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July 2022

# PREVENTING A DIRTY BOMB

## Vulnerabilities Persist in NRC's Controls for Purchases of High- Risk Radioactive Materials

# GAO Highlights

Highlights of [GAO-22-103441](#), a report to the Chairman, Committee on Homeland Security, House of Representatives

## Why GAO Did This Study

Radioactive materials are commonly used throughout the U.S. in technological devices for medical, industrial, and research purposes. However, these materials, if used improperly, can be harmful and dangerous. For example, in the hands of terrorists, even a small amount could be used to construct a radiological dispersal device, also known as a dirty bomb. A dirty bomb uses conventional explosives to spread radioactive material.

GAO was asked to review NRC's license verification system for high-risk radioactive materials. This report examines (1) the effectiveness of NRC's license verification system for ensuring that high-risk radioactive materials are not purchased using a forged or altered license and (2) vulnerabilities that could affect NRC's ability to verify licenses for the purchase of high-risk radioactive material. GAO conducted a covert investigation of controls on purchasing radioactive materials. Additional details on GAO's covert testing will be included in an Official Use Only version of this report that will be issued soon.

## What GAO Recommends

GAO recommends that NRC (1) immediately require vendors to verify category 3 licenses with the appropriate regulatory authority and (2) add security features to its licensing process that improve the integrity of the process and make it less vulnerable to altering or forging licenses. To address our recommendations, NRC proposed a rulemaking to strengthen licensing. However, vulnerabilities will remain until NRC implements the rule.

View [GAO-22-103441](#). For more information, contact Allison Bawden at (202) 512-3841 or [bawdena@gao.gov](mailto:bawdena@gao.gov) or Howard Arp at (202) 512-5222 or [arpj@gao.gov](mailto:arpj@gao.gov).

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## PREVENTING A DIRTY BOMB

### Vulnerabilities Persist in NRC's Controls for Purchases of High-Risk Radioactive Materials

#### What GAO Found

The Nuclear Regulatory Commission's (NRC) current system for verifying licenses does not adequately protect against the purchase of high-risk radioactive materials using a fraudulent license. Licenses control the type and quantity of radioactive material allowed to be possessed. Quantities of radioactive materials are defined as category 1 through 5, with 1 being the most dangerous. Using shell companies with fraudulent licenses, GAO successfully purchased a category 3 quantity of radioactive material of concern from two different vendors in the U.S. Specifically, GAO provided a copy of a license that GAO forged to two vendors, subsequently obtained invoices, and paid the vendors. GAO refused to accept shipment at the point of delivery, ensuring that the material was safely and securely returned to the sender.

As GAO has previously reported, a category 3 quantity of radioactive material can, on its own, result in billions of dollars of socioeconomic costs if dispersed using a dirty bomb. By purchasing more than one shipment of a category 3 quantity of radioactive material, GAO also demonstrated that a bad actor might be able to obtain a category 2 quantity by purchasing and aggregating more than one category 3 quantity from multiple vendors. NRC officials told GAO that NRC plans to proceed with existing initiatives to implement new verification regulations by late 2023 but does not plan to take immediate corrective actions to address the issues that GAO found.

#### Radioactive Material Delivered to GAO's Shell Company (box on left)



Source: GAO. | GAO-22-103441

NRC requires a valid license to possess category 3 quantities of radioactive material, but the paper licenses it issues can be altered and used to make illicit purchases of radioactive materials. During this investigation, GAO created forged licenses to facilitate purchases. GAO's shell companies were successful in acquiring the material because they are not subjected to more stringent controls required for purchases of larger quantities of material. GAO's investigation demonstrates that the integrity of NRC's current license verification processes can be compromised.

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## Abbreviations

CBP	U.S. Customs and Border Protection
IAEA	International Atomic Energy Agency
LVS	License Verification System
NRC	Nuclear Regulatory Commission
NSTS	National Source Tracking System
WBL	Web-Based Licensing System

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July 14, 2022

The Honorable Bennie G. Thompson  
Chairman  
Committee on Homeland Security  
House of Representatives

Dear Mr. Chairman:

Radioactive materials are commonly used throughout the U.S. for medical and industrial purposes such as treating cancer, sterilizing medical instruments, and detecting flaws in metal welds. Among the materials most commonly used for these applications are americium-241/beryllium, cesium-137, cobalt-60, and iridium-192. However, these materials, if used improperly, can be harmful and dangerous; in the hands of terrorists, even a small amount could be used to construct a radiological dispersal device, also known as a dirty bomb. These types of bombs use conventional explosives to spread radioactive material.<sup>1</sup> Beyond the harm caused by the explosives, a dirty bomb detonation would likely result in significant social and economic harm from public panic, decontamination costs, and denial of access for extended periods to the area in which the detonation took place. We refer to these radioactive materials as “high-

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<sup>1</sup>The U.S. Nuclear Regulatory Commission (NRC) and the Department of Energy identify radionuclides of concern that pose the greatest risk of being used by terrorists to make a radiological dispersal device, also known as a dirty bomb. The list includes americium-241, cesium-137, cobalt-60, iridium-192, americium-241/beryllium, californium-252, curium-244, gadolinium-153, plutonium-238, plutonium-239/beryllium, promethium-147, radium-226, selenium-75, strontium-90, thulium-170, and ytterbium-169.

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risk” based on the potential consequences from their release into the environment through a dirty bomb.<sup>2</sup>

Recent security threats have raised concern that terrorists or other bad actors could target radioactive material for theft and use in a domestic attack. From 2011 through 2020, the U.S. Nuclear Regulatory Commission (NRC) reported 4,512 nuclear materials events, which include instances of lost or stolen radioactive materials, radiation overexposures, leaking sources of radioactive material, and other events.<sup>3</sup> Furthermore, NRC officials told us that since 1990, there have been 34 specific events involving the theft, sabotage, and vandalism of high-risk radioactive materials. One of these incidents occurred in April 2019, when a technician was arrested after stealing three iridium-192 radiography devices from his workplace in Arizona.<sup>4</sup> According to a court filing, the technician intended to release the radioactive material at a nearby mall but was arrested after a 2-hour standoff and before he could do so. Furthermore, National Nuclear Security Administration officials we interviewed told us that current assessments of the threat environment show an increasing interest in using radioactive material for making a dirty bomb. NRC officials we interviewed told us that their operating assumption for NRC’s regulatory frameworks has been, and continues to

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<sup>2</sup>In 2016, NRC interpreted “high-risk” to mean the largest quantities of radioactive material (categories 1 and 2 out of five categories). According to NRC, the agency’s interpretation of “high-risk” to mean category 1 and 2 quantities is consistent with Radiation Source Protection and Security Task Force reports that are submitted to the President and Congress every four years. The task force was established in the Energy Policy Act of 2005 and is comprised of 14 federal agencies. In our 2019 report, we used the views of security experts to define high-risk, and these experts generally agreed that high-risk includes both larger quantities and some smaller quantities of radioactive materials, including some category 3 quantities. See Nuclear Regulatory Commission, *Report to Congress under Public Law 113-235: Effectiveness of Part 37 of Title 10 of the Code of Federal Regulations* (Washington, D.C.: Dec. 14, 2016); and GAO, *Combating Nuclear Terrorism: NRC Needs to Take Additional Actions to Ensure the Security of High-Risk Radioactive Material*, [GAO-19-468](#) (Washington, D.C.: Apr. 4, 2019).

<sup>3</sup>NRC’s Nuclear Material Events Database contains records of events involving nuclear material reported to NRC.

<sup>4</sup>The material in the devices is regulated under NRC’s applicable safety and security regulations found in Title 10 of the Code of Federal Regulations (CFR). The requirements of 10 CFR Part 37 (commonly known as Part 37), address additional security topics such as physical security, access controls, monitoring and detection, and employee trustworthiness and reliability.

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be, that terrorist groups may be interested in acquiring radioactive material for malicious purposes.

NRC is responsible for licensing the commercial possession and use of radioactive materials and regulating the security of such materials in the U.S. In addition, NRC has discontinued its regulatory authority over licensing and regulating certain radioactive materials in 39 states, known as agreement states, which have entered into an agreement with NRC under the Atomic Energy Act to regulate certain radioactive materials in those states.<sup>5</sup> NRC and agreement states license, monitor, track, and require security for radioactive materials to protect both workers and the public from exposure to hazardous levels of radiation generated by the activities of licensees. Agreement state programs must be compatible with NRC's regulatory program for radioactive materials.<sup>6</sup>

We have reported on deficiencies in and opportunities to improve agencies' policies and procedures relating to the security of radioactive materials. NRC has taken a number of actions to address some of our previous recommendations. However, NRC has not yet implemented a number of recommendations to address vulnerabilities that we identified in these policies and procedures.<sup>7</sup> In particular, for many years we have reported on vulnerabilities associated with using paper-based licenses that can be altered or forged. Examples of these vulnerabilities include the following:

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<sup>5</sup>42 U.S.C. § 2021(b). NRC is authorized to enter into agreements to allow states to assume regulatory authority for licensing and regulating source, by-product, and special nuclear materials in quantities insufficient to form a critical mass. NRC must find that a state's program is compatible with NRC's program for regulating such materials as well as adequate to protect public health and safety before entering into these agreements. According to NRC staff, NRC also retains authority over federal entities in areas of exclusive federal jurisdiction and for the protection of common defense and security. Agreement states do not operate power plants, regulate exports or imports of materials, or undertake certain disposal activities.

<sup>6</sup>42 U.S.C. §§ 2021(b), (d)(2); NRC, Agreement State Program Policy Statement, 82 Fed. Reg. 48535 (Oct. 18, 2017).

<sup>7</sup>See GAO, *Priority Open Recommendations: Nuclear Regulatory Commission*, [GAO-22-105602](#) (Washington, D.C.: June 3, 2022).

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- In March 2006, we demonstrated that it was possible to transport unlicensed radioactive material through ports of entry into the U.S. using a fraudulent license.<sup>8</sup>
  - In the course of a 2007 investigation, we established a shell company through which we obtained a valid NRC license that we altered to secure commitments to purchase a dangerous quantity of radioactive material.<sup>9</sup>
  - In the course of a 2016 investigation, we established three shell companies and successfully obtained a valid license for one of these companies that we altered to secure commitments to purchase a dangerous quantity of radioactive material.<sup>10</sup>

In December 2021, the NRC began rulemaking that could result in implementation of one of the recommendations from our 2016 investigation. Specifically, NRC officials told us that they will propose a rule that, if finalized, would provide two acceptable methods for verifying licenses, including (1) direct contact with the regulator, such as through a phone call; or (2) through using NRC's license verification system.<sup>11</sup> If implemented, this process would strengthen NRC license verification controls, making it more difficult to purchase materials using a forged or altered license.

This report provides our first review of NRC's and agreement states' materials licensing programs since our 2016 report. You asked us to review issues related to the security of radioactive materials. This report

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<sup>8</sup>GAO, *Border Security: Investigators Successfully Transported Radioactive Sources Across Our Nation's Borders at Selected Locations*, [GAO-06-545R](#) (Washington, D.C.: Mar. 28, 2006). U.S. Customs and Border Protection (CBP) subsequently took corrective actions to address this vulnerability. However, in both 2008 and 2018, we found that these actions were not properly implemented. See GAO, *Nuclear Security: NRC and DHS Need to Take Additional Steps to Better Track and Detect Radioactive Materials*, [GAO-08-598](#) (Washington, D.C.: June 19, 2008); and *Nuclear Security: CBP Needs to Take Action to Ensure Imported Radiological Material Is Properly Licensed*, [GAO-18-214](#) (Washington, D.C.: Jan. 10, 2018).

<sup>9</sup>GAO, *Nuclear Security: Actions Taken by NRC to Strengthen Its Licensing Process for Sealed Radioactive Sources Are Not Effective*, [GAO-07-1038T](#) (Washington, D.C.: July 12, 2007). NRC implemented the three recommendations in this report. However, one of these recommendations was not effectively implemented, as we reported in 2016.

<sup>10</sup>GAO, *Nuclear Security: NRC Has Enhanced the Controls of Dangerous Radioactive Materials, but Vulnerabilities Remain*, [GAO-16-330](#) (Washington, D.C.: July 1, 2016). NRC has yet to implement any of the recommendations from that report.

<sup>11</sup>Nuclear Regulatory Commission, SECY-17-0083: Re-Evaluation of Category 3 Source Security and Accountability in Response to SRM-COMJMB-16-0001 (Dec. 21, 2021).

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examines (1) the effectiveness of NRC's license verification system for ensuring that high-risk radioactive materials are not purchased using a forged or altered license and (2) vulnerabilities that could affect NRC's ability to verify licenses for the purchase of high-risk radioactive material.

This report is a public version of a sensitive report that will be issued later this year. NRC deemed some of the information in that report to be sensitive, which must be protected from public disclosure. Therefore, this report omits sensitive information about the investigative process and a finding that presents information that could be exploited. Although the information provided in this report is more limited, the report addresses the same objectives as the sensitive report and uses the same methodology.

To test the effectiveness of NRC's license verification system for ensuring that high-risk radioactive materials are not purchased using a forged or altered license, we conducted internet research on domestic radioactive material vendors and shippers. We used covert investigative techniques to perform this investigation. We communicated with radioactive material vendors to determine the availability of the radioactive material, its cost, and existing shipping options.

Once viable vendors were identified, we placed our orders. Upon receipt, each shipment of radioactive material was refused and returned to the vendor, leaving possession of the radioactive material within control of the associated shipper or vendor at all times. We visually inspected each shipment, enabling us to confirm that the shipment we were refusing had indeed arrived and was from the expected vendors. In conducting our investigative work, we used only publicly available technologies and information, and required no special access to government information.

To identify vulnerabilities that could affect NRC efforts to verify licenses for the purchase of high-risk radioactive material, we reviewed GAO reports outlining NRC license verification processes, interviewed NRC officials, and considered *Standards for Internal Control in the Federal Government*.<sup>12</sup> We compared NRC's license verification processes to the results we obtained through our covert testing.

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<sup>12</sup>GAO, *Standards for Internal Control in the Federal Government*, [GAO-14-704G](#) (Washington, D.C.: Sept. 10, 2014).

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During the course of our investigation, we sought to purchase radioactive materials internationally to be imported into the U.S. in order to test U.S. Customs and Border Protection's (CBP) license verification processes. We ultimately abandoned our testing of CBP before completion because of safety and security concerns. For more information, see appendix I.

We conducted this performance audit from March 2019 to July 2022 in accordance with generally accepted government auditing standards.<sup>13</sup> We conducted our related investigative work in accordance with investigation standards prescribed by the Council of Inspectors General on Integrity and Efficiency.

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## Background

In September 2003, the U.S. and other nations endorsed the International Atomic Energy Agency's (IAEA) Code of Conduct, which establishes basic principles and guidance to promote the safe and secure use of radioactive material. The Code of Conduct applies to category 1, 2, and 3 quantities of radioactive material—all of which are potentially dangerous to human health and could, if not properly controlled, cause death or permanent injuries to a person who handled or was in contact with them.<sup>14</sup>

NRC and the agreement states use data systems to track the location of certain radioactive materials and to manage radioactive material licensing. The National Source Tracking System (NSTS), deployed in January 2009, tracks category 1 and 2 radionuclides that NRC and the Department of Energy have determined are attractive for use in a dirty bomb or for other malicious purposes and that warrant national tracking. NSTS is a transaction-based system that tracks each major step that such radioactive sources take within the U.S.<sup>15</sup> NRC and agreement state licensees are responsible for reporting the manufacture, shipment, arrival,

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<sup>13</sup>In March 2020, this performance audit was suspended because of the national public health emergency. Our work was restarted in January 2021.

<sup>14</sup>A category 1 quantity of a given radionuclide, the most dangerous, is defined as an amount 1,000 times or more than the amount necessary to cause permanent human injury; a category 2 quantity is defined as an amount at least 10 times but less than 1,000 times the amount necessary to cause permanent human injury. A category 3 quantity of a given radionuclide is defined as at least the minimum amount, but less than 10 times the amount, sufficient to cause permanent injury. Category 4 and 5 quantities of radioactive materials are unlikely to cause permanent injury.

<sup>15</sup>10 C.F.R. § 20.2207.

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disassembly, and disposal of all nationally tracked sources.<sup>16</sup> More specifically, NSTS includes the radionuclide, quantity (by activity), manufacturer, manufacture date, model number, serial number, and site address. The licensee has until the close of the next business day following a transaction—such as the sale of radioactive materials from a vendor to a customer—to enter it into the system. As a result, the locations of all such sources are accounted for and closely tracked.

NRC's Web-Based Licensing System (WBL)—deployed in August 2012—provides quick access to up-to-date information on all NRC and nine of 39 agreement states' specific licenses for all radioactive materials and sources in all five IAEA categories. WBL enables the user to enter, maintain, track, and search radioactive material licensing and inspection information.<sup>17</sup> WBL also includes pdf images of all paper copies of category 1 and 2 licenses for both NRC and agreement state licensees.<sup>18</sup>

NRC also developed a third system—the License Verification System (LVS)—which was deployed in May 2013. LVS draws on the information in NSTS and WBL and provides information to regulators and vendors and other would-be transferors on whether those applicants seeking to acquire category 1 and 2 sources are legitimately licensed to do so.<sup>19</sup> This is particularly important, as we have previously demonstrated, because paper licenses issued by NRC and agreement states can be altered or forged.<sup>20</sup> LVS provides a means to mitigate the risks of fraudulent licenses.

IAEA and NRC recognize the risks to human health and safety of category 3 quantities of radioactive materials, especially for certain

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<sup>16</sup>NSTS does not, however, track shipments in real time by providing, for example, information about shipping, route, modes of transport, and so forth. Instead, it tracks, according to NRC, the transfer of sources from one authorized licensee to another.

<sup>17</sup>Thirty agreement states do not include category 3-5 license information in WBL. According to NRC officials, they do, however, include all category 1 and 2 licenses in WBL to facilitate the verification of these licenses, as required by 10 C.F.R. § 37.71.

<sup>18</sup>WBL is a means for managing NRC's and agreement states' paper-based licensing system.

<sup>19</sup>As we reported in 2016, NRC officials said that the complexity of licenses makes it impractical to implement a fully automated license verification system. A fully automated system would require a computer program that could calculate whether a licensee has sufficient margin between what it currently possesses and the possession limits in its license to obtain additional material.

<sup>20</sup>See [GAO-16-330](#).

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isotopes. However, category 3 quantities are not included in NSTS, and category 3 licenses are only included in LVS if they are also included in WBL.

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## Our Testing Found Vulnerabilities in NRC's System for Verifying Licenses for Purchases of Radioactive Materials

Our efforts to test the effectiveness of NRC's system for verifying licenses for the purchase of radioactive materials revealed vulnerabilities in the system. Specifically, we found that NRC's processes for verifying licenses do not adequately protect against the purchase of some high-risk radioactive materials by actors using a forged or altered license. NRC is taking some steps to strengthen its licensing program. However, current gaps will remain unaddressed until at least the end of 2023.

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## NRC's System for Verifying Licenses Does Not Adequately Protect against the Purchase of Some High-Risk Radioactive Materials Using a Fraudulent License

Our testing found that NRC's current system for verifying licenses is inadequate to effectively protect against purchases of high-risk radioactive materials using a fraudulent license. To test NRC's system for verifying licenses, we developed shell companies and reached out to two different vendors in the U.S. to purchase category 3 quantities of a radioactive material. We successfully purchased a category 3 quantity of radioactive material of concern from these two vendors.

We did not attempt to purchase category 1 or 2 quantities of radioactive materials because those quantities require vendors to verify the validity of licenses with the regulatory authority or through using LVS. NRC does not specifically require vendors to verify the validity of licenses for category 3 radioactive materials purchases with the regulatory authority or through LVS. Instead, transferors have several options, including obtaining a copy of the transferee's license, for verifying that the transferee has a license.

To make our purchase, GAO investigators provided a copy of a license that we forged to two vendors and subsequently obtained invoices; paid the companies; had the material shipped for pickup by a representative of our shell company (actually, one of GAO's investigators); and confirmed delivery of the material. The material shipped to us from our two purchases is shown in figure 1.

Figure 1: Photos of the High-Risk Radioactive Materials Purchased Using Fraudulent Licenses and Delivered to GAO's Shell Company (photos from November 2021 and March 2022)



Source: GAO. | GAO-22-103441

NRC and agreement states have more stringent verification measures for those seeking to acquire category 1 or category 2 quantities of radioactive material. Our shell companies were not subject to these more stringent requirements because we were seeking a category 3 quantity of material. However, even on its own, a category 3 quantity of radioactive material could result in billions of dollars of socioeconomic costs if dispersed using a dirty bomb, as we have previously reported.<sup>21</sup> By purchasing more than one shipment of a category 3 quantity of radioactive material, we demonstrated that a bad actor may have been able to accumulate a category 2 quantity by purchasing multiple category 3 quantities from multiple vendors.

<sup>21</sup>GAO-19-468.

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## NRC Is Taking Some Steps to Strengthen Its Licensing Program, but Current Gaps Will Remain Unaddressed until at Least the End of 2023

NRC officials told us in January 2022 that they have begun a Commission-directed rulemaking that if implemented, would strengthen the license verification controls for purchases of category 3 radioactive materials. Specifically, NRC officials told us that under the rulemaking they envision agreement states would either (1) voluntarily enter licenses into WBL to permit online verification of licenses or (2) require that vendors in their state contact regulatory officials to verify licenses. The final rule content would be informed by public comment and agreement state participation. According to NRC officials, the proposed rulemaking will take between 18 months and 2 years to complete. The officials told us that they believe that these changes would improve verification of licenses for category 3 material.<sup>22</sup> However, our Official Use Only report contains information that if left unaddressed, may diminish the effectiveness of these changes.

NRC officials we interviewed told us in April 2022 that they plan no additional actions beyond the rulemaking to address the vulnerabilities identified by our investigation. That is, the vulnerabilities will remain during the period that the rulemaking is being conducted. NRC officials estimate that the rulemaking will not be completed until at least the end of 2023. However, NRC officials told us that they have the authority to quickly issue additional binding security requirements to licensees via an NRC order, if warranted. For example, NRC could issue an order immediately requiring vendors to verify licenses via a phone call to NRC or to agreement state officials, if the agency believed that doing so was necessary to promote the common defense and security. NRC officials told us that there was no sufficient basis to do so, however.

Similarly, NRC officials stated that the consequences stemming from the detonation of a dirty bomb using category 3 radioactive materials would be insufficient to require issuing immediately effective orders. However, as we found in 2019, a dirty bomb using a category 3 quantity of radioactive materials could be expected to cause hundreds of deaths

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<sup>22</sup>Some past NRC initiatives to improve radioactive security have not been implemented. For example, in 2009, after years of study, NRC staff recommended that the Commission approve a final rule requiring that category 3 materials be tracked in NSTS. When considering the recommendation, the Commission was evenly divided. Specifically, the Commission split two to two and, thus, did not adopt the recommendation. Accordingly, it continues to be the case that only category 1 and 2 sources are required to be tracked in NSTS. Similarly, NRC's Category 3 Source Security and Accountability Working Group recommended key improvements in 2017 that have yet to be implemented.

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from evacuations and billions of dollars of socioeconomic effects.<sup>23</sup> As an example, in May 2019, an incident at the University of Washington resulted in \$156 million in cleanup and other costs as the result of an accident involving about 1 curie of cesium-137—which is less than a category 3 quantity.<sup>24</sup> However, as we previously found, NRC does not consider socioeconomic effects when determining what security measures should be required for radioactive materials that could be used in a dirty bomb.<sup>25</sup> Instead, NRC only considers events that result in prompt fatalities and immediate health effects from radiation, which are unlikely to occur even with quantities much greater than category 3.<sup>26</sup>

Our work shows that it is possible for bad actors to obtain category 3 radioactive materials with forged licenses. NRC’s proposed rulemaking to address this, if implemented, would not go into effect until at least the end of 2023, according to a timeline presented to us by NRC officials. This would leave the vulnerabilities we identified unaddressed until then. Without taking action to address these vulnerabilities in the short term, while the rulemaking process is proceeding, NRC risks the exploitation of those vulnerabilities by a bad actor.

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## Our Testing Exploited Vulnerabilities in NRC’s Ability to Accurately Verify Licenses for Purchases of High-Risk Radioactive Materials

Our ability to test the effectiveness of NRC’s processes for verifying licenses identified vulnerabilities that could affect NRC’s ability to verify licenses used to purchase radioactive materials. Specifically, we found that NRC relies on paper licenses that are vulnerable to alteration and forgery.

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<sup>23</sup>[GAO-19-468](#).

<sup>24</sup>GAO, Alternatives to Radioactive Materials: A National Strategy to Support Alternative Technologies May Reduce Risks of a Dirty Bomb, [GAO-22-104113](#) (Washington, D.C.: Oct. 21, 2021).

<sup>25</sup>[GAO-19-468](#).

<sup>26</sup>In [GAO-19-468](#), we recommended that NRC consider socioeconomic effects. However, NRC disagreed with the recommendation and has not taken any action to implement it.

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## NRC Relies on Paper Licenses That Are Vulnerable to Alteration and Forgery

NRC requires a valid license to possess category 3 quantities of radioactive material. However, the paper licenses that it issues can be altered and used to make illicit purchases of radioactive materials. As stated above, during our investigation, we created forged licenses to facilitate our purchases. This is also consistent with how we altered valid paper licenses obtained using shell companies in 2007 and 2016.<sup>27</sup>

During this investigation, we succeeded because paper licenses can be easily altered. As a result, bad actors could alter or forge valid licenses, bypass current NRC controls, and obtain dangerous quantities of radioactive material. As discussed earlier, our investigation showed that a bad actor could use a forged license to accumulate a category 2 quantity of radioactive material by making multiple category 3 purchases.

*Standards for Internal Control in the Federal Government* state that management should identify, analyze, and respond to risks related to achieving the defined objectives.<sup>28</sup> In addition, these standards state that management should design the entity's information system and related control activities to achieve objectives and respond to risks. In this regard, effective management designs control activities for security management of the entity's information system. Objectives for security management include integrity, meaning that information is safeguarded against improper modification or destruction, which includes ensuring the information's nonrepudiation and authenticity. Until NRC either moves away from paper-based licenses, or strengthens its verification processes to ensure that a bad actor cannot circumvent the integrity of its system through security features, such as multifactor authentication, high-risk radioactive material will remain vulnerable to being purchased with a forged or altered license.<sup>29</sup>

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## Conclusions

NRC has begun a process to address vulnerabilities identified in our 2016 report regarding license verification for category 3 quantities of high-risk radioactive materials. This process, if implemented, would result in

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<sup>27</sup>[GAO-07-1038T](#) and [GAO-16-330](#).

<sup>28</sup>[GAO-14-704G](#).

<sup>29</sup>According to the Department of Homeland Security, multifactor authentication is a layered approach to securing data and applications where a system requires a user to present a combination of two or more credentials to verify a user's identity for login. Multifactor authentication increases security because even if one credential becomes compromised, unauthorized users will be unable to meet the second authentication requirement and will not be able to access the targeted physical space, computing device, network, or database.

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meaningful upgrades to security procedures, potentially by the end of 2023. However, until the vulnerabilities are addressed, meaningful gaps in NRC's license verification process will remain. NRC officials we interviewed told us that they do not consider the threat or consequences from the release of category 3 materials to be sufficient to take immediate action, though they have the authority to do so. By not taking immediate action, NRC is permitting this vulnerability to remain, despite potentially significant social and economic consequences.

As our investigation showed, continued reliance on paper-based licensing is problematic. NRC has several options for strengthening its licensing system including, for example, moving away from paper-based licensing toward an electronic or digital system. Alternatively, NRC might choose to continue with paper-based licensing but require additional security features, such as multifactor verification. Finally, NRC could strengthen its process by implementing our 2016 recommendations to include category 3 quantities of radioactive materials in NSTS and all category 3 licenses in WBL.

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## Recommendations for Executive Action

We are making the following two recommendations to NRC:

The Chairman of NRC should immediately require that vendors verify category 3 licenses with the appropriate regulatory authority. (Recommendation 1)

The Chairman of NRC should add security features to its licensing process to improve its integrity and make it less vulnerable to altering or forging licenses. These security features could include multifactor authentication or moving away from paper licenses to electronic-based licensing. (Recommendation 2)

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## Agency Comments

We provided a draft of this report to NRC and the Department of Homeland Security (DHS) for review and comment. DHS did not comment on the report. NRC provided comments, which are reproduced in appendix II. In addition, NRC and DHS provided technical comments, which we incorporated as appropriate.

NRC partially agreed with our first recommendation and agreed with our second recommendation. Specifically, regarding our first recommendation, NRC agreed with the need to take action to require vendors to verify category 3 licenses with the appropriate regulatory agency. In addition, as we outlined in our report, NRC has begun a rulemaking process to address the vulnerabilities identified by our

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investigation. However, NRC is not planning to address these vulnerabilities immediately. As a result, these vulnerabilities will remain during the period of time that the rulemaking is being conducted. NRC officials estimate that the rulemaking will not be completed until at least the end of 2023. Regarding our second recommendation, NRC, as part of its rulemaking process, will consider adding enhanced security features in the licensing process and providing guidance to regulators and licensees. In addition, NRC will take into consideration specific methods that we suggested in our report. If NRC implements these measures, the integrity of its licensing process will be improved.

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As agreed with your office, unless you publicly announce the contents of this report earlier, we plan no further distribution until seven days from the report date. At that time, we will send copies to the Secretary of Homeland Security, the Chairman of the Nuclear Regulatory Commission, and other interested parties. In addition, the report will be available at no charge on the GAO website at <https://www.gao.gov>.

If you or your staff have any questions about this report, please contact us at (202) 512-3841 or [bawdena@gao.gov](mailto:bawdena@gao.gov), or (202) 512-5222 or [arpj@gao.gov](mailto:arpj@gao.gov). Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made significant contributions to this report are listed in appendix III.



Allison Bawden  
Director, Natural Resources and Environment



J. Howard Arp,  
Director, Forensic Audit and Investigative Services

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# Appendix I: Our Test of the Effectiveness of U.S. Customs and Border Protection's Verification of Licenses for Imported Radioactive Materials

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The Department of Homeland Security's U.S. Customs and Border Protection (CBP) works with the Nuclear Regulatory Commission (NRC) to ensure that only properly licensed radiological material enters the U.S. NRC authorizes the importation and possession of radioactive materials through licenses. CBP monitors ports of entry to help ensure that only properly licensed shipments of material are permitted to enter the U.S. CBP uses various data systems to track shipments into the U.S. and identify shipments for license verification. CBP also has established procedures for verifying licenses of private-sector entities who are intended to receive shipments of material coming through U.S. ports of entry.

CBP has implemented a policy and procedures requiring CBP officials at airports to contact experts within a centralized CBP office to verify licenses for radiological material being shipped into the U.S.<sup>1</sup> Specifically, CBP issued its "Radiation Detection Standard Operating Procedures Directive" policy in March 2014.<sup>2</sup> This policy outlined when CBP officials at ports of entry are required to contact internal experts at CBP's Teleforensic Center who possess the technical expertise to verify that NRC and agreement state licenses for radiological materials are legitimate.<sup>3</sup> The function of the Teleforensic Center is to provide field CBP officials with assistance in resolving scientific and technological questions, including detection, isolation, and control of potential threats that may result from the presence of chemical, biological, radiological, or nuclear materials.

CBP updated its procedures in response to recommendations that we made in 2018. Specifically, they (1) augmented their current system to better comply with license verification policies and procedures, (2) conducted an assessment reviewing relevant policies and procedures, and (3) created a tiered ruleset that better identifies shipments of radioactive material.

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<sup>1</sup>GAO, *Nuclear Security: CBP Needs to Take Action to Ensure Imported Radiological Material Is Properly Licensed*, [GAO-18-214](#) (Washington, D.C.: Jan. 10, 2018).

<sup>2</sup>CBP Directive No. 5290-015B.

<sup>3</sup>Ports of entry are facilities that provide for the controlled entry into or departure from the United States. Specifically, a port of entry is any officially designated location (seaport, airport, or land border location) where CBP officers clear passengers, merchandise and other items; collect duties; enforce customs and other U.S. laws; and inspect persons seeking to enter or applying for admission into, or departing the United States pursuant to U.S. immigration and travel controls.

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**Appendix I: Our Test of the Effectiveness of  
U.S. Customs and Border Protection's  
Verification of Licenses for Imported  
Radioactive Materials**

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As part of this investigation, we initially sought to test the effectiveness of CBP's verification of licenses for imported radioactive materials and, in particular, the effectiveness of the updates that CBP made to its procedures in response to our 2018 recommendations. During the course of our testing, we reached out to radioactive materials vendors in Africa, Asia, Europe, and South America; we received offers from companies in China and Hungary. We ultimately abandoned our testing before completion because of conditions put on our purchases that would have resulted either in (1) not executing a test of CBP's implementation of its updated procedures or (2) compromising carefully researched safety and security conditions necessary to ensuring that material we purchased would never leave the control of a vetted shipper.

Specifically, some vendors referred us to subsidiaries in the U.S. that could sell us the material that we sought. However, buying from domestic subsidiaries would not test CBP license verification procedures, as this material would never go through a U.S. port of entry. Some of the vendors did not sell small quantities of radioactive materials that would allow us to test category 3 quantities of material, and others who made offers to sell us radioactive materials did not use the shipper that we had vetted to ensure that we could safely and securely return the material to the vendor.

In one case, we were ready to make a purchase from a foreign vendor, but the vendor contacted the agreement state to verify our forged license.<sup>4</sup> When the agreement state realized that our license was fraudulent, it contacted the Federal Bureau of Investigation, which reached out to us, and we abandoned the effort to make this purchase. The vendor was not required by U.S. regulation to verify the license with the agreement state, and doing so was contrary to its financial interest. However, the vendor's action underscored the importance of our 2016 recommendation that NRC require all vendors of category 3 radioactive materials to verify licenses.<sup>5</sup>

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<sup>4</sup>As stated above, NRC does not specifically require vendors to verify the validity of licenses for purchases of category 3 radioactive materials by contacting the regulatory authority. The agency requires that vendors choose from a list of options for verification purposes, including simply obtaining a copy of the license. Contacting the regulatory authority is the most stringent option under NRC's regulations.

<sup>5</sup>GAO, *Nuclear Security: NRC Has Enhanced the Controls of Dangerous Radioactive Materials, but Vulnerabilities Remain*, [GAO-16-330](#) (Washington, D.C.: July 1, 2016).

# Appendix II: Comments from the Nuclear Regulatory Commission



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

June 29, 2022

Ms. Allison Bawden  
Director, Natural Resources and Environment  
U.S. Government Accountability Office  
441 G Street NW  
Washington, DC 20548

SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION COMMENTS ON DRAFT  
GOVERNMENT ACCOUNTABILITY OFFICE REPORT GAO-22-103441,  
"PREVENTING A DIRTY BOMB – VULNERABILITIES PERSIST IN NRC'S  
CONTROLS FOR PURCHASES OF HIGH-RISK RADIOACTIVE MATERIALS"

Dear Ms. Bawden:

Thank you for the opportunity to review and comment on the United States Government Accountability Office (GAO) draft report GAO-22-103441, "Preventing a Dirty Bomb – Vulnerabilities Persist in NRC's Controls for Purchases of High-Risk Radioactive Materials," which the U.S. Nuclear Regulatory Commission (NRC) received on June 17, 2022. We appreciate the efforts by GAO to identify opportunities to enhance NRC regulations, as well as the collegiality with which you have consistently shared information on issues of interest. We take your recommendations seriously and will continue our efforts to strengthen the safety and security of radioactive materials.

Together, the NRC and Agreement States have established a strong regulatory framework that ensures the safety, security, and control of radioactive sources. This framework includes regulations that ensure appropriate access to high-risk radioactive sources; secure storage of these sources; and effective detection, assessment, and response to any unauthorized access. This framework also includes robust oversight and enforcement programs. Collectively, this regulatory approach considers reasonable threats and provides both prevention and mitigation of consequences, such that the NRC maintains reasonable assurance of adequate protection of public health and safety, as well as common defense and security.

The NRC's mission and regulatory framework are complemented by those of several other Federal agencies. Each of these agencies, including the Department of Homeland Security (DHS), the Department of Energy, and the Federal Bureau of Investigation, play an integral role in the domestic architecture for radioactive security. Through forums such as the 14-agency Radiation Source Protection and Security Task Force (Task Force), Federal agencies coordinate on a routine basis to ensure that the United States is appropriately positioned to protect the country from potential terrorist threats such as the use of radioactive material in a radiological dispersal device (RDD) or radiation exposure device. In October 2018, the Task Force submitted a report to the President and Congress (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18276A155). The Task Force concluded that there are no significant gaps in the area of radioactive source protection and security that are not already being addressed by ongoing efforts of the appropriate agencies. The 2022 report is in the final stages of development, and the NRC does not anticipate any change in this conclusion.

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**Appendix II: Comments from the Nuclear  
Regulatory Commission**

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A. Bawden

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In the subject draft report, the GAO staff emphasizes that their recommendations should be implemented immediately. This urgency is based on the GAO's conclusions from their report GAO-19-258SU; however, the NRC disagreed with the conclusions from this report (ADAMS Accession No. ML19077A341). The conclusions in GAO-19-258SU lack important context in that they focus on the potential consequences of an RDD without accounting for certain aspects of risk (i.e., threat and vulnerability), which include consideration of the probability of an event, the credible capabilities of adversaries, the protection afforded by the existing regulatory framework, and the sophisticated national infrastructure that is maintained under the leadership of DHS. In order to make a risk-informed determination regarding the appropriate level of safety and security controls to protect radioactive materials, including the urgency with which the NRC issues requirements (that is, whether to issue requirements by immediately effective Order or by a publicly transparent rulemaking process), it is necessary to consider all aspects of risk, and to assess the impact of any additional security measures on the beneficial use of radioactive materials.

In its draft report, the GAO made two recommendations for action by the NRC. The NRC's comments with respect to the recommendations follow.

**GAO Recommendation 1:** The Chairman of the NRC should immediately require that vendors verify category 3 licenses with the appropriate regulatory agency.

**NRC Response:** The NRC agrees with requiring vendors to verify Category 3 licenses with the appropriate regulatory agency and has already begun rulemaking that would require such verification, based on Commission direction in December 2021. The proposed rule is expected to be transmitted to the Commission in October 2023 for their consideration. The NRC is taking internal process steps to appropriately expedite this rulemaking. The existing regulatory framework considers all aspects of both safety and security risk—threat, vulnerability, and consequence—and is applied in a graded approach to mitigate the risk from resulting radiation effects. Given this framework, the NRC maintains reasonable assurance of adequate protection of public health and safety, as well as common defense and security. Therefore, while this rulemaking will provide an improvement in overall security, the NRC does not have a sufficient basis to issue immediately effective requirements. Furthermore, following the rulemaking process under the Administrative Procedure Act enables the NRC to incorporate public feedback, providing for fully informed and effective requirements that can be implemented without unintended impacts.

**GAO Recommendation 2:** The Chairman of the NRC should add security features to its licensing process to improve its integrity and make it less vulnerable to altering or forging licenses. These security features could include multi-factor authentication or moving away from paper licenses to electronic-based licensing.

**NRC Response:** The NRC agrees with considering enhanced security features in the licensing process. As part of the rulemaking process already underway to require license verification, the NRC will consider providing guidance to regulators and licensees that will reduce the potential for altered or forged licenses to be used in acquiring Category 3 radioactive sources, which could include the specific methods suggested by GAO. The rulemaking will be conducted in coordination with the Agreement States, which will jointly implement the new requirements.

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**Appendix II: Comments from the Nuclear  
Regulatory Commission**

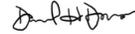
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A. Bawden

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The enclosure provides detailed comments and suggestions from the NRC on the draft GAO report. Should you have any questions concerning these comments, please contact John Jolicoeur at [John.Jolicoeur@nrc.gov](mailto:John.Jolicoeur@nrc.gov) or 301-415-1642.

Sincerely,



Signed by Dorman, Dan  
on 06/29/22

Daniel H. Dorman  
Executive Director  
for Operations

Enclosure:  
U.S. Nuclear Regulatory Commission Detailed  
Comments on U.S. Government Accountability  
Office (GAO) Draft Report GAO-22-103441  
"Preventing a Dirty Bomb – Vulnerabilities  
Persist in NRC's Controls for Purchases of  
High-Risk Radioactive Materials"

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# Appendix III: GAO Contacts and Staff Acknowledgments

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## GAO Contacts

Allison Bawden at (202) 512-3841 or [bawdena@gao.gov](mailto:bawdena@gao.gov)  
J. Howard Arp at (202) 512-5222 or [arpj@gao.gov](mailto:arpj@gao.gov)

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## Staff Acknowledgments

In addition to the contacts named above, Ned Woodward (Assistant Director), Rob Graves (Assistant Director), Jeffrey Barron (Analyst-in-Charge), William Bauder, Antoinette Capaccio, Kendall Childers, John Delicath, Cindy Gilbert, James Murphy, Cynthia Norris, Patricia Powell, and Dan Royer made contributions to this report.

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A. Nicole Clowers, Managing Director, [ClowersA@gao.gov](mailto:ClowersA@gao.gov), (202) 512-4400, U.S. Government Accountability Office, 441 G Street NW, Room 7125, Washington, DC 20548

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## Public Affairs

Chuck Young, Managing Director, [youngc1@gao.gov](mailto:youngc1@gao.gov), (202) 512-4800  
U.S. Government Accountability Office, 441 G Street NW, Room 7149  
Washington, DC 20548

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## Strategic Planning and External Liaison

Stephen J. Sanford, Managing Director, [spel@gao.gov](mailto:spel@gao.gov), (202) 512-4707  
U.S. Government Accountability Office, 441 G Street NW, Room 7814,  
Washington, DC 20548

