Introduction: Why a New Database?

Providing free and open access to centralized information on material that has been lost, stolen, or is otherwise out of regulatory control, the new Global Incidents and Trafficking Database prepared by the James Martin Center for Nonproliferation Studies (CNS) offers researchers and policymakers a unique resource to assess the nature and scope of nuclear security risks. The initial 2013 Annual Report, and subsequent reports, will highlight relevant implications for policymakers working to improve nuclear security.

Maintaining control over nuclear and other radioactive material globally is vital to both nonproliferation and prevention of nuclear terrorism. As a conference bringing together regulatory, intelligence, and law enforcement organizations from around the world and convened by the International Atomic Energy Agency (IAEA) affirmed, "terrorist groups have the intention of attempting to acquire and use nuclear or radioactive material for malicious acts," and "the possibility of an attempt is real."[1] Even a poorly constructed radiological dispersion device—commonly but inaccurately known as a "dirty bomb"—could incite widespread panic and generate significant contamination. This makes it imperative to keep nuclear and other radioactive materials under regulatory control at all times.

Non-state actors cannot build an improvised nuclear device or a radiological dispersion device (RDD) unless regulatory control for the relevant materials has been compromised due to theft, loss, or abandonment. Yet as the CNS database shows, with so much radioactive material in use worldwide, it is routinely lost or stolen. The theft near Mexico City in December 2013 of a truck carrying a cobalt-60 teletherapy machine is the most well-known recent example. It involved a radioactive source particularly well-suited to use in an RDD. But it is important to understand how *any* type of nuclear or radioactive material requiring control has left regulatory control. Whether the loss of control is due to an intentional criminal act or negligence, each incident has some nuclear security impact, because: (1) the associated materials are now hypothetically available for unauthorized purposes, including criminal or terrorist acts; and (2) the circumstances surrounding loss of control over the materials may illuminate gaps in the global nuclear security architecture that could alert policymakers, regulators, law enforcement, and other relevant authorities, and enable them to take corrective actions to prevent more serious diversion of materials. For these reasons, the database accompanying this report tracks open source information on incidents involving loss of regulatory control over any nuclear or other radioactive material requiring such control.

This new database seeks to fill a critical gap. No other existing database is both globally comprehensive and freely available to the public. The International Atomic Energy Agency's (IAEA) Incident and Trafficking Database (ITDB) is the most significant comparison product, but its collection and reporting constraints (it is for official use only), make it useful only to those policymakers and nuclear security professionals who have access to the data, and not to academics and most non-governmental experts and researchers. While the IAEA reports annually on incident numbers and provides selected examples, it does not share incident details publicly. More than 120 states—representing approximately two-thirds of the IAEA's total membership—report information to the ITDB. However, because ITDB reporting is voluntary, member states may fail to report incidents in a timely manner or at all. While ITDB staff monitor open source literature for media and other incident reports, neither detailed reports to member states nor public reports of aggregate incident numbers include any incident unless it has been reported or confirmed by the relevant member state's ITDB liaison.

A number of other databases exist. For example, the International Criminal Police Organization (INTERPOL) and the European Union's law enforcement agency (EUROPOL) maintain the Geiger Project and Rutherford databases respectively. But neither is available to the public. Other databases, such as the one maintained at the University of Salzburg and the Threat and Diversion Incident Analysis System (THADIAS) database maintained by Argonne National Laboratory in Illinois, are only accessible with the permission of the owners. National regulatory authorities in countries with strong accountancy and transparency standards—such as the U.S. Nuclear Regulatory Commission (NRC)—may provide public reporting on cases, but do so only for incidents occurring within their jurisdictions. Furthermore, regulatory authorities generally provide little context for specific incidents, limiting the utility of the data to general audiences.

From 1991 to 2012, CNS maintained a trafficking database that is available on the Nuclear Threat Initiative website; however, it exclusively covered incidents within or emanating from the Newly Independent States (NIS).[2] The new CNS Global Incidents and Trafficking Database relies on a mix of official (e.g., regulatory agencies) and unofficial (e.g., media reports) sources, and thus may include incidents not captured by the ITDB or publicly reported by government agencies. Moreover, as the resource matures and additional years of data are added, the CNS database will enable researchers to examine trends and assess the impact of new policies designed to reduce the threat.

Note on Methodology

For a complete methodology and dataset, please refer to the full database at http://www.nti.org/analysis/articles/global-incidents-and-trafficking-database.

- The database includes incidents reported January 1, 2013 through December 31, 2013.
- CNS researchers conducted global searches in fourteen major languages. Use of these languages also enabled in-depth native language searches for incidents in ninety-one countries.
- Researchers used a variety of sources, including countries' regulatory agencies, national and local news sources, and country-specific search engines.

Figure 1. Global Search Methodology.

Summarized Key Findings and Policy Implications

While the database remains a work in progress, the 153 incidents recorded in 2013 alone highlight the existence of ongoing safety and security risks posed by nuclear and other radioactive material out of regulatory control. Although it is too early to identify concrete trends, six key findings from the 2013 data have potential policy implications for how governments, regulatory authorities, and commercial end-users can improve their capacity to understand, mitigate, and prevent future incidents. These initial findings will be monitored as more data are accumulated, and corresponding policy implications will be reassessed and refined annually.

Please note: *This summary is provided for quick-reference purposes. The subsequent full report places the findings and implications in appropriate context, explaining each in greater depth in relation to the associated data and research.*

Key Finding 1: Highly Variable Transparency

For some countries with extensive nuclear or radioactive material holdings, there were few reported incidents, and none reported by the national regulatory authority (e.g., Russia, China, Brazil, and India). Conversely, the United States, Canada, and France comprised the majority of reported incidents, and almost all incidents were publicly reported by their respective regulatory authorities.

Policy Implication 1: Improving Transparency Through Capacity Building

Improving transparency and reporting worldwide would undoubtedly increase overall understanding of the problem, providing a more informed basis for effective policy solutions. Limited progress may be possible through capacity building in cases where the opacity problem is the result of limited regulatory capabilities.

Key Finding 2: Very Few Nuclear Material Incidents

Very few incidents involved nuclear material, accounting for only 8 percent of the 2013 dataset. Of the 12 cases that involved uranium and plutonium, none were reported to have involved material that was weapons usable in form or quantity.

Policy Implication 2: Remaining Vigilant About Nuclear Materials Security

The limited 2013 data concerning nuclear materials incidents provides an inadequate basis for policy recommendations. Critically, however, the fact that only 12 of the reported 2013 cases involved uranium or plutonium should not invite policy complacency concerning nuclear materials security. Given the catastrophic consequences that would result from an act of nuclear terrorism, the international community should remain vigilant about nuclear materials security, continuing to improve control and accountancy of nuclear materials worldwide.

Key Finding 3: Non-Nuclear Radioactive Materials Routinely Go Out of Regulatory Control

The majority of incidents involved non-nuclear radioactive materials, and particularly those used in industrial and medical applications. Few incidents, however, involved material that presented a significant safety or security risk.

Policy Implication 3: Improving Non-Nuclear Radioactive Material Control

While highly limited, the 2013 dataset highlights some ongoing difficulties in keeping non-nuclear radioactive materials under regulatory control. Subsequent findings examine in greater detail possible mechanisms for improving control over non-nuclear radioactive materials.

Key Finding 4: The Apparent Role of Human Negligence

The majority of incidents appear to have resulted from avoidable human negligence.

Policy Implication 4: Improving Training and Oversight to Reduce Negligence

A combination of improved personnel nuclear security training and enhanced end-user accountability could help minimize the number of future incidents primarily attributable to human negligence.

Key Finding 5: Transport Vulnerabilities

Incidents in 2013 suggest that materials are particularly vulnerable during transport.

Policy Implication 5: Focusing on Security for Materials in Transit

Increased policy emphasis should be given to how to improve security for radioactive materials in transit. National regulatory policies differ. In some cases, new regulatory requirements or guidelines may be useful. However, simple improvements to end-user training and awareness could also significantly decrease the number of incidents occurring in transit.

Key Finding 6: Opportunities for Radioactive Material Minimization

Many incidents involved radioactive materials—including particularly dangerous types—used in applications for which non-radioactive alternatives exist.

Policy Implication 6: Studying Conversion Opportunities

Replacing radioactive sources with non-radioactive alternatives, where appropriate, could reduce security risks and lessen regulatory burdens. In some cases, however, alternative technologies may not be practical or economically viable; thus careful cost-benefit analysis is needed to determine where conversion is warranted and how incentives can be best crafted to facilitate this process.

Key Finding 1: Highly Variable Transparency

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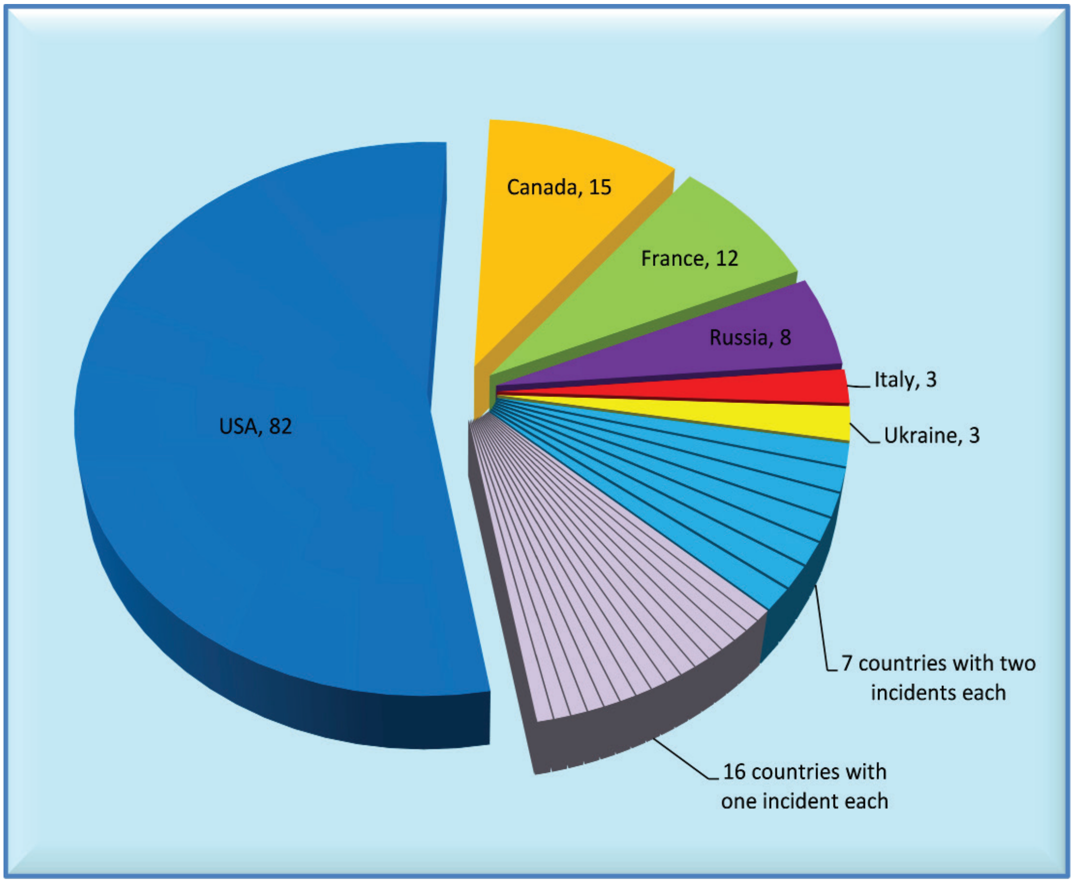
Figure 2. Incidents by Country.



Countries with two incidents: Belgium, England, Georgia, India, Israel, Japan, South Africa. Countries with one incident: Algeria, Australia, Brazil, China, Finland, Iran, Ireland, Malta, Mexico, Nigeria, Poland, Scotland, Sierra Leone, South Korea, Spain, and Sri Lanka.

Of the 153 cases documented in this new database, occurring in 30 different countries, 53 percent occurred in the United States, 10 percent in Canada, 8 percent in France, and 5 percent in Russia. A state regulatory authority issued reports of incidents in just five countries (Belgium, Canada, France, Japan, and the United States). In all other countries, incident reports appeared solely in the news media. Of the eighty-two incidents in the United States, seventy-eight were reported by the NRC; of the remaining four, three were reported in the media, and one by a state agency.

The data present an incomplete picture, but the geographical distribution of incidents suggests uneven levels of detection and/or reporting by countries' national regulatory authorities. For some countries with extensive nuclear or radioactive material holdings, there were few reported incidents, and none reported by the national regulatory authority. This was the case for Russia (8 cases); China (1 case); Brazil (1 case); and India (2 cases). These extremely low numbers are particularly striking in that they are comparable to the number of reported cases in some small countries that lack advanced nuclear sectors, such as Malta (1 case).

The robustness of countries' nuclear security cannot be implied from the available data, because countries' nuclear material holdings, detection capabilities, regulatory infrastructures, and transparency vary widely. Some of the countries listed as having the largest numbers of incidents may have reported a relatively large number of incidents because they have strong nuclear security cultures and good nuclear security programs, which have resulted in more incidents being caught and transparently reported. Likewise, a lack of incident reporting by national regulatory authorities or users of radioactive materials in certain countries does not always imply that the country has either a good nuclear security culture or a good nuclear security program; many more incidents may occur than are caught and/or reported.

In several instances, national regulatory authorities were newly established (Ghana), or had recently changed (Italy), leading to a lack of an official dataset. In one case (Nigeria), two undated regulatory-related events mentioned in a news report could not be dated and properly assessed due to the lack of official reporting. Weak or nonexistent governance in some locations worldwide inhibits incident reporting. For example, there is significant evidence to suggest that illegal uranium mining and shipment occurs in the Democratic Republic of the Congo.[3] However, no such incidents are included in the dataset, for lack of credible official or unofficial reporting. Wide variations in national regulatory capacity, reporting norms, and transparency therefore render meaningful country-to-country dataset comparisons impossible.

Policy Implication 1: Improving Transparency Through Capacity Building

Improving transparency and reporting worldwide would undoubtedly increase overall understanding of the problem, providing a more informed basis for effective policy solutions. Limited progress may be possible through capacity building in cases where the opacity problem is the result of limited regulatory capabilities.

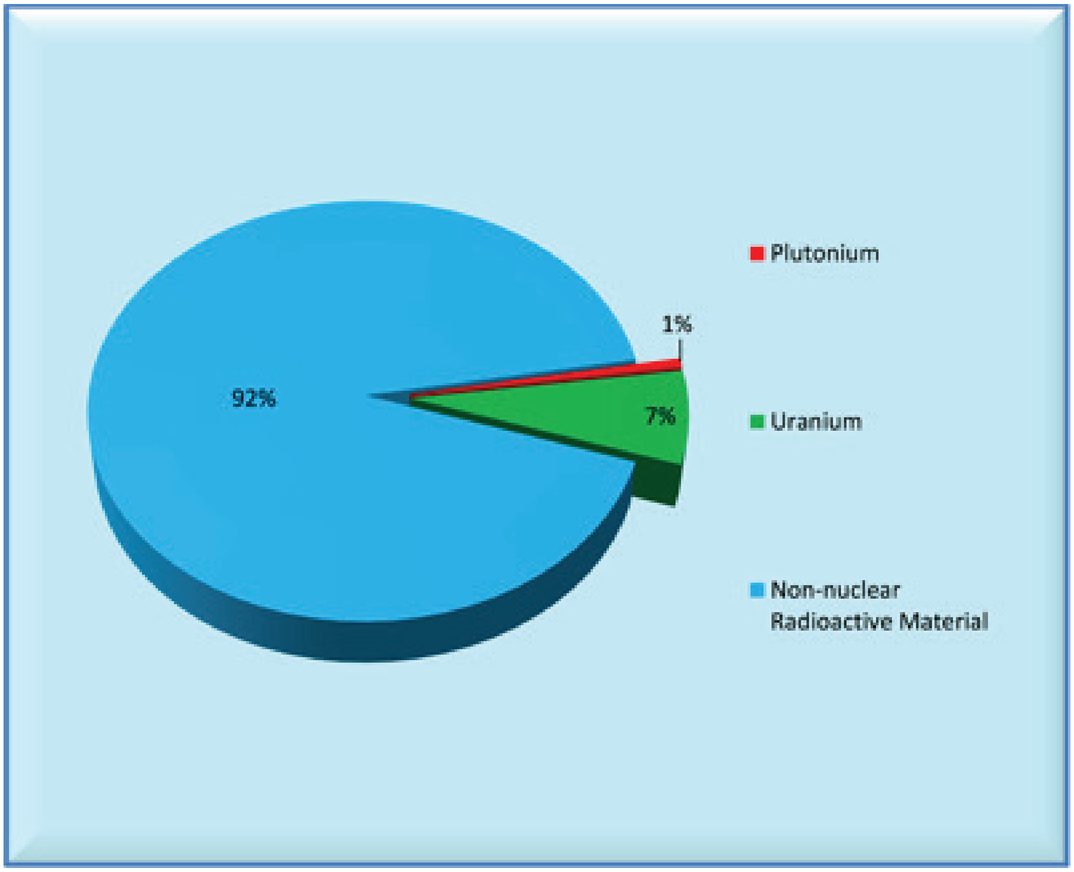
The IAEA does not make any country-specific incident data available publicly unless it is authorized by a country to do so, as it must operate the ITDB as directed by the member states. While some member states, such as the United States, report incidents and trafficking both to the ITDB and the general public, others only agree to provide data to the ITDB on the understanding that the information will remain confidential. ITDB reporting is voluntary, and each member state is free to determine what incidents it will report. The voluntary nature of ITDB reporting gives rise to concerns that some ITDB member states may fail to report or confirm incidents, and that reporting criteria may not be uniform among the ITDB member states.

Capacity building programs may offer the most promising avenue for progress to improve transparency and reporting globally. While some governments may fail to report incidents of which they are aware, others simply lack the capacity to regulate radioactive materials effectively. If no materials in a given country are genuinely under regulatory control, it is equally impossible to monitor and account for materials that fall out of regulatory control. UN Security Council Resolution 1540 provides one avenue for progress on this front. Adopted in 2004, UNSCR 1540 requires all states to support efforts to prevent non-state actors from developing, acquiring, manufacturing, possessing, transporting, transferring, or using nuclear, chemical, or biological weapons and their delivery systems. All states are required to establish appropriate controls to prevent the illicit trafficking of materials and components usable in such weapons. Through the 1540 Committee, major supporters of the resolution, including the United States, the European Union, and Japan, provide education, training, and other capacity-building assistance to states who request help improving their capabilities to comply with UNSCR 1540.

Key Finding 2: Very Few Nuclear Material Incidents

Very few incidents involved nuclear material, accounting for only 8 percent of the 2013 dataset. Of the 12 cases that involved uranium and plutonium, none were reported to have involved material that was weapons usable in form or quantity.

Figure 3. Incidents by Material Type.



Out of control uranium and plutonium represent only 8 percent of reported incidents. These included five involving depleted uranium; one involving uranium oxide, nitrate, and acetate; one involving an unknown quantity of yellowcake; one involving uranium tail millings; and three involving an unknown form of uranium. Only one incident involved plutonium, in the form of a plutonium-beryllium neutron source. The source was stolen from storage at Tabriz University in Iran on August 13, 2013; a preliminary investigation indicated that it had been removed from its shielding.

The low number of reported incidents involving uranium and plutonium is at least in part a reflection of the more robust security mechanisms for nuclear versus other radioactive materials. Control over nuclear materials has improved dramatically in recent years due in part to President Obama's 2009 call to "secure all vulnerable nuclear material in four years."[4] Out of this initiative emerged the Nuclear Security Summit process, which has served to focus high-level attention globally on strengthening nuclear security, and to build a common sense of urgency around the threat of nuclear terrorism. As a result, many countries have upgraded security measures at sites housing weapons-usable material, consolidated material holdings to fewer locations, or eliminated their stocks entirely.

In addition, a number of countries have strengthened national legislation governing nuclear security. This is in part due to a push within the summit process to bring into force the 2005 amendment to the Convention on the Physical Protection of Nuclear Material (CPPNM), the ratification of which requires states to adopt laws and regulations to ensure adequate physical protection for nuclear material located on their territories. Absent the amendment, the convention's provisions on physical protection only apply to nuclear material while in international transport. The IAEA also released an updated version of its recommendations on the physical protection of nuclear materials in 2011.[5] While implementation of the IAEA recommendations is voluntary, most nuclear suppliers require compliance with them as a condition for bilateral nuclear trade agreements, creating strong incentives for states to do so.

Despite substantial improvements, it remains difficult to assess the degree to which more serious nuclear material incidents may be either underreported or unknown. Not all nuclear traffickers are caught; even more fundamentally, poor nuclear materials accountancy in some countries makes it impossible to know whether nuclear material is missing, and in what forms and/or quantities.

Policy Implication 2: Remaining Vigilant About Nuclear Materials Security

The limited 2013 data concerning nuclear materials incidents provides an inadequate basis for policy recommendations. Critically, however, the fact that only twelve of the reported 2013 cases involved uranium or plutonium should not invite policy complacency concerning nuclear materials security. Given the catastrophic consequences that would result from an act of nuclear terrorism, the international community should remain vigilant about nuclear materials security, continuing to improve control and accountancy of nuclear materials worldwide.

Key Finding 3: Non-Nuclear Radioactive Materials Routinely Go Out of Regulatory Control

The majority of incidents involved non-nuclear radioactive materials, and particularly those used in industrial and medical applications. Few incidents, however, involved material that presented a significant safety or security risk.

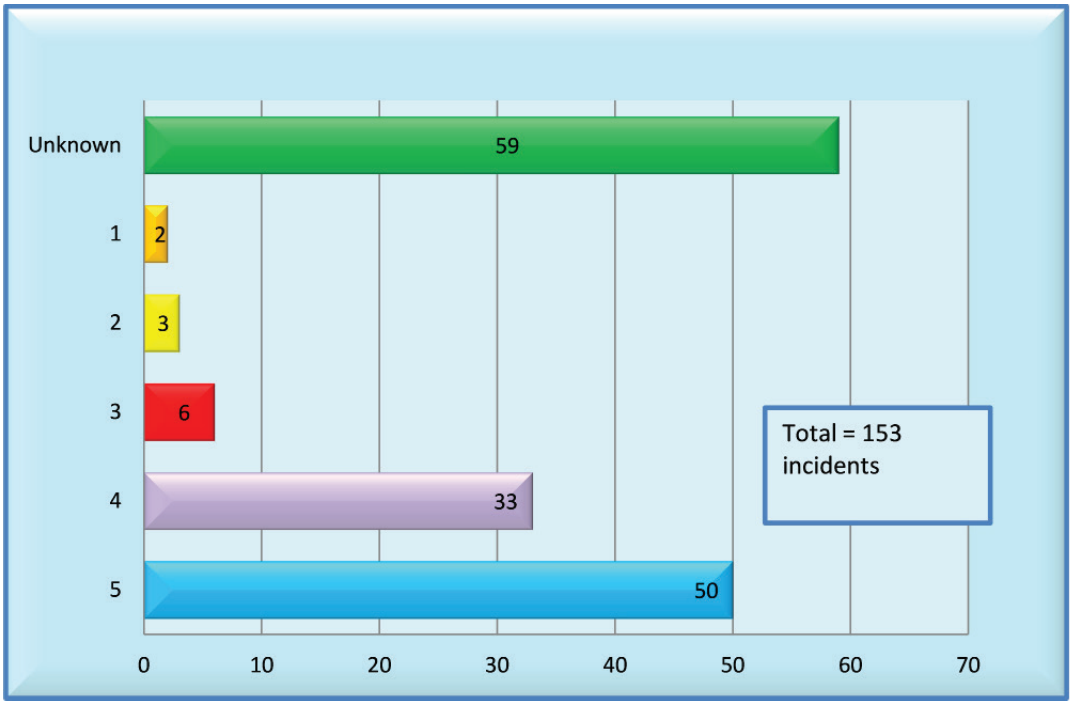
The far larger number of reported incidents involving non-nuclear radioactive materials relative to nuclear materials could be the result of several factors. First, non-nuclear radioactive materials routinely go out of control because of their comparatively vast numbers. The IAEA notes that, "millions of radioactive sources have been distributed worldwide over the past 50 years, with hundreds of thousands currently being used, stored, and produced."[6] Second, whereas a significant percentage of nuclear materials are under direct government or military control, the majority of other radioactive materials are in civil use, often in low-security settings such as construction job sites or hospital operating rooms. Third, national legislation governing the control of non-nuclear radioactive material is generally weaker than that covering nuclear material. Improving the security of these materials has not been a high priority at the international level.

Although an act of radiological terrorism would cause far less destruction than an act of nuclear terrorism, such an event could result in mass panic and economic disruption. In a 2002 *Scientific American* article, researchers with the Federation of American Scientists calculated the hypothetical effects of a dirty bomb containing 3,500 curies of cesium-137—which weighs just 41.4 grams or 1.46 ounces—exploded in New York City.[7] They found that such a device could contaminate most of Manhattan to levels above current Environmental Protection Agency decontamination guidelines, affecting hundreds of billions of dollars' worth of property, and requiring a costly and time-consuming cleanup (not least because cesium-137 binds with concrete and asphalt, making it very difficult to remove). While an attack utilizing a radiological dispersion device has yet to occur, some extremist groups have indicated an interest. For example, in 1995 Chechen rebels boasted of their ability to construct a dirty bomb by contacting a Russian television station to declare they had buried a container of radioactive material in Moscow's Ismailovsky Park.[8] Security authorities subsequently discovered a partially buried container holding 10-50 millicuries of cesium-137 in the precise location indicated by the rebels. The origin of the cesium was never identified.[9]

Fortunately, few of the reported incidents involved the most dangerous radioactive materials. The IAEA categorizes radioactive sources according to their safety and security risks. Categories 1-3 are considered extremely dangerous, very dangerous, and dangerous to persons, respectively, making these sources of greatest concern for radiological terrorism. Two Category 1 cases reportedly occurred in 2013. In December 2013, a highly publicized incident occurred in Mexico, in which thieves stole a truck that was transporting a device containing cobalt-60 to a disposal center. The thieves were arrested and the device recovered. A far less publicized Category 1 event occurred in Canada, involving another cobalt-60 source. A "gamma knife" device, used in the medical sector, was reported missing; at the time of writing, it had not been recovered. Both incidents demonstrate ongoing difficulties in keeping the most dangerous radiological sources secure.

While IAEA Category 1, 2, and 3 radioactive sources pose the greatest risks, the loss of regulatory control over sources in other categories can still generate significant public concern. Furthermore, it must be understood that the IAEA categorization scheme is based only on external radiation exposure, or "pocket doses" as some refer to the concept (i.e., the potential harm caused by a source located in one's pocket). Certain sources, such as those containing polonium-210, may not pose a threat when outside the human body; therefore, their lethality may be underestimated in the IAEA's categorization scheme. If an individual received a direct internal dose of such a source, for example through ingestion, the danger could be magnified. Four reported incidents involved a lost polonium-210 Category 4 source. Two of these incidents involved devices that contained twenty times the lethal dose of polonium-210, which would be more than sufficient to cause significant injury, or death by poisoning or contamination of food or water supplies (e.g., polonium-210 was allegedly used to assassinate former Russian FSB officer Alexander Litvinenko in London in 2006).[10] None of these devices were found, and in one case, nearly five months passed between the licensee's last use of the device and the day it was reported missing.

Figure 4. Incidents by IAEA Category.



Understanding the distribution of radioactive materials incidents relative to their civil applications also provides insights into the data. Non-nuclear radioactive materials used in the industrial, commercial, medical, academic and research sectors are all represented in the 2013 dataset. Radioactive sources are found at construction sites, in hospitals and clinics, at universities and research institutions, and even in private homes. For data collected in 2013, incidents involving industrial applications represented 34 percent of all cases, while medical applications represented 17 percent. It is commonly understood that the majority of radioactive material use occurs in the industrial and medical sectors, making it unsurprising that the majority of incidents occurred in these sectors.

The greater number of incidents involving out of control industrial sources when compared to incidents involving medical sources may reflect differences in the characteristics of the sources used in the respective applications rather than the distribution of sources between these applications. Radioactive sources used in some medical applications are typically large, and once installed, a device—such as a radiotherapy machine used for cancer treatment—is generally stationary, making a loss or theft all but impossible while the source is in use. In contrast, many industrial sources—such as gauges used to measure density and moisture content—are portable, making them particularly susceptible to loss or theft while being used at job sites or during the significant periods of time they spend in transit.

Policy Implication 3: Improving Non-Nuclear Radioactive Material Control

While highly limited, the 2013 dataset highlights some ongoing difficulties in keeping non-nuclear radioactive materials under regulatory control. Subsequent findings examine in greater detail possible mechanisms for improving control over non-nuclear radioactive materials.

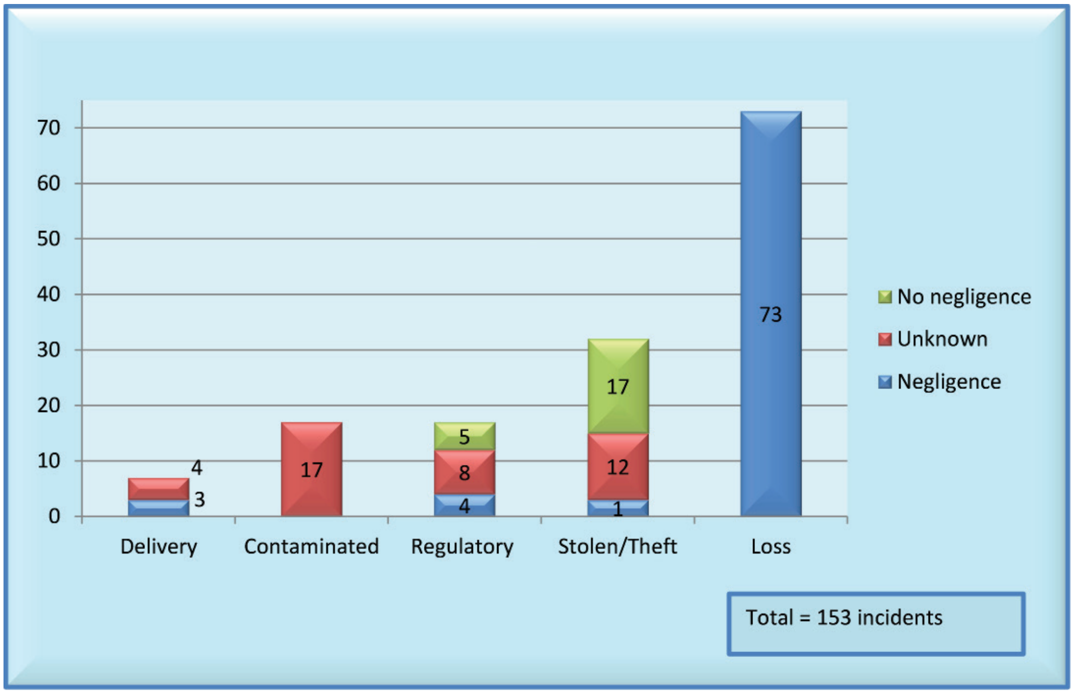
While few of the reported incidents involving non-nuclear radioactive materials present serious security risks, they highlight mechanisms through which more dangerous radioactive materials could go out of regulatory control. The 2013 dataset also illuminates an ongoing need for countries' regulatory bodies and relevant non-governmental organizations to work with major users of radioactive materials—from construction firms to hospitals—to improve control over radioactive materials in the civilian sector. As discussed in Key Finding 4, human negligence appears to be a major contributing factor to many incidents in the industrial, medical, and other sectors. As such, one of the most effective and practicable approaches to reducing incidents may be for regulators to work with end-users to improve nuclear security training and awareness among relevant personnel.

Improving awareness may be particularly important in cases where sources are not heavily regulated but nonetheless could pose serious risks (e.g., sources containing polonium-210). Updating the IAEA categorization scheme to capture the threat posed by ingested or inhaled sources, or to better account for the attractiveness of certain sources usable in a radiological dispersion device, is probably unrealistic. The IAEA's categorization scheme is used for a variety of purposes beyond security guidance, and revising it would therefore have broader implications. It is important, however, that regulators and users understand how the categorization scheme functions, and its limitations with respect to the specific devices they employ on a daily basis.

Key Finding 4: The Apparent Role of Human Negligence

The majority of incidents appear to have resulted from avoidable human negligence.

Figure 5. Incidents Linked to Negligence.



Fifty-three percent of the reported incidents in 2013 were linked to negligence, including one-hundred percent of the 73 losses. These incidents were therefore largely avoidable, had relevant individuals taken greater precautions. For example, on February 1, 2013, a patient was treated with iodine-125 radioactive seeds. During the post-surgical cleanup, a seed was apparently mistakenly discarded as medical waste. In another incident reported on April 4, 2013, a person in California transporting a soil moisture gauge containing 50 millicuries of americium-241 placed the gauge in his pickup truck next to the tailgate and drove to a new job site. Upon arriving, he noticed the gauge was missing. On May 15, 2013, a worker in West Virginia using a similar gauge put it in the back of his truck and drove about one-and-a-half miles, at which point he realized the gauge was missing and that the tailgate was down. The gauge was retrieved from a highway. On September 11, 2013, another moisture density gauge was reported stolen from the back of a pickup truck in Virginia. However, it had actually fallen off the truck and was recovered.

Lax inventory controls are another common form of negligence. For example, during a routine February 7, 2013 inspection at a paper plant in Pine Hill, Alabama, an inspector noticed that a fixed gauge containing 100 millicuries of cesium-137 had been missing since March 2005.

Policy Implication 4: Improving Training and Oversight to Reduce Negligence

A combination of improved personnel nuclear security training and enhanced end-user accountability could help minimize the number of future incidents primarily attributable to human negligence.

Individuals who routinely use devices containing radioactive sources—such as construction workers or hospital technicians—may not fully understand the potential security and safety risks of a lost or stolen device. It is impossible to definitively link negligence with a lack of training; however, inadequate training is known to negatively affect awareness and attentiveness.

While broader trends cannot be established, the 2013 dataset also suggests that often, when a loss or theft occurs due to negligence, there is little or no personnel accountability. Warnings, reprimands, and citations are rarely reported as having been given when an incident occurs, and losses due to negligence are typically categorized as accidents. It is a matter of debate whether such policies should change, as negative employment consequences would be likely to disincentivize self-reporting by individuals when radioactive materials are lost or stolen.

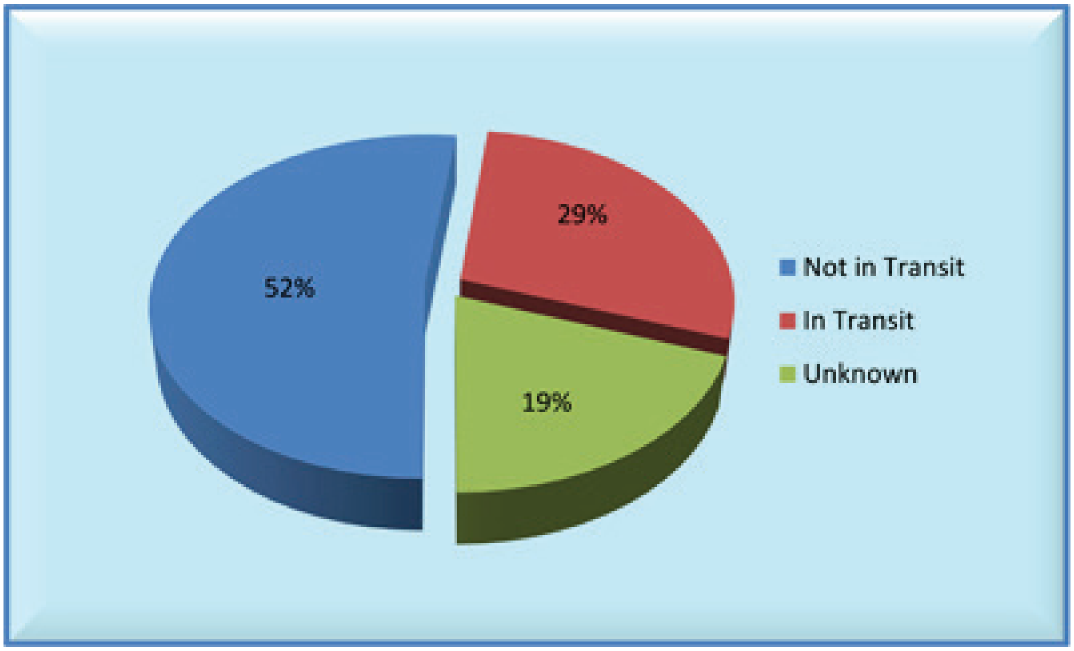
Lessons from the U.S. case may have wider global applicability, as the human security element is universally challenging. A 2011 Government Accountability Office (GAO) report stated that "NRC-required training is not sufficient, and personnel at hospital and medical facilities are not required to have security training, although they implement NRC requirements at their sites."[11] The GAO cites two specific examples of Radiation Safety Officers (RSOs), one with a background as a health physicist, and the other with a background in construction. Both expressed doubt concerning their abilities to understand and implement security measures. RSOs have primary managerial responsibility for the safety and security of radioactive materials at their organizations. It is highly unlikely, if such managers lack sufficient nuclear security training, that individual workers will understand the risks associated with radioactive sources employed in their fields.

In addition to education and training to increase awareness and attentiveness, basic security measures could have prevented or mitigated many of the incidents that resulted from negligence. For example, the U.S. NRC's 2005 Increased Control Order provided a framework for increasing security in regards to Category 1 and 2 sources. The order required licensees to restrict access to Category 1 and 2 sources to individuals deemed trustworthy and reliable; to monitor such sources; detect unauthorized access; and have a response plan in place with local law enforcement.[12] While these requirements are general, RSOs interviewed by the GAO stated that the requirements made a "great difference" and provided "very clear justification" for the costs associated with security measures.[13] No such document, either from the IAEA, the NRC, or other national regulatory bodies, addresses basic security measures for Category 3, 4, and 5 sources in the same manner.

Key Finding 5: Transport Vulnerabilities

Incidents in 2013 suggest that materials are particularly vulnerable during transport.

Figure 6. Incidents During Transit.



Nearly one-third of all documented incidents in 2013 (29 percent) involved material in transit.[14] Of the 30 reported thefts of material, 57 percent involved transportation, while 15 percent of the 73 losses did.

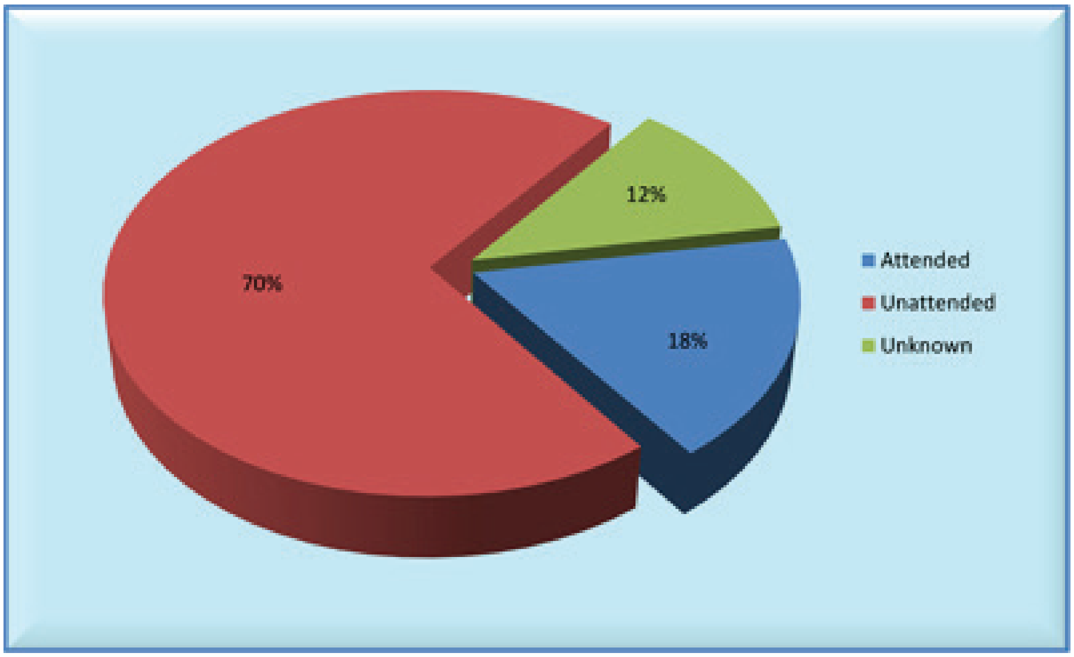
Incidents that occurred in transport are further classified as either "movement," in which the device was in a moving vehicle (28 incidents); or "stationary" (14 incidents), in which the vehicle was not in motion at the time of the incident. Critically, all stationary incidents were thefts.

The most publicized incident in 2013 was a theft during movement. On December 2, 2013, gunmen near Mexico City forced the drivers of a truck transporting a decommissioned cancer therapy machine to abandon their vehicle. The machine contained an encapsulated Category 1 cobalt-60 source (reportedly about 3,000 curies), thus posing serious safety and security concerns. Mexican authorities appealed to the public for help locating the truck and its contents, while also alerting the thieves to the dangerous nature of the radioactive material sealed inside the device.[15] Two days later, police recovered the material in a cornfield, with the truck nearby.

Since thefts of materials in transit are of particular policy interest, these are further classified, possibly illuminating areas of security vulnerability. First, thefts during transit are classified as "stolen from vehicle" (11 incidents); "stolen with vehicle" (2 incidents); "stolen from individual" (2 incidents); or "unknown" (2 incidents). An example of a "stolen from vehicle" incident was reported on February 4, 2013, in Phoenix, Arizona, where an individual broke into a locked steel box bolted to the bed of a truck parked outside a private home and stole a density gauge. There is no proof that the individual was aware of what he was stealing; many such crimes appear to be thefts of opportunity. One "stolen with vehicle" incident occurred on November 18, 2013, when an individual stole a truck carrying a density gauge while the truck was parked outside of a home. As in most cases classified as "stolen with vehicle," it appears that the individual targeted the vehicle without being aware of its contents. In one "stolen from individual" incident, an individual was riding a passenger train and carrying a portable industrial X-ray device. At one point, the individual noticed the device was missing and reported it stolen.

Thefts during transit are also classified according to whether the material stolen was attended or unattended when the theft occurred. The material was attended at the time of the theft in only three of the 17 thefts during transit. In the remaining 14 incidents, the material had been left unattended when the theft occurred.

Figure 7. Thefts During Transit.



Policy Implication 5: Focusing on Security for Materials in Transit

Increased policy emphasis should be given to how to improve security for radioactive materials in transit. National regulatory policies differ. In some cases, new regulatory requirements or guidelines may be useful. However, simple improvements to end-user training and awareness could also significantly decrease the number of incidents occurring in transit.

In most countries, once a device containing radioactive material is licensed for use, there appears to be little regulation governing its transportation and storage (this is particularly true of Category 3, 4, and 5 sources). In the United States, while radioactive sources must be locked into vehicles while in transit, regulations do not prohibit leaving sources in an unattended vehicle.[16] Incident data for 2013, which includes multiple thefts from parked vehicles, suggests the possible need for additional regulation of radioactive materials while in transit, such as requiring that materials not be left unattended for lengthy periods in areas where there is general public access.

Many of the incidents that occurred during transport reflect simple negligence, and could easily have been avoided (e.g., incidents in which a licensee forgot to secure a source, and the source fell off the truck while in transit). Such incidents reinforce Key Finding 4, concerning the need to improve nuclear security training for personnel working with radioactive materials.

Key Finding 6: Opportunities for Radioactive Material Minimization

Many incidents involved radioactive materials—including particularly dangerous types—used in applications for which non-radioactive alternatives exist.

There are numerous applications for which radioactive materials are used when acceptable non-radioactive technological substitutes exist, suggesting possible avenues for technology conversion. Indeed, a 2008 National Academy of Sciences report found non-radioactive replacements "exist for nearly all applications of Category 1 and 2 [radioactive] sources."[17] For example, many hospitals in the United States and other developed countries have switched from using teletherapy devices, such as the Category I cobalt-60 source stolen outside Mexico City in December 2013, to employing linear accelerators (linacs) to deliver comparable medical treatment. Like X-ray machines, "accelerators produce radiation only when they are on, but do not contain anything radioactive and therefore pose little risk of misuse."[18] Similarly, the "Gamma Knife" that went missing in Canada in April 2013 is commonly used to treat brain lesions, a treatment which in some cases can be performed by linac-based alternatives.[19]

The use of radioactive materials when alternatives exist imposes both security risks and a regulatory burden on government, industry, and end-users, which may or may not outweigh any technology conversion costs. Indeed, non-radioactive alternatives can lower and even eliminate the particular manufacturing, transportation, recycling, and disposal costs that arise precisely because of the safety and security concerns associated with life-cycle management of radioactive sources. Furthermore, in some countries, such as the United States, licensees and manufacturers are often not required to pay the full costs of disposal of certain sources, which passes the burden on to regulators and therefore the public.[20] This is partly because there is no commercial disposal pathway available for certain sources, forcing end-users to keep them in storage and creating risks of improper source disposal. Indeed, a number of 2013 incidents appear to have resulted from improper disposal of a device containing a radioactive source. The U.S. National Nuclear Security Administration's Offsite Source Recovery Project (OSRP) recovers unwanted or abandoned sources, and a number of countries committed to similar efforts at the 2012 Nuclear Security Summit, but at least in the case of the OSRP, a "substantial backlog remains."[21]

In the long-term, converting new production to non-radioactive alternatives—when this is warranted—will reduce the overall costs and risks associated with appropriate long-term disposal of radioactive materials. However, conversion efforts should specifically provide for the safe, secure, and comprehensive disposal of obsolete sources. Otherwise, they risk precipitating en masse improper disposal of any devices containing obsolete sources, worsening associated safety and security challenges in the short-term. Two 2013 cases involved radiological sources used historically in high school science classrooms; an incident in France involved obsolete sources last used in the 1960s and 1970s. Obsolete radioactive "lightning preventers" even surfaced in one 2013 case.[22] These incidents highlight the importance of proper disposal of obsolete sources once new technologies replace them.

Policy Implication 6: Studying Conversion Opportunities

Replacing radioactive sources with non-radioactive alternatives, where appropriate, could reduce security risks and lessen regulatory burdens. In some cases, however, alternative technologies may not be practical or economically viable; thus careful cost-benefit analysis is needed to determine where conversion is warranted and how incentives can be best crafted to facilitate this process.

2013 data suggest the need to examine whether it would be feasible, appropriate, and cost-effective to phase out certain uses of radioactive materials and convert to non-radioactive substitutes. The regulatory costs associated with their manufacture, distribution, use, and disposal, along with the safety and security risks they pose if mishandled or improperly disposed of, may exceed the costs of utilizing an alternative, non-radioactive technology. Cost-benefit analysis of select cases could determine if conversion is warranted, and assess how much government assistance would be needed to encourage suppliers to move to non-radioactive technologies and dispose of obsolete sources.

Preliminary Conclusions

A central takeaway from the 2013 data is the need for a thorough and open debate on how best to address the safety and security risks posed by nuclear and other radioactive material out of regulatory control. By centralizing both official and unofficial reports, the CNS Global Incidents and Trafficking Database and associated 2013 preliminary findings seek to inform the debate about how to reduce and manage the risks of "out of control" nuclear and other radioactive materials. However, governments, industry, and the media remain the pivotal linchpins to enhanced transparency. Fully bridging the information gap on the nature and scope of the problem will only be possible with major improvements to countries' reporting capacity and transparency. The problems with materials security described in this report are almost certainly more widespread than 2013 incident numbers and geographic distribution suggest, but how much more is unknown. While entrenched political and commercial barriers impede transparency, capacity-building efforts—through, for example, enhanced implementation of UNSCR 1540—could prove effective in countries where transparency problems are causally linked to weak national regulatory capabilities. Addressing individuals' and countries' reluctance to report known incidents publically will be far more challenging.

Although it is not possible to draw definitive conclusions based on a single year of data, the six key findings and associated policy implications presented in this report highlight possible areas for further study. In designing policies to improve regulatory control over nuclear and other radioactive materials, careful cost-benefit analysis will be essential. A clear thematic takeaway from the 2013 data is that tensions persist between the imperative of improving nuclear and other radioactive materials security and continuing to reap societal benefits from their peaceful use. As a 2011 GAO report observes of medical use regulatory dilemmas, "officials from smaller medical facilities told us that implementing specific security requirements—such as cameras and other surveillance equipment—could jeopardize their continued operations because of the costs associated with this equipment."[23] Regulation addressing issues such as materials in transport, material minimization, and personnel training and accountability could prove burdensome to civil users, impeding the ability of hospitals to treat patients or construction firms to complete jobs. Further study and outreach to key stakeholders is needed to determine where action is actually warranted and will not unfairly disadvantage critical peaceful uses. Striking the right balance between security and use needs will pose increasing challenges as time passes, for as the IAEA notes, "[t]he use and availability of nuclear material and other radioactive material can be expected to grow, thereby increasing the risks of illicit trafficking and the potential for radioactive material to fall out of regulatory control."[24]

As the CNS database matures and more data become available for analysis, future reports will seek to compare incidents within specific countries from year to year, identify trends, and examine the impact—if any—of new policies.

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14. Transit or transport refers to material that is currently not in its permanent storage location. Transit includes material in shipment, material in a vehicle under transit, and material stored in a stationary vehicle. Further, transit includes material being carried by an individual. For example, one incident involves a device stolen from an individual on a passenger train. Transit does not include any material detected at a scrap yard, even if the material was in a disposal vehicle. Last, transit does not include material in a hospital that is not in storage, but in another part of the hospital (e.g., on its way to an operating room).

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