



March 2023

# OVERSEAS NUCLEAR MATERIAL SECURITY

A Comprehensive  
National Strategy  
Could Help Address  
Risks of Theft and  
Sabotage

Accessible Version

# GAO Highlights

Highlights of [GAO-23-106486](#), a report to congressional requesters

## Why GAO Did This Study

According to NNSA, there is enough nuclear material around the world to make tens of thousands of nuclear weapons. Some of this material is in countries facing significant security challenges. The theft of nuclear materials or sabotage of a nuclear facility could result in a dangerous release of radiation.

GAO was asked to review U.S. efforts to secure international nuclear materials. This report (1) describes the risks to securing international nuclear materials identified by federal officials and experts; (2) examines the extent to which federal programs address these risks; and (3) assesses the extent to which U.S. agencies plan and coordinate their nuclear material security programs, and a national strategy exists to help ensure alignment of programs' objectives. GAO reviewed relevant plans and program documentation and interviewed federal officials and nongovernmental experts.

## What GAO Recommends

GAO is making three recommendations, including that NNSA and DOD programs follow leading collaboration practices to clarify and document roles and responsibilities when working in the same countries, and that NSC's future national strategy include guidance for agencies to align their activities with the strategy's goals. NNSA and DOD agreed with GAO's recommendations; NSC did not comment. This is a public version of a Controlled Unclassified Information (CUI) report that GAO issued in December 2022. Information that NNSA and NSC deemed CUI has View [GAO-23-106486](#). For more information, contact Allison Bawden at (202) 512-3841 or [bawdena@gao.gov](mailto:bawdena@gao.gov).

March 2023

## OVERSEAS NUCLEAR MATERIAL SECURITY

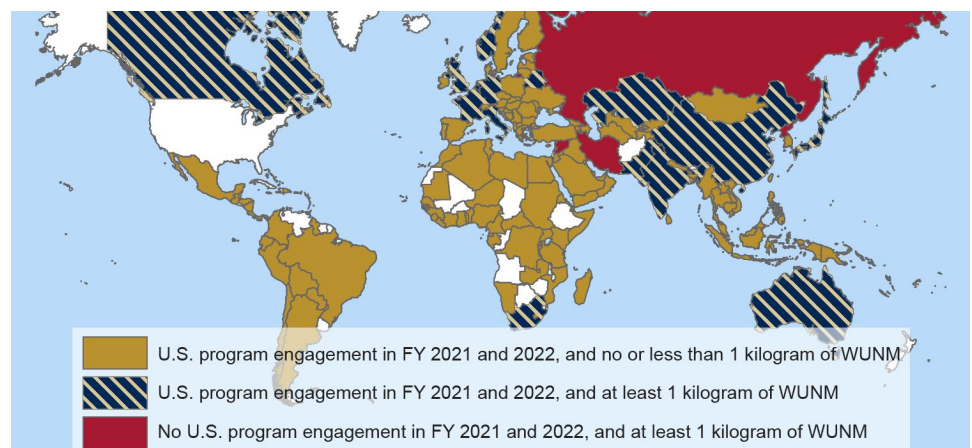
### A Comprehensive National Strategy Could Help Address Risks of Theft and Sabotage

## What GAO Found

Federal officials and nuclear security experts identified existing risks to the security of nuclear materials worldwide, such as inadequate physical security at facilities containing these materials. Officials and experts also identified trends that could exacerbate risks, such as advancements in cyber capabilities.

GAO identified federal programs, including those under the National Nuclear Security Administration (NNSA) and Department of Defense (DOD), which are taking steps to address these risks. These steps include increasing facility security, countering nuclear smuggling, and reducing the use of weapon usable nuclear material in civilian nuclear applications. However, challenges exist in carrying out this work. For example, for selected countries with security risks, the state of bilateral relations limits U.S. efforts to secure international nuclear materials.

#### U.S. Program Efforts to Secure Nuclear Materials, including Weapon Usable Nuclear Material (WUNM), Fiscal Years (FY) 2021 and 2022



Sources: GAO analysis of documentation and information from the National Nuclear Security Administration, Department of State, Department of Defense, and Nuclear Regulatory Commission; Map Resources (map). | [GAO-23-106486](#)

Of the 23 programs GAO reviewed, some conduct similar work in the same countries, and GAO found that where programs overlap, they generally coordinate with one another. However, GAO found that a few of the overlapping programs did not clearly document their roles and responsibilities, as called for in leading practices for collaboration. For example, a DOD program has plans to undertake nuclear security capacity-building efforts in two countries where NNSA programs are undertaking similar efforts. NNSA officials identified the potential for these efforts to be duplicative, if roles are not further clarified.

The National Security Council (NSC) is developing a national strategy related to international nuclear material security, but it is uncertain how this strategy will guide agency and program efforts. By developing a national strategy that includes implementation guidance for agencies and programs, NSC can help program managers make informed decisions to align and prioritize their current and future activities with the nuclear material security goals articulated in the strategy.

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### **Abbreviations**

CUI	Controlled Unclassified Information
DOD	Department of Defense
GNS	Global Nuclear Security
HALEU	high-assay low enriched uranium
HEU	highly enriched uranium
IAEA	International Atomic Energy Agency
INS	International Nuclear Security
LEU	low enriched uranium
NNSA	National Nuclear Security Administration
NRC	Nuclear Regulatory Commission
NSC	National Security Council
NSDD	Nuclear Smuggling Detection and Deterrence
WMD	weapons of mass destruction
WUNM	weapon usable nuclear material

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March 30, 2023

The Honorable Adam Smith  
Ranking Member  
Committee on Armed Services  
House of Representatives

The Honorable Chuck Fleischmann  
House of Representatives

The Honorable Jimmy Panetta  
House of Representatives

Throughout the world, nuclear materials are produced and used in military and civilian applications. According to the Department of Energy's National Nuclear Security Administration (NNSA), there are enough nuclear materials in the world—mainly in the form of highly enriched uranium (HEU) and separated plutonium—to make tens of thousands of nuclear weapons or explosive devices.<sup>1</sup> U.S. agencies, the International Atomic Energy Agency (IAEA),<sup>2</sup> and other organizations have generally highlighted two broad risks associated with the security of nuclear materials: (1) unauthorized removal (theft) of nuclear materials with the intent to construct a nuclear weapon or explosive device capable of dispersing radiation into the environment and (2) sabotage of a facility containing nuclear materials that could result in a dangerous release of radiation.

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<sup>1</sup>Materials that can be used to construct a nuclear device are HEU (uranium enriched to 20 percent or greater in the isotope uranium-235); uranium-233; and separated plutonium containing less than 80 percent of the isotope plutonium-238. Low enriched uranium (LEU) contains less than 20 percent, and greater than 0.7 percent uranium-235. Most commercial nuclear reactor fuel is enriched to between 3 percent and 5 percent uranium-235.

<sup>2</sup>The IAEA is an autonomous international organization affiliated with the United Nations. The IAEA has the dual role of promoting the peaceful uses of nuclear energy through the transfer of nuclear science and technology and verifying that nuclear material subject to safeguards is not diverted for the production of nuclear weapons or other proscribed purposes. Since its founding, IAEA has taken on additional roles and established related programs, including a nuclear security program.

Several U.S. government agencies pursue programs to address various aspects of nuclear material theft and sabotage risks around the world.<sup>3</sup> The main agencies involved in these programs and the principal organizations within each agency are NNSA and its Office of Defense Nuclear Nonproliferation; the Department of State and its Bureau of International Security and Nonproliferation; the Department of Defense (DOD) and its Defense Threat Reduction Agency; and the Nuclear Regulatory Commission (NRC). These agencies spend a total of almost a billion dollars per year on international nuclear material security programs. In addition, the National Security Council (NSC) guides U.S. efforts to secure international nuclear materials by identifying risks, developing priorities and strategies for executive branch agencies, and overseeing interagency coordination and policy. In 2021, NSC began conducting a review of federal efforts to secure international nuclear materials and may develop a national strategy that could include directives for relevant agencies.<sup>4</sup>

We have previously found that U.S. agencies and programs have had mixed success in their efforts to help secure international nuclear materials and have faced challenges. Significant efforts have been made to address global nuclear material security. Between 2009 and 2016, four international Nuclear Security Summits were held to encourage world leaders to improve nuclear security. In addition, from April 2009 through December 2013, worldwide, NNSA removed or disposed of 1,616 kilograms of HEU or plutonium, downblended 4,900 kilograms of HEU, upgraded 32 buildings with increased physical protections, and converted or confirmed as shutdown 23 foreign research reactors to run on low enriched uranium (LEU) fuel.<sup>5</sup> In 2011, we reported on agencies' efforts to coordinate their programs that address theft and smuggling of nuclear

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<sup>3</sup>While agencies generally referred to their efforts to promote nuclear material security worldwide as programs, we found that agencies did not consistently use the term program when describing their efforts. For instance, some agencies referred to discrete efforts as offices, program offices, or subprograms within a larger program. To simplify this report, we generally refer to discrete agency efforts as programs when summarizing and refer to the individual names of these efforts as offices or subprograms when described on their own.

<sup>4</sup>According to NSC officials, this review is being conducted pursuant to formal interagency structures and processes established by the White House, *Memorandum on Renewing the National Security Council System*, National Security Memorandum/nSM-2 (Washington, D.C.: Feb. 4, 2021).

<sup>5</sup>Downblending refers to the mixing of weapon usable or highly enriched material with other materials so it is no longer weapon usable or highly enriched.



materials,<sup>6</sup> and in 2015 we reported on NNSA's plans to conduct priority nuclear material removal from countries with a high risk of theft or sabotage.<sup>7</sup> In both instances, we found deficiencies in coordination and planning that agencies later remedied.

However, continuing risks remain to nuclear materials around the world. For example, according to the IAEA's 2022 Incident and Trafficking Database, countries voluntarily reported 38 incidents of a confirmed or likely act of trafficking or malicious use of nuclear or other radioactive materials between 2016 and 2021. A 2020 study by the nongovernmental organization the Nuclear Threat Initiative found that progress on nuclear security had slowed since 2018, and the number of countries with worsening rankings for their ability to protect nuclear materials against the threat of theft and sabotage had increased.<sup>8</sup> In 2020, we reported that while NNSA had completed numerous projects to enhance the security of nuclear materials in Russia—from improving physical security with cameras and fencing to better training of security personnel—nearly all cooperative U.S. nuclear security programs with Russia ended in 2014

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<sup>6</sup>GAO, *Nuclear Nonproliferation: Action Needed to Address NNSA's Program Management and Coordination Challenges*, [GAO-12-71](#) (Washington, D.C.: Dec. 14, 2011). This report recommended that NNSA justify funding and improve performance measures for several different offices and programs within its Office of Defense Nuclear Nonproliferation. In addition, there were two recommendations to NSC to reduce program overlap in combating nuclear smuggling overseas. All of these recommendations were subsequently closed.

<sup>7</sup>GAO, *Nuclear Nonproliferation: DOE Made Progress to Secure Vulnerable Nuclear Materials Worldwide, but Opportunities Exist to Improve Its Efforts*, [GAO-15-799](#) (Washington, D.C.: Sept. 23, 2015). This report had a recommendation for the Department of Energy to complete the prioritization for removal or disposition of nuclear material at foreign locations and one to conduct physical protection visits at foreign sites with certain U.S.-obligated nuclear material. Both recommendations were subsequently implemented.

<sup>8</sup>The Nuclear Threat Initiative is a nonprofit, nonpartisan global security organization focused on reducing nuclear and biological threats that could imperil humanity. The Nuclear Threat Initiative's Nuclear Security Index provides a benchmark of the nuclear security conditions on a country-by-country basis in 176 countries. See Nuclear Threat Initiative, *NTI Nuclear Security Index: Losing Focus in a Disordered World*, 5<sup>th</sup> ed. (July 2020).

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when Russia invaded Crimea. As a result, we found it is likely that some nuclear material security risks in Russia have persisted.<sup>9</sup>

You asked us to review issues related to U.S. efforts to help secure international nuclear materials. This report (1) describes the risks to securing international nuclear materials identified by federal officials and nuclear security experts; (2) examines the extent to which federal programs are taking steps to address identified risks to securing international nuclear materials; and (3) assesses the extent to which agencies plan and coordinate their nuclear material security programs, and a national strategy exists to help ensure alignment of programs' objectives.

This report is a public version of a Controlled Unclassified Information (CUI) report that we issued in December 2022.<sup>10</sup> The National Nuclear Security Administration and National Security Council deemed some of the information in our December 2022 report to include CUI, which must be protected from public disclosure. Therefore, this report omits some information about particular countries and selected program activities. Although the information provided in this report is more limited, the report addresses the same objectives as the CUI report and uses the same methodology.<sup>11</sup>

The scope of our review includes weapon usable nuclear material (WUNM), such as HEU and plutonium; reactors and facilities that utilize or house WUNM; and reactors and facilities that utilize or house materials that are not directly usable in constructing a nuclear weapon, but that

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<sup>9</sup>GAO, *Nuclear Nonproliferation: Past U.S. Involvement Improved Russian Nuclear Material Security, but Little Is Known about Current Conditions*, [GAO-20-392](#) (Washington, D.C.: Feb. 27, 2020).

<sup>10</sup>GAO, *Overseas Nuclear Material Security: A Comprehensive National Strategy Could Help Address Risks of Theft and Sabotage*, [GAO-23-104715SU](#) (Washington, D.C.: Dec. 21, 2022).

<sup>11</sup>On March 2, 2023, the White House announced that the President had signed National Security Memorandum 19 to Counter Weapons of Mass Destruction Terrorism and Advance Nuclear and Radioactive Material Security worldwide. Because the issuance of this strategy occurred after the completion of our audit work for our December 2022 Controlled Unclassified Information (CUI) report, this public version of our report does not assess the administration's new strategy. Consequently, we have not updated information in this report or revised our recommendations from the CUI version of the report.

could make the facilities targets for nuclear theft or sabotage.<sup>12</sup> The scope of programs in our review included those that

- improve security at facilities with nuclear material;
- remove or consolidate nuclear materials to more secure locations;
- convert facilities from the use of WUNM;
- build nuclear material security capacity in partner countries;
- monitor security of nuclear material;
- deter, detect, and interdict nuclear material smuggling; and
- enhance trade controls over sensitive goods and technology, including dual-use goods,<sup>13</sup> that could be used to produce more nuclear material.

Using this scope, we identified 23 programs at NNSA, DOD, State, and NRC that are involved in an aspect, or aspects of, these nuclear material security efforts.

To address all three objectives, we reviewed relevant agency and program documents that discuss policies, plans, and activities to address risks to securing international nuclear materials, and potential challenges to such efforts. We also interviewed federal officials, representatives from the Department of Energy's national laboratories, and nongovernmental nuclear security experts. Our interview subjects included federal officials from the 23 programs we identified at NNSA, DOD, State, and NRC; federal officials from the NSC; representatives from 10 national laboratories and production sites involved in international nuclear material security efforts; and a nongeneralizable sample of nuclear security experts from 15 nongovernmental organizations. We identified the experts from nongovernmental organizations through a search of relevant literature, news articles, and other materials. We refer to the individuals we interviewed from the national laboratories, production sites, and

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<sup>12</sup>The scope of our review does not encompass the security of radiological materials, or the security of nuclear materials in the U.S. The scope of our review also does not include the IAEA Safeguards program—which seeks to verify that nuclear material subject to safeguards is not diverted for the production of nuclear weapons or other proscribed purposes—and U.S. programs focused solely on safeguards efforts.

<sup>13</sup>Dual-use goods include goods with both commercial and military uses that can be used to produce weapons of mass destruction or for other military or terrorism-related purposes.

nongovernmental organizations collectively as “nuclear security experts” or “experts.”

To describe the risks to securing international nuclear materials identified by federal officials and nuclear security experts, we reviewed agency documents—such as strategic plans, agency performance reports, budget justification documents, reports to Congress, and interagency memorandums—and reports and materials produced by nongovernmental organizations. We interviewed officials affiliated with the 23 federal programs we identified with roles in international nuclear material security. We also interviewed a total of 85 experts from 10 Department of Energy national laboratories and production sites, as well as 15 nongovernmental organizations. We analyzed the information gathered from these documents and interviews and grouped similar risks together that were consistently identified to help describe the risk landscape.

To determine the extent to which federal programs are taking steps to address the identified risks to securing international nuclear materials, we relied on the same agency documents and interviews with the same federal officials and experts outlined previously. We used these interviews and documents to determine which federal programs worked to address the identified risks and what risks were unaddressed by federal programs overall or in specific countries.

To determine the extent to which agencies plan and coordinate their nuclear material security programs, and a national strategy exists to help ensure alignment of programs’ objectives, we examined planning documentation from each of the 23 federal programs we identified. We interviewed federal officials about existing program plans, as well as any plans for updating or revising their program plans. We analyzed whether these program plans followed existing agency program management policies and guidance, as well as leading practices in program management.

In our assessment of the plans of the 23 federal programs, we reviewed standards for program management outlined in the Project Management Institute, Inc.’s *The Standard for Program Management*, Fourth Edition

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(2017) and *Governance of Portfolios, Programs, and Projects: A Practice Guide* (2016).<sup>14</sup>

We also interviewed federal officials from the 23 programs about interagency and intra-agency collaboration practices, including whether potentially overlapping programs have established clear and documented roles and responsibilities. We analyzed those practices against leading practices for collaboration established in previous GAO work.<sup>15</sup> We also interviewed NSC officials about their ongoing efforts to develop a national strategy for nuclear material security. From those interviews, we reviewed planned or potential elements of the strategy and compared those against desirable characteristics of national strategies that we have identified in previous work.<sup>16</sup> Appendix I presents a more detailed description of our objectives, scope, and methodology.

The performance audit upon which this report is based was conducted from January 2021 to December 2022 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate, evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives. We subsequently worked with NNSA and NSC from December 2022 to March 2023 to prepare this version of the original CUI report for public release. This public version was also prepared in accordance with these standards.

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<sup>14</sup>Project Management Institute, Inc., *The Standard for Program Management*, Fourth Edition (2017); *Governance of Portfolios, Programs, and Projects: A Practice Guide* (2016). The Project Management Institute, Inc. is a not-for-profit association that provides global standards for, among other things, program management. These standards are utilized worldwide and provide guidance on how to manage various aspects of projects, programs, and portfolios. For example, NNSA cites the Project Management Institute, Inc.'s standards as a source of best practices in its program management policy.

<sup>15</sup>GAO, *Managing for Results: Implementation Approaches Used to Enhance Collaboration in Interagency Groups*, [GAO-14-220](#) (Washington, D.C.: Feb. 14, 2014); and *Managing for Results: Key Considerations for Implementing Interagency Collaborative Mechanisms*, [GAO-12-1022](#) (Washington, D.C.: Sept. 27, 2012).

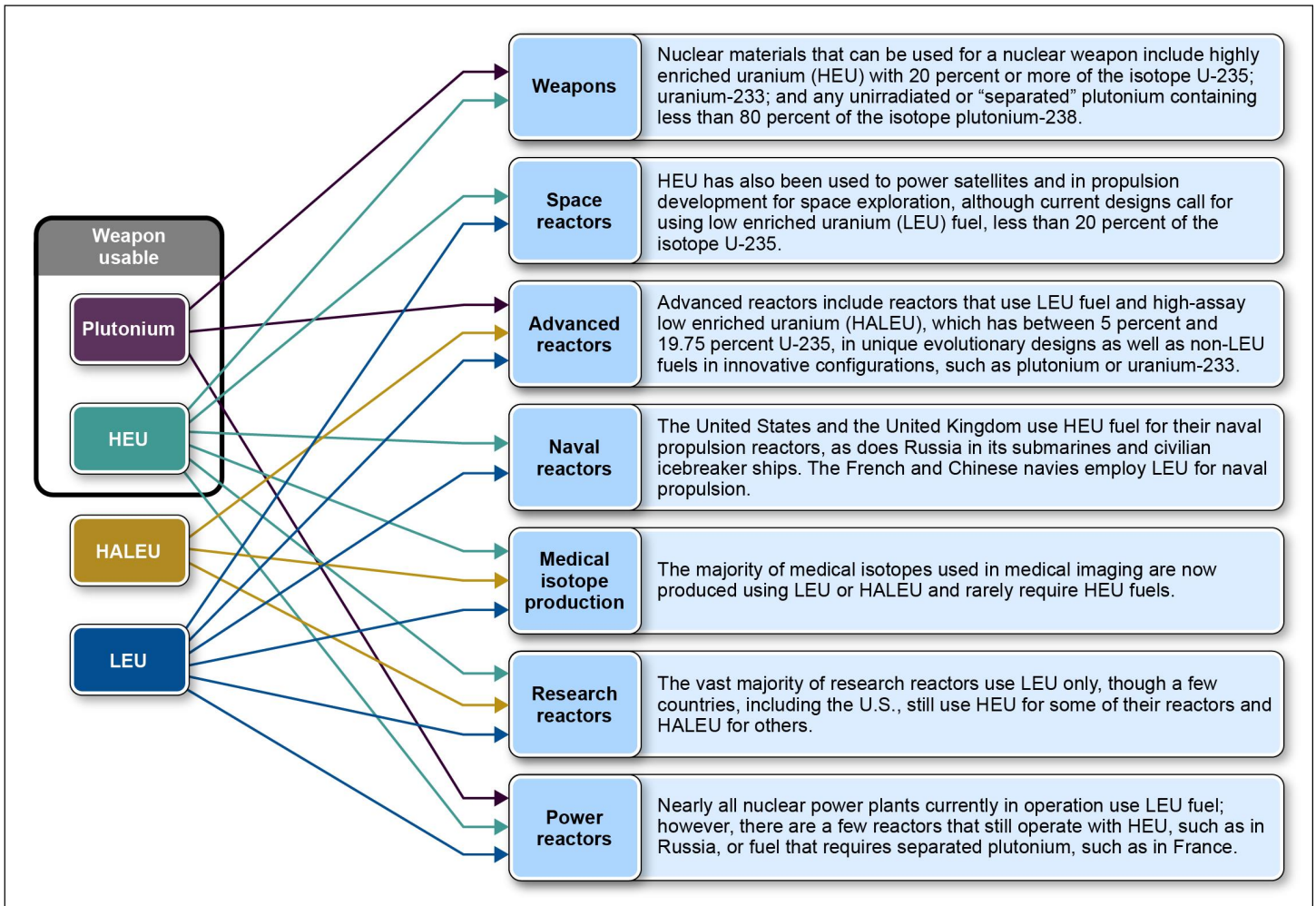
<sup>16</sup>GAO, *Combating Terrorism: Evaluation of Selected Characteristics in National Strategies Related to Terrorism*, [GAO-04-408T](#) (Washington, D.C.: Feb. 3, 2004).

## Background

### Nuclear Materials and Facilities Uses and Locations

There are a variety of both military and civilian uses for nuclear materials. The primary uses for and types of nuclear materials are shown in figure 1.

Figure 1: Primary Uses for Nuclear Materials



Source: GAO analysis of agency and open source documentation. | GAO-23-106486

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**Text of Figure 1: Primary Uses for Nuclear Materials**

**Plutonium (Weapon usable)**

**HEU (Highly enriched uranium) (Weapon usable)**

**HALEU (high-assay low enriched uranium)**

**LEU (low enriched uranium)**

- Weapons: Nuclear materials that can be used for a nuclear weapon include highly enriched uranium (HEU) with 20 percent or more of the isotope U-235; uranium-233; and any unirradiated or “separated” plutonium containing less than 80 percent of the isotope plutonium-238.
- Space reactors: HEU has also been used to power satellites and in propulsion development for space exploration, although current designs call for using low enriched uranium (LEU) fuel, less than 20 percent of the isotope U-235.
- Advanced reactors: Advanced reactors include reactors that use LEU fuel and high-assay low enriched uranium (HALEU), which has between 5 percent and 19.75 percent U-235, in unique evolutionary designs as well as non-LEU fuels in innovative configurations, such as plutonium or uranium-233.
- Naval reactors: The United States and the United Kingdom use HEU fuel for their naval propulsion reactors, as does Russia in its submarines and civilian icebreaker ships. The French and Chinese navies employ LEU for naval propulsion.
- Medical isotope production: The majority of medical isotopes used in medical imaging are now produced using LEU or HALEU and rarely require HEU fuels.
- Research reactors: The vast majority of research reactors use LEU only, though a few countries, including the U.S., still use HEU for some of their reactors and HALEU for others.
- Power reactors: Nearly all nuclear power plants currently in operation use LEU fuel; however, there are a few reactors that still operate with HEU, such as in Russia, or fuel that requires separated plutonium, such as in France.

Source: GAO analysis of agency and open source documentation. | GAO-23-106486

The IAEA defines a significant quantity as the approximate amount of nuclear material, accounting for processing losses, for which the possibility of manufacturing a nuclear explosive device cannot be excluded. The IAEA currently uses values for a significant quantity of 8 kg plutonium, 8 kg U-233, and 25 kg U-235 (when the U-235 amount is

greater than or equal to 20 percent).<sup>17</sup> Figure 2 shows Harold Agnew, a physicist who worked on the Manhattan Project that oversaw the development of the first U.S. nuclear bombs, holding a case containing the plutonium core of the Fat Man bomb,<sup>18</sup> which consisted of just over 6 kg of plutonium. The photograph demonstrates the small size of the material required and why the IAEA recommends material be accounted for down to the milligram.

**Figure 2: Harold Agnew Holding a Case Containing the Plutonium Core of the Fat Man Bomb**



Source: Los Alamos National Laboratory. | GAO-23-106486

Nuclear materials, including WUNM, are used or stored in numerous facilities in many countries around the world. According to information from NNSA and nuclear security experts, 22 countries each possess more than 1 kg of HEU or plutonium, and 61 countries have operational

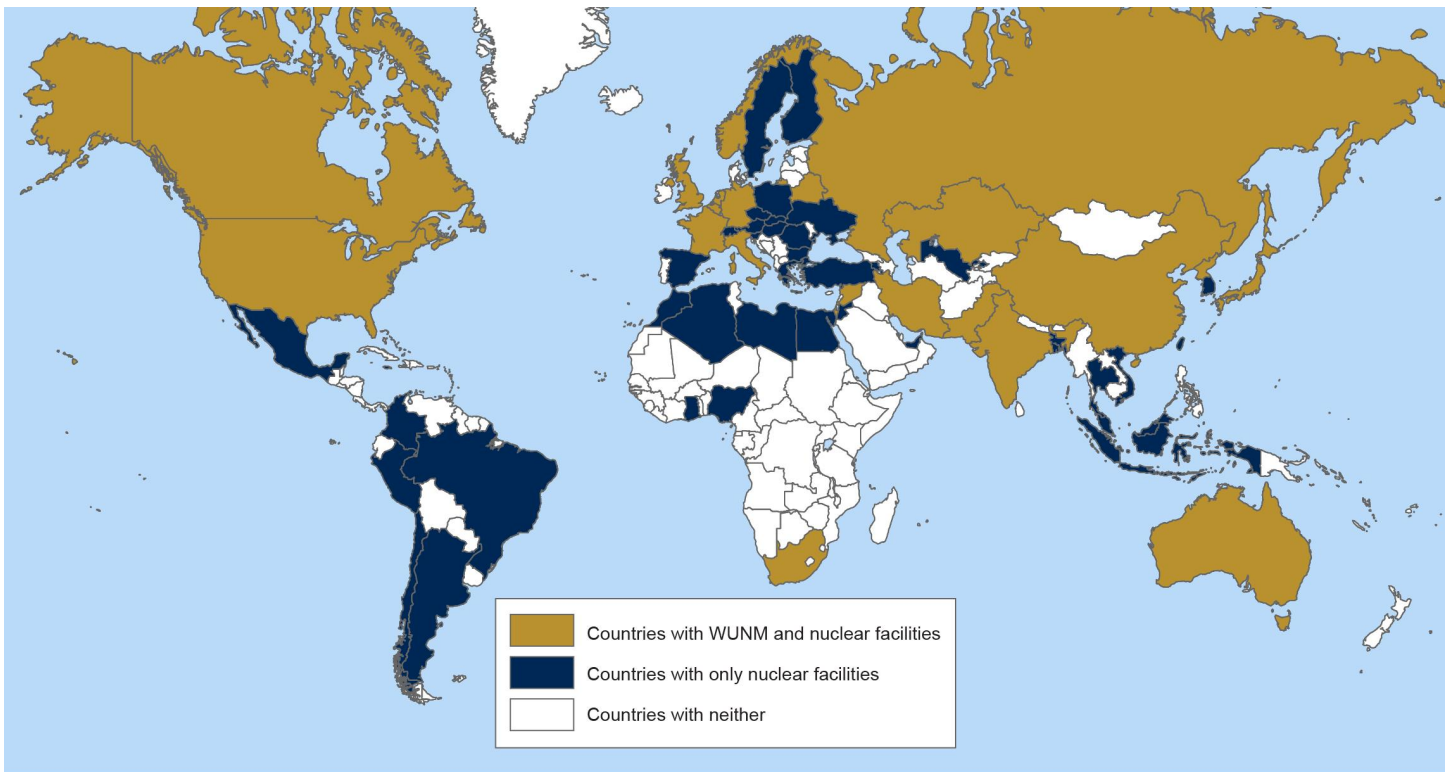
<sup>17</sup>International Atomic Energy Agency, *IAEA Safeguards Glossary 2022 Edition* (Vienna, Austria: 2022).

<sup>18</sup>Fat Man was the code name for the nuclear bomb detonated over the Japanese city of Nagasaki by the U.S. on August 9, 1945.



nuclear facilities—such as nuclear power plants—that do not necessarily use WUNM, but which could nevertheless be targets of nuclear sabotage. These countries are depicted in the map in figure 3, and listed in appendix II.

**Figure 3: Weapon Usable Nuclear Materials (WUNM) and Nuclear Facilities around the World**



Sources: GAO analysis of information from the National Nuclear Security Administration; the International Panel on Fissile Materials; and the International Atomic Energy Agency Power Reactor Information System, Research Reactor Database, and Nuclear Fuel Cycle Facilities Database; Map Resources (map). | GAO-23-106486

**Figure 3: Weapon Usable Nuclear Materials (WUNM) and Nuclear Facilities around the World**

- **Countries with WUNM and nuclear facilities**
  - Australia
  - Belgium
  - Belarus
  - Canada
  - China

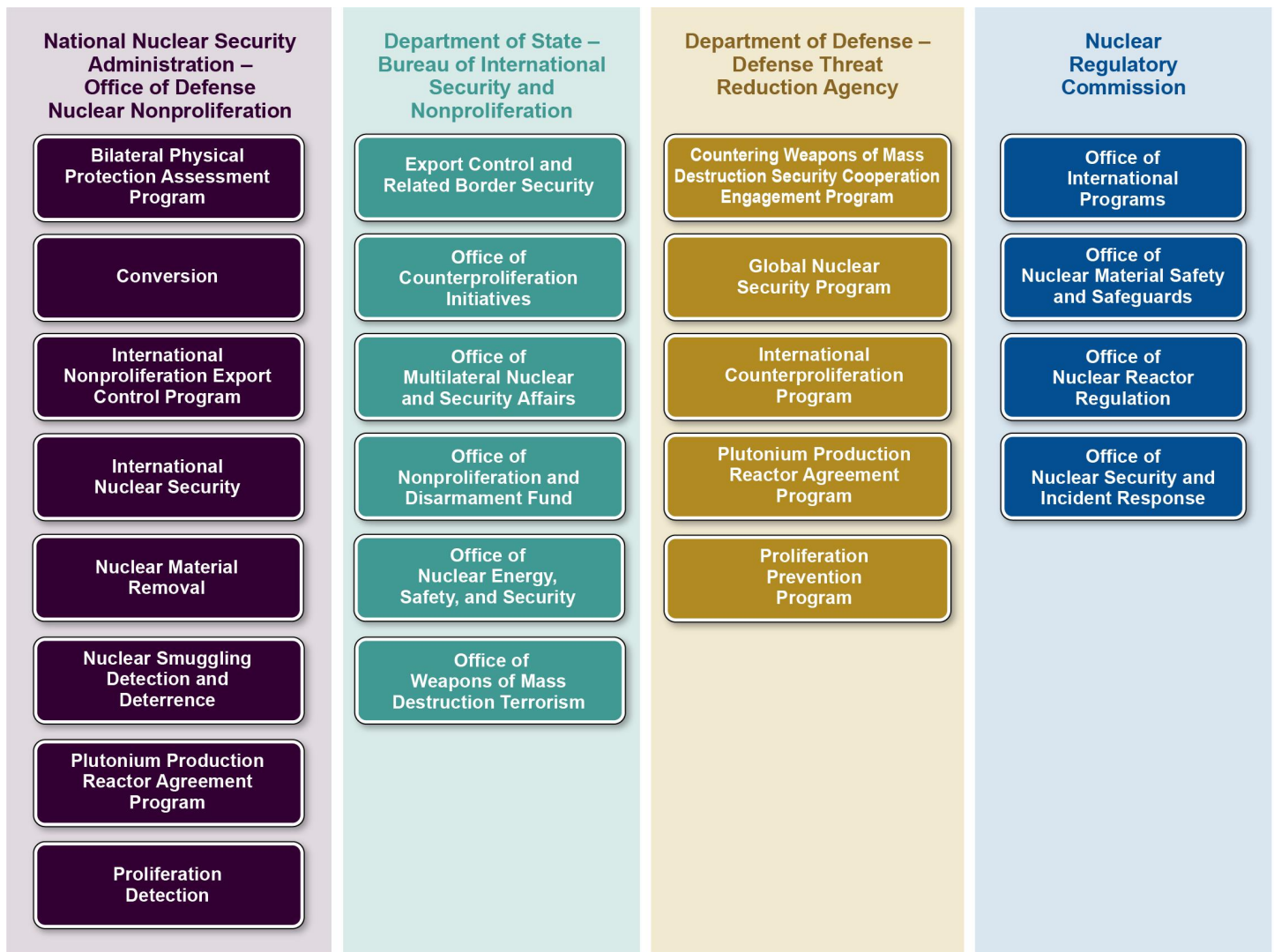
- France
- Germany
- India
- Iran
- Israel
- Italy
- Japan
- Kazakhstan
- Netherlands
- North Korea
- Norway
- Pakistan
- Russia
- South Africa
- Syria
- United Kingdom
- United States
- **Countries with only nuclear facilities**
  - Algeria
  - Argentina
  - Armenia
  - Austria
  - Bangladesh
  - Brazil
  - Bulgaria
  - Chile
  - Colombia
  - Czechia
  - Egypt
  - Finland

- Ghana
- Greece
- Hungary
- Indonesia
- Jamaica
- Jordan
- Libya
- Malaysia
- Mexico
- Morocco
- Nigeria
- Peru
- Poland
- Romania
- Slovakia
- Slovenia
- South Korea
- Spain
- Sweden
- Switzerland
- Taiwan
- Thailand
- Turkey
- Ukraine
- United Arab Emirates
- Uzbekistan
- Vietnam
- **Countries with neither**
  - All remaining countries

## Federal Programs Involved in Improving the Security of International Nuclear Materials

The 23 federal programs we identified that play some role in improving the security of international nuclear materials are outlined in figure 4.

**Figure 4: U.S. Agencies and Their Programs Working to Improve the Security of International Nuclear Materials**



Source: GAO analysis of documentation and information from the National Nuclear Security Administration, Department of State, Department of Defense, and Nuclear Regulatory Commission. | GAO-23-106486

These programs may work directly with partners on the ground in foreign countries, or indirectly by providing support to other federal programs, such as in developing policy, coordinating diplomacy, monitoring risks, or conducting research and development. Table 1 describes the primary mission of each of the 23 programs related to improving the security of international nuclear materials. Specific examples of program activities were omitted because the information is sensitive.

**Table 1: Federal Programs That Play a Role in Improving the Security of International Nuclear Materials**

	<b>Program</b>	<b>Primary program mission as it relates to the security of international nuclear materials</b>
<b>National Nuclear Security Administration (NNSA) programs</b>	<b>Bilateral Physical Protection Assessment Program</b>	Ensure the security of nuclear materials of U.S. origin provided for peaceful purposes and held or expected to be held in foreign facilities.
	<b>Conversion</b>	Convert civilian research reactors and medical isotope production facilities from using highly enriched uranium to low enriched uranium.
	<b>International Nonproliferation Export Control Program</b>	Detect and prevent the illicit or inadvertent transfer of nuclear and dual-use <sup>a</sup> materials, equipment, and technology.
	<b>International Nuclear Security</b>	Lead U.S. efforts to prevent theft and sabotage of nuclear materials and facilities worldwide.
	<b>Nuclear Material Removal</b>	Prevent nuclear terrorism by working with partner countries to eliminate inventories of weapon usable nuclear materials around the world.
	<b>Nuclear Smuggling Detection and Deterrence</b>	Build capacity of partner countries to detect, disrupt, and investigate smuggling of nuclear materials that could be used in acts of terrorism.
	<b>Plutonium Production Reactor Agreement Program</b>	Verify the continued shutdown of Russia's last plutonium production reactor, and monitor Russian plutonium produced from shutdown reactors that were still operating in 1997 when the Plutonium Production Reactor Agreement was signed. <sup>b</sup>
<b>Department of State programs</b>	<b>Proliferation Detection</b>	Advance U.S. nuclear security capabilities to develop timely, early proliferation detection capabilities and high-confidence verification and monitoring capabilities in support of the U.S. government's nuclear nonproliferation and security goals.
	<b>Export Control and Related Border Security</b>	Help countries establish legal frameworks and indigenous institutional capabilities to regulate trade in proliferation-sensitive items.
	<b>Office of Counterproliferation Initiatives</b>	Prevent and disrupt weapons of mass destruction (WMD) in countries of concern for nuclear proliferation. <sup>c</sup>
	<b>Office of Multilateral Nuclear and Security Affairs</b>	Support International Atomic Energy Agency (IAEA) efforts in all aspects of nuclear security, at all locations, by providing management and oversight of the U.S. annual voluntary contributions.
	<b>Office of Nonproliferation and Disarmament Fund</b>	Stop the proliferation of WMD, missiles, and advanced or destabilizing conventional weapons.
	<b>Office of Nuclear Energy, Safety, and Security</b>	Develop and coordinate U.S. government nuclear safety and security policies within various forums, including the IAEA.
	<b>Office of Weapons of Mass Destruction Terrorism</b>	Prevent, detect, and respond to WMD terrorism and materials out of regulatory control.

	Program	Primary program mission as it relates to the security of international nuclear materials
<b>Department of Defense (DOD) programs</b>	<b>Countering Weapons of Mass Destruction Security Cooperation Engagement Program</b>	Enhance partner nations' preparedness to respond to major chemical, biological, radiological, and nuclear incidents and disasters resulting from either accidental or intentional acts.
	<b>Global Nuclear Security Program</b>	Secure nuclear threats at their source by facilitating the cooperative elimination of foreign nuclear weapons and nuclear weapon components, support the safe and secure transportation and storage of nuclear materials, and improve partner-nations' abilities to counter nuclear smuggling.
	<b>International Counterproliferation Program</b>	Build partner nation capacity and political will to prevent and counter WMD proliferation and disrupt proliferation networks by applying expertise to assess and improve training, equipment, and doctrine.
	<b>Plutonium Production Reactor Agreement Program</b>	Verify the continued shutdown of Russia's last plutonium production reactor, and monitor Russian plutonium produced from shutdown reactors that were still operating in 1997 when the Agreement was signed.
	<b>Proliferation Prevention Program</b>	Prevent the proliferation of WMD materials, components, technology, and expertise by strengthening the capability of foreign government partners to detect and interdict trafficking of WMD materials on land and maritime borders.
<b>Nuclear Regulatory Commission (NRC) programs</b>	<b>Office of International Programs</b>	Foster and maintain collaboration with international counterparts and multilateral organizations to positively influence global and domestic nuclear safety and security, license exports of all nuclear material for peaceful use, and ensure that physical security criteria are met before authorizing export.
	<b>Office of Nuclear Material Safety and Safeguards</b>	Provide technical and safeguards review of applications for specific licenses for export of nuclear equipment, components, and materials, in support of the Office of International Programs.
	<b>Office of Nuclear Reactor Regulation</b>	Provide regulatory assistance for advanced reactors, including light water small modular reactors and non-light water-cooled reactors, and exchange information on import and export of nuclear technology and material.
	<b>Office of Nuclear Security and Incident Response</b>	Conduct bilateral physical protection visits and other activities relating to export licensing to ensure there is adequate protection for U.S. exported material.

Source: GAO analysis of documentation and information from NNSA, the Department of State, DOD, and NRC. | GAO-23-106486

<sup>a</sup>Dual-use goods include goods with both commercial and military uses that can be used to produce weapons of mass destruction or for other military or terrorism-related purposes.

<sup>b</sup>The same program is implemented in coordination by DOD and NNSA, with different program roles. Therefore, it is listed separately under each agency.

<sup>c</sup>WMD includes nuclear weapons but can also include chemical and biological weapons.

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## Officials and Experts Identified a Range of Risks to Securing Nuclear Materials against Theft and Sabotage

Federal officials and nuclear security experts we interviewed identified a range of existing risks to securing international nuclear materials against theft and sabotage. Federal officials and experts also identified potential technological, political, and other trends that could amplify nuclear material theft or sabotage concerns.

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### Existing Risks to the Security of Nuclear Materials around the World

Federal officials and other nuclear security experts we interviewed identified a range of existing risks to securing international nuclear materials, which have persisted as concerns for many years. Federal officials and experts also identified certain countries where these risks are present. The existing risks, with specific details omitted because the information is sensitive, include:

- **Inadequate physical security.** Physical security typically refers to the various protective measures facilities take when they design their layout, purchase detection hardware, or develop incident response procedures to defend against theft and sabotage. According to agency documentation, protective measures—including fences; perimeter defenses; sensors; cameras; and an armed, responsive guard force—are needed to protect against threats. Agency documentation and statements by NNSA officials and six experts indicated that risks to materials can arise when facilities do not have a properly trained guard force with a response plan for intrusions, cameras are not properly installed or monitored, or when staff have not planned for a cyberattack and have not installed defenses, among other things.

Some former Soviet Union countries still possess Soviet-era nuclear materials and have high levels of corruption. According to a 2019 report by nuclear experts, this could complicate preventative

measures, such as when funds for physical security or other upgrades are not spent responsibly.<sup>19</sup>

Further, not all countries are parties to the Convention on the Physical Protection of Nuclear Material and its Amendment, which establishes legal obligations for countries regarding the physical protection of nuclear materials for peaceful purposes, among other things. Countries that are not parties to the treaty or its Amendment include countries with WUNM, such as Iran and North Korea, as well as countries with nuclear facilities. The treaty and its Amendment emphasize the need for both physical protection of material at facilities and for material in transit, which NNSA reported was a key priority in its December 2021 report on preventing proliferation risks.<sup>20</sup>

Agency documentation, federal officials from all four agencies, and three experts from production sites and 16 experts from nongovernmental organizations indicated that physical security of nuclear materials whether at facilities or in transit is a major concern. Agency documentation, officials, and experts identified half a dozen countries where physical security risks remain high. In some of those cases, these risks may be considered high due to terrorist threats or proximity to areas of conflict.

- **Inadequate security against insider threats.** IAEA defines an insider threat as an individual with authorized access to facilities or sensitive information who could commit or facilitate a criminal act directed at nuclear materials. NNSA's December 2021 report on preventing proliferation risks found that insider threats are one of the greatest risks to nuclear security.<sup>21</sup> In fact, the known HEU and plutonium thefts have involved insiders, according to agency documentation. For example, an insider has access to restricted areas that hold nuclear materials, and they could potentially tamper with or modify security systems, or disrupt careful material accounting records designed to alert facility managers to losses of material.

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<sup>19</sup>Matthew Bunn, Nickolas Roth, and William Tobey, *Project on Managing the Atom: Revitalizing Nuclear Security in an Era of Uncertainty* (Cambridge, MA: Harvard Kennedy School, January 2019).

<sup>20</sup>Department of Energy, NNSA, *Prevent, Counter, and Respond—NNSA's Plan to Reduce Global Nuclear Threats Fiscal Years 2022-2026: Report to Congress* (Washington, D.C.: December 2021).

<sup>21</sup>Department of Energy, *Prevent, Counter, and Respond—NNSA's Plan to Reduce Global Nuclear Threats Fiscal Years 2022-2026: Report to Congress*.



IAEA documentation identifies and two nuclear security experts from nongovernmental organizations told us about the need for multilayered and comprehensive approaches to insider threat mitigation, including personnel vetting, effective material control and accounting systems, and access control points to sensitive areas. Without strong personnel vetting, such as thorough background checks, malign actors can slip into the system.

Further, inefficient material accounting systems can prevent authorities from detecting theft, should it occur. For example, according to a national laboratory, in 1992, a Russian scientist was able to steal around 1.5 kg of HEU from a facility due to a 3 percent “irretrievable loss” standard in accounting. By stealing 1 percent, the scientist was able to avoid immediate detection. In addition, weak access control points could allow unauthorized personnel with hostile intentions into areas with nuclear materials, or other sensitive areas. While insider threats are a risk everywhere nuclear materials exist, agency documentation we reviewed identified five countries believed to be at high risk of such threats.

- **Weak controls for counter-smuggling and illicit trafficking.** This risk concerns unauthorized access to, and movement of, nuclear materials and related technology. Smuggling typically refers to illegally moving material in ways that may go undetected with or without crossing international borders. Illicit trafficking refers to the unauthorized acquisition, provision, possession, use, transfer, or disposal of nuclear materials, including the discovery of uncontrolled materials. NNSA, State, and DOD officials emphasized to us the need for counter-smuggling capabilities and better export control laws and regulations and enforcement capabilities related to nuclear material and dual-use goods in order to quickly detect and interdict materials outside of regulatory control. This vulnerability is present in countries with and without nuclear materials, especially those that share a border with countries that experts indicated have significant corruption, terrorist activity, known smuggling corridors, or contested space where borders are not clear, according to federal officials and experts.

Even with improvements over many years of work, there are limitations in detection technologies at border crossings and untrained or underfunded counter-smuggling law enforcement personnel, according to agency documentation. According to agency documentation and federal officials from NNSA, State, and DOD, as well as three nuclear security experts from nongovernmental

organizations and one from a national laboratory, there are seven countries that pose significant nuclear smuggling risks.

NNSA and State officials, as well as nuclear security experts we interviewed, identified other areas of the world where there are significant risks to nuclear security from illicit transfers and smuggling. This includes areas with high volumes of international trade, where nuclear materials and dual-use goods often pass through. For example, according to DOD documentation, Southeast Asia is a major transit and transshipment hub including for high-tech goods with dual-use applications, and State officials told us that some Southeast Asian countries may not have transit and transshipment export controls. Additionally, Southeast Asia has vulnerable smuggling pathways and is a violent extremist organization hot spot, according to NNSA documentation. Agency documentation, officials from NNSA and DOD, and experts from a national laboratory identified several Southeast Asian countries of concern for these risks.

- **Widespread use and increasing stockpiles of WUNM.** In general, NNSA officials and nine experts from nongovernmental organizations told us that the use and accumulation of WUNM carries inherent risk. The widespread use and production of HEU and plutonium for civilian or military purposes could exacerbate other nuclear material security risks by creating or sustaining large or multiple targets of opportunity for theft and sabotage. States may be able to achieve more effective nuclear security, potentially at a lower cost, if they have fewer locations with WUNM to protect, according to experts. Some concerns that officials and experts identified about widespread use or increasing production of HEU and plutonium include:
  - HEU fuel: For example, Russia operates 32 facilities that utilize HEU fuel. Experts reported that Russia has been slow in its efforts to convert those facilities to run on high-assay or high-density low enriched uranium fuel. Russia also powers its civilian icebreaker ships with HEU and is exporting a small amount of HEU as research reactor fuel.
  - Use of plutonium for power generation: Six experts cited concerns about existing or planned efforts by certain countries to utilize plutonium for civilian power generation. Experts noted that countries which have, or are establishing, civilian nuclear reprocessing capabilities have resulted in, or may lead to, large and increasing stockpiles of plutonium.
  - Military buildup: Agency documentation and eight nuclear security experts from nongovernmental organizations expressed particular

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concerns about expanding stockpiles of nuclear materials and weapons, including the production of HEU and plutonium in several specific countries for military purposes.

- **Limited partner capacity to implement or sustain effective security programs.** Capacity limitations in U.S. partners may affect their ability to effectively secure nuclear materials in their countries. This risk can also affect or exacerbate all other risks related to theft and sabotage. Some countries with which the U.S. partners to secure nuclear materials face limitations related to personnel, funding, or legal constraints that make it difficult to implement and sustain an effective security apparatus, according to NNSA, State, and DOD officials. These limitations may include inadequate numbers of qualified and trained staff, lack of financial resources to sustain nuclear security programs, or limited law enforcement capabilities. NNSA officials, four experts from nongovernmental organizations, and experts from one national laboratory identified concerns with four countries regarding their capacity to implement and sustain nuclear security programs. For example, experts from a national laboratory said that the law enforcement authorities and staff in one of those countries is limited by competing demands due to the presence of violent extremist organizations and other challenges in the country. As a result, sustaining effective counter nuclear smuggling capabilities in this country will require additional attention and longer-term engagement. Moreover, some partner countries can be overwhelmed by working with multiple U.S. agencies, especially if the country has limited staff to respond to multiple requests from different U.S. programs, according to federal officials we interviewed from each agency.

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## Potential Trends That Could Amplify Risks to the Security of International Nuclear Materials

In addition to existing risks to securing international nuclear materials against theft and sabotage, federal officials and security experts also identified a number of potential trends that could exacerbate or amplify existing risks. These trends, with several specific details omitted because of sensitivity, include:

- **Technical trends.** Federal officials from NNSA, State, and NRC, and five experts from nongovernmental organizations, two from national laboratories, and two from production sites noted that technical advancement, such as in cyberwarfare, could pose a danger to nuclear materials around the world. As nuclear material facilities

around the world increasingly rely on digital technology, NNSA documentation indicates that security and safety systems at a nuclear facility could be compromised through a cyberattack, exacerbating the risk of theft and sabotage. For example, a cyberattack could be used to disable physical protections, such as cameras or digitally controlled access points. Nuclear plants connected to the internet could be vulnerable to outside attackers taking control of the technical portions of the plant and using that control to attempt an act of sabotage.

NNSA documentation also discusses concerns with issues arising from additive manufacturing and other potentially disruptive technologies, such as automated aerial vehicles or artificial intelligence. The widespread use of three-dimensional printers (also known as additive manufacturing) potentially allows nonstate actors to bypass export control and counter-smuggling efforts to produce proliferation-sensitive items anywhere in the world. According to NNSA's December 2021 report on preventing proliferation risks, additive manufacturing can offer benefits in rapid prototyping and design optimization for detection systems, but these tools could also become ever more capable of manufacturing proliferation-sensitive items, challenging the multilateral export control regimes to keep pace as the technology becomes globally ubiquitous.<sup>22</sup> Other potentially disruptive technologies, such as drones, are being developed competitively for commercial purposes, which heightens the dangers of theft and sabotage, according to agency documentation. For example, drones can give access to nuclear facilities from the air, which may enable malicious actors to map or bypass physical security defenses.

- **Volatile political environments.** Federal officials and experts told us that international political developments could have a profound effect on existing risks to securing nuclear materials. State officials and experts from a nongovernmental organization and two national laboratories noted that political instability within a country—as a result of civil war or hostilities with a neighboring country, among other reasons—may pull resources, attention, and commitment away from nuclear material security infrastructure and capabilities.

The Russian invasion of Ukraine in February 2022 has also led to deterioration in the nuclear security sphere, according to DOD officials and a nuclear security expert. Ukraine is home to several nuclear plants and has had difficulty maintaining security and safety at some

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<sup>22</sup>Department of Energy, *Prevent, Counter, and Respond—NNSA's Plan to Reduce Global Nuclear Threats Fiscal Years 2022-2026: Report to Congress*.

of its nuclear facilities during the ongoing Russian invasion. For example, a fire broke out at the Zaporizhzhia nuclear power plant in Ukraine in March 2022 because of Russian artillery shelling the plant. DOD officials emphasized that theft and sabotage risks become more likely in war zones where freedom of access to facilities increases and smuggling is easier to conduct.

Federal officials from NNSA, State, and NRC, as well as six experts from nongovernmental organizations and 10 from national laboratories, also noted that international political disagreements or ideological differences between the U.S. and other countries may allow risks to nuclear materials to persist or deepen as a consequence of limited bilateral cooperation. For example, they told us that the absence of U.S. and international cooperation with Russia after it invaded Ukraine in 2014 and 2022, as well as the overall deterioration of bilateral relations with another important country, have hindered progress on nuclear security.

- **Development of additional nuclear infrastructure.** Federal officials from NNSA noted that there are an increasing number of countries interested in nuclear power and that are planning to build power reactors to reduce their future carbon emissions. Federal officials and experts told us that they were concerned by the nuclear material security implications associated with this growth, including (1) the development of nuclear infrastructure in nuclear newcomer countries; and (2) the expansion of reactors, in any country, that utilize certain fuels, which could be targeted for theft and sabotage.<sup>23</sup>

NNSA officials and four experts told us of their concerns about nuclear newcomers, including specific countries with new power reactors under construction, because of those countries' limited experience in operating nuclear infrastructure and working with nuclear regulatory bodies. Four nuclear security experts also said that nuclear newcomers may not have independent nuclear regulatory bodies, appropriate security training, or trained and experienced facility operators. As of June 2022, according to the IAEA, there are 13 planned research reactors and 11 research reactors under construction; some of these will be the first in certain countries.

NNSA officials and two nuclear security experts were also concerned with the growth of certain advanced reactors with fuel types that may

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<sup>23</sup>Nuclear newcomers refers to the set of countries that do not currently operate any nuclear power facilities but have plans to build ones or are currently constructing new reactors.

utilize WUNM. The IAEA database on nuclear power indicates that 53 power reactors, including a few that could use WUNM fuels, are under construction worldwide in 2022. For example, certain countries have plans to build reprocessing facilities that an expert identified as a concern because such facilities would increase the production of separated plutonium. Moreover, NNSA officials and an expert indicated that there are plans by firms in the U.S. to build reactors domestically and abroad that utilize high-assay low enriched uranium (HALEU),<sup>24</sup> but the frameworks to safely and securely transport, handle, and dispose of this material are not yet in place.

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## Federal Programs Work to Address Identified Risks but Not in All Countries

The 23 federal programs we reviewed are taking steps to address the identified risks to securing international nuclear materials. However, these programs are not addressing the identified risks in or with some countries where U.S. work has been prohibited or is limited. Federal programs have developed strategies to address some identified risks even when they do not work directly in some countries, such as by working with neighboring countries or through international organizations. Lastly, federal program efforts to address some risks to securing international nuclear materials are complicated by certain U.S. policies and practices. The identity of some selected countries and details regarding the risks, challenges, and the scope of U.S. program engagement in those countries were omitted in this section for sensitivity reasons.

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## Federal Programs Work to Address the Identified Risks to International Nuclear Materials

Together the 23 programs we identified as playing a role in improving the security of international nuclear materials against theft and sabotage have taken steps to address all the identified risks.<sup>25</sup> Specifically:

- **Physical security.** Thirteen agency programs work to address the risk of inadequate physical security at facilities containing nuclear materials or materials in transit. These include NNSA programs—such

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<sup>24</sup>HALEU is enriched to between 5 percent and 19.75 percent uranium-235.

<sup>25</sup>For a complete list of which programs address which risks, see appendix III.

as International Nuclear Security (INS) and the Bilateral Physical Protection Assessment Program—DOD programs—Global Nuclear Security (GNS)—and NRC programs with contributions and support from programs at State. Among other things, these programs conduct site visits, recommend security upgrades, provide and help install new security equipment, and perform training. For example:

- NNSA’s INS program is a major contributor to physical security programs around the world. INS works with nearly 60 countries, shares best practices, conducts training workshops, and coordinates various conferences to improve physical security awareness and transportation security, as well as occasionally providing equipment upgrades to facilities.
- NNSA’s Bilateral Physical Protection Assessment Program conducts site visits and recommends physical security upgrades in various countries that have U.S.-origin nuclear materials and bilateral nuclear cooperation agreements.<sup>26</sup>
- NRC’s Office of Nuclear Security and Incident Response assists the Bilateral Physical Protection Assessment Program with technical evaluations of the adequacy of physical protection in other countries.
- DOD’s GNS program—that seeks to secure nuclear materials in storage and in transit—has ongoing efforts to provide training to security forces responsible for physical security at sensitive nuclear sites containing WUNM in a specific country.
- **Insider threats.** Seven federal programs work to address the risk of insider threats at foreign nuclear material facilities by holding workshops and trainings, among other things. For example, NNSA’s INS has a goal to ensure that partner countries have the capability to prevent sabotage at nuclear facilities by insiders or prevent removal of nuclear material by insiders, which the program seeks to achieve by providing training, among other things. INS officials said that they are currently working with regional leaders in the Middle East, North

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<sup>26</sup>U.S. bilateral nuclear cooperation agreements are sometimes referred to as 123 agreements. Section 123 of the Atomic Energy Act of 1954, as amended, outlines the process and requirements for negotiating nuclear cooperation agreements, which provide the framework for U.S. exports for civilian purposes of certain nuclear material and equipment, including major components of nuclear reactors. Exports under 123 agreements are conditioned on the maintenance of adequate physical security for any transferred materials and components. Atomic Energy Act of 1954, Pub. L. No. 83-703, § 123, 68 Stat. 919, 940 (codified as amended at 42 U.S.C. § 2153).

Africa, and South America on insider threats, and partnered with Belgium to hold an insider threat symposium in 2019.

- **Counter-smuggling and illicit trafficking.** Seventeen federal programs work to address the risk of smuggling and illicit trafficking of nuclear materials and related equipment. These programs may provide detection equipment or help establish regulatory frameworks for exports, among other things. For example:
  - NNSA's Nuclear Smuggling Detection and Deterrence (NSDD) program—which seeks to detect, disrupt, and investigate smuggling of nuclear materials—is working in over 80 countries to deploy a combination of portable, mobile, and stationary radiation detection equipment as part of larger counter nuclear smuggling systems designed to secure points of entry, poorly regulated frontier areas, and various other locations against the nuclear smuggling threat.
  - In support of NSDD, NNSA's Proliferation Detection program has recently developed a new computer algorithm to improve the ability of radiation portal monitors to detect nuclear material at ports of entry.
  - DOD's Proliferation Prevention Program has been working to reduce WMD trafficking threats—including nuclear threats—in former Soviet republics, among other places, by providing detection and surveillance equipment and training.
  - State's Office of Counterproliferation Initiatives works to prevent illicit transfers and transactions involving dual-use goods and the movement of materials from countries of concern for nuclear proliferation.
  - One objective of State's Export Control and Related Border Security program is to increase the number of countries that adopt effective strategic trade control legislation, including penalties. This program has been working with NNSA's International Nonproliferation Export Control Program in certain countries on this.
  - NRC's Nuclear Material Safety and Safeguards Office reports and maintains records of certain nuclear materials exported to other countries to ensure that exact amounts of material are tracked.<sup>27</sup>

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<sup>27</sup>The Nuclear Material Management and Safeguards System tracks U.S.-obligated exports of nuclear materials and is operated by NNSA, with financial and technical support from NRC.



- **Widespread use and increasing stockpiles of WUNM.** Nine federal programs work to address the risks associated with the continued widespread use or increasing production of WUNM. For example:
  - NNSA’s Conversion program—which seeks to convert civilian research reactors and medical isotope production facilities from using highly enriched uranium to using low enriched uranium—is working in countries such as Kazakhstan, to eliminate the need for WUNM and indefinite WUNM storage facilities.
  - NNSA’s Nuclear Material Removal program—which seeks to eliminate WUNM around the world—works to remove or confirm the disposition of excess WUNM, such as HEU, in Kazakhstan and other countries.
  - NNSA’s and DOD’s Plutonium Production Reactor Agreement programs annually monitor the storage of at least 9,000 kilograms of Russian plutonium oxide (as declared by Russia) based on a bilateral agreement from 1997 that was amended in 2003.<sup>28</sup>
- **Limited partner capacity.** Nineteen federal programs work to address specific risks associated with U.S. foreign partners’ capacity to effectively secure nuclear materials. For example:
  - DOD’s International Counterproliferation Program and its Countering Weapons of Mass Destruction Security Cooperation Engagement Program are taking actions to enhance a foreign partner’s capacity to address a range of nuclear material security risks through intensive trainings.
  - State’s Office of Multilateral Nuclear and Security Affairs works to support IAEA member states by providing funding for specific IAEA nuclear security efforts.
  - State’s Office of Weapons of Mass Destruction Terrorism co-chairs the Global Initiative to Combat Nuclear Terrorism, which

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<sup>28</sup>The U.S. programs involved in these monitoring visits and meetings are NNSA’s Plutonium Production Reactor Agreement program; DOD’s Plutonium Production Reactor Agreement program; and State’s Office of Nuclear Energy, Safety, and Security. NNSA experts conduct the monitoring visits, while DOD provides logistical and linguistic support. State is the policy lead for bilateral meetings of the Joint Implementation and Compliance Commission, which oversees the implementation of the Plutonium Production Reactor Agreement, including the planning of monitoring visits with Russian officials. In fiscal year 2022, federal officials from the Plutonium Production Reactor Agreement programs told GAO that they coordinated with Russian counterparts about potential future monitoring visits, but nothing was scheduled because of the COVID-19 pandemic. There is no current agreed upon plan for the restart of monitoring visits.

shares best practices with and promotes capacity building in countries that would benefit most from support for efforts to combat nuclear and radiological terrorism.<sup>29</sup>

- **Technical trends.** Fifteen federal programs work to address the potential risks associated with the technical trends discussed earlier in this report. For example:
  - INS, in partnership with NRC, has been collaborating with several countries to address cybersecurity risks for nuclear facilities. During the COVID-19 pandemic, INS developed a remote program to provide virtual cybersecurity training to partner countries.
  - NNSA's Office of Nuclear Export Controls, under which the International Nonproliferation Export Control Program is organized, is also part of a working group that is assessing the risks to strategic trade control posed by new technologies, such as additive manufacturing, and working to develop and propose new controls.
- **Volatile political environments.** Four federal programs work to address this potential risk. For example:
  - State's Office of Nuclear Energy, Safety, and Security—which seeks to secure nuclear materials by strengthening international cooperation and coordination—works to coordinate U.S. agencies in foreign countries and assists in navigating political issues.
  - Funding available through State's Office of Nonproliferation and Disarmament Fund promote nonproliferation, disarmament, and weapons destruction “notwithstanding any other provision of law,” and without any time restrictions. State has used this authority to fund projects in countries where other U.S. programs are barred from operating by U.S. sanctions or other legal restrictions. Therefore, according to a State document, it can respond to rapidly emerging threats or when political conditions quickly change. For example, the Office of Nonproliferation and Disarmament Fund currently has a contingency fund for North Korea and stands ready to address stockpiles, nuclear infrastructure, and delivery systems, should that political situation change.

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<sup>29</sup>In April 2022, the U.S. suspended co-chair cooperation with Russia and is now continuing international cooperation to counter radiological and nuclear terrorism through other channels.

- **Development of additional nuclear infrastructure.** Seven federal programs work to address this potential risk. For example:
  - State's Office of Nuclear Energy, Safety, and Security is working to minimize the risks to nuclear materials that may emerge as more countries consider developing nuclear power in response to rising concerns of climate change. Specifically, the office is working to help countries strengthen their regulations and protections for nuclear materials.<sup>30</sup>
  - The NRC's Office of International Programs provides overall coordination for NRC's international activities. It plans, develops, and implements programs, in concert with other NRC offices, to carry out policies in the international arena, including export and import licensing responsibilities. This office also establishes and maintains working relationships with individual countries and international nuclear organizations, as well as other involved U.S. government agencies, to facilitate and implement the NRC's international cooperation and assistance activities in support of the NRC's mission. This includes sharing best practices to help support the development of strong regulatory counterparts to influence the development and maintenance of new and existing nuclear security regimes around the world.
  - NRC's subject matter experts in other offices, such as the Nuclear Reactor Regulation Office, can also aid countries seeking to license new or advanced reactors.

Since March 2020, the COVID-19 pandemic has limited travel for most NNSA programs.<sup>31</sup> Federal officials from all 23 programs we interviewed said that the pandemic has interrupted the normal tempo of work. Officials from State, DOD, and NRC reported no travel and reported experiencing

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<sup>30</sup>There are additional U.S. programs involved in building partner country capacity to support the secure, safe, and responsible deployment of advanced nuclear reactor technology, which State officials and nuclear security experts told us are more inherently secure than some reactors from foreign countries. These include the Foundational Infrastructure for Responsible Use of Small Modular Reactor Technology program that started in fiscal year 2021 under State's Office of Cooperative Threat Reduction and financing programs at the Export-Import Bank of the U.S. These programs were not included in the scope of this report because they are only working on potential future vulnerabilities and not existing risks.

<sup>31</sup>INS, the Bilateral Physical Protection Assessment Program, and the Plutonium Production Reactor Agreement program reported no travel, while other programs reported limited travel in fiscal year 2021. For example, Nuclear Material Removal officials said they have traveled in certain situations with extensive COVID-19 testing, approvals, and quarantines, and they have been able to move forward on mission-critical needs.

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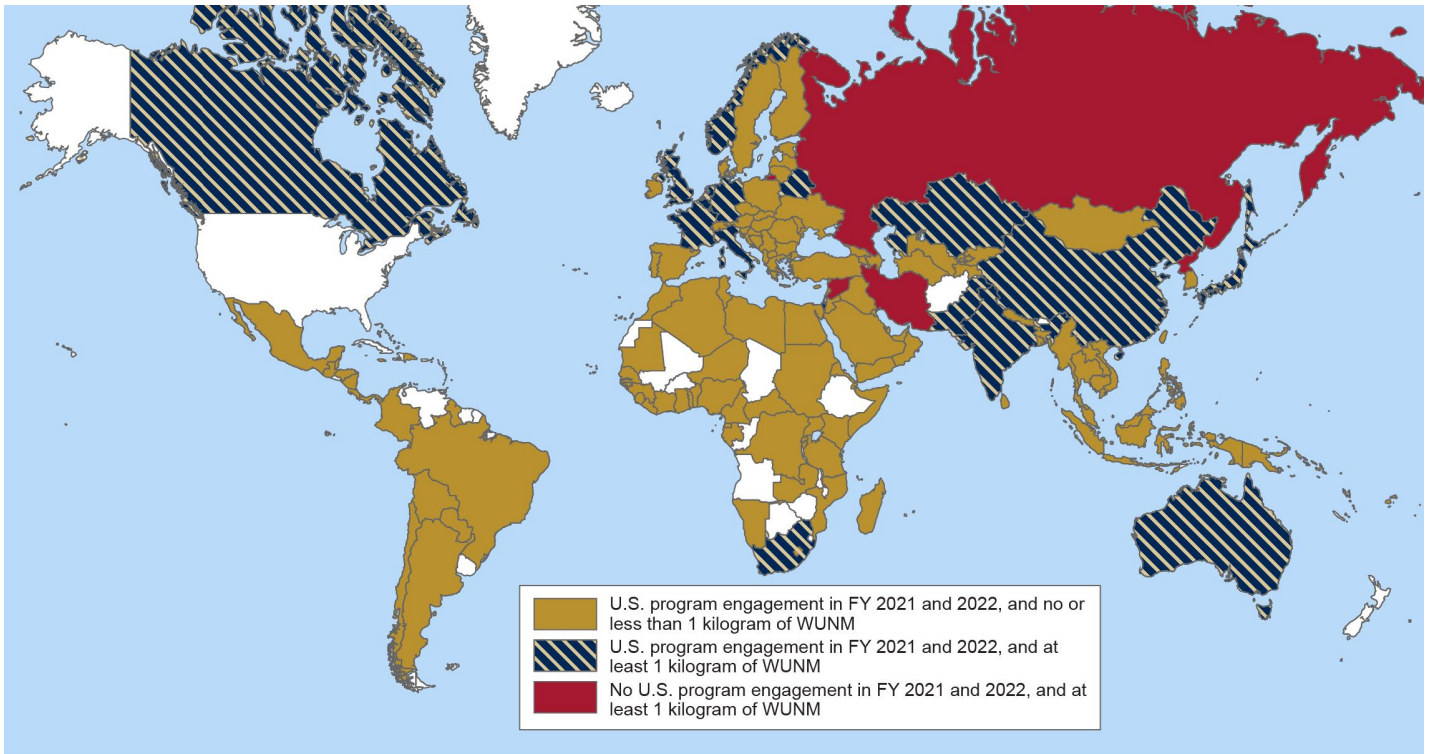
many disruptions during the pandemic. For example, the Proliferation Prevention Program delayed plans for counter-smuggling work in Georgia. Moreover, NNSA officials also reported that some countries with identified nuclear security risks have refused virtual engagements, citing concerns about the sensitive nature of this work and cybersecurity issues.

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### Federal Programs Are Not Active in Some Countries That Present Risks

Federal programs cannot always address identified risks to securing international nuclear materials in some countries because bilateral cooperation in these countries has been prohibited or is limited. Federal programs have developed strategies to address some risks even when they do not work directly in or with those countries, although, according to officials, the opportunity to make substantial progress in securing nuclear materials in these countries is limited until political situations change. Figure 5 displays the countries with which U.S. programs have engaged in fiscal year 2021 or plan to engage with in fiscal year 2022 as well as those that are known to have WUNM.

**Figure 5: Countries with U.S. Program Engagement and Weapon Usable Nuclear Material (WUNM), Fiscal Years (FY) 2021 and 2022**



Sources: GAO analysis of documentation and information from the National Nuclear Security Administration, Department of State, Department of Defense, and Nuclear Regulatory Commission; Map Resources (map). | GAO-23-106486

**Text of Figure 5: Countries with U.S. Program Engagement and Weapon Usable Nuclear Material (WUNM), Fiscal Years (FY) 2021 and 2022**

- **Countries With U.S. Program Engagement in FY 2021 and 2022**
  - Albania
  - Algeria
  - Andorra
  - Argentina
  - Armenia
  - Austria
  - Azerbaijan
  - Bahamas
  - Bangladesh
  - Barbados
  - Belize
  - Benin
  - Bolivia
  - Bosnia and Herzegovina

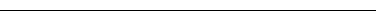
- Brazil
- Bulgaria
- Burundi
- Cabo Verde
- Cambodia
- Cameroon
- Central African Republic (CAR)
- Chile
- Colombia
- Comoros
- Congo, Democratic Republic of the
- Costa Rica
- Cote d'Ivoire
- Croatia
- Cyprus
- Czechia
- Denmark
- Djibouti
- Dominican Republic
- Ecuador
- Egypt
- Equatorial Guinea
- Eritrea
- Estonia
- Fiji
- Finland
- Gabon
- Gambia
- Georgia
- Ghana
- Greece
- Guatemala
- Guinea
- Guinea-Bissau
- Guyana
- Honduras
- Hungary
- Indonesia
- Iraq
- Ireland
- Jamaica
- Jordan
- Kenya
- Kosovo
- Kuwait
- Kyrgyzstan
- Laos
- Latvia

- Lebanon
- Lesotho
- Liberia
- Libya
- Lithuania
- Madagascar
- Malaysia
- Maldives
- Malta
- Marshall Islands
- Mauritania
- Mauritius
- Mexico
- Moldova
- Mongolia
- Montenegro
- Morocco
- Mozambique
- Myanmar (formerly Burma)
- Namibia
- Nauru
- Nepal
- Nicaragua
- Niger
- Nigeria
- North Macedonia (formerly Macedonia)
- Oman
- Palau
- Panama
- Papua New Guinea
- Paraguay
- Peru
- Philippines
- Poland
- Portugal
- Qatar
- Romania
- Rwanda
- Saint Vincent and the Grenadines
- Samoa
- Saudi Arabia
- Senegal
- Serbia
- Seychelles
- Sierra Leone
- Singapore
- Slovakia
- Slovenia

- Solomon Islands
- Somalia
- South Korea (ROK)
- Spain
- Sri Lanka
- Sudan
- Sweden
- Switzerland
- Taiwan
- Tajikistan
- Tanzania
- Thailand
- Togo
- Tonga
- Trinidad and Tobago
- Tunisia
- Turkey
- Turkmenistan
- Uganda
- Ukraine
- United Arab Emirates (UAE)
- Uzbekistan
- Vanuatu
- Vietnam
- Yemen
- Zambia
- **Countries With at Least 1 kilogram of WUNM and U.S. Program Engagement in FY 2021 and 2022**
  - Australia
  - Belgium
  - Canada
  - Belarus
  - China
  - France
  - Germany
  - India
  - Israel
  - Italy
  - Japan
  - Kazakhstan
  - Netherlands
  - Norway
  - Pakistan
  - South Africa
  - United Kingdom



- **Countries With at Least 1 Kilogram of WUNM, but Without U.S. Program Engagement in FY 2021 and 2022**
  - Iran
  - North Korea
  - Syria
  - Russia
- **Countries Without U.S. Program Engagement in FY 2021 and 2022**
  - All remaining countries

Sources: GAO analysis of documentation and information from the National Nuclear Security Administration, Department of State, Department of Defense, and Nuclear Regulatory Commission;  Map Resources (map). | GAO-23-106486

Note: We define engagement as active work in, or training for, a country or outreach to perform future work in, or training for, a country. This could include bilateral or regional engagement. With respect to engagement in Russia, in fiscal year 2021, one U.S. program coordinated with Russian counterparts about repatriation of Russian-origin materials from third-party countries; however, they did not discuss or work on materials in Russia. Additionally, a few U.S. programs coordinated with Russian counterparts about potential monitoring visits, but nothing was scheduled because of the COVID-19 pandemic, and there are no current plans for restarting monitoring visits.

### Countries Where Cooperation with the U.S. Has Been Prohibited or Is Limited

There are multiple countries that, according to officials, federal programs consider high priorities for nuclear material security risk reduction efforts, but the nature of the United States' relationship with those nations has precluded meaningful or significant cooperative nuclear material security activities. Agency officials identified challenges to U.S. engagement and cooperation with these countries.

First, NNSA and State officials told us that nearly all work on nuclear security with Russia has been generally prohibited since 2014. In 2014, following Russian aggression in Ukraine and U.S. diplomatic responses, Russia ended nearly all nuclear security cooperation with the U.S. Russia is in possession of nearly 190,000 kg of plutonium and about 700,000 kg of HEU at over 25 sites with facilities across the country. This is enough for an enormous number of weapons based on IAEA's significant quantity measures of HEU and plutonium.

### North Korea's Nuclear Material and Security

North Korea began developing its nuclear program during the 1950s, gaining knowledge and a research reactor from the Soviet Union. The North Korean nuclear program was also assisted in its uranium enrichment efforts by the A. Q. Khan network, through which insiders from Pakistan transferred knowledge and centrifuges to North Korea in the mid-1990s.

Starting in the 1990s there were different international negotiations seeking to limit North Korea's nuclear weapons program. Although North Korea did shut down its plutonium production for a number of years in the 1990s and early 2000s based on these negotiations, it is unclear whether the country ever intended to slow its weapons development programs, as clandestine efforts, such as a covert uranium enrichment program, have come to light. In 2003, North Korea was the first country to announce its withdrawal from the Treaty on the Nonproliferation of Nuclear Weapons.

Exact figures and counts for nuclear material and nuclear weapons currently in North Korea are unknown publicly. However, according to the intelligence community, North Korea has put plutonium and highly enriched uranium into nuclear warheads. The security status of this material is also unknown, although there has been some evidence that the North Korean government had sought to smuggle equipment and material to other countries, such as Libya and Myanmar, in the 2000s.

Sources: GAO analysis of open source information. | GAO-23-106486

U.S. programs are not currently working in Russia to address risks related to its large stockpile of, and facilities with, WUNM. For example, officials from the Conversion program told us that there are at least 12 HEU reactors in Russia that the program does not include in its scope but which the program could include, if U.S.-Russian relations were to change. The Plutonium Production Reactor Agreement programs still have access rights to conduct monitoring visits at one shutdown reactor and one plutonium storage facility in Russia. Although these programs usually conduct at least two monitoring visits a year and held a few meetings with Russian counterparts, no such monitoring visit has taken place since October 2019 because of the COVID-19 pandemic.

Second, federal officials identified five countries that have resisted working with U.S. programs on nuclear material security. For example, federal officials from NNSA, DOD, and NRC told us that they would like to engage more with several specific countries, but there is resistance to accepting assistance from the U.S. for a variety of reasons—such as sovereignty and national security concerns. Officials said certain countries do not want to provide U.S. federal programs with access to their materials nor, by virtue of accepting U.S. assistance, be seen as unable to properly protect them independently. Other countries have generally resisted, for political reasons, working with the United States on removal of HEU or downblending HEU to a low enriched form. Federal officials told us that some U.S. programs engage in discussions with these countries, but most are limited or constrained by these factors.

Third, in some cases, the absence of bilateral diplomatic relations precludes any form of engagement on nuclear security, such as in North Korea, Iran, and Syria (see sidebar for more information on North Korea). There are also countries where officials cannot work because of safety and security concerns. For example, NSDD officials said that they carefully consider safety concerns for federal officials that may impact on-the-ground work if border areas face civil unrest, activity by violent extremist organizations, or limits to law enforcement control. Program officials told us that even if the U.S. had diplomatic relations with Syria, security and safety conditions in the country could prevent implementation of NSDD program activities.

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## Federal Programs' Strategies to Address Risks When Not Working Directly in or with Some Countries

Federal officials we interviewed said that in many cases, where their ability to work with certain countries has been prohibited or is limited, they often employ one or more of the following strategies:

- **Addressing risks through efforts with other countries.** NNSA and DOD officials said that they sometimes make progress in countries where there are poor or limited bilateral relations by working with other countries in the region. For example, federal programs—such as GNS—have worked with South Korea to address risks from nuclear materials in North Korea by training forces ready to act at a moment's notice in the event of a regime collapse or crisis. Further, to counter potential nuclear smuggling risks emanating from countries such as Iran—where NSDD is unable to work directly—the program has worked with neighboring countries to install detection equipment along their borders and train and better equip their border security guards. DOD's Proliferation Prevention Program follows a similar model in conducting a range of counter-WMD activities in countries that border Russia, such as by providing nuclear material detection training and equipment to Georgia. While these efforts may reduce the risk of materials leaving certain countries, they do not improve security within countries where there are poor or limited bilateral relations.
- **Pursuing indirect confidence-building activities.** Federal officials from NNSA, State, and DOD told us that programs pursue confidence-building activities with hard-to-access foreign governments. These activities could include technical exchanges on best practices in nuclear power that the federal officials hope could lead to more intensive bilateral nuclear material security cooperation or motivate the foreign governments to address nuclear material security risks themselves. Officials from NNSA, DOD, and State, as well as eight experts from nongovernmental organizations and one from a national laboratory, told us that federal programs have taken this approach with one hard-to-access foreign government for years because of limited success with government-to-government bilateral negotiations on nuclear material security cooperation. Instead, several U.S. programs work with a center of excellence in the country to establish a forum for information exchanges. It is unclear whether these dialogue processes have led to improved nuclear security or

not, since U.S. programs do not have direct access to measure any such progress.

- **Working through multilateral organizations.** Federal officials from NNSA, State, and DOD said they also work through multilateral organizations, such as the IAEA, when bilateral engagement is not an option. For example, GNS has been working with the IAEA to update and translate nuclear security trainings in multiple languages so that the IAEA can expand its reach to improve global nuclear security practices, especially to priority countries where GNS cannot engage because of limitations in bilateral relations. Similarly, INS works closely with the IAEA to engage certain countries that would otherwise be less amenable to cooperating bilaterally with the U.S. on nuclear security issues. Federal programs also work with other multilateral organizations, such as the Regional Arms Control Verification and Implementation Assistance Centre,<sup>32</sup> to help INS engage 10 countries with which INS has no other relationship. However, it is not clear how these efforts are impacting nuclear material security in countries where bilateral engagement is not an option.

Even with these strategies and efforts, it is unclear whether substantial progress has been made in securing materials or facilities in countries or locations where the U.S. does not have access to measure progress. Seven experts from nongovernmental organizations told us it is unlikely for progress to be made in these countries due to political situations.

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### Federal Programs' Efforts to Address Some Risks Are Complicated by Certain U.S. Policies and Practices

Federal officials and nuclear security experts we interviewed identified additional challenges to efforts to secure nuclear materials worldwide against theft and sabotage that stem from certain U.S. policies and practices. The experts we interviewed also stated that such policies and practices could be viewed by other countries as a possible double standard or potentially as undermining the United States' ability to achieve certain international nuclear material security goals. Specifically, officials and experts identified challenges stemming from U.S. policies and practices related to:

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<sup>32</sup>The Regional Arms Control Verification and Implementation Assistance Centre is an international, independent organization, with the mission to foster dialogue and cooperation on security matters in South Eastern Europe through a partnership between the countries of the region and their international partners.

- **High-income countries.** State and NNSA officials indicated that State policy limits direct program expenditures from State programs in high-income countries, as defined by the World Bank. For example, officials from State's Export Control and Related Border Security program identified a country in South America where there may be vulnerabilities in combatting illicit smuggling activity. However, because it is a high-income country, the program cannot spend funds there directly without additional approvals. The State policy requires programs to receive special approval in order to provide assistance to developed countries, including justification for why it is necessary, to overcome the general presumption that developed countries can fund their own efforts. The justification must be grounded in critical U.S. national security, foreign policy, or development objectives.<sup>33</sup> NNSA, DOD, and NRC officials told us that they do provide assistance to high-income countries when working on nuclear material security.
- **U.S. use of HEU-powered naval reactors.** There is disagreement between experts and officials we interviewed about the risks associated with the U.S. use of HEU-powered naval reactors. In 2018, the U.S. Navy and the Department of Energy jointly determined that the U.S. should not pursue an LEU-based naval nuclear fuel system. This determination was based in part on a 2016 report to Congress, which concluded that LEU would be inherently less capable and more expensive than HEU-based fuel for aircraft carriers and that LEU would not meet the requirements of current submarine reactors.<sup>34</sup> Nuclear security experts identified the continued use and promotion of HEU for naval reactors domestically as having the potential to undermine the ability of U.S. nuclear material security programs to minimize use and production of HEU in other countries. For example, six experts from nongovernmental organizations indicated that HEU use in the U.S. Navy creates difficulties for the U.S. to convince several other specific countries not to develop production of HEU for naval nuclear power purposes. However, some federal officials told us that they have not seen evidence that U.S. use of HEU for naval nuclear propulsion has limited the ability of the U.S. to reduce HEU risks in other countries.

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<sup>33</sup>Department of State, U.S. Agency for International Development, Office of Foreign Assistance, *FY 2021 Operational Plan Guidance* (2021).

<sup>34</sup>Department of Energy, *Conceptual Research and Development Plan for Low-Enriched Uranium Naval Fuel, Report to Congress* (Washington, D.C.: July 2016).

- **Spent nuclear fuel reprocessing and accumulation of separated plutonium.** According to State officials, the U.S. has a long-standing policy position to discourage expansion or initiation of foreign reprocessing programs but has no policy with respect to seeking reduction or elimination of countries' existing activities.<sup>35</sup> For example, some federal programs such as State's Office of Nuclear Energy, Safety, and Security and INS, have worked to discourage the initiation of civilian spent nuclear fuel reprocessing in a specific country. However, according to State officials, the U.S. does not have a policy to eliminate existing civilian reprocessing programs in certain countries—which State officials told us are intended to be used for energy production—because the United States does not wish to interfere with the peaceful use of nuclear energy. This is based on a policy stemming from article IV of the Treaty on the Nonproliferation of Nuclear Weapons, which broadly permits states party to the treaty to develop atomic energy for peaceful purposes.

Further, seven experts from nongovernmental organizations we interviewed stated that ongoing domestic development of spent nuclear fuel reprocessing capabilities in the U.S. could complicate U.S. efforts to dissuade foreign partners from expanding or initiating similar reprocessing programs for their spent fuel. For example, nuclear security experts from the Department of Energy's Idaho National Laboratory described for us the continued U.S. research and development efforts on reprocessing the U.S. Navy's spent fuel, including an experimental method of reprocessing spent fuels. Federal officials told us that there is an ongoing effort to develop clearer guidance on the United States' reprocessing policy.

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## A National Strategy Could Address Variations in Nuclear Material Security Programs' Planning and Coordination

Agencies and programs vary in the extent to which they have plans to guide the execution of their activities, in part because some agencies have program planning requirements, while others do not. Additionally, a few of the 23 programs are planning or conducting activities that overlap

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<sup>35</sup>According to federal officials, one of the main tools the U.S. uses to achieve this policy goal is the negotiating process for a 123 agreement between the U.S. and a foreign partner, in which the U.S. can seek a commitment from the partner country not to undertake spent nuclear fuel reprocessing or uranium enrichment programs.

with one another and, in some of these cases, the programs have not clarified or documented roles and responsibilities. NSC's ongoing strategic review, and the new strategy to counter nuclear material security risks that may result from it, could help address some of these agency- and program-level planning and coordination issues.

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### Agencies and Programs Vary in the Extent to Which They Have Program Plans

We found variations in the extent to which the programs included in our review have developed program-specific plans for their future activities and efforts to secure nuclear materials internationally. Generally recognized practices from the Project Management Institute, Inc. indicate that program management plans are most useful when they include a program's mission, goals and objectives, challenges, and performance measures and when they align with organizational strategies.<sup>36</sup> We found that NNSA programs have generally developed individual program plans, while the programs we reviewed at State, DOD, and NRC generally have not developed program-specific plans. These differences are in part accounted for by variations in agency-level requirements and practices for program planning:

- **NNSA.** Most of the NNSA programs we reviewed have developed specific programmatic plans to guide their future efforts. According to Defense Nuclear Nonproliferation policy, its programs should develop plans that align with national priorities.<sup>37</sup> Several NNSA programs have complete and updated plans in one document, such as the Bilateral Physical Protection Assessment Program, NSDD, Plutonium Production Reactor Agreement Program, and International Nonproliferation Export Control Program. A few other NNSA programs have complete and updated planning documentation that was provided to us in multiple documents, such as the Nuclear Material Removal program, as well as INS, which plans its activities in nine

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<sup>36</sup>Project Management Institute, Inc., *The Standard for Program Management*, Fourth Edition (2017).

<sup>37</sup>Department of Energy, National Nuclear Security Administration, Office of Defense Nuclear Nonproliferation, *Management System Description* (Mar. 30, 2018). In addition, the Department of Energy has a policy on Program Management that also requires programs to have plans. See Department of Energy, *Program Management Policy*, DOE P 410.3 (Washington, D.C.: Sept. 23, 2021).

separate functional area plans, such as one for physical protection and another for transport security.

- **State.** Most of the State programs we reviewed did not have their own specific management plans, for several reasons. First, State officials told us that they do not have a policy that requires programs to develop individual management plans. Second, State officials told us that they do not consider the Office of Counterproliferation Initiatives; the Office of Nuclear Energy, Safety, and Security; or the Office of Multilateral Nuclear and Security Affairs to be programming offices because they do not have dedicated funding for programming.<sup>38</sup> Instead, officials from these three offices told us that they conduct planning for specific efforts through agency-wide strategic planning processes. Additionally, while the Office of Weapons of Mass Destruction Terrorism does receive dedicated program funding, it does not have an individual management plan. However, according to State officials, nuclear material security is not currently a major focus area for this office.
- **DOD.** The DOD programs we reviewed do not have program-specific management plans because DOD planning for the Defense Threat Reduction Agency does not typically occur at the program level. Instead, according to DOD officials, individual programs are often guided by plans developed at higher levels within the agency. For example, according to DOD officials, the DOD programs involved in securing nuclear materials internationally receive annual planning direction generated at higher levels within the Office of the Secretary of Defense on the projects or countries where these programs should focus in the coming year.<sup>39</sup> However, according to officials, DOD programs do follow the spirit of best practices in program and project management through their planning efforts. Programs such as the Proliferation Prevention Program and GNS have project plans for individual countries, in addition to higher-level planning.

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<sup>38</sup>State officials consider these offices to be policy offices. This is in contrast to State's Export Control and Related Border Security program, which does have dedicated program funding and detailed subprogram plans, such as for its Border Security Operations subprogram.

<sup>39</sup>Planning direction regarding the projects and countries where these programs should focus is based on a range of criteria including (1) the WMD threat level; (2) the WMD risk level; (3) alignment with DOD, Defense Threat Reduction Agency, and national efforts, such as national strategies from NSC; and (4) coordination with other agencies, such as State and the Department of Energy, in how funding and program support matches DOD efforts.



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- **NRC.** None of the NRC programs we reviewed had their own specific program management plans related to nuclear security. However, this is because NRC develops an agency-wide plan specific to its international activities. This plan identifies the goals and priorities for each NRC program involved in securing international nuclear materials that we reviewed. NRC officials we interviewed also told us that their planned activities are prioritized based on broader U.S. national security and foreign policy priorities.

Since not all agencies have requirements for programs to develop such plans, it is challenging to determine the extent to which programs have established goals and measures to achieve them, as well as how these programs are collectively working toward shared objectives.

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### A Few Federal Programs Have Not Clarified or Documented Their Roles and Responsibilities

We found that some overlapping programs have not clarified or documented their respective roles and responsibilities, raising concerns of potential duplication, while other overlapping programs have done so. According to leading practices on collaboration outlined in prior GAO work, identifying roles and responsibilities in a written document provides a powerful tool for effective collaboration when working on similar issues or challenges.<sup>40</sup> In addition, leading practices for collaboration also state that all parties should define and articulate a common outcome, identify and address needs by leveraging resources, and agree on roles and responsibilities.<sup>41</sup>

We found several federal programs that conduct similar activities in the same locations where the programs are following leading practices and have established clearly documented roles and responsibilities. For example, NNSA's International Nonproliferation Export Control Program and State's Export Control and Related Border Security program work very closely on a variety of projects, including capacity building and best practice sharing in a Southeast Asian country about export controls. The International Nonproliferation Export Control Program receives a portion of its funding for work in this country from the Export Control and Related Border Security program through a documented interagency agreement and has an engagement plan that specifies each program's role and

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<sup>40</sup>[GAO-12-1022](#).

<sup>41</sup>[GAO-14-220](#).

responsibilities. DOD's and NNSA's Plutonium Production Reactor Agreement programs have signed a memorandum of understanding that defines which agency is responsible for implementing different aspects of the agreement between the United States and Russia. Formally documenting roles and responsibilities in these ways can help prevent duplication of effort.

However, we found that some overlapping programs in DOD and NNSA have not documented their roles and responsibilities for securing nuclear materials when conducting similar efforts in the same countries. For example, DOD's Proliferation Prevention Program and NNSA's NSDD both work in several specific countries on counter-smuggling and illicit trafficking but have not documented specific program roles and responsibilities. Federal officials we interviewed from both programs said that communication between agencies on these projects to prevent overlap occurs regularly, but no documentation of roles and responsibilities exists. The absence of clearly documented roles and responsibilities could raise risks of possible future duplication, if the personnel responsible for informally coordinating were to leave the programs. Similarly, NNSA's INS and DOD's GNS both work in several specific countries to secure the transport and storage of nuclear materials. However, neither INS nor GNS officials had clearly documented the roles and responsibilities between the two programs.

Additionally, GNS officials also told us that they are beginning to develop capacity-building efforts in two European countries. However, INS—and NSDD—already work in these countries. Based on current engagement plans, in fiscal year 2022, DOD's GNS, and NNSA's INS or NSDD will be working to address the same risks in the same countries and engaging with the same foreign officials in both countries. GNS officials we interviewed said that they coordinate with INS and NSDD through frequent informal meetings. These GNS officials told us that they do not need to document this collaboration because their current coordination is sufficient to prevent duplication. Yet, NNSA officials we interviewed expressed concerns that GNS roles and responsibilities in the two countries are currently unclear. They added that any overlap with NNSA programs may stretch partner country capacity and cause confusion or be overwhelming for small foreign staffs. As a result, this overlap may undermine ongoing efforts to enhance the security of nuclear materials in these countries.

More generally, GNS has recently added counter nuclear smuggling to its mission statement. According to NNSA officials, this is an area in which

NSDD has worked for decades, and GNS adding this mission has the potential to create more overlap or duplication in the future and require additional coordination. By not establishing clear and documented roles and responsibilities, overlap between federal programs may result in duplication and the unnecessary expenditure of funds. It may also place additional burdens on partner countries that have limited capacity to work with the U.S. on nuclear security matters.

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### NSC Is Developing a National Strategy, but It Is Uncertain if It Will Guide Agencies' and Programs' Efforts

The NSC's ongoing strategic review of U.S. nuclear security efforts to develop a national strategy has the potential to focus attention on addressing current gaps and aligning agencies' programs with shared objectives. This is especially important in the absence of program plans and for improving programs' coordination to avoid duplication. We have previously reported that complex interagency and intergovernmental efforts, such as programs working to secure nuclear materials overseas, can benefit from the development of a national strategy.<sup>42</sup> We have also previously identified a set of desirable characteristics in national strategies that can enhance their usefulness in resource and policy decisions and to better assure accountability.<sup>43</sup> For example, the NSC's strategy could identify appropriate relationships between individual programs, resolve conflicting roles, and address how agencies' program plans and activities are aligned to achieve shared objectives. See appendix IV for descriptions of these desirable characteristics.

Details on the NSC strategic review, including on the review's timeframes, its scope, and its specification of potential agency organizational roles and responsibilities, were omitted because NSC officials deemed that information to be sensitive.

We have previously reported that a national strategy should ideally address how it relates to agency and program plans to implement the strategy.<sup>44</sup> Desirable characteristics include identifying organizational roles, responsibilities, and coordination so that relevant agencies know

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<sup>42</sup>[GAO-12-71](#).

<sup>43</sup>[GAO-12-71](#).

<sup>44</sup>[GAO-04-408T](#).

who will be implementing what parts of the strategy and can coordinate their efforts.<sup>45</sup> For instance, a national strategy could address its relationship with relevant plans of implementing agencies, or provide guidance on the roles, responsibilities, and capabilities of the implementing agencies and programs.<sup>46</sup>

However, because the strategic review is ongoing, it is uncertain if and what type of agency or program level implementation guidance the NSC will produce as a result of the review.

This is important, because even though NSC has not completed its review, agencies are already changing or reevaluating their nuclear security program missions or roles on their own initiative. For example, in February 2022, NNSA announced that it planned to establish a federal advisory committee to review the priorities of its Office of Defense Nuclear Nonproliferation in light of the current geopolitical environment. It is not yet known if the assessment will result in changes to program organization, mission, or scope. However, one senior NNSA official told us that the review will be used to assess risks and determine whether the Office of Defense Nuclear Nonproliferation is implementing programs that effectively address those risks.

In addition, a few DOD and State programs have transitioned to focus more on chemical and biological weapon threats than nuclear threats. For example, DOD's Countering Weapons of Mass Destruction Security Cooperation Engagement Program shifted programming to primarily focus on chemical and biological threats. This is because, according to DOD officials, many nuclear security threats have been addressed, aside from the remaining hard cases, which are not able to be addressed by this program alone. Since fiscal year 2018, State's Cooperative Threat Reduction—Global Threat Reduction Program has ended all of its traditional nuclear security programming and transitioned its nuclear

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<sup>45</sup>[GAO-04-408T](#).

<sup>46</sup>[GAO-04-408T](#).

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security projects to be managed by NNSA's International Nuclear Security, according to State officials.<sup>47</sup>

It is too early to know whether the NSC's ongoing strategic review of U.S. nuclear security efforts and the national strategy that may result from it will provide clear implementation guidance. However, such guidance could help agencies align programs and develop plans consistent with the national strategy's goals, including those programs that are changing or reevaluating the future of their nuclear security efforts.

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## Conclusions

Even with the efforts of the U.S. and other countries, there are still significant risks to securing nuclear materials against theft or sabotage, which could result in catastrophic damage and mass casualties. NNSA, State, DOD, NRC, and NSC have worked for years to improve the security and limit the use and transfer of nuclear materials.

A few federal programs that are working to address the same risks to securing nuclear materials in the same countries as other federal programs have not clearly established or documented program roles and responsibilities. Officials from some of these programs identified concerns that without such clarification, duplication of effort is possible. By clarifying and documenting roles and responsibilities, NNSA and DOD can avoid duplication, unnecessary spending, and burdening partner countries that have limited capacity to work with the U.S. on securing nuclear materials.

NSC is currently developing a national strategy related to nuclear materials security, but it is not clear what, if any, implementation guidance will result from this effort. By clarifying and documenting the roles and responsibilities between relevant overlapping programs, the NSC's national strategy can also help avoid duplicative efforts. Additionally, by developing a national strategy that includes implementation guidance to agencies and programs, NSC can help the programs make informed

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<sup>47</sup>The Global Threat Reduction Program is not included in the 23 programs in this report because it no longer has nuclear security programming. Historically this program did work on nuclear security risks, such as insider threats and building partner capacity in Southeast Asia and Africa. In 2022, this program is focusing on chemical terrorism threats by state and nonstate actors instead of on nuclear terrorism threats. Officials said that this shift came about because there was a gap in addressing chemical and biological threats, and NNSA is ensuring the sustainability of past State efforts in the nuclear security sphere.

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decisions for how to align and prioritize their current and future activities with the nuclear material security goals articulated in the strategy.

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## Recommendations for Executive Action

We are making a total of three recommendations, including one to NNSA, one to DOD, and one to NSC. Specifically:

The NNSA Deputy Administrator for Defense Nuclear Nonproliferation should clarify and document the roles and responsibilities for programs that work to address similar issues in the same countries as other federal programs to avoid program overlap or duplication, especially with DOD's Cooperative Threat Reduction programs. (Recommendation 1)

The DOD Deputy Assistant Secretary of Defense for Nuclear and Countering Weapons of Mass Destruction Policy should clarify and document the roles and responsibilities for programs that work to address similar issues in the same countries as other federal programs to avoid program overlap or duplication, especially with NNSA's Defense Nuclear Nonproliferation programs. (Recommendation 2)

The Chairman of the National Security Council, or their designee, should ensure that the forthcoming national strategy incorporates the desirable characteristics of a national strategy, including clarifying and documenting appropriate roles and responsibilities between agencies and programs in addressing nuclear material security risks and providing implementation guidance for agencies and programs to align their activities and future plans with the strategy's goals and objectives. (Recommendation 3)

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## Agency Comments

We provided a draft of the CUI version of this report for review and comment to the National Nuclear Security Administrator, Secretary of Defense, Secretary of State, Executive Director of the Nuclear Regulatory Commission, and the National Security Council.

NNSA, DOD, and NRC provided written comments on the CUI version of this report, which are reproduced in appendixes V-VII. The Department of State responded by email that it did not have comments on the draft report aside from one technical comment, which we incorporated as appropriate. NSC also responded by email that it did not have any

comments. NNSA and NRC provided technical comments, which we incorporated as appropriate.

In their written comments, NNSA and DOD agreed with our recommendations directed to their respective agencies on coordination. DOD officials noted that the recommendation is best addressed to the Deputy Assistant Secretary of Defense for Nuclear and Countering Weapons of Mass Destruction Policy, rather than the Deputy Assistant Secretary of Defense for Threat Reduction and Arms Control. We made this change in the report. This draft was provided to the agencies again to ensure its suitability for public release.

We are sending copies of this report to the appropriate congressional committees, the National Nuclear Security Administrator, Secretary of Defense, Secretary of State, Executive Director of the Nuclear Regulatory Commission, and the National Security Council. In addition, the report is available at no charge on the GAO website at <http://www.gao.gov>.

If you or your staff members have any questions about this report, please contact me at (202) 512-3841 or [bawdena@gao.gov](mailto:bawdena@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 key contributions to the report are listed in appendix VIII.

A handwritten signature in black ink, appearing to read "Allison Bawden". The signature is fluid and cursive, with a long horizontal stroke at the end.

Allison Bawden  
Director, Natural Resources and Environment

## Appendix I: Objectives, Scope, and Methodology

You asked us to review issues related to U.S. efforts to help secure international nuclear materials. This report (1) describes the risks to securing international nuclear materials identified by federal officials and nuclear security experts; (2) examines the extent to which federal programs are taking steps to address identified risks to securing international nuclear materials; and (3) assesses the extent to which agencies plan and coordinate their nuclear material security programs, and a national strategy exists to help ensure alignment of programs' objectives.

This report is a public version of a report containing Controlled Unclassified Information (CUI) that we issued in December 2022.<sup>1</sup> The National Nuclear Security Administration and National Security Council deemed some of the information in our December report to include CUI, which must be protected from public disclosure. Therefore, this report omits sensitive information about selected countries and related agency actions. Although the information provided in this report is more limited, the report addresses the same objectives as the CUI report and uses the same methodology.<sup>2</sup>

The scope of our review for all three objectives includes weapon usable nuclear material (WUNM), such as highly enriched uranium and plutonium; reactors and facilities that utilize or house WUNM; and reactors and other facilities that utilize or house materials that are not directly usable in constructing a nuclear weapon but that could make the

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<sup>1</sup>GAO, *Overseas Nuclear Material Security: A Comprehensive National Strategy Could Help Address Risks of Theft and Sabotage*, GAO-23-104715SU (Washington, D.C.: Dec. 21, 2022).

<sup>2</sup>On March 2, 2023, the White House announced that the President had signed National Security Memorandum 19 to Counter Weapons of Mass Destruction Terrorism and Advance Nuclear and Radioactive Material Security worldwide. Because the issuance of this strategy occurred after the completion of the audit work for our December 2022 Controlled Unclassified Information (CUI) report, this public version of our report does not assess the administration's new strategy. Consequently, we have not updated information in this report or revised our recommendations from the CUI version of the report.



facilities targets for nuclear theft or sabotage.<sup>3</sup> For all three objectives, we identified, gathered documentation from, and interviewed relevant officials and experts, including

- U.S. federal officials in the Department of Energy’s National Nuclear Security Administration (NNSA), Department of State, Department of Defense (DOD), Nuclear Regulatory Commission (NRC), and the National Security Council (NSC);
- nuclear security experts from academia and nongovernmental organizations; and
- knowledgeable personnel from Department of Energy national laboratories and production sites that support U.S. nuclear security efforts.

To identify federal officials and programs that have a role in improving the security of international nuclear materials, we reached out to the agencies that had previously worked in this space based on recent GAO reports, Congressional Research Service reports, and agencies and programs identified by nuclear security experts in recent publications. We then asked these agencies about the missions and activities of all relevant programs, offices, and subprograms. If offices or subprograms operate like programs, we refer to them as programs for simplicity when summarizing in this report, but use the full names when referenced individually, such as how they are listed below. We identified 23 programs listed below in four agencies in addition to the National Security Council, speaking with a total of 86 individual federal officials.

NNSA programs:

- Bilateral Physical Protection Assessment Program
- Conversion
- International Nonproliferation Export Control Program
- International Nuclear Security
- Nuclear Material Removal

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<sup>3</sup>The scope of our review does not encompass the security of radiological materials, or the security of nuclear materials in the U.S. The scope of our review also does not include the International Atomic Energy Agency (IAEA) Safeguards program—which seeks to verify that nuclear material subject to safeguards is not diverted for the production of nuclear weapons or other proscribed purposes—and U.S. programs focused solely on safeguards efforts.

- Nuclear Smuggling Detection and Deterrence
- Plutonium Production Reactor Agreement Program
- Proliferation Detection

State programs:

- Export Control and Related Border Security Program
- Office of Counterproliferation Initiatives
- Office of Multilateral Nuclear and Security Affairs
- Office of Nonproliferation and Disarmament Fund
- Office of Nuclear Energy, Safety, and Security
- Office of Weapons of Mass Destruction Terrorism

DOD programs:

- Countering Weapons of Mass Destruction Security Cooperation Engagement Program
- International Counterproliferation Program
- Global Nuclear Security
- Plutonium Production Reactor Agreement Program
- Proliferation Prevention Program

NRC programs:

- Office of International Programs
- Office of Nuclear Material Safety and Safeguards
- Office of Nuclear Reactor Regulation
- Office of Nuclear Security and Incident Response

The scope of programs in our review includes those that work with international partner countries to improve security at facilities with nuclear material; remove or consolidate nuclear materials to more secure locations; convert facilities from the use of WUNM; build nuclear material security capacity in partner countries; and monitor the security of nuclear materials. We also included programs working with partner countries to deter, detect, and interdict nuclear material smuggling and to enhance international export controls over trade in sensitive goods and technology,

including dual-use goods. We have expressly included export control programs that focus on nonproliferation efforts because of their efforts in strengthening trade controls, such as those related to nuclear materials and dual-use goods. Export controls and export control programs may focus on more than nuclear materials and dual-use goods, but we determined that they provided valuable additional perspective on these issues and risks and should be included as relevant programs.

To identify outside nuclear security experts from nongovernmental organizations to provide their views on international nuclear material security, we contacted experts previously identified as nuclear material security experts in recent GAO work, and conducted a review of relevant literature, news articles, and experts identified by Congress in recent congressional testimonies on nuclear material.<sup>4</sup> From these initial sources, we identified nine experts and held interviews. We asked these initial experts to give us names of additional individuals who met our criteria for an expert, then asked the same of the additional experts we interviewed. We used this process to ensure our list of potential experts was complete. Our criteria for experts included that they: currently work in the nuclear material security field in a professional capacity; have more than 5 years of experience in this field; hold at least one relevant advanced degree; hold a nongovernmental position; and have published work related to nuclear material security within the last 5 years. We interviewed nuclear material security experts for their views on U.S. efforts to secure international nuclear materials and we reviewed their published works on these topics. In order to ensure balance, we also asked identified experts if there were other experts who held viewpoints opposed to their own and then reached out to interview those experts as well. Overall, we selected, contacted, and spoke to 21 individual experts from 15 different nongovernmental organizations out of 25 identified individuals.<sup>5</sup>

In addition to these nongovernmental experts, we also asked federal officials from NNSA to identify knowledgeable personnel at U.S. national laboratories and production sites that support U.S. nuclear security efforts. We considered these knowledgeable contractor personnel experts

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<sup>4</sup>For example, see GAO, *Nuclear Nonproliferation: Past U.S. Involvement Improved Russian Nuclear Material Security, but Little Is Known about Current Conditions*, [GAO-20-392](#) (Washington, D.C.: Feb. 27, 2020), which conducted a literature search to identify nongovernmental experts in nuclear material security, among other things.

<sup>5</sup>The four identified experts that did not speak with us indicated that they did not meet our criteria or did not respond to our requests to engage.

in international nuclear material security because they are currently working with federal officials to address risks to international nuclear material security, but do not necessarily meet the criteria we required the experts from nongovernmental organizations to meet. We spoke with 64 experts from the following 10 national laboratories or production sites:

- Argonne National Laboratory
- Idaho National Laboratory
- Lawrence Livermore National Laboratory
- Los Alamos National Laboratory
- Oak Ridge National Laboratory
- Pacific Northwest National Laboratory
- Pantex Plant
- Sandia National Laboratory
- Savannah River Site and
- Y-12 National Security Complex.

Whenever possible, we attribute statements to experts and clarify if they are from a nongovernmental organization or a national laboratory or production site. In rare instances, we may refer to experts without a numeric identifier or clarification on what type of experts. Plural references indicate that more than one expert from those we interviewed held a certain viewpoint or indicated a current fact, but it could have come from their written work, such as articles or reports or from interviews with us. Whenever possible, we attributed statements to officials associated with relevant programs or agencies, such as “NNSA officials said,” or “according to officials from the Proliferation Prevention Program.”<sup>6</sup>

To describe the risks federal officials and nuclear security experts identified with respect to securing international nuclear materials, we gathered documentation from and interviewed all the individuals described above about risks. The documentation we gathered and reviewed included reports and articles from academia and nongovernmental organizations identified by our selected experts, as well

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<sup>6</sup>When multiple programs or agencies stated the same facts or opinions, we summarized by agency, such as NNSA, State, DOD, and NRC officials. We listed these in the same order each time, from the agency with the most out of the identified 23 programs (NNSA with eight) to that with the least (NRC with four).

as agency strategic plans, agency performance reports, budget justification documents, reports to Congress, interagency memorandums, and internal program documentation used to determine the risks in individual countries. We analyzed the information gathered from documentation and interviews and grouped similar risks together that were consistently identified to help describe the complete risk landscape.

In discussing risks with federal officials, not every risk topic or country with risks was discussed in every interview because officials discussed what was most relevant for their program. For example, the programs working on export control did not necessarily discuss risks related to secure fencing that a program focused on physical security might, but could discuss export control risks at a level that a physical security program would not. We also gathered information on the locations of weapon usable nuclear material and nuclear facilities worldwide using agency information and information from the nongovernmental organization the International Panel on Fissile Materials, and three IAEA databases. These IAEA databases were

- the Power Reactor Information System, a comprehensive database of nuclear power plants worldwide;
- the Research Reactor Database, an authoritative database containing information on research reactors in 67 countries; and
- the Nuclear Fuel Cycle Facility Database, which lists nuclear fuel cycle facilities worldwide.

We conducted data reliability assessments for these databases and found their information to be sufficiently reliable.

To determine the extent to which federal programs are taking steps to address identified risks to securing international nuclear materials against theft and sabotage, we gathered documentation from, and spoke with, the same officials and experts discussed above and asked about ongoing and planned work for fiscal years 2021 and 2022, as well as challenges to completing that work. We used these interviews and documents to determine which federal programs addressed the identified risks and what risks were unaddressed by federal programs overall or in specific countries.

To determine the extent to which agencies have developed management plans for their nuclear material security programs, we gathered and reviewed available program plans and then gathered and reviewed

agency-level plans. We also interviewed federal officials about current plans and plans for updating or altering program management plans in the future, as well as reasons why some programs did not have plans. We analyzed whether these plans followed existing agency program management policies and guidance as well as leading practices in program management.

To identify practices for managing complex programs and projects, we also reviewed the Project Management Institute, Inc.'s (PMI) *The Standard for Program Management*, Fourth Edition (2017) and *Governance of Portfolios, Programs, and Projects: A Practice Guide* (2016).<sup>7</sup> These standards do not explicitly identify leading practices, but do define program management performance domains (program life cycle management, program strategy alignment, program governance, program stakeholder engagement, and program benefits management). Within these domains, PMI identifies principles that are generally recognized as good practices for organizations that need to effectively manage complex programs and projects. According to PMI, "generally recognized" means that the principles described are applicable to most portfolios and programs, most of the time, and that there is widespread consensus about their value and usefulness; and "good practice" means that there is a general agreement that the application of these principles and performance management activities can enhance the chances of success and are proven to work over a wide range of portfolios and programs. For program management, it is generally recognized that programs should develop program management plans that include a program mission, goals and objectives, challenges, and performance measures and that such plans align with organizational strategies.

To determine the extent to which agencies coordinate their nuclear material security program planning, we gathered documentation related to collaboration, such as memos and interagency agreements and asked federal officials about their interagency and intra-agency collaboration practices. We compared this with leading practices in collaboration that

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<sup>7</sup>Project Management Institute, Inc., *The Standard for Program Management*, Fourth Edition (2017); *Governance of Portfolios, Programs, and Projects: A Practice Guide* (2016). The Project Management Institute, Inc. is a not-for-profit association that provides global standards for, among other things, program management. These standards are utilized worldwide and provide guidance on how to manage various aspects of projects, programs, and portfolios. For example, NNSA cites the Project Management Institute, Inc.'s standards as a source of best practices in its program management policy.

GAO has established in previous work, such as whether overlapping programs have clear and documented roles and responsibilities.<sup>8</sup>

To determine the extent to which a national strategy exists to help ensure alignment of programs' objectives, we gathered documentation and interviewed officials from each of the 23 programs and the NSC. We interviewed NSC officials about the current status of their review on efforts related to nuclear security, including plans and progress toward developing strategies, such as a national strategy. We then compared their plans and progress towards a national strategy to desirable characteristics in developing national strategies, which are described in appendix IV.<sup>9</sup>

The performance audit upon which this report is based was conducted from January 2021 to December 2022 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate, evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives. We subsequently worked with NNSA and NSC from December 2022 to March 2023 to prepare this unclassified version of the original CUI report for public release. This public version was also prepared in accordance with these standards.

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<sup>8</sup>GAO, *Managing for Results: Implementation Approaches Used to Enhance Collaboration in Interagency Groups*, [GAO-14-220](#) (Washington, D.C.: Feb. 14, 2014); and *Managing for Results: Key Considerations for Implementing Interagency Collaborative Mechanisms*, [GAO-12-1022](#) (Washington, D.C.: Sept. 27, 2012).

<sup>9</sup>See GAO, *Combating Terrorism: Evaluation of Selected Characteristics in National Strategies Related to Terrorism*, [GAO-04-048T](#) (Washington, D.C.: Feb. 3, 2004) for the first GAO reference to these desirable characteristics.

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## Appendix II: Countries with Nuclear Materials and Facilities

According to agency information and the nongovernmental organization the International Panel on Fissile Materials, the countries listed in column one in table 2 had at least 1 kilogram of weapon usable nuclear material as of May 2021. The countries listed in column two had nuclear facilities, according to the International Atomic Energy Agency's (IAEA) Power Reactor Information System, a comprehensive database of nuclear power plants worldwide; the IAEA's Research Reactor Database, an authoritative database containing information on research reactors in 67 countries; and IAEA's Nuclear Fuel Cycle Facilities Database, which lists nuclear fuel cycle facilities worldwide, as of October 2021.

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**Table 2: Countries That Have Weapon Usable Nuclear Materials and Nuclear Facilities**

- **Countries with weapon usable nuclear materials<sup>a</sup>**
  - Australia
  - Belarus
  - Belgium
  - Canada
  - China
  - Democratic People's Republic of Korea (North Korea)
  - France
  - Germany
  - India
  - Islamic Republic of Iran (Iran)
  - Israel
  - Italy
  - Japan
  - Kazakhstan
  - Netherlands



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**Appendix II: Countries with Nuclear Materials  
and Facilities**

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- Norway
- Pakistan
- Russian Federation (Russia)
- South Africa
- Syrian Arab Republic (Syria)
- United Kingdom of Great Britain and Northern Ireland
- United States of America
- **Countries with nuclear facilities<sup>b</sup>**
  - Algeria
  - Argentina
  - Armenia
  - Australia
  - Austria
  - Bangladesh
  - Belarus
  - Belgium
  - Brazil
  - Bulgaria
  - Canada
  - Chile
  - China
  - Colombia
  - Czechia
  - Democratic People's Republic of Korea (North Korea)
  - Egypt
  - Finland
  - France
  - Germany
  - Ghana
  - Greece

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**Appendix II: Countries with Nuclear Materials  
and Facilities**

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- Hungary
- India
- Indonesia
- Islamic Republic of Iran (Iran)
- Israel
- Italy
- Jamaica
- Japan
- Jordan
- Kazakhstan
- Libya
- Malaysia
- Mexico
- Morocco
- Netherlands
- Nigeria
- Norway
- Pakistan
- Peru
- Poland
- Republic of Korea (South Korea)
- Romania
- Russian Federation (Russia)
- Slovakia
- Slovenia
- South Africa
- Spain
- Sweden
- Switzerland
- Syrian Arab Republic (Syria)

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**Appendix II: Countries with Nuclear Materials  
and Facilities**

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- Taiwan<sup>c</sup>
- Thailand
- Turkey
- Ukraine
- United Arab Emirates
- United Kingdom of Great Britain and Northern Ireland
- United States of America
- Uzbekistan
- Vietnam

Source: GAO analysis of information from the National Nuclear Security Administration; the International Panel on Fissile Materials; and the International Atomic Energy Agency Power Reactor Information System, Research Reactor Database, and Nuclear Fuel Cycle Facilities Database. | GAO-23-106486

<sup>a</sup>These countries have reported or are estimated to have at least 1 kilogram of weapon usable nuclear material, which includes plutonium and highly enriched uranium, as of May 2021.

<sup>b</sup>These countries have nuclear facilities already built. This list does not include countries with facilities under construction, unless they also have facilities that are already built, as of October 2021.

<sup>c</sup>Taiwan is listed as a country for simplicity, but it is not recognized as a separate country by the United States. U.S. law provides that whenever the laws of the U.S. refer or relate to foreign countries, nations, states, governments, or similar entities, such terms shall include and shall apply to Taiwan. 22 U.S.C. § 3303. Furthermore, the data we used listed Taiwan separately from China.

## Appendix III: Risks Addressed by Agency and Program

Tables 3 and 4 identify categories of risk related to securing nuclear materials against theft or sabotage and an “X” indicates that a program works to address that risk category. We summarized this information based on the risks that federal officials and nuclear security experts identified, as well as if the 23 programs and the agencies they are organized under conduct work or have missions or goals related to that risk category. Existing risks to securing international nuclear materials against theft and sabotage are risks that have persisted for years (see table 3). Potential risks are those that could amplify nuclear material theft or sabotage concerns (see table 4).

**Table 3: Existing Risks to Securing International Nuclear Materials against Theft and Sabotage, and Federal Programs That Address These Risks**

Agency/program	Physical security	Insider threats	Counter-smuggling and illicit trafficking	Widespread use and increasing stockpiles	Limited partner capacity
Bilateral Physical Protection Assessment Program	YES	YES	NO	NO	YES
Conversion	YES	NO	NO	YES	YES
International Nonproliferation Export Control Program	NO	NO	YES	NO	YES
International Nuclear Security	YES	YES	NO	YES	YES
Nuclear Material Removal	YES	YES	YES	YES	YES
Nuclear Smuggling Detection and Deterrence	NO	NO	YES	NO	YES
Plutonium Production Reactor Agreement Program	YES	NO	NO	YES	NO
Proliferation Detection	NO	NO	YES	NO	NO
<b>National Nuclear Security Administration (Total out of 8 programs)</b>	<b>5</b>	<b>3</b>	<b>4</b>	<b>4</b>	<b>6</b>
Export Control and Related Border Security	NO	NO	YES	NO	YES
Office of Counterproliferation Initiatives	NO	NO	YES	NO	NO
Office of Multilateral Nuclear and Security Affairs	NO	NO	NO	NO	YES

**Appendix III: Risks Addressed by Agency and Program**

<b>Agency/program</b>	<b>Physical security</b>	<b>Insider threats</b>	<b>Counter-smuggling and illicit trafficking</b>	<b>Widespread use and increasing stockpiles</b>	<b>Limited partner capacity</b>
Office of Nonproliferation and Disarmament Fund	YES	YES	YES	YES	YES
Office of Nuclear Energy, Safety, and Security	NO	NO	YES	YES	YES
Office of Weapons of Mass Destruction Terrorism	NO	NO	YES	NO	YES
<b>Department of State (Total out of 6 programs)</b>	<b>1</b>	<b>1</b>	<b>5</b>	<b>2</b>	<b>5</b>
Countering Weapons of Mass Destruction Security Cooperation Engagement Program	NO	NO	YES	NO	YES
Global Nuclear Security	YES	YES	YES	YES	YES
International Counterproliferation Program	YES	YES	YES	NO	YES
Plutonium Production Reactor Agreement Program	YES	NO	NO	YES	NO
Proliferation Prevention Program	NO	NO	YES	NO	YES
<b>Department of Defense (Total out of 5 programs)</b>	<b>3</b>	<b>2</b>	<b>4</b>	<b>2</b>	<b>4</b>
Office of International Programs	YES	NO	YES	NO	YES
Office of Nuclear Material Safety and Safeguards	YES	NO	YES	YES	YES
Office of Nuclear Reactor Regulation	YES	NO	YES	NO	YES
Office of Nuclear Security and Incident Response	YES	YES	YES	NO	YES
<b>Nuclear Regulatory Commission (Total out of 4 programs)</b>	<b>4</b>	<b>1</b>	<b>4</b>	<b>1</b>	<b>4</b>
<b>Total programs (out of 23)</b>	<b>13</b>	<b>7</b>	<b>17</b>	<b>9</b>	<b>19</b>

Legend: — = program does not work in that risk category.

Source: GAO analysis of documentation and interviews from the National Nuclear Security Administration, the Department of State, the Department of Defense, and the Nuclear Regulatory Commission. | GAO-23-106486

**Appendix III: Risks Addressed by Agency and Program**

**Table 4: Potential Risks to Securing International Nuclear Materials against Theft and Sabotage, and Federal Programs That Address These Risks**

<b>Agency/program</b>	<b>Technical trends</b>	<b>Political environments</b>	<b>Additional nuclear infrastructure</b>
Bilateral Physical Protection Assessment Program	YES	NO	NO
Conversion	YES	NO	NO
International Nonproliferation Export Control Program	YES	NO	NO
International Nuclear Security	YES	NO	YES
Nuclear Material Removal	YES	YES	YES
Nuclear Smuggling Detection and Deterrence	YES	NO	NO
Plutonium Production Reactor Agreement Program	NO	NO	NO
Proliferation Detection	YES	NO	NO
<b>National Nuclear Security Administration (Total out of 8 programs)</b>	<b>7</b>	<b>1</b>	<b>2</b>
Export Control and Related Border Security	YES	NO	NO
Office of Counterproliferation Initiatives	NO	NO	NO
Office of Multilateral Nuclear and Security Affairs	YES	NO	NO
Office of Nonproliferation and Disarmament Fund	YES	YES	YES
Office of Nuclear Energy, Safety, and Security	NO	YES	YES
Office of Weapons of Mass Destruction Terrorism	NO	NO	NO
<b>Department of State (Total out of 6 programs)</b>	<b>3</b>	<b>2</b>	<b>2</b>
Countering Weapons of Mass Destruction Security Cooperation Engagement Program	NO	NO	NO
Global Nuclear Security	YES	NO	NO
International Counterproliferation Program	NO	NO	NO
Plutonium Production Reactor Agreement Program	NO	NO	NO
Proliferation Prevention Program	NO	NO	NO

**Appendix III: Risks Addressed by Agency and Program**

<b>Agency/program</b>	<b>Technical trends</b>	<b>Political environments</b>	<b>Additional nuclear infrastructure</b>
<b>Department of Defense (Total out of 5 programs)</b>	<b>1</b>	<b>0</b>	<b>0</b>
Office of International Programs	YES	YES	YES
Office of Nuclear Material Safety and Safeguards	YES	NO	YES
Office of Nuclear Reactor Regulation	YES	NO	YES
Office of Nuclear Security and Incident Response	YES	NO	NO
<b>Nuclear Regulatory Commission (Total out of 4 programs)</b>	<b>4</b>	<b>1</b>	<b>3</b>
<b>Total programs (out of 23)</b>	<b>15</b>	<b>4</b>	<b>7</b>

Legend: -- = program does not work in that risk category.

Source: GAO analysis of documentation and interviews from the National Nuclear Security Administration, the Department of State, the Department of Defense, and the Nuclear Regulatory Commission. | GAO-23-106486

# Appendix IV: Desirable Characteristics for a National Strategy

**Table 5: Summary of Desirable Characteristics for a National Strategy**

<b>Desirable characteristic</b>	<b>Description</b>
Purpose, scope, and methodology	Addresses why the strategy was produced, the scope of its coverage, and the process by which it was developed.
Problem definition and risk assessment	Addresses the particular national problems and threats the strategy is directed towards.
Goals, subordinate objectives, activities, and performance measures	Addresses what the strategy is trying to achieve, steps to achieve those results, as well as the priorities, milestones, and performance measures to gauge results.
Resources, investments, and risk management	Addresses what the strategy will cost, the sources and types of resources and investments needed, and where resources and investments should be targeted based on balancing risk reduction with costs.
Organizational roles, responsibilities, and coordination	Addresses who will be implementing the strategy, what their roles will be compared to others, and mechanisms for them to coordinate their efforts.
Integration and implementation	Addresses how a national strategy relates to other strategies' goals, objectives, and activities, and to subordinate levels of government and their plans to implement the strategy.

Source: GAO data from GAO, *Combating Terrorism: Evaluation of Selected Characteristics in National Strategies Related to Terrorism*, [GAO-04-408T](#) (Washington, D.C.: Feb. 3, 2004). | GAO-23-106486



# Appendix V: Comments from the National Nuclear Security Administration



Department of Energy  
Under Secretary for Nuclear Security  
Administrator, National Nuclear Security Administration  
Washington, DC 20585



October 28, 2022

Ms. Allison B. Bawden  
Director, Natural Resources and Environment  
U.S. Government Accountability Office  
Washington, DC 20548

Dear Director Bawden:

Thank you for the opportunity to review the Government Accountability Office (GAO) draft report "Overseas Nuclear Material Security: A Comprehensive National Strategy Could Help Address Risks of Theft and Sabotage" (GAO-23-104715). The Department of Energy's National Nuclear Security Administration (NNSA) appreciates GAO recognition of its critical role in securing nuclear materials around the world and mitigating associated proliferation and international security risks. As the report indicates, this is an ongoing challenge that involves the collective effort of several federal agencies.

NNSA agrees with the auditors' observations regarding the importance of effectively coordinating potentially overlapping and duplicative efforts of other agencies in the same countries. Consistent with best practices and the GAO recommendations from the report, NNSA will coordinate with U.S. Government partners that address similar issues in the same countries, in particular the Department of Defense, to clarify and document its roles and responsibilities for key proliferation prevention and threat reduction programs dealing with overseas nuclear material security. The estimated completion date for documenting these activities is March 2023.

Subject matter experts have also provided technical comments for your consideration under separate cover to enhance the clarity and accuracy of the report. If you have any questions about this response, please contact Dean Childs, Director, Audits and Internal Affairs, at (202) 836-3327.

Sincerely,

A handwritten signature in black ink, appearing to read "Jill H", is positioned above the printed name.

Jill Hruby

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## Text of Appendix V: Comments from the National Nuclear Security Administration

October 28, 2022

Ms. Allison B. Bawden

Director, Natural Resources and Environment

U.S. Government Accountability Office Washington, DC 20548

Dear Director Bawden:

Thank you for the opportunity to review the Government Accountability Office (GAO) draft report "Overseas Nuclear Material Security: A Comprehensive National Strategy Could Help Address Risks of Theft and Sabotage" (GAO-23-104715). The Department of Energy's National Nuclear Security Administration (NNSA) appreciates GAO recognition of its critical role in securing nuclear materials around the world and mitigating associated proliferation and international security risks. As the report indicates, this is an ongoing challenge that involves the collective effort of several federal agencies.

NNSA agrees with the auditors' observations regarding the importance of effectively coordinating potentially overlapping and duplicative efforts of other agencies in the same countries. Consistent with best practices and the GAO recommendations from the report, NNSA will coordinate with U.S. Government partners that address similar issues in the same countries, in particular the Department of Defense, to clarify and document its roles and responsibilities for key proliferation prevention and threat reduction programs dealing with overseas nuclear material security. The estimated completion date for documenting these activities is March 2023.

Subject matter experts have also provided technical comments for your consideration under separate cover to enhance the clarity and accuracy of the report. If you have any questions about this response, please contact Dean Childs, Director, Audits and Internal Affairs, at (202) 836-3327.

Sincerely,

Jill Hruby

## Appendix VI: Comments from the Department of Defense

UNCLASSIFIED



OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE  
2600 DEFENSE PENTAGON  
WASHINGTON, D.C. 20301-2600

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

Ms. Bawden:

Thank you for the opportunity to work with your office on the development of GAO Draft Report 23-104715, "OVERSEAS NUCLEAR SECURITY: A Comprehensive National Strategy Could Help Address Risks of Theft and Sabotage," dated October 2022.

The Department of Defense concurs in the substance of Recommendation 2, but believes that the Deputy Assistant of Defense for Nuclear and Countering Weapons of Mass Destruction Policy, rather than the Deputy Assistant of Defense for Threat Reduction and Arms Control is the appropriate official to undertake this effort. The Department has no other concerns with the recommendation as written.

The Department will address the recommendation through our annual interagency working sessions that inform the development of the policy priorities of the Department's Cooperative Threat Reduction Program. The Department already invites the National Nuclear Security Administration to participate in those interagency working sessions, and will take appropriate steps to clarify and document the roles and responsibilities each U.S. Government department or agency will undertake when working in the same country.

Sincerely,

A handwritten signature in black ink that reads "Richard C. Johnson". The signature is written in a cursive style and extends to the right with a long horizontal stroke.

Richard C. Johnson  
Deputy Assistant Secretary of Defense,  
Nuclear and Countering Weapons of Mass  
Destruction

UNCLASSIFIED

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## Text of Appendix VI: Comments from the Department of Defense

Ms. Allison Bawden

Director, Natural Resources & Environment, U.S. Government Accountability Office  
441 G Street NW

Washington, DC 20548 Ms. Bawden:

Thank you for the opportunity to work with your office on the development of GAO Draft Report 23-104715, "OVERSEAS NUCLEAR SECURITY: A Comprehensive National Strategy Could Help Address Risks of Theft and Sabotage," dated October 2022.

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Sincerely,

Deputy Assistant Secretary of Defense, Nuclear and Countering Weapons of Mass  
Destruction

# Appendix VII: Comments from the Nuclear Regulatory Commission



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

October 14, 2022

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 "OVERSEAS NUCLEAR  
MATERIAL SECURITY: A Comprehensive National Strategy Could Help Address  
Risks of Theft and Sabotage" (GAO-23-104715).

Dear Ms. Bawden,

Thank you for the opportunity to review and comment on the draft Government Accountability Office Report "Overseas Nuclear Material Security: A Comprehensive National Strategy Could Help Address Risks of Theft and Sabotage" (GAO-23-104715) which the U.S. Nuclear Regulatory Commission (NRC) received on September 14, 2022. The NRC staff has reviewed the draft report and is in general agreement with the content of the draft audit report. The NRC staff recognizes there are no recommendations for the NRC. Please see comments in the enclosure to this letter.

If you have any questions concerning staff's comments, please direct them to John R. Jolicoeur at 301-415-1642 or [john.jolicoeur@nrc.gov](mailto:john.jolicoeur@nrc.gov).

Sincerely,

A handwritten signature in black ink, appearing to read "Dan Dorman".

Signed by Dorman, Dan  
on 10/14/22

Daniel H. Dorman  
Executive Director  
for Operations

Enclosure:  
As Stated

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## Text of Appendix VII: Comments from the Nuclear Regulatory Commission

October 14, 2022

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 “OVERSEAS NUCLEAR MATERIAL SECURITY: A Comprehensive National Strategy Could Help Address Risks of Theft and Sabotage” (GAO-23-104715).

Dear Ms. Bawden,

Thank you for the opportunity to review and comment on the draft Government Accountability Office Report “Overseas Nuclear Material Security: A Comprehensive National Strategy Could Help Address Risks of Theft and Sabotage” (GAO-23-104715) which the U.S. Nuclear Regulatory Commission (NRC) received on September 14, 2022. The NRC staff has reviewed the draft report and is in general agreement with the content of the draft audit report. The NRC staff recognizes there are no recommendations for the NRC. Please see comments in the enclosure to this letter.

If you have any questions concerning staff’s comments, please direct them to John R. Jolicoeur at 301-415-1642 or [john.jolicoeur@nrc.gov](mailto:john.jolicoeur@nrc.gov).

Sincerely,

Daniel H. Dorman Executive Director for Operations

Signed by Dorman, Dan on 10/14/22

Enclosure:

As Stated

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## GAO Contact

# Appendix VIII: GAO Contact and Staff Acknowledgments

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## Staff Acknowledgments

In addition to the contact named above, William Hoehn (Assistant Director), Natalie Block (Analyst in Charge), Antoinette Capaccio, John Delicath, Cindy Gilbert, Cory Gerlach, Riley Knight, Corinna Nicolaou, and Dan C. Royer made key contributions to this report.

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