United States Senate
PERMANENT SUBCOMMITTEE ON INVESTIGATIONS
Committee on Homeland Security and Governmental Affairs

Carl Levin, Chairman
Norm Coleman, Ranking Minority Member

DIRTY BOMB VULNERABILITIES

STAFF REPORT

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UNITED STATES SENATE

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DIRTY BOMB VULNERABILITIES

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I. INTRODUCTION

Since 2003, the U.S. Senate Permanent Subcommittee on Investigations ("PSI" or the "Subcommittee") has engaged in a bipartisan investigation into U.S. government efforts to prevent a nuclear or radiological attack on U.S. interests. The Subcommittee's efforts have included oversight investigations into U.S. port security and global supply chain security.[1] In addition, PSI has, with the assistance of the U.S. Government Accountability Office (the "GAO"), probed certain vulnerabilities in the U.S. government's practices and procedures for issuing licenses to possess radiological materials. This report is another component in that effort, examining certain vulnerabilities in U.S. regulation of radiological materials and whether America's enemies could exploit those weaknesses to develop a so-called "dirty bomb."[2] Finally, this report presents certain recommendations to remedy those vulnerabilities.

II. EXECUTIVE SUMMARY

Dirty bombs pose an ongoing terrorist threat that the United States must be prepared to counter. The Executive Director of the 9/11 Commission stated in 2004 that Al Qaeda "remains interested in using a radiological dispersal device or 'dirty bomb.' … Documents found in al Qaeda facilities contain accurate information on the usage and impact of such weapons."[3] Similarly, in September 2006, then-leader of Al Qaeda in Iraq Abu Hamza al-Muhajir was reported to have called for "nuclear scientists and explosive experts" to help his terrorist group manufacture "unconventional weapons, whether biological or dirty, as they call them."[4] Likewise, would-be terrorists arrested in London in August 2004 reportedly sought to construct "a crude radiological dirty bomb."[5]

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[1] The Subcommittee's investigation into these security matters has featured a series of hearings including a May 2005 hearing entitled "*The Container Security Initiative and The Customs-Trade Partnership Against Terrorism: Securing the Global Supply Chain or Trojan Horse?*" In March 2006, the Subcommittee held a two-part hearing called "*Neutralizing the Nuclear and Radiological Threat: Securing the Global Supply Chain: Parts One and Two*." In conjunction with that hearing, the Subcommittee released a bipartisan report, entitled *An Assessment of U.S. Efforts to Secure the Global Supply Chain*, which provided a detailed assessment of numerous port security and global supply chain security programs. *See* http://www.hsgac.senate.gov/index.cfm?Fuseaction=Hearings.Detail&HearingID=336 and http://www.hsgac.senate.gov/index.cfm?Fuseaction=Hearings.Detail&HearingID=335.

[2] The U.S. Nuclear Regulatory Commission defines a "dirty bomb" as follows: A "dirty bomb" is one type of a "radiological dispersal device" (RDD) that combines a conventional explosive, such as dynamite, with radioactive material. The terms dirty bomb and RDD are often used interchangeably in the media. Most RDDs would not release enough radiation to kill people or cause severe illness - the conventional explosive itself would be more harmful to individuals than the radioactive material. However, depending on the scenario, an RDD explosion could create fear and panic, contaminate property, and require potentially costly cleanup." *See* NRC *Fact Sheet on Dirty Bombs* at http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/dirty-bombs.html. While the NRC states that a nuclear bomb would be a "Weapon of Mass Destruction," it indicates that a dirty bomb is a "Weapon of Mass Disruption," in which "contamination and anxiety are the terrorists' major objectives." *See id.*

[3] *See* Staff Statement of Dr. Philip D. Zelikow, Executive Director of the National Commission on Terrorist Attacks Upon the United States, June 16, 2004.

[4] *See* David Rising, Associated Press, "*Al Qaeda in Iraq Beckons Nuclear Scientists*," September 29, 2006 ("The fugitive terrorist chief said experts in the fields of 'chemistry, physics, electronics, media and all other sciences -- especially nuclear scientists and explosives experts' should join his group's jihad, or holy war, against the West. 'We are in dire need of you,' said the speaker. 'The field of jihad can satisfy your scientific ambitions, and

In light of this threat, regulation and tracking of radioactive materials have become more important than ever.[6] This report explores some fundamental gaps in the federal government's regulation of radiological materials, in particular, vulnerabilities in the procedures employed by the U.S. Nuclear Regulatory Commission (the "NRC") to administer licenses for such materials. These vulnerabilities were exposed when the GAO, at the request of this Subcommittee, conducted a clandestine operation to create a dummy corporation and obtain a valid NRC materials license to purchase certain nuclear materials. After a cursory review, the NRC issued the materials license to GAO's dummy corporation in just 28 days.

Additional weaknesses were identified when the GAO was able to counterfeit the NRC license – using publicly available, off-the-shelf computer software – to remove restrictions on the quantity of radiological materials permitted under the license. GAO investigators then used the counterfeited licenses to execute contracts to buy enough radiological materials to meet the NRC's definition of a "dangerous" quantity – enough to build a dirty bomb. Perhaps more importantly, investigators reported that they could have easily prolonged their effort, generating dozens of fake licenses, visiting multiple suppliers, and stockpiling significantly higher amounts of this (and potentially more radioactive) material. The GAO states that it could have purchased "substantially more radioactive source material," possibly enough to reach the threshold of a "very dangerous" quantity. In other words, the modest amount of radiological materials that the GAO sought to purchase was but a demonstration amount, and it could have been considerably larger and considerably more dangerous.

The weaknesses in NRC licensing procedures are not new. In fact, as described in this report, several entities – including the GAO, the NRC Inspector General, and this Subcommittee – have recommended over the past four years that the NRC improve its licensing procedures to ensure that radiological materials will be used as intended. To its credit, the NRC has recently shown a willingness to strengthen its licensing process, including making changes in June 2007 as a response to the GAO's latest clandestine operation. Those recently-adopted changes are reviewed below, along with several recommendations designed to improve NRC regulation even further.

Based upon its investigation, the Subcommittee staff makes the following recommendations:

- The NRC should reevaluate the apparent good-faith presumption that pervades its licensing process.
- The NRC should regulate Category 3 sources more stringently. Specifically, the NRC should (i) physically inspect applicants' facilities *before* the issuance of a Category 3 materials license, and (ii) consider including Category 3 sources in the proposed National Source Tracking System.
- The NRC should act quickly to establish a web-based licensing system to ensure that source materials can be obtained only in authorized amounts by legitimate users.

These recommendations are designed to bolster the NRC's ability to prevent radiological materials from being acquired to create a dirty bomb.

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the large American bases [in Iraq] are good places to test your unconventional weapons, whether biological or dirty, as they call them.'").

[5] *See* Adam Zagorin and Elaine Shannon, Time Magazine, "*London's Dirty-Bomb Plot*," October 3, 2004, http://www.time.com/time/magazine/article/0,9171,1101041011-708959,00.html.

[6] The term "radioactivity" denotes the spontaneous disintegration of an unstable atomic nucleus, resulting in the emission of helium nuclei (called alpha particles), electrons (called beta particles), and/or gamma rays (high-energy x-rays). *See* NRC *Glossary* at http://www.nrc.gov/reading-rm/basic-ref/glossary.

III. BACKGROUND

A. RADIOLOGICAL MATERIALS

Radioactive materials play a vital role in American medicine, research, and industry. Such radiological materials, which are generally called "sealed sources," are used for a wide array of purposes throughout the United States. In medicine, for example, sealed sources help to diagnose injuries, treat cancer, and sterilize medical devices. Similarly, sealed sources are used to irradiate food, to detect flaws in metal welds, to determine the density of a variety of materials, and to detect the presence of minerals miles below the Earth's surface.

WHAT IS A "SEALED SOURCE"?

The term "sealed source" is important in the radiological community. The NRC defines a sealed source as "any radioactive material or byproduct encased in a sealed metal or plastic capsule to prevent leakage." Sealed sources may be as small as a coin or contained in machines as large as an SUV. Under normal conditions, sealed sources present an insignificant contamination hazard but can be dangerous if exposed.

B. THE NRC AND AGREEMENT STATES

The Atomic Energy Act of 1954 authorizes the NRC to regulate the possession and use of sealed sources through regulatory requirements, licensing, inspection, and enforcement.[7] Section 274 of the Act authorizes the NRC to delegate this licensing, inspection, and enforcement authority to states that agree to regulate their residents' use of sealed sources. States that enter such contracts with the NRC are commonly called "Agreement States." To qualify, "the States must first demonstrate that their regulatory programs are compatible with NRC's program and adequate to protect public health and safety."[8] After entering into an agreement with the NRC, the respective states then become responsible for regulating the possession and use of radiological materials within their borders. The NRC periodically evaluates the Agreement States' programs to ensure that they remain compatible with NRC regulations and are generally effective in protecting health and public safety.[9]

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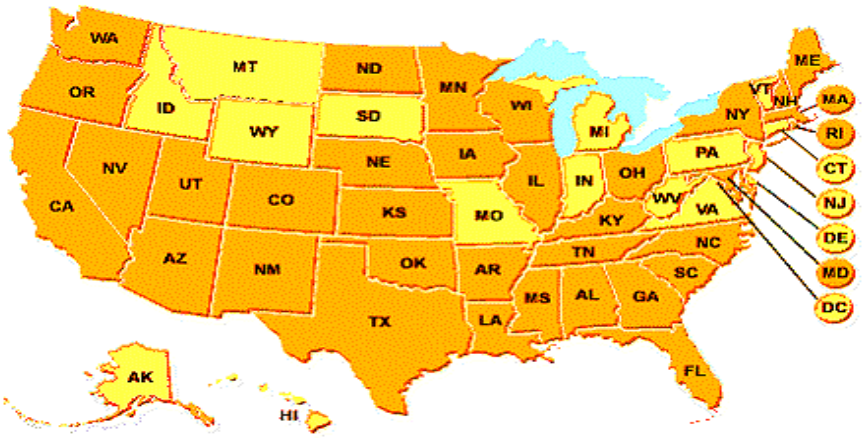
[7] *See* 42 USC 2021 *et seq*.

[8] *See* NRC Office of the Inspector General, *Summary Report and Perspectives on Byproduct Material Security and Control*, OIG-07-A-12, March 30, 2007 (the "NRC Inspector General 2007 Report").

[9] *See* GAO, *Nuclear Security: Federal and State Action Needed to Improve Security of Sealed Radioactive Sources*, GAO-03-804, August 6, 2003 (the "GAO August 2003 Report").



Map Reflecting 34 Agreement States (in dark shading) and 16 Non-Agreement States (in light shading)

There are currently 34 Agreement States, as reflected in the figure above.[10] For the 16 remaining non-agreement states, as well as the District of Columbia, the Commonwealth of Puerto Rico, and various territories of the United States, the NRC itself regulates the use of sealed sources.

C. THE CATEGORY SYSTEM & ITS LIMITATIONS

The NRC classifies radioactive materials using a scale from 1 through 5 according to the source's immediate or near-immediate effects on human health. This categorization regime is based in large measure on the International Atomic Energy Agency ("IAEA") Code of Conduct on the Safety and Security of Radioactive Sources.[11] The code of conduct contains basic principles necessary for the safe and secure use of radioactive materials.

Under this regime, Category 1 sources are considered the most dangerous and Category 5 sources are considered the least dangerous. Categories 1 and 2, the most dangerous materials, receive the most stringent security and safety requirements. Category 3, while still considered "dangerous" by the IAEA and the NRC, is subject to much more lenient measures. Categories 4 and 5, in turn, are subject to even fewer requirements. For example, a 10-microcurie quantity of cesium-137, an amount unlikely to harm anyone, falls under Category 5 and would be exempt from licensing requirements.[12] In contrast, 3,000 curies of the same material, which would be enough to seriously injure or kill anyone exposed to it for

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[10] According to the Organization of Agreement States, three additional states (New Jersey, Pennsylvania, and Virginia) have begun the process of becoming Agreement States. *See* http://www.agreementstates.org.

[11] *See* GAO, *Nuclear Security: DOE Needs Better Information to Guide Its Expanded Recovery of Sealed Radiological Sources*, GAO-05-967, September 22, 2005 (the "GAO September 2005 Report"); IAEA, Code of Conduct on the Safety and Security of Radioactive Sources, September 8, 2003 (the "IAEA Code of Conduct"). *See also* IAEA, *Categorization of Radioactive Sources*, IAEA-TECDOC-1344, July 2003 (the "IAEA Categorization of Radioactive Sources").

[12] According to the NRC Glossary, a "curie" is "[t]he basic unit used to describe the intensity of radioactivity in a sample of material. The curie is equal to 37 billion (3.7×10^{10}) disintegrations per second, which is approximately the activity of 1 gram of radium. A curie is also a quantity of any radionuclide that decays at a rate of 37 billion disintegrations per second. It is named for Marie and Pierre Curie, who discovered radium in 1898." *See* http://www.nrc.gov/reading-rm/basic-ref/glossary/curie-ci.html.

several minutes, would qualify as a Category 1 source and would be subjected to stringent health, security and use regulation.

As noted above, the category system is focused almost exclusively on the source's *immediate* or *near-immediate* effects on human health. Due to this discrete focus, the category system has certain significant limitations. In particular, it explicitly excludes: (1) any probabilities of harm from delayed effects of radiation – termed "stochastic effects" – such as radiation-induced cancer developing later in life; [13] and (2) socioeconomic consequences resulting from the dispersion of radioactive material. In other words, in designating the category for a specific source amount, the category system considers only immediate harm to human health, while ignoring the social and economic impacts of a radiological attack and the long-term health effects on a population.

D. MATERIALS LICENSES

The NRC and Agreement States issue licenses to allow authorized entities to possess and use certain radiological materials. There are two types of licenses for sealed sources – general and specific. Generally-licensed devices are considered inherently safe because they house radioactive materials that are either trivial in size or embedded inside large and immobile machines. Generally-licensed devices, such as fixed gauges, luminous exit signs, and smoke detectors, require no authorization to purchase and use.

Most sealed sources with industrial or medical uses, however, require a specific materials license. Specific licenses must be obtained from either the NRC or an Agreement State. Roughly 22,000 specific materials licenses have been issued; the Agreement States administer approximately 17,450 of those licenses, while the NRC administers approximately 4,500.[14] According to the NRC, each year the NRC issues about 200 new materials licenses, while the Agreement States issue about 800.

To qualify for a specific materials license, an applicant must demonstrate that use of the radioactive material will meet safety requirements set forth in NRC regulations or in applicable Agreement State regulations. NRC offers extensive, user-friendly guidance to assist potential applicants in completing required paperwork (the "Licensing Guidance"). In fact, NRC provides suggested answers to the questions on its license applications. The figure below is an excerpt of the Licensing Guidance illustrating how the NRC provides "Suggested Responses" – including specific language – to application queries.

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[13] The NRC defines "stochastic effects" as "effects that occur by chance, generally occurring without a threshold level of dose, whose probability is proportional to the dose and whose severity is independent of the dose. In the context of radiation protection, the main stochastic effects are cancer and genetic effects." *See* NRC Glossary.

[14] *See* GAO, *Nuclear Security: Actions Taken by NRC to Strengthen Its Licensing Process for Sealed Radioactive Sources Are Not Effective*, GAO-07-1038T, July 12, 2007 (the "GAO July 2007 Report").

EXCERPT OF NRC GUIDANCE PROVIDING SPECIFIC LANGUAGE FOR APPLICATIONS

ITEMS 7 THROUGH 11: TRAINING AND EXPERIENCE, FACILITIES AND EQUIPMENT, RADIATION SAFETY PROGRAM, AND WASTE DISPOSAL

Item No. And Title	Suggested Response	Yes	Alternative Procedures Attached
7. INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING AND EXPERIENCE – RADIATION SAFETY OFFICER Name:_____	Before obtaining licensed materials, the proposed RSO will have successfully completed one of the training courses described in Criteria in the section entitled "Individual(s) Responsible for Radiation Safety Program and Their Training and Experience – Radiation Safety Officer" in NUREG-1556, Vol. 1, Rev. 1, dated November 2001.	❒	❒
8. TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS	Before using licensed materials, authorized users will have successfully completed one of the training course described in Criteria in the section entitled "Training for Individuals Working In or Frequenting Restricted Areas" in NUREG-1556, Vol. 1, Rev 1, dated November 2001.	❒	❒

If the application meets approval criteria, a license will be issued. Once a license is issued, NRC policy requires that all new licensees be inspected within one year, regardless of the category of the source or other materials being used.[15] One NRC official stated that Agreement States generally have the same requirement.

E. THE GAO REPORT IN 2003

In August 2003, the GAO released a report, entitled *Nuclear Security: Federal and State Action Needed to Improve Security of Sealed Radioactive Sources*, that examined numerous issues related to the security of sealed sources of radiological materials. In particular, the GAO study focused on "(1) the number of sealed sources in the United States, (2) the number of sealed sources lost, stolen, or abandoned, (3) the effectiveness of federal and state controls over sealed sources, and (4) the [NRC] and state efforts since September 11, 2001, to strengthen security of sealed sources."[16]

The report expressed alarm at an NRC licensing process that "leaves sealed sources vulnerable" by "failing to establish the authenticity of the prospective licensee and whether information provided in the application is indeed valid."[17] The report contrasted the NRC's procedures to those of several Agreement States that required the physical inspection of a licensee's facilities prior to the issuance of a license. Importantly, the 2003 GAO report recommended that the NRC modify its licensing procedures

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[15] *See* NRC, *Inspection Manual*, Chapter 2800, November 25, 2003.

[16] *See* GAO August 2003 Report.

[17] *See id.*

"to ensure that sealed sources cannot be purchased before NRC's verification—through inspection or other means—that the materials will be used as intended."[18]

F. NRC INSPECTOR GENERAL REPORTS IN 2006 AND 2007

In 2006, the Inspector General of the NRC (the "NRC-IG") examined the NRC's regulation of source materials, and concluded that NRC officials were not aware of all the potential security gaps in the materials license application and review process.[19] Reiterating this point in a 2007 report, the NRC-IG asserted that "this lack of awareness was attributed to NRC's failure to take a comprehensive look inwards at its own business and regulatory processes, which would include conducting vulnerability assessments of the license application and review process. As a result, individuals with malevolent intentions could exploit vulnerabilities in the license application and review process to obtain byproduct material for use in a dirty bomb."[20]

The March 2006 NRC-IG report recommended that the NRC (1) conduct a complete vulnerability assessment of its materials program, including the license application and review process and the methods used by licensees to purchase source materials from suppliers; and (2) modify the license application and review process to mitigate the risks identified in the vulnerability assessment.[21]

G. PSI INVESTIGATION AND HEARING IN 2006

In conjunction with its ongoing investigation into nuclear and radiological threats to the U.S., the Subcommittee requested in 2005 that the GAO probe certain vulnerabilities in NRC licensing procedures.[22] Pursuant to the Subcommittee's request, GAO investigators conducted a clandestine operation in which they purchased, via telephone, a small quantity of radioactive source material from a commercial source by posing as employees of a fictitious company. Then, using commercial, off-the-shelf computer software, they created NRC licenses modeled after official documents found on the internet. Two GAO teams then used the fraudulent NRC licenses to smuggle the radioactive materials into the U.S. in two simultaneous border crossings. The Subcommittee held a hearing on the GAO investigation in March 2006.

Although the radioactive material was detected at the borders, Customs and Border Protection officers at these sites failed to recognize the phony licenses and had no mechanism to determine whether the proffered licenses were in fact valid. Therefore, even though the Customs officials at the borders largely followed proper procedures in stopping the GAO vehicles, they permitted the GAO teams to enter the country with their cargo.

In late March, 2006, the Subcommittee held a two-part hearing called "*Neutralizing the Nuclear and Radiological Threat: Securing the Global Supply Chain: Parts One and Two*." At that hearing, Senator Norm Coleman, then-Chair of PSI, inquired about the implementation of an NRC materials license database and explored possible measures to confirm applicant validity, urging the NRC to "reform the processes by which anyone can acquire radiological material."[23] The NRC subsequently established a

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[18] *See id.*

[19] *See* NRC Office of the Inspector General, *Audit of the NRC Byproduct Materials License Application and Review Process*, OIG-06-A-11, March 10, 2006 (the "NRC Inspector General March 2006 Report").

[20] *See* NRC Inspector General 2007 Report.

[21] *See* NRC Inspector General March 2006 Report.

[22] *See* GAO Testimony, *Border Security: Investigators Transported Radioactive Sources Across Our Nation's Borders at Two Locations*, GAO-06-583T, March 28, 2006.

[23] *See* http://www.hsgac.senate.gov/index.cfm?Fuseaction=Hearings.Detail&HearingID=336 and http://www.hsgac.senate.gov/index.cfm?Fuseaction=Hearings.Detail&HearingID=335.

system enabling U.S. border personnel to quickly verify the authenticity of NRC licenses presented at the border.[24]

H. NRC AMENDS ITS LICENSING PROCEDURES IN DECEMBER 2006

In response to recommendations from the GAO, the NRC-IG, and this Subcommittee, the NRC amended its materials licensing procedures in December 2006. Specifically, the NRC adopted a program to assist NRC reviewers in assessing materials license applications.[25] The revised process was entitled "Checklist to Ensure that Radioactive Materials Will Be Used as Intended" (the "Checklist").

The Checklist prompts NRC reviewers to make two threshold determinations – namely, whether the applicant is unknown to the reviewer and has not previously received a materials license; and whether the application seeks authorization for Category 1 or 2 sources (*i.e.*, the most dangerous radiological materials). There is no scrutiny if the answer to both threshold questions is "No" – *i.e.*, the applicant is known and the requested license is for sources in Category 3 or below. In such circumstances, the review process basically ends and a license will generally be issued. In fact, the Checklist plainly instructs reviewers that, if the answer to either threshold question is "No," "then do not complete Step 2. Sign and date the completed form []."[26]

If the answer to either question is "Yes" – *i.e.*, the applicant is unknown or the application requests materials in Categories 1 or 2 – reviewers are prompted to proceed to Step 2, which gives guidance to the reviewer regarding further scrutiny of the application. For instance, the guidance suggests requesting supplemental information concerning the ownership of the applicant and the authority and training of the applicant's Radiation Safety Officer. As noted above, the NRC provides Licensing Guidance to applicants on how to respond to NRC queries, including offering "Suggested Responses" to specific questions.[27]

In addition to the information requests, the Checklist provides guidance on whether a visit to the applicant's facilities is required. The guidance requires a physical inspection for applications for Category 1 and 2 sources before a license is issued. For applications for Category 3 or 4 sources, however, the physical inspection requirement is considerably more lenient. Pursuant to the Checklist, a license for Category 3 sources or below may be issued before an on-site visit. The on-site visit may take place up to 12 months *after* the license has been issued. In contrast to the NRC procedures for post-issuance visits, several Agreement States conduct an on-site visit before the issuance of a license to verify the legitimacy of potential licensees.[28] According to GAO, several Agreement States either inspect facilities before a license is issued or hand-deliver the licenses in order to observe the applicant's facilities.[29]

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[24] *See* NRC, *The NRC Source Data Team and U.S. Customs*, www.nrc.gov/security/byproduct/export-import/source-data-team.html.

[25] *See* NRC, *Checklist to Ensure that Radioactive Materials Will Be Used as Intended*, December 2006.

[26] *See id.*

[27] *See* NRC, *Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Portable Gauge Licenses*, NUREG-1556, Vol. 1, November 2001.

[28] *See* GAO August 2003 Report.

[29] *See id.*

IV. THE 2007 INVESTIGATION

Building on its previous review of NRC licensing procedures, the Subcommittee asked GAO in October 2006 to test whether the NRC's revised licensing procedures were effective. The facts surrounding the GAO's efforts are recounted in detail in GAO's testimony before the Subcommittee, entitled *Actions Taken by NRC to Strengthen Its Licensing Process for Sealed Radioactive Sources Are Not Effective*.[30] Below is a brief review of the GAO's 2007 operation and its recommendations.

A. OBTAINING A REAL NRC LICENSE FOR A FAKE COMPANY

Pursuant to the Subcommittee's October 2006 request, GAO investigators incorporated two dummy corporations in Delaware in the fall of 2006. These two companies had no capitalization, no operations, no websites, no physical facilities, and no employees. Using aliases and the names of the bogus corporations, GAO investigators applied for two NRC materials licenses – one directly from the NRC and one through an Agreement State. They requested a license to obtain specified low quantities of Category 4 materials. The differences between the two results could not be more stark.

Shortly after the GAO submitted its application to the materials licensing agency in the Agreement State, the agency sent a letter to the GAO's dummy "company," indicating that GAO's application was incomplete: "During the Department's review of your application dated February 12, 2007, deficiencies were found." The State sought additional information regarding company personnel, the Radiation Safety Officer's authority to stop unsafe operations, and disposal procedures. The GAO indicated that regulators also insisted on interviews, physical inspections, and tours of the non-existent company's facilities. In total, the State licensing agency indicated that the process would take roughly seven months. In light of the rigorous application process – in particular, the required physical inspection of the applicant's facilities – GAO elected to withdraw its application.

GAO's application sought licenses for portable moisture density gauges. (An example of such a gauge can be found in the image below, which was obtained from the NRC website. *See* NRC, *Fact Sheet on Dirty Bombs*.) These gauges contain alpha and gamma-emitting sealed sources such as cesium-137 and americium-241 and are used to evaluate the properties of soil, water, and pavement. Like many sealed sources, they are designed to be carried in the field and can be found at hundreds of construction sites around the country.

EXAMPLE OF MOISTURE DENSITY GAUGE

The application to the NRC, in contrast, was subjected to very little scrutiny. According to GAO's testimony, the NRC exchanged a couple of faxes and phone calls with the "company executive." Satisfied with that cursory review, the NRC mailed the materials license to the company's "headquarters," which was a drop-box at a retail UPS location. From the date of application to the issuance of the license, the entire process lasted 28 days. GAO investigators essentially obtained a valid materials license from the NRC without ever leaving their desks.

[30] *See* GAO July 2007 Report.

COMPARISON OF REVIEWS CONDUCTED BY NRC AND AGREEMENT STATE		
	Agreement State	**NRC**
Length of Review	7 months[31]	28 days
Physical Inspection?	Yes	No
License Received?	No	Yes

[31] As noted above, the state regulator informed the GAO investigators, who were acting in a clandestine manner, that the licensing process would take seven months and that it required a physical inspection of the applicant's facilities. In light of the exhaustive nature of the impending review, GAO investigators elected to withdraw the application to that state on behalf of the phony entity. In other words, a site visit was requested by the state agency, but no actual inspection occurred.

B. COUNTERFEITING THE NRC LICENSE

After receiving the valid NRC license, GAO investigators then counterfeited it. Using off-the-shelf computer software, they scanned the license into a computer, created multiple facsimiles to purchase radioactive material, and removed the limits on the quantities of source materials authorized to be purchased. Redacted copies of the authentic NRC license and one of the counterfeited GAO documents are reproduced below. The key difference between the two documents is in Sections 8(A) and 8(B), in which the maximum amounts in the valid license are removed in the counterfeited version.

COMPARISON OF VALID NRC LICENSE AND COUNTERFEITED GAO LICENSE

Valid License Issued by NRC (Redacted)

NRC FORM 374 U.S. NUCLEAR REGULATORY COMMISSION PAGE 1 OF 4 PAGES

MATERIALS LICENSE

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974 (Public Law 93-438), and Title 10, Code of Federal Regulations, Chapter I, Parts 30, 31, 32, 33, 34, 35, 36, 39, 40, and 70, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess, and transfer byproduct, source, and special nuclear material designated below; to use such material for the purpose(s) and at the place(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations of the applicable Part(s). This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, as amended, and is subject to all applicable rules, regulations, and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.

Licensee

1. [redacted] Inc.

2. [redacted]

3. License number [redacted]

4. Expiration date March 31, 2017

5. Docket No. [redacted]

Reference No.

6. Byproduct, source, and/or special nuclear material	7. Chemical and/or physical form	8. Maximum amount that licensee may possess at any one time under this license
A. Cesium 137	A. Sealed Sources [redacted]	A. 60 millicuries total, and no single source to exceed the maximum activity specified in the device's certificate of registration issued by the U.S. Nuclear Regulatory Commission or an Agreement State
B. Americium 241	B. Sealed Sources [redacted]	B. 200 millicuries total, and no single source to exceed the maximum activity specified in the device's certificate of registration issued by the U.S. Nuclear Regulatory Commission or an Agreement State

9. Authorized use:

A. and B. In Troxler Electronic Laboratories Models 3400 series, and 4640B, and CPN International Model MC series portable gauging devices for measuring physical properties of materials.

License Counterfeited by GAO (Redacted)

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MATERIALS LICENSE

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974 (Public Law 93-438), and Title 10, Code of Federal Regulations, Chapter I, Parts 30, 31, 32, 33, 34, 35, 36, 39, 40, and 70, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess, and transfer byproduct, source, and special nuclear material designated below; to use such material for the purpose(s) and at the place(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations of the applicable Part(s). This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, as amended, and is subject to all applicable rules, regulations, and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.

Licensee

1. [redacted]

2. [redacted]

3. License number [redacted]

4. Expiration date March 31, 2017

5. Docket No [redacted]

Reference No.

6. Byproduct, source, and/or special nuclear material	7. Chemical and/or physical form	8. Maximum amount that licensee may possess at any one time under this license
A. Cesium 137	A. Sealed Sources [redacted]	A. No single source to exceed the maximum activity specified in the device's certificate of registration issued by the U.S. Nuclear Regulatory Commission or an Agreement State
B. Americium 241	B. Sealed Sources [redacted]	B. No single source to exceed the maximum activity specified in the device's certificate of registration issued by the U.S. Nuclear Regulatory Commission or an Agreement State

9. Authorized use:

A. and B. In Troxler Electronic Laboratories Models 3400 series, and 4640B, and CPN International Model MC series portable gauging devices for measuring physical properties of materials.

After altering the quantity of allowable source material, GAO investigators contracted with two different companies to purchase a significant number of portable moisture density gauges.[32] Those gauges, in the aggregate, contain an amount of americium-241 and cesium-137 that is vastly in excess of the amount authorized on the original NRC license. The aggregate amount of radiological materials that the GAO contracted to buy would meet the NRC's definition of a "dangerous" quantity and would be sufficient to construct a dirty bomb.

Even though the amount of radiological materials would have been sufficient for a dirty bomb, the amount of the radiological materials sought in the GAO operation is actually understated. Investigators indicated that they could have easily prolonged their effort, generating dozens of fake licenses, visiting multiple suppliers, and stockpiling significantly higher amounts of this (and potentially more radioactive) material. The GAO states that it could have purchased "substantially more radioactive source material," possibly enough to reach the threshold of a "very dangerous" quantity. In other words, the modest amount of radiological materials that GAO sought to purchase was but a demonstration amount, and it could have been considerably larger.

In conjunction with its clandestine operation, the GAO made the following recommendations to the NRC:

1. The NRC needs to "develop improved guidance for examining NRC license applications [in order] to provide reasonable assurance that licenses for radioactive materials will only be issued to those with legitimate uses."
2. The NRC should conduct "periodic oversight of license application examiners so that the NRC will be assured that any new guidance is being appropriately applied."
3. The NRC should "explore options to prevent individuals from counterfeiting NRC licenses, especially if this allows the purchase of more radioactive materials than they are approved for under the terms of the original license."

C. FOLLOWING THE 2007 INVESTIGATION, NRC REVISES ITS LICENSING PROCESS

Several months ago, GAO informed the NRC of its most recent operation. Shortly thereafter, the NRC temporarily halted its licensing process and revised its licensing procedures. In particular, the NRC issued a Supplemental Interim Guidance to address "a recently identified gap in NRC's pre-license guidance" (the "Interim Guidance").[33] The principal change reflected in the Interim Guidance is a modest increase in the scrutiny of new applications for specific licenses for Categories 3 and 4 sources. Before June 2007, no site visits were required for Category 3 or 4 applicants before a license was issued and the first visit to a licensed facility could occur up to 12 months after license issuance. The Interim Guidance changes that process and requires that reviewers conduct pre-licensing "visits" with applicants:[34]

> [T]his supplemental interim guidance now requires that all applications for a new license will have a pre-licensing visit or meeting. The purpose of this visit is to verify the information provided by the applicant to assure that the radioactive materials will be used as intended.[35]

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[32] GAO declined to take actual possession of the radiological materials.

[33] *See* NRC, *Supplemental Interim Guidance for Checklist to Ensure that Radioactive Materials Will Be Used as Intended*, NUREG-1556, Volume 20, Appendix C, June 12, 2007.

[34] *See id.*

[35] *See id.*

To be clear, however, the Interim Guidance does not necessarily require that the reviewer's "visit" include a physical inspection of an applicant's facilities.[36] Instead, a reviewer may satisfy the "visit" requirement by meeting with an agent of the applicant in an NRC office.[37]

V. RECOMMENDATIONS

A. THE NRC SHOULD REEVALUATE THE APPARENT GOOD-FAITH PRESUMPTION THAT PERVADES ITS LICENSING PROCESS.

An examination of the NRC's administration of materials licensing reveals one paramount theme: the NRC licensing procedures appear to assume that all applicants are acting in good faith and do not harbor malicious motives. Indeed, it appears that there is an insufficient degree of institutional skepticism and, therefore, little in the way of a true screening process. For instance, as described above, the NRC's Licensing Guidance spoon-feeds applicants with model language and stock responses to application queries in order to streamline the licensing process. Summarizing the licensing process, one GAO investigator stated, "It's a paperwork process asking for boilerplate."

Another sign of the NRC's assumption of good faith is that physical inspection of an applicant's facilities can occur up to one year after a license has been issued. GAO highlighted this very concern in 2003:

> [W]e found a potential security weakness in NRC's licensing process to obtain sealed sources. The process assumes an applicant is acting in good faith and allows applicants to acquire sealed sources as soon as a new license is issued by mail. It can then take NRC as long as 12 months to conduct its first inspection, leaving the possibility that materials will be obtained and used maliciously in the meantime.[38]

Similarly, the NRC-IG found that the NRC's adoption of the IAEA category system (which, as noted above, excludes important categories of harm) does not sufficiently account for potential bad actors, such as terrorists: "By its very definition, such an approach would discount the intentions and capabilities of a malevolent entity bent on obtaining byproduct material that could be used in a dirty bomb."[39]

The NRC has shown a willingness to consider these concerns. For instance, as noted above, it recently revised its licensing procedures to require a physical inspection or at least a face-to-face meeting before the issuance of a materials license. More steps, however, are needed.

B. THE NRC SHOULD REGULATE CATEGORY 3 SOURCES MORE STRINGENTLY.

NRC licensing procedures governing Category 3 sources are not sufficiently rigorous. Category 3 sources deserve more stringent regulation because they are more dangerous than the current category regime suggests. As noted above, the NRC's category system is based on the IAEA Code of Conduct.[40] That scale is based almost exclusively on one narrow category of harm: the immediate or near-immediate effects on human health. The system expressly excludes from its categorization criteria both (1) any probabilities of harm from delayed effects of radiation – termed "stochastic effects" – such as radiation-

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[36] *See id.*

[37] *See id.*

[38] *See id*.

[39] *See* NRC Inspector General 2007 Report.

[40] *See* GAO September 2005 Report, IAEA Code of Conduct and IAEA Categorization of Radioactive Sources.

induced cancer developing later in life;[41] and (2) socioeconomic consequences resulting from the dispersion of radioactive material. Excluding those important categories of harm underestimates the potential impact of the dispersal of a Category 3 source.

The NRC-IG articulates that very conclusion in a 2007 report, concluding that the "NRC policy for evaluating the risks of dirty bombs … does not recognize all of the potential effects of a dirty bomb."[42] The IG report lamented that the NRC policy took into account only "prompt fatalities." The report also stated:

> When questioned by Government auditors or elected officials about the bases of its security-related actions or about its efforts to identify and close vulnerabilities in its material licensing and tracking programs, NRC has consistently pointed to a "graded, risk-informed" approach to byproduct material security. For NRC, the "graded, risk-informed" approach results in the identification of "risk-significant" or "highrisk" sources, equivalent to IAEA Category 1 and 2 sources. NRC's "graded, risk-informed" approach discounts factors related to malevolent terrorist intentions because the agency focuses the performance of its mission—including those related to common defense and security—to scientific and engineering evaluations of licensed activities that use radioactive material. Indeed, the agency notified the House Committee on Government Reform that factors—such as psychological, social, and economic effects—can vary and provide a less stable measure for establishing security measures. By its very definition, such an approach would discount the intentions and capabilities of a malevolent entity bent on obtaining byproduct material that could be used in a dirty bomb.[43]

The IG report also stated that "measuring dirty bomb consequences without consideration of these additional consequences [*i.e.*, technical, socioeconomic, psychological, environmental and other effects] causes the NRC to understate the risk these weapons pose to national security."[44]

There is currently no mechanism to prevent malevolent actors from stockpiling numerous lower-risk sources well beyond the limits authorized in the license. This methodical aggregation could allow a terrorist to "fly beneath the radar" and avoid regulation and detection while accumulating more and more source material. This report offers recommendations regarding a web-based licensing system that would minimize this risk.

Considering that the categorization system does not address the full scope of the impact of radioactive dispersal and that there is no mechanism to prevent aggregation of lower-risk sources, the NRC should subject Category 3 sources to heightened scrutiny. In particular, the NRC should regulate Category 3 sources more carefully by (1) requiring an *on-site visit* before a Category 3 license is issued and (2) considering incorporating Category 3 sources into the National Source Tracking System.

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[41] *See id*.

[42] *See* NRC Inspector General 2007 Report.

[43] *See* NRC Inspector General 2007 Report. Notably, the Inspector General has questioned the efficacy of NRC's "risk-informed" categorization regime, noting that "although the staff states that the approach is risk-informed, OIG has not been presented with any documentary evidence of a risk assessment." *See* NRC Office of the Inspector General, *Audit Report – Audit of the Development of the National Source Tracking System*, OIG-06-A-10, February 23, 2006 (the "NRC Inspector General Feb. 2006 Report").

[44] *See id.*

1. The NRC Should Physically Inspect Applicants' Facilities *before* the Issuance of a Category 3 Materials License.

As noted above, under the current category system, applications for Categories 1 and 2 sources receive substantially heightened scrutiny from NRC reviewers. Category 3 sources should be similarly regulated. For instance, at the time of the GAO's 2007 operation, the NRC did not require physical inspection of licensee facilities prior to the issuance of licenses for Category 3 sources; the only on-site visit would generally take place during the 12-month period *after* issuance of a license. In contrast, many Agreement States verify the legitimacy of potential licensees via either pre-licensing inspection or hand delivery of the licenses. This is a crucial difference, since a licensee can make purchases as soon as a license is received in the mail – *i.e*, before the NRC has verified the legitimacy of the applicant.

To its credit, the NRC's recently-issued Interim Guidance makes strides in the direction of mandatory inspections of facilities seeking licenses. Specifically, it requires NRC reviewers to visit with applicants face-to-face before the issuance of a license. That Interim Guidance, however, contains a significant loophole – namely, that "all applications for a new license will have a pre-licensing visit *or meeting*."[45] Therefore, the "visit" requirement could be satisfied without an on-site physical inspection of an applicant's facilities but rather an in-person interview at NRC offices. For applications involving Category 3 sources and above, the standard procedure – perhaps allowing for rare exceptions – should require an on-site physical inspection of an applicant's facilities before the issuance of a license.

2. The NRC Should Consider Including Category 3 Sources in the Proposed National Source Tracking System.

Under the current regulatory regime, NRC licensees are not required to report radioactive material inventories to NRC. As a result, there is no mechanism for the government to track radiological materials from cradle to grave, *i.e.*, the manufacture, transport, receipt, disassembly, and disposal of sealed sources. Without such a tracking mechanism, radiological sources can end up anywhere from landfills to terrorist cells.

Recognizing the importance of tracking certain source materials, the Department of Energy (DOE) and NRC established an Interagency Working Group on RDDs in July 2002. This working group explored the possibility of creating a nationwide system that would track radiological sources and recommended that NRC develop such a tracking system "to better understand and monitor the location and movement of certain radioactive sources."[46] In response, the NRC adopted plans for a National Source Tracking System (the "NSTS"), which would be a web-based system containing cradle-to-grave information on high-risk sealed sources. The proposed NSTS as currently planned, however, will track only Category 1 and 2 sources.

The NRC-IG recently noted that the omission of Category 3 sources from the NSTS is "another gap in the agency's approach to material security."[47] Moreover, the GAO noted an inconsistency with the exclusion of Category 3 sources from NSTS, stating "the aggregate radioactivity of co-located individual sources poses enough of a safety and security risk to warrant their recovery by DOE, but the sources will not be tracked in NSTS because they are not Category 1 or 2 sources."[48] The Health Physics Society, an independent scientific organization of radiation safety professionals, also noted that the NRC should

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[45] *See* NRC *Supplemental Interim Guidance* (emphasis added).

[46] *See* NRC Inspector General Feb. 2006 Report.

[47] *See* NRC Inspector General 2007 Report.

[48] *See* GAO, *Nuclear Security: DOE Needs Better Information to Guide Its Expanded Recovery of Sealed Radiological Sources*, GAO-05-967, September 22, 2005.

consider including Category 3 sources in the proposed NSTS "because of the potential for unacceptable personal injury, economic, or social consequences from a mismanaged or poorly secured individual Category 3 source."[49]

> The HPS recommends that, because of the potential for unacceptable personal injury, economic, or social consequences from a mismanaged or poorly secured individual Category 3 source, the NRC should be consistent with the approach of the IAEA and consider that Category 3 sources warrant inclusion in the tracking system, unless an analysis can demonstrate that the large number of such sources and the economic cost for tracking them would be overly burdensome. If the analysis demonstrates that the inclusion of all Category 3 sources is not justified on an economic basis, an evaluation should be performed as to how aggregate quantities of Category 3 sources that roll up to Category 1 or 2 thresholds can be identified and included in the tracking system or to identify if there are alternatives other than an "all or nothing" approach. For example, the analysis might identify some types of Category 3 sources that could be excluded while others should appropriately be included in the tracking system or may identify alternatives to the National Source Tracking System that accomplish the same results for these sources.

The issue of whether some or all Category 3 sources should be included in NSTS has generated significant debate within the NRC and in written comments submitted by Agreement States and experts. To date, the NRC has not decided the extent to which Category 3 sources will be tracked. Key concerns include the cost and logistics involved in tracking Category 3 materials, whether tracking those materials would divert attention and resources from more dangerous Category 1 and 2 materials, and whether it would make sense to track some but not all Category 3 sources. The NRC should continue to work with all stakeholders to determine the feasibility of Category 3 inclusion and to conduct appropriate cost-benefit analyses. It is important, however, to resolve this matter in the near future so that the NSTS, already five years in the planning, can be deployed as soon as possible.

C. THE NRC SHOULD ACT QUICKLY TO ESTABLISH A WEB-BASED LICENSING SYSTEM TO ENSURE THAT SOURCE MATERIALS CAN BE OBTAINED ONLY IN AUTHORIZED AMOUNTS BY LEGITIMATE USERS.

Counterfeit NRC materials licenses were the common denominator of both the 2006 and 2007 GAO clandestine operations. Preventing the use of altered licenses remains a serious obstacle to securing radiological material. Numerous witnesses interviewed by the Subcommittee indicated that many companies use multiple radiological devices scattered among hundreds of worksites, each of which house copies of the NRC materials license. Moreover, customers and suppliers are typically separated by great distances (sometimes thousands of miles), and therefore, most transactions are completed with phone calls and faxed copies of NRC licenses. This is why the GAO had no trouble at all passing counterfeit licenses off as authentic in both the 2006 and 2007 operations – faded copies and smudged faxes are standard operating procedure when it comes to NRC licenses.

In light of the fact that these licenses will inevitably be copied and faxed repeatedly, the solution cannot lie in simply including watermarks and improving defenses in the document itself. Such solutions

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[49] *See* Health Physics Society, *Continued Federal And State Action Is Needed For Better Control Of Radioactive Sources*, PS021-0, January 2006.

might be sufficient only insofar as an original license was being examined, not a fourth-generation fax thereof. To the contrary, the answer to preventing the use of counterfeit licenses must lie in creating a mechanism by which suppliers and law enforcement officials can verify that a proffered license is in fact authentic.

One such mechanism is a web-based licensing system. A web-based system, which is currently under development by the NRC, would close two glaring loopholes in the effort to reduce the unauthorized transfer and possession of radioactive materials. First, it would permit suppliers of radiological materials to access a secure, NRC database to confirm, in real time, a license's authenticity. Suppliers, law enforcement officials, and federal and state regulators, using such a system, could confirm within minutes (1) the name of the authorized user; (2) the name and authorized amount of the source material; and (3) the type and number of devices the licensee is entitled to purchase.

Second, a web-based system would reduce the possibility of aggregation – *i.e.*, a licensee avoiding regulation by stockpiling low-risk radioactive material by repeatedly purchasing the maximum allowable amount from multiple suppliers. In other words, such a system would enable suppliers and regulators alike to track a licensee's purchases and confirm—again, in real time—whether the licensee has already met or exceeded the license's maximum allowable amount.

VI. CONCLUSION

The recommendations in this report are designed to bolster our government's efforts to prevent a radiological attack in the United States. It is clear that terrorists are interested in using a dirty bomb to wreak havoc in this country. In the words of one homeland security expert, the impact of such an attack – even a relatively simple and small dirty bomb – could be a "nightmare scenario."[50] As a result, the government must be more vigilant in regulating and tracking radioactive materials in the U.S. One critical step is to prevent America's enemies from acquiring radiological materials in the first place. To that end, the NRC should focus on ensuring that such materials can be obtained only in authorized amounts by legitimate users. These measures will help ensure that the "nightmare scenario" of a dirty bomb attack never occurs.

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[50] *See* Richard Falkenrath, Deputy Commissioner for Counterterrorism of the New York City Police Department and former Deputy Homeland Security Adviser to President George W. Bush, *quoted in* Jon Fox, Global Security Newswire, "'*Dirty Bomb' Could Be Disastrous, NYPD Official Says*," June 13, 2007.