] pledged its support to improve the security of radioactive materials and urged all countries to take measures to strengthen regulatory control of high-risk sources. In 2005, in Gleneagles, Scotland, the G8 reiterated its support for the security of high risk radioactive sources, commending the more than 70 countries that had committed to implementing the IAEA Code of Conduct on the Safety and Security of Radioactive Sources and urged all other states to adopt the Code.

What is the State Department's role in ensuring that the other G8 countries continue to focus support for and activities to secure these sources?

Answer:

The Department of State has been instrumental in ensuring that other G-8 countries continue to focus support for and engage in activities to secure radiological sources. Our representative on the G-8 Nuclear Safety and Security Group (NSSG) has successfully pressed other member states to maintain radiological source security and support for the IAEA Code of Conduct for the Safety and Security of Radiological Sources. At each NSSG meeting we review the challenges and progress of each implementing country's implementation of the Code of Conduct. We use our participation at the G-8 NSSG meetings to encourage our G-8 colleagues to implement the provisions of the Code of Conduct within their own borders and to influence countries outside of the G-8 to do the same.

Because the U.S. has taken the lead in securing radioactive sources worldwide, our influence and leadership in the G-8 NSSG is significant. The State Department fostered the concept of the global adherence to the Code during the U.S. G-8 Presidency in 2004. The Department of State leads U.S. delegations and coordinates interagency activities to gain broad international support at the highest levels for strengthening the control of radioactive sources throughout their entire lifecycle. In 2003, our efforts led to the successful revision of the Code of Conduct to incorporate post-9/11 security concerns and in 2005 we helped develop the first international framework for the import and export of radioactive sources that is now published as a supplement to the Code of Conduct as the IAEA Guidance on the Import and Export of Radioactive Sources (Guidance).

Our success would not have been possible without the technical and legal input of the NRC and DOE and the commitment of both Agencies to implement the provisions of the Code of Conduct and the Guidance. Key provisions of the Code of Conduct and Guidance were codified in U.S. law with the Energy Policy Act of 2005, and NRC rules implementing export controls for high-activity radioactive sources became effective December 28, 2005. Because of this, the U.S. became the first country to put in place new export controls for radioactive sources, fulfilling G-8 commitments and enabling the U.S. to lead by example.

For countries outside the G-8, the NSSG also supports and promotes IAEA programs that provide technical and regulatory assistance to develop and strengthen national infrastructures for the life-cycle management of radioactive sources. These include the Model Project on Upgrading Radiation Protection Infrastructures (Model Project) and the Regulatory Authority Information System (RAIS). Since the U.S. Presidency in 2004, the IAEA has been invited to brief the NSSG group on the current status of implementation of the Code of Conduct, on commitments made to the import/export Guidance, and on countries participating in the Model Project. With G-8 support, the United States enjoys additional leverage from the funds it provides to the IAEA for global radioactive source security.

Post-Hearing Questions for the Record
Mr. Andrew Bieniawski, Associate Deputy Administrator,
National Nuclear Security Administration
Hearing on U.S. International Efforts to Secure Radiological Materials
Subcommittee on Oversight of Government Management, the Federal Workforce, and the District of Columbia
Committee on Homeland Security and Governmental Affairs
March 13, 2007

QUESTIONS FROM SENATOR DANIEL K. AKAKA

Q1: You have testified that you have improved coordination with the State Department and Nuclear Regulatory Commission regarding your radiological source security activities. Can you briefly provide examples of such improved coordination?

A1: GTRI has improved cooperation and coordination on radiological security issues with the Department of State (DOS) and the Nuclear Regulatory Commission (NRC). In fact, the GAO report states that "DOE has improved coordination with State and NRC to secure radiological sources worldwide. Since we last reported on this matter in 2003, DOE has involved State and NRC in its international radiological threat reduction activities more often and has increased information-sharing with the agencies."

A specific example of this increased coordination was an effort by DOE and the NRC to support a State-led interagency program to establish the Iraq Radioactive Source Regulatory Authority (IRSRA) and develop a radiological regulatory infrastructure in Iraq. DOE and State provided IRSRA with equipment, training, technical assistance, and funding to help the new agency assume increased responsibility for establishing radiological source regulations and procedures consistent with international standards. Specifically, with funding and logistical support from DOE, State coordinated several meetings in Amman, Jordan in December 2004 to provide IRSRA personnel training by IAEA staff. Other examples of increased coordination include meetings with our counterparts from the Department of State on nuclear and radiological security issues several times a week. In addition, we hold regularly scheduled information exchanges with the NRC on international and domestic efforts to reduce radiological threats. We coordinate with the Department of State and the NRC on consultancies and technical meetings in support of the IAEA. DOE, DOS, and NRC have worked together to shape the IAEA Code of Conduct on the Safety and Security of Radioactive Sources as well as helped the IAEA develop model regulations, training, and accounting systems for radiological materials. In addition, we are attempting to leverage our domestic activities (orphaned source recovery and State and local advisory activities) in support of NRC's domestic radiological security efforts. NRC has also contributed to numerous international training activities sponsored by GTRI.

Q2: DOE, NRC and the IAEA produced a categorization of radioactive sources so that the U.S. and other countries could focus limited resources on the most risky, dangerous sources that could be used in a dirty bomb. How do you plan to ensure that facilities in countries receiving physical security upgrades are able to maintain them to protect DOE's significant investment over the long term and what, in your opinion, is the best way to ensure long-term control of these sources?

A2: In order to ensure that physical security upgrades are maintained over the long-term, we agree with GAO's recommendation on the need to expand our current 3-year maintenance and warranty support program into a long-term strategic sustainability plan to address unsecured radiological sources around the world. To implement this recommendation, we have established an internal working group that is currently reviewing several existing programs that address the issue of sustainability, including elements of the NA-25 Material Protection, Control and Accounting Program's long-term sustainability plan to determine if they are applicable to GTRI. It is also important to balance the need for sustainable security and the objective of making radiological security an international issue that warrants an effective international solution for sustaining security over vulnerable high risk radioactive sources around the world. Therefore, we are currently developing sustainability plans that include using the International Atomic Energy Agency and countries that are part of the Global Initiative to Combat Nuclear Terrorism as vehicles to help implement and ensure resources for long-term sustainability of security upgrades.

Q3: I am disturbed to learn that GAO found inadequate maintenance and related problems at sites that it visited where upgrades were installed. How are you going to fix those problems and what do you believe it says about the long term success of your program?

A3: In response to the GAO report, NNSA is currently reviewing our existing quality assurance program to determine what additional changes could be implemented. Our current quality assurance program includes: (1) having the contract for the development of a protection upgrade design reviewed and approved by NNSA physical protection experts prior to payment for the design document; (2) insisting the approved design document is a precondition to proceeding with procurement of protection equipment and installation; (3) conducting post-installation visits by our technical experts for the purpose of assuring all equipment and systems are installed as agreed upon in the design document (if installations are performed incorrectly, payments are withheld until corrections are made). We will further investigate this process to identify and implement additional improvements.

As part of this review, NNSA is also assessing the effectiveness of its existing process of assurance visits that provide a mechanism for both the identification and correction of potential foreign contractor performance issues. As part of our existing assurance process, the GTRI project teams take special care to ensure the contractor fully understands the requirements spelled forth in the contract prior to award. Detailed statements of work (SOW) are established and negotiated with the facility staff and contractor prior to implementing. In most cases, the SOW is accompanied by a schematic showing the exact placement of the equipment prescribed. The project teams take special care to ensure the contractor fully understands the requirements spelled forth in the contract prior to award. If despite all of these efforts, the contractor performs in a substandard way, the assurance visits provide both the mechanism for the identification of substandard work and more importantly its correction. In this context, assurance visits are conducted for the purpose of assuring equipment is installed as agreed upon in the design document. If installations are performed incorrectly, payments for installation are withheld until corrections are made. We will further investigate this process to identify and implement additional improvements.

Regarding the long-term success of our program, as noted earlier, we are working with the IAEA and countries that are part of the Global Initiative to Combat Nuclear Terrorism to help implement and ensure resources for long-term sustainability of security upgrades at vulnerable sites around the world.

Q4A: I applaud the efforts of the NRC and DOE to help secure these dangerous radioactive sources worldwide. I would add, however, that prevention is only part of the issue – the other part is preparedness and response.

Can you tell me what you are doing with these countries to which you provide assistance so that, in the event of a dirty bomb attack, they are prepared to respond?

A4A: We agree that it is important to strengthen the ability of foreign partners to respond to any terrorist use of radioactive materials. Under the President's Global Initiative to Combat Nuclear Terrorism, we are encouraging greater cooperation among technical experts, and hope to be able to sponsor an international exercise later this year. Our cooperation with Russia under the Bratislava accords also includes cooperation on nuclear emergency response. As part of this cooperation, our technical teams participated in a radiological search and emergency response exercise in Russia last year. We engage in bilateral emergency response cooperation with a number of other countries, including a particularly close relationship with the UK.

In addition, we assist foreign governments and international organizations world wide to develop capable emergency management programs and infrastructure to reduce the risk of nuclear emergencies as well as to mitigate consequences. The NNSA works with more than 44 foreign governments and 9 international organizations to provide the core elements of an emergency program: development and implementation of policies, plans and procedures and establishment of corresponding training programs; conduct of nuclear and radiological emergency training courses, drills and exercises, including evaluation and feedback programs for improvements; and support for emergency operations centers and for technical assistance, including hardware, software and other infrastructure elements. We are engaged with specific countries to ensure there is a coordinated effort for responding to nuclear terrorism and are also involved with specific partners through outreach provided by DOS in support of international special events. Our collaboration provides valuable opportunities for technical exchange on enhancing response capabilities and equipment improvements.

Q4B. Are these countries conducting emergency exercises to improve their ability to respond to a dirty bomb attack?

A4B. Currently we have conducted or are in the planning stages to conduct exercises with Australia, China, England, Germany, India, Israel, Japan, Russia, Singapore, Turkey, Italy, Canada, Brazil, Dubai, and Greece to improve the capability to response to nuclear terrorism incidents. These exercises are in support of DOS and DoD initiatives or directed by DOE and the host country to validate training activities and mutual agreements. However, the concept of nuclear terrorism and RDDs is new to some counties and we are working with these countries to establish a mutual process and opportunities for training.

We also provide assistance to foreign partners in developing and conducting emergency drills and exercises. Exercises provide valuable tests of emergency management systems that yield results and "lessons learned" necessary for continued improvements to emergency preparedness and response programs. Results from drills, exercises, and evaluation programs are used to develop and improve training programs and emergency plans and procedures to ensure the effectiveness of emergency management systems. We have sponsored exercises in Russia, trained South Koreans on exercise development, and collaborate with

Japan through the exchange of data and observation of exercises. With the Nuclear Energy Agency, we developed a radioactive contamination table top exercise scenario for use by multiple countries to test the planning and ability to manage intermediate- and long-term food and agriculture countermeasures to mitigate exposure to the public. Future plans include exchanging exercise specific information with France, Sweden, Japan, Argentina, Brazil and South Korea, and sponsoring additional exercises in Russia to ensure appropriate preparedness and response to nuclear/radiological events involving Russian nuclear activities.

QUESTIONS FROM SENATOR PETE V. DOMENICI

I commend Chairman Akaka for holding this important hearing to review the federal government's effort to secure radiological sources in other countries. Following the terrorist attacks of September 11, 2001, the concerns for unsecured radiological sources to be used in "dirty bombs" has intensified. Congress has directed the National Nuclear Security Administration (NNSA) to step up efforts in dealing with radioactive materials. The International Radiological Threat Reduction (IRTR) program was incorporated into the Global Threat Reduction Initiative (GTRI) to identify, secure, remove and/or facilitate the disposition of high risk vulnerable nuclear and radiological material around the world that pose a threat to the United States.

This issue is not a U.S. one alone. The IRTR is intended to build international support for national programs to deal with this threat together because the threat is just that to the international community. NNSA works with the Nuclear Regulatory commission (NRC) and the International Atomic Energy Agency (IAEA) as well as other pertinent manufacturers and distributors of nuclear materials to protect it from theft or diversion. The Energy Policy Act of 2005 directs the NRC to strengthen requirements for screening plant employees and to provide regulatory assistance to other countries, notably Russia and Former Soviet Union (FSU) countries. I understand that G-8 also supports and pledges support to improve the security of radioactive materials.

The GAO's January report asserts that NNSA has made progress in securing radiological sources at hundreds of sites in more than 40 countries, but the expansion of the program in securing sites in Russia and the FSUs on HEU and plutonium has diverted the limited program funding from securing resources from some high priority radiological sites.

We all know that Russia, as a major international energy player, is intensifying its civilian nuclear program both domestically and world-wide. Russia must meet its obligation to advance not only the global energy security, but also nuclear non-proliferation and safeguarding of nuclear materials.

We, in the U.S., have devoted a lot of resources and effort to make sure the nuclear materials in Russia and FSUs are secured. It is high time for Russia to assume the responsibility and share the costs to address this serious issue that confronts the world.

Q1: I would like to know what is Russia's effort in policy and funding for securing radiological materials in Russia and other FSUs?

A1: Russia has made a significant effort in policy and funding to protect and secure radiological materials both within Russia and the former Soviet Republics. Since approximately 1998, Russia and its international partners Norway and France directly funded the recovery of 185 vulnerable radioisotopic thermoelectric generators (RTGs) in Russia. This complements GTRI efforts in Russia where we have funded the recovery of 132 vulnerable RTGs in Russia since 2004. This effort by Russia, France and Norway saved our program approximately $28 million and accelerated threat reduction efforts. In addition, during 2007, the Russian Ministry of Housing and Construction is expected to provide approximately $1M to improve the security of radiological storage repositories and the Russian Ministry of Defense and the Ministry of Transportation are both providing in-kind transportation assistance (about $1M in 2007) to help address the threat posed by vulnerable remaining radioisotopic thermoelectric generators (RTGs) in Russia. In addition to these efforts, Russia is working with the Global Threat Reduction Initiative (GTRI) and the International Atomic Energy Agency (IAEA) to develop regulations that will clearly define the rules and requirements related to licensing and use of the radiological materials. Rostechnadzor, the Russian nuclear regulatory agency, also recently conducted several radiological inspections and issued fines and legal sanctions in response to its findings.

Regarding efforts by Russia in the countries of former Soviet Union (FSU), Russia, the U.S., and the International Atomic Energy Agency (IAEA) have successfully cooperated under this so-called Tripartite Initiative to recover and secure radiological materials outside Russia. Specifically, through this Tripartite Initiative, hundreds of vulnerable radiological sources have been secured in former Soviet Republics such as Armenia, Azerbaijan, Belarus, Estonia, Lithuania, Georgia, Ukraine, Tajikistan, Kazakhstan, Moldova, and Uzbekistan.

Q2: I encourage NNSA to work closely with the NRC, the State Department, the Homeland Security Department and other agencies, both domestic and internationally, to develop a governmental-wide plan to strengthen controls over nuclear materials. I would like to know how such a plan can be produced?

A2: The Global Threat Reduction Initiative (GTRI) has developed an overall prioritized multi-year plan to strengthen controls over radiological materials worldwide. As part of our interagency coordination process, we have shared this draft plan and prioritization with other U.S. government agencies, such as the Nuclear Regulatory Commission and the State Department, as well as with the International Atomic Energy Agency (IAEA). As part of this coordination process, representatives from GTRI and the State Department have also been working with the IAEA and representatives of seven other Key Donor States to the IAEA's Nuclear Security Fund to establish a mechanism for each of the parties to report to the other members a summary of all projects undertaken to secure nuclear and other radioactive materials around the world, whether conducted bilaterally, through the IAEA, or on a multilateral basis in partnership with other countries. We believe that this initiative will enhance cooperation and coordination of efforts among these major contributors to the IAEA's Nuclear Security Fund and the IAEA and will help eliminate duplication efforts by the IAEA and it Key Donor States.

RESPONSE TO POST-HEARING QUESTIONS FROM MARCH 13, 2007
SENATE COMMITTEE ON HOMELAND SECURITY HEARING ON
U.S. INTERNATIONAL EFFORTS TO SECURE RADIOLOGICAL MATERIALS

Questions for Ms. Dunn Lee from Chairman Akaka

QUESTION 1. I applaud the efforts of the NRC and DOE to help secure these dangerous radioactive sources worldwide. I would add, however, that prevention is only part of the issue - the other is preparedness and response.

A. Can you tell me what you are doing with these countries to which you provide assistance so that, in the event of a dirty bomb attack, they are prepared to respond?

ANSWER: NRC's efforts to assist its foreign regulatory counterparts in enhancing security over radioactive sources does not currently include preparedness and response. The Department of Energy (DOE), the International Atomic Energy Agency (IAEA) and the European Commission all have extensive programs underway or planned in this area. When combined with the NRC's activities in regulating the safe and secure uses of radioactive materials, all of these various assistance efforts will result in reducing both the potential for and the consequences of an event involving a radiological dispersal device (an RDD or "dirty bomb").

B. Are these countries conducting emergency exercises to improve their ability to respond to a dirty bomb attack?

ANSWER: Many of NRC's foreign regulatory counterparts either are participating, or plan on participating, in terrorism-related emergency exercises conducted under the auspices of the IAEA.

QUESTION 2. If Congress allocates funds to NRC specifically to improve source security worldwide, how would you approach this issue and what would you focus on first and why?

ANSWER: The NRC believes that the countries of the former Soviet Union continue to be areas of the highest risk for either experiencing an attack involving an RDD or for being the source of radioactive material that might be used in an RDD attack conducted elsewhere. As such, NRC would focus its initial efforts in these countries.

Current NRC-sponsored activities in Armenia, and efforts beginning in Georgia and Azerbaijan focus on helping our regulatory counterparts develop the necessary infrastructure to implement key provisions of the IAEA-sponsored Code of Conduct on the Safety and Security of Radioactive Sources (Code of Conduct). Activities conducted to date have included assistance to develop national registries of radioactive sources and making recommendations for improvements to existing radioactive source-related laws and regulations to ensure that the regulator is legally authorized to license and enforce regulations for the safe and secure use of radioactive materials.

Should additional funding be available, NRC would initially perform similar activities with its regulatory counterparts in other countries of the former Soviet Union. Additional assistance needs would also be identified on a country-specific basis.

QUESTION 3. What do you believe are the root causes of inadequate and inconsistent coordination among the U.S. agencies that GAO discussed in its report?

ANSWER: NRC believes that both the Departments of State and Energy (DOS and DOE) have important roles to play in international efforts to secure radioactive sources; unfortunately, all three agencies compete for limited funds to implement their different missions. DOS's strength lies in its ability to formulate appropriate U.S. Government policy and maintain diplomatic ties with national leadership, ensuring that there is political support for endorsing and implementing international guidance on securing radioactive sources. DOE's strength lies in its ability to assess and upgrade national physical protection and transportation security systems. NRC's strength lies in its 32 years of experience as the U.S. regulator of civilian uses of radioactive material, including radioactive sources. These strengths, effectively combined, will foster an improved long-term, sustainable oversight and control of radioactive sources consistent with the IAEA-sponsored Code of Conduct.

However, beginning in 2001, the moves to expeditiously secure the highest-risk radioactive materials in foreign and often chaotic environments, without agreed-upon international guidance, and without sufficient funding, created some inconsistent efforts. The need to take near term action was perceived to outweigh the benefits of a more coordinated long-term response that could lead to sustainable results. As the international environment has stabilized, individual agencies within the U.S. Government have created more effective mechanisms to consult internally and with our bilateral and multilateral foreign counterparts.

NRC views planned and ongoing U.S. Government-sponsored radioactive source-related activities in Iraq as an effective model for internal U.S. Government coordination. In 2004, DOS and DOE began work with the Iraqi Government to secure nuclear and radioactive materials, to catalog radioactive sources and their whereabouts, and to create an Iraqi regulatory authority with responsibility for radioactive materials. NRC, now integrated with the DOS and DOE efforts, is providing regulatory assistance on the review of the country's national legal structure and is advising Iraq on the development of regulations for disposal of low-level radioactive waste and storage of unwanted radioactive sources.

QUESTION 4. What has been the impact of DOE not providing the $5 million needed by NRC to implement its regulatory program to control radioactive sources in counterpart countries?

ANSWER: The unavailability of the $5 million in FY2004 funding has resulted in a three year delay in NRC's advising some of its foreign regulatory counterparts on how to implement key provisions of the IAEA-sponsored Code of Conduct.

QUESTION 5. As we have heard, DOE did not provide the NRC with the $5 million to implement a regulatory program overseas.

Without those additional funds, does NRC have the resources, including staff, to take on a larger role?

ANSWER: The NRC believes it can leverage existing activities to take on a larger international assistance role, including its considerable domestic radioactive source security enhancement-related experience, its international experience as a leader in endorsing adherence to the IAEA Code of Conduct and aiding IAEA in developing guidance for national regulators, and its previous limited direct assistance efforts to countries like Armenia and Iraq. Direct funding would enable us to expand ongoing or planned radioactive source-related regulatory strengthening activities. If we receive additional funding, staff resources will not be an issue.

Post-Hearing Questions for the Record Submitted By The Honorable Senator Daniel K. Akaka

Questions for Mr. Alois – GAO

Q. Your report noted that about 70 percent of the sites secured by DOE, as of September 30, 2006, were hospitals and oncology clinics. Why, in your opinion, did DOE focus so much attention on these sites?

As we noted in our January 2007 report *(Nuclear Nonproliferation: DOE's International Threat Reduction Program Needs to Focus Future Efforts on Securing the Highest Priority Radiological Sources,* GAO-07-282*),* national laboratory officials and security specialists said that DOE installed security upgrades at so many hospitals and oncology clinics because the upgrades are relatively modest in scope and cost. In addition, completing upgrades at medical facilities also served to demonstrate rapid program progress because the security upgrades could be completely relatively quickly. Our report also noted that in measuring program performance DOE asserted that the number of sites completed represented the best available measurement. We recommended, however, that DOE establish meaningful performance measurements that demonstrate real risk reduction and go beyond quantitative lists of the number of countries and sites that have received physical security upgrades.

Q. DOE has prioritized its efforts to secure radioactive sources based on several factors, including known terrorist threat and current level of security. Do you believe this new approach is an improvement?

Our report pointed out that DOE's reorganization of its nuclear and radiological threat reduction efforts in 2006 is a step in the right direction toward improving the management of the program. In addition, the reorganization produced new guidance for selecting sites to receive physical security upgrades based on a single integrated threat reduction strategy. This integrated strategy prioritizes security efforts on a number of factors. Of primary importance is the attractiveness of the different types of radiological and nuclear material. Other factors include the site's proximity to U.S. strategic interests, such as military bases overseas or commercial ports, external threat environment within the country, and internal site vulnerability. We believe DOE has taken a thoughtful approach for the purpose of prioritizing its efforts to secure radioactive sources in the future. However, it remains to be seen how effectively the selection criteria are applied over a sustained period of time.

Q. What kinds of facilities should DOE focus their program on and why?

In our view, DOE should focus on the highest priority threats, such as radioisotope thermoelectric generators (RTG) and waste storage sites containing large amounts of dangerous radiological sources. Regarding RTGs, we noted that there are over 700 RTGs in Russia that are operational or abandoned and are vulnerable to theft or potential misuse. Collectively, these devices likely represent the largest unsecured quantity of radioactivity in the world. Each has activity levels ranging from 25,000 to 250,000 curies of strontium-90, similar to the amount of such material released from the Chernobyl accident. Because of the quantity of radioactive material in each RTG—and their vulnerability—we recommended that DOE remove as many as possible in Russia. In addition, as an interim measure, DOE should improve the security of the remaining RTGs until they can be removed from service.

Q. How does the absence of a long-term sustainability plan hamper DOE's efforts to help ensure that its investment in physical security upgrades will be maintained by the recipient countries?

Without a comprehensive sustainability plan that adequately addresses a country's ability to reliably install and maintain security upgrades, DOE risks losing a significant portion of its investment to improve the security of radiological sources in many countries. In our report we pointed out several instances where DOE upgrades have already experienced maintenance problems. For example, in Georgia we found that a storage facility containing RTGs and a seed irradiator—which has thousands of curies of a cesium-137 source—had several large openings in the roof. In Lithuania, we visited an oncology clinic and observed that the security cable used to secure a teletherapy machine's cobalt-60 source, had been broken for almost a month. For these reasons, we recommended that DOE develop a long-term sustainability plan that includes, among other things, future resources required to implement the plan.

Q. Do you believe that the NRC has a role to play in efforts to secure radioactive sources and if so, what is that role?

We believe that NRC has an important role to play in U.S. government efforts to help other countries secure radioactive sources. Our report states that NRC has a long history of supporting regulatory strengthening activities in the countries of central and eastern Europe and the former Soviet Union. These efforts have included training other countries' nuclear regulators in all aspects of licensing and inspection procedures and developing a control and accounting system for nuclear material materials. These regulatory strengthening activities could be expanded if NRC had additional funding to do so. Because of NRC's prior track record, we asked the Congress to consider providing NRC with authority and a direct appropriation to conduct regulatory development activities to help improve other countries' security over sources. We also stated that NRC's regulatory support activities need to be fully coordinated with those of the Departments of State and Energy and the International Atomic Energy Agency.

Post-Hearing Questions for the Record Submitted By
The Honorable Senator Daniel K. Akaka
Hearing on U.S. International Efforts to Secure Radiological Materials
Subcommittee on Oversight of Government Management, the Federal Workforce, and the District of Columbia
Committee on Homeland Security and Governmental Affairs
March 13, 2007

Questions for Dr. Dodd – HPS

In your opinion, how can the U.S. best ensure the long-term control of radioactive sources in other countries?

In my opinion, the best thing we can do is to continue to support the efforts of the IAEA in encouraging the implementation of the Code of Conduct on the Safety and Security of Radioactive Sources. In addition, the USA should give serious consideration to encouraging the IAEA and its Member States to make the Code legally binding in international law. I believe that this will help with the problems of *priority* and *personnel* identified in my testimony. If a country has a legal commitment to the Code, then it is obligated to give it a certain degree of priority and to provide the necessary resources to comply with it. This in turn may give the work sufficient status within the country to encourage well-qualified staff to stay.

In the meantime, we should continue doing what we are doing with regard to helping address the problems of vulnerable Category 1 and 2, and perhaps 3 radioactive sources. The efforts of the Off-Site Radioactive Source Recovery program are particularly impressive domestically and consideration should be given to giving them a broader, international mandate.

Answers to Post-Hearing Questions for March 13, 2007, Hearing on U.S. International Efforts to Secure Radiological Materials

Charles D. Ferguson
Fellow for Science and Technology
Council on Foreign Relations
April 18, 2007

Question:
Do you think that the installation of Advanced Spectroscopic Port units at various points of entry will be effective in stopping someone from smuggling a radioactive source from entering a country or lessen the threat that an al Qaeda operative could build a dirty bomb and detonate it in the U.S.?

Answer:
Installation of the ASP units is not a silver bullet in stopping someone from smuggling a radioactive source into the United States or in preventing an al Qaeda operative from building a dirty bomb. However, the ASP system can strengthen an important layer of defense. That layer is often called "second line of defense." It is probably better to think of it as a terminal line or near terminal line of defense because it tries to block hazardous radioactive material from getting closer to desired terrorist targets such as American cities. I believe that the United States is wise to invest resources in ASP. But I would caution that Americans should not develop a false sense of security with such a detection system. It is still possible that a terrorist could smuggle in a well-shielded radioactive source or could "legitimately" purchase a radioactive source and, even if the source is detected, the paper work (license) could indicate that it is a legally purchased source. Finally, an ASP system would do nothing to stop a terrorist from acquiring radioactive sources within the United States to build dirty bombs.

Question:
In a recent article published in the New Yorker magazine, Maureen McCarthy, a senior advisor in the Department of Homeland Security intelligence and analysis office stated that weapons of mass destruction were split into two categories: "catastrophic" and "limited." According to this taxonomy, dirty bombs, according to the article, fell into the limited category.

Why do you think DHS categorized dirty bombs in that way and do you agree with it?

Answer:
I think DHS developed this categorization to account for the fact that practically all dirty bombs would not constitute a true weapon of mass destruction (WMD), as almost all security experts define a WMD. A true WMD would have the potential and likelihood of killing thousands if not hundreds of thousands of people as well as causing massive property damage. A dirty bomb is "limited" in the sense that very few people would likely die in the near term from exposure to the ionizing radiation from the radiological

weapon. However, if conventional explosives are used to disperse the radioactive material, dozens of people, or perhaps even a few hundred people, could die from the dirty bomb. Over the long term (from many years to a few decades), hundreds of people who were exposed to the radiation from the dirty bomb could develop cancer. Nonetheless, these consequences, though serious, are limited in comparison to the massive destruction that a nuclear weapon, a true WMD, could cause. In sum, I agree with the DHS categorization. But I would not want such a categorization to limit the government's response to countering the threat of dirty bombs.

Question:
In that same New Yorker article, author Steve Coll describes a system being advocated by DHS called the "global nuclear-detection architecture." That architecture includes an "improved system for real-time tracking of all commercial nuclear materials in the United States."

What is your opinion about this plan, and do you believe it would effectively address securing radioactive sources?

Answer:
I believe that such a plan has been needed for a long time and was heartened to read in the article that DHS is advocating for this system. However, I would caution against developing a false sense of security. Real-time tracking is only as good as the human response to an alarm. Imagine a scenario in which a terrorist steals a radioactive source that has a tracking mechanism attached to it. The terrorist cuts the source from the device that contained it. The tracking system would then send an alarm to the authorities. If the authorities have not developed an adequate response plan, the terrorist may be able to steal the source without being caught and use it in an act of radiological terrorism. In sum, I want to emphasize that I strongly support developing a real-time tracking system as well as training authorities to develop effective response plans to theft or diversion of radioactive sources.

Post-Hearing Questions for the Record Submitted By
The Honorable Senator Daniel K. Akaka
Hearing on U.S. International Efforts to Secure Radiological Materials
Subcommittee on Oversight of Government Management, the Federal Workforce, and the District of Columbia
Committee on Homeland Security and Governmental Affairs
March 13, 2007

Questions for Dr. Ferguson - Council on Foreign Relations

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