



U.S. DEPARTMENT OF
ENERGY

NNSA
National Nuclear Security Administration

Prevent, Counter, and Respond—NNSA's Plan to Reduce Global Nuclear Threats

FY 2020-FY 2024

Report to Congress
July 2019

National Nuclear Security Administration
United States Department of Energy
Washington, DC 20585

This page left blank intentionally.

Message from the Administrator

The Department of Energy (DOE) performs a unique and indispensable role in reducing global nuclear and radiological dangers, contributing to U.S. national security and global security writ large. Chiefly performed through the work of DOE's National Nuclear Security Administration (NNSA), these activities comprise the Prevent-Counter-Respond framework, which provides a dynamic defense-in-depth against current and long-term nuclear threats.

Under this framework, NNSA works to *prevent* would-be proliferant states and non-state actors from acquiring nuclear weapons or weapons-usable nuclear material (WUNM), *counter* efforts of both would-be proliferant states and non-state actors to acquire or develop these capabilities, and *respond* to nuclear incidents worldwide, whether deliberate terrorist acts or nuclear accidents. As part of an all-hazards emergency management program, and in close cooperation with our interagency and international partners, we continuously monitor the global landscape to ensure the United States can anticipate and respond to developments that may threaten the nation's security.

DOE/NNSA's threat reduction programs address a number of challenges, including inadequately secured nuclear and radioactive materials in regions of concern and increasing global stockpiles of WUNM. Growing interest in civil nuclear power, particularly in the developing world, could increase the number of latent nuclear-threshold states, underscoring the importance of DOE/NNSA's contribution to strengthening the international nuclear safeguards regime. These countries may also have little or no experience in safely managing nuclear facilities and protecting nuclear materials, presenting a vulnerability that malicious actors may seek to exploit.

DOE/NNSA is also working to address threats posed by the spread of new nuclear technologies and manufacturing processes. As these capabilities continue to emerge, it will be incumbent upon the nuclear security enterprise to keep pace, assessing the security implications of new advances and developing measures to mitigate risks. No less important will be the need to maintain the scientific and technological base required to ensure that the United States does not fall victim to technology surprise.

DOE/NNSA's national laboratories, plants, and sites possess an unparalleled level of scientific and technical expertise. These national assets are crucial to understanding the evolving threat environment and developing technical solutions to prevent, counter, and respond to nuclear threats. Consequently, ensuring that the nuclear security enterprise has the capabilities, including modern facilities and intellectual capital, needed to perform the vital mission of protecting the American people by reducing global nuclear threats is—and will remain—among our highest priorities.

This report is provided to the following Members of Congress:

- **The Honorable James Inhofe**
Chairman, Senate Committee on Armed Services
- **The Honorable Jack Reed**
Ranking Member, Senate Committee on Armed Services
- **The Honorable Adam Smith**
Chairman, House Committee on Armed Services
- **The Honorable William "Mac" Thornberry**
Ranking Member, House Committee on Armed Services

- **The Honorable Deb Fischer**
Chairman, Subcommittee on Strategic Forces
Senate Committee on Armed Services
- **The Honorable Martin Heinrich**
Ranking Member, Subcommittee on Strategic Forces
Senate Committee on Armed Services
- **The Honorable Mike Rogers**
Chairman, Subcommittee on Strategic Forces
House Committee on Armed Services
- **The Honorable Jim Cooper**
Ranking Member, Subcommittee on Strategic Forces
House Committee on Armed Services
- **The Honorable James R. Risch**
Chairman, Senate Committee on Foreign Relations
- **The Honorable Bob Menendez**
Ranking Member, Senate Committee on Foreign Relations
- **The Honorable Eliot L. Engel**
Chairman, House Committee on Foreign Affairs
- **The Honorable Michael McCaul**
Ranking Member, House Committee on Foreign Affairs
- **The Honorable Richard Shelby**
Chairman, Senate Committee on Appropriations
- **The Honorable Patrick Leahy**
Vice Chairman, Senate Committee on Appropriations
- **The Honorable Lamar Alexander**
Chairman, Subcommittee on Energy and Water Development
Senate Committee on Appropriations
- **The Honorable Dianne Feinstein**
Ranking Member, Subcommittee on Energy and Water Development
Senate Committee on Appropriations
- **The Honorable Nita M. Lowey**
Chairwoman, House Committee on Appropriations
- **The Honorable Kay Granger**
Ranking Member, House Committee on Appropriations
- **The Honorable Marcy Kaptur**
Chairwoman, Subcommittee on Energy and Water Development
House Committee on Appropriations
- **The Honorable Michael K. Simpson**
Ranking Member, Subcommittee on Energy and Water Development
House Committee on Appropriations

If you have questions about this report or the underlying activities it describes, please contact Ms. Nora F. Khalil, Associate Administrator for External Affairs, at (202) 586-7332, or Ms. Bridget Forcier, Associate Director for External Coordination, Office of the Chief Financial Officer, at (202) 586-0176.

Sincerely,

A handwritten signature in black ink that reads "Lisa E. Gordon-Hagerty". The signature is written in a cursive style with a long horizontal line extending from the end of the name.

Lisa E. Gordon-Hagerty

Message from the Secretary

The Department of Energy's National Nuclear Security Administration (DOE/NNSA) is indispensable to the Nation's efforts to prevent the further proliferation of nuclear weapons, counter the threat of nuclear and radiological terrorism, and respond to nuclear and radiological incidents around the world. This report describes how DOE/NNSA applies the nuclear security enterprise's scientific and technical capabilities and highly-skilled workforce to meet these objectives. The activities described in the report reflect high-level Administration priorities as identified in the *National Security Strategy* (White House 2017), *Nuclear Posture Review Report* (Department of Defense 2018), the *National Strategy for Countering Weapons of Mass Destruction Terrorism* (White House 2018), and other national strategic guidance.

This report is a companion to the *Fiscal Year 2020 Stockpile Stewardship and Management Plan* (DOE/NNSA 2019), which describes DOE/NNSA's activities to maintain the U.S. nuclear stockpile and strengthen its foundational capabilities, including infrastructure. In keeping with the United States' commitment to transparency and informed public dialogue, updated versions of both reports are published each year.

In the early decades of the nuclear age, U.S. leaders recognized that without proper controls on nuclear technology and materials, dozens of countries could acquire nuclear weapons and produce a dangerously unstable world. This concern led to an extraordinary range of U.S. efforts to dissuade or prevent the acquisition of nuclear weapons by additional states. Many of these activities remain pillars of the global nonproliferation regime today, including formal treaties, alliances, security guarantees, and export controls on sensitive technology. DOE/NNSA is on the forefront of this Administration's efforts to detect and prevent proliferant activities and ensure the peaceful use of nuclear energy around the world.

Over time, U.S. concern for the proliferation of nuclear capabilities extended to terrorist organizations and other non-state actors, spurring a diverse set of programs to keep nuclear and radioactive materials beyond such groups' reach. Since the early 1990s, the United States has led worldwide efforts to eliminate or secure vulnerable materials and erect global defenses should nuclear or radioactive materials become available on the black market or fall into the hands of terrorists. These defenses include radiation detection systems to deter and disrupt nuclear and radioactive material smuggling, and specialized assets to locate and disable nuclear and radiological devices within the homeland and overseas. Finally, in conjunction with the Department's all-hazard emergency management program, DOE/NNSA maintains technical personnel and equipment to respond to any type of nuclear or radiological incident worldwide.

Sincerely,

A handwritten signature in black ink that reads "Rick Perry". The signature is written in a cursive, slightly slanted style.

Rick Perry

Executive Summary

Over the past six decades, the United States, working closely with allies and partners, has built a global nonproliferation regime designed to prevent the further spread of nuclear weapons and weapons-useable materials while ensuring access to peaceful applications of nuclear energy worldwide. Composed of arms control and nonproliferation-related treaties, safeguards inspections, nuclear supplier controls, and other elements, this nonproliferation regime has helped draw sharp distinctions between civil and military nuclear programs, facilitating the expansion of the global commercial nuclear sector without an attendant flood of nuclear-armed states. In response to concerns over nuclear terrorism, the United States also launched an international effort to safeguard or eliminate the world's most vulnerable nuclear material. In the space of a generation, much of this material has been placed beyond the reach of terrorists and other non-state actors, denying them the crucial ingredients to build a nuclear device.

Although these achievements are significant, managing global nuclear threats is an enduring and dynamic mission. The fact that nuclear weapons and the material, equipment, technology, and expertise needed to build them exist ensures that stringent measures to prevent nuclear proliferation will always be necessary. Likewise, despite the formidable cost and difficulty of developing these weapons, the unique fear they invoke suggests that certain extremist groups may pursue them as the ultimate means of terrorizing their enemies. Protecting nuclear and radioactive materials from non-state actors is therefore a responsibility that persists in perpetuity. Should nuclear security measures fail, responding to nuclear incidents requires well-practiced crisis response capabilities to locate and neutralize a nuclear device, as well as competencies in consequence management to contend with the aftermath of a nuclear detonation.

While these requirements are enduring, other challenges to reducing global nuclear and radiological threats are far more fluid. In the coming decades, scientific advances and manufacturing improvements may create new pathways to nuclear weapons, presenting the prospect of sudden, unexpected changes in the nuclear threat. Further, the dissemination of knowledge on the internet continues to increase the availability of dangerous information. Adapting to this shifting global terrain will require a high degree of institutional agility.

The Department of Energy's National Nuclear Security Administration (DOE/NNSA) bears principal responsibility for executing many of the U.S. Government's diverse nuclear and radiological threat reduction missions. DOE/NNSA's framework for discharging this responsibility comprises three core functions—Prevent, Counter, and Respond—that span the nuclear threat spectrum. Activities under this rubric range from securing nuclear materials and controlling dual-use technology to obstructing adversary weapons development and managing the effects of a nuclear incident. The specific objectives of these functional areas are as follows.

1. **Prevent** would-be proliferant states from developing nuclear weapons or acquiring weapons-useable nuclear material, equipment, technology, and expertise, and prevent non-state actors from acquiring nuclear and radioactive materials that can be used for malicious purposes;
2. **Counter** the efforts of both would-be proliferant states and non-state actors to acquire, develop, disseminate, deliver, or use the materials, expertise, or components of a nuclear or radiological device; and
3. **Respond** to the full spectrum of nuclear and radiological emergencies at home or abroad, including deliberate nuclear and radiological attacks and accidents to minimize the damage from such incidents.

Pursuing these objectives provides an overarching framework for the activities of the three DOE/NNSA offices principally responsible for the nuclear threat reduction mission—the Office of Defense Nuclear Nonproliferation (DNN), the Office of Counterterrorism and Counterproliferation (CTCP), and the Office of Emergency Operations. This report describes DOE/NNSA threat reduction activities, highlights recent accomplishments in this mission space, outlines relevant changes to the global nuclear threat environment, and describes DOE/NNSA’s plans to adapt to this changing landscape in order to prevent, counter, and respond to the threat of nuclear proliferation and nuclear terrorism.¹

Prevent

DOE/NNSA’s “prevent” function area encompasses efforts to inhibit would-be proliferant states and terrorists from obtaining nuclear weapons, nuclear or radioactive materials, and related technology and expertise. DNN has primary responsibility for this effort.

With respect to preventing state-based proliferation, DOE/NNSA programs help to uphold the Treaty on the Non-Proliferation of Nuclear Weapons (NPT). Under the NPT, the Treaty’s Non-Nuclear Weapon States parties enjoy access to nuclear energy for peaceful purposes in accordance with their strict compliance with the Treaty’s nuclear nonproliferation requirements. DOE/NNSA helps to preserve the integrity of the Treaty by supporting the International Atomic Energy Agency (IAEA) safeguards system to detect and deter undeclared nuclear activities and the diversion of nuclear material from civil uses to weapons programs. To this end, DOE/NNSA helps build IAEA safeguards capacity by providing the IAEA with technology and expertise and training partner States.

DOE/NNSA also supports the promise of peaceful nuclear applications around the world enshrined in Article IV of the NPT through its contributions to the Peaceful Uses Initiative. DOE/NNSA builds domestic and international export control capacity to prevent the proliferation of weapons-relevant materials, equipment, and technology. Additional nonproliferation work includes developing technologies and approaches to verify compliance with other nonproliferation and arms control agreements, contributing broadly to international stability. DOE/NNSA also advances capabilities, including satellite-based sensors, to detect foreign nuclear weapons activities and nuclear explosive tests.

The second central effort under the prevent line of work is to deny non-state actors the building blocks of an improvised nuclear device (IND) or radiological dispersal device (RDD), the latter also known as a “dirty bomb.” Although the scientific and engineering challenges of building an IND are daunting, the single most critical requirement to construct such a device is access to special nuclear material. Consequently, DOE/NNSA operates programs worldwide to minimize or eliminate such materials no longer in use and increase security of vulnerable nuclear material stockpiles, with priority given to materials that are at highest risk of acquisition and use by terrorists. Similar efforts are undertaken to eliminate disused radioactive materials or better secure materials still needed for medical and other applications.

To improve nuclear facility security around the world, DOE/NNSA provides partner countries with security system upgrades, support to mitigate insider threats and improve transportation security, and training to strengthen their regulations, inspections, security culture, and cybersecurity awareness. Foreign capacity

¹ This report is a companion to the *Fiscal Year 2020 Stockpile Stewardship and Management Plan* (DOE/NNSA 2019), which describes DOE/NNSA’s activities to maintain the U.S. nuclear stockpile and strengthen its foundational capabilities, including infrastructure. This report also complements two other national level annual reports to Congress: *The Global Nuclear Detection Architecture Annual Report to Congress* (Department of Homeland Security 2019), which addresses selected Prevent and Counter capabilities and *The National Nuclear Forensics and Attribution Annual Report to Congress* (Department of Homeland Security 2019) which addresses selected Counter capabilities.

building also includes assistance in improving partner abilities to deter, detect, interdict, and investigate the smuggling of nuclear and radioactive materials. This support includes the provision of radiation detection systems at border crossings, between crossing points, and along aviation and maritime corridors. These programs constitute a strong “defense-in-depth” that requires malevolent actors to defeat multiple layers of security to acquire and deliver an IND or RDD.

Noteworthy DOE/NNSA accomplishments in the prevent function area during fiscal year (FY) 2018 include:

- Secured 87 buildings with high-risk radioactive material in 24 countries, including 42 buildings in the United States, bringing the cumulative total of secured buildings to 2,283 and recovered radioactive sources to more than 63,700 worldwide;
- Replaced 39 cesium-based irradiators with alternative non-radioisotopic technologies for a cumulative total of 58 irradiators replaced;
- Trained cumulatively over 6,300 law enforcement and responders on alarm response;
- Removed or confirmed the disposition of over 352 kilograms of highly enriched uranium (HEU) from multiple countries;
- Conducted over 100 bilateral and multilateral nuclear and radiological security workshops;
- Provided 17 trainings to U.S. enforcement agencies on export control requirements to prevent the exploitation of U.S. industry for nefarious purposes;
- Participated in 67 export control workshops with foreign partners to help strengthen national systems of export control;
- Reviewed close to 6,000 U.S. dual-use license applications for nonproliferation concerns to facilitate legitimate commerce while preventing nuclear proliferation;
- Provided technical analyses of close to 3,000 interdiction cases to help inform U.S. Government interdiction efforts; and
- Advanced a scientific campaign to improve the United States’ ability to detect and analyze foreign nuclear explosive tests.

Counter

DOE/NNSA’s “counter” function area consists of programs and activities to thwart active adversary attempts to acquire the materials, equipment, or expertise needed to develop and use a nuclear or radiological device. CTCF has primary responsibility for this effort.

The preponderance of activities in the *Counter* mission space concern the denial of nuclear capabilities to terrorists, although many of these measures would have relevance to would-be proliferant states that attempt to develop nuclear weapons through non-traditional means. For example, a hostile country seeking to acquire nuclear materials illicitly rather than making the scientific investments to develop them indigenously might employ behaviors similar to a terrorist organization with the same purpose. U.S. capabilities to detect and disrupt such efforts would be applicable to both categories of actors.

While no evidence suggests that terrorists possess nuclear or radiological capabilities or even an organized program to acquire them, such weapons have an inherent appeal to terrorist groups, presenting an enduring challenge to global security. Therefore, denying terrorist groups these nuclear and radioactive materials will be a mission that persists in perpetuity. DOE/NNSA administers an array of programs to keep these materials and associated technology and information beyond the reach of terrorists. At the root of those efforts is the application of scientific expertise at the national laboratories to understand

and characterize the range of nuclear threat devices that a non-state actor with access to nuclear material might attempt to construct. This specialized knowledge informs a range of technical and policy solutions to detect and defeat terrorist efforts to acquire nuclear capabilities. These include security standards for nuclear material storage and transport, search and detection capabilities, and nuclear incident response procedures.

Should a *deliberate* nuclear or radiological incident occur, DOE/NNSA maintains a cadre of on-call technical specialists who are trained and equipped to perform crisis response missions worldwide. In addition to the intrinsic virtue of saving lives, these teams help deny terrorists the effects they would seek in employing nuclear or radiological weapons, which in turn diminishes the attractiveness of such attacks. Specific capabilities in this domain include highly mobile incident response personnel who can search for nuclear and radiological devices based on a variety of signatures and threat intelligence. Once a threat device is interdicted, DOE/NNSA can then use its specialized knowledge to characterize and render safe the device, or substantially mitigate its effects.

DOE/NNSA technical experts provide threat assessment and analytic support to the Intelligence Community, helping to identify clandestine activities indicative of terrorist interest in nuclear weapons. Liaison officers at key Department of Defense Combatant Commands also ensure that DOE/NNSA scientific knowledge influences contingency planning and support operations.

DOE/NNSA also makes significant investments in nuclear forensics capabilities to ensure the United States' ability to attribute the source of material found outside of regulatory control or used in a terrorist nuclear attack. These capabilities constitute an important element of the Nation's strategy to deter hostile states from supporting would-be nuclear terrorists. By demonstrating the ability to rapidly and confidently attribute such support using advanced scientific tools, the United States can credibly threaten reprisal against any states who are complicit in the use of nuclear weapons or devices.

Noteworthy DOE/NNSA accomplishments in the *Counter* mission space during FY 2018 include the following.

- Provided operational support and assistance to international partners for select major public events to enhance radiological and nuclear security activities;
- Hosted five technical exchanges with international partners to advance understanding of radiological and nuclear incident preparedness and conducted two scenario-based policy discussions focusing on counterterrorism and counter nuclear smuggling; and
- Established a new communication system to ensure that information related to potential nuclear threats can be rapidly shared with U.S. allies.

Respond

DOE/NNSA's "respond" function area encompasses the range of capabilities that enable DOE/NNSA to respond to all manner of nuclear or radiological incidents and accidents both in the United States and internationally. These capabilities constitute a major element of DOE's all-hazards emergency management capability. CTCP and the Office of Emergency Operations share responsibility for executing the *Respond* mission.

Although the United States maintains advanced tools to interdict and disable nuclear and radiological threat devices, if such an attack succeeds, DOE/NNSA also maintains strong consequence management capabilities. These capabilities include technologies and expertise to understand weapon effects and environmental conditions that influence radiation dispersal. These capabilities facilitate emergency responders to make rapid, informed decisions that help mitigate casualties. DOE/NNSA also maintains

regional teams across the country to assess radiological incidents and advise decision makers on steps to minimize associated hazards. These teams provide a ready regional resource in the event of any type of nuclear or radiological incident, including searching for lost radioactive sources, resolving radiological alarms, ensuring the safety of national-level security events, and supporting threat-based radiological searches in support of law enforcement. DOE/NNSA also fields specially trained teams to respond to accidents involving U.S. nuclear weapons.

The *Respond* mission also includes the requirement to manage many other types of emergencies, such as nuclear reactor accidents. During the 2011 Fukushima nuclear disaster, for example, DOE/NNSA technical competencies such as atmospheric and radiological environmental modeling, dose assessment, and health physics were brought to bear, critically influencing the responses of both the U.S. and Japanese governments. These capabilities constitute an emergency response architecture that serves the United States and partner nations around the world.

Noteworthy DOE/NNSA accomplishments in the *Respond* mission space during FY 2018 include the following.

- Provided radiological detection and analytical support to four national-level events, including the Super Bowl and the President’s State of the Union Address, and over 50 regional events, in concert with Federal, state, and local departments and agencies to ensure the safety and security of event participants;
- Conducted 19 tabletop exercise training events, training more than 1,390 emergency response personnel, and implemented new training on radiological awareness and emergency public information in conjunction with domestic tabletop exercise events;
- Trained hundreds of U.S. law enforcement officers and other security personnel to conduct rapid and safe responses to the attempted theft of radioactive material;
- Conducted training on medical management of radiation injuries for professionals from 13 countries and many U.S. Federal agencies;
- Provided technical expertise and training to advance the IAEA Incident and Emergency Center as the global focal point for emergency preparedness and response for nuclear and radiological safety- or security-related incidents, including coordination of international assistance; and
- Sustained a 24/7/365 Emergency Operations Center and restructured the DOE Daily Operational Brief for optimal senior leadership situational awareness.

Looking Ahead

The *Fiscal Year 2020 Prevent, Counter, and Respond* report describes DOE/NNSA’s plans to develop and execute program activities over the next five years that support the U.S. Government’s nuclear and radiological threat reduction mission. NNSA is working toward important critical milestones over the next five years, which include:

- Secure an additional 520 buildings—300 domestically and 220 internationally—containing high-priority radioactive materials; recover and disposition approximately 5,000 disused sources; and transition an additional 353 cesium-based irradiators;
- Continue to strengthen the capabilities of partner countries to deter, detect, and investigate the smuggling of nuclear and radioactive materials;
- Build IAEA capacity to investigate indications of undeclared nuclear material and activities and make universal the *de facto* international standard for safeguards agreements—a Comprehensive

Safeguards Agreement with an Additional Protocol, which is the legal agreement that gives the IAEA additional authorities and tools to verify that nuclear material remains in peaceful use, and a modified Small Quantities Protocol (if applicable);

- Improve the United States' ability to monitor foreign underground nuclear explosions by increasing understanding of the generation and propagation of seismic and acoustic signatures from underground explosions;
- Complete fabrication of the Space and Atmospheric Burst Reporting System-3 and Space and Endo-atmospheric Nuclear detonation Surveillance Experimentation and Risk Reduction payloads for delivery to the United States Air Force in FY 2019;
- Continue to develop and demonstrate advanced nonproliferation detection testbeds;
- Continue to conduct regional nuclear render safe training and operations and begin implementing the Capability Forward initiative, under which more decisive capabilities to neutralize nuclear devices will be distributed to 14 major U.S. cities by FY 2022;
- Develop an Emergency Management Unified Coordination Structure (UCS) and achieve Full Operational Capability by December 2020; and
- Enhance the capabilities and capacities of the Continuity of Operations, Continuity of Government, and Enduring Constitutional Government Programs to ensure preservation of the United States' constitutional form of government.

Over the longer term, DOE/NNSA will be at the forefront of developing policies and technologies in response to challenges to both U.S. national security and global stability writ large. An ever-changing geopolitical environment, including evolving threats from rogue states and terrorists, coupled with the ever-increasing pace of scientific and technological advancement, may necessitate revision to the traditional security frameworks to address the threat landscape of the future. DOE/NNSA is embracing a next-generation enterprise prepared to develop, plan, and execute programs to manage evolving and emerging challenges.

Over the last several years, U.S.-Russia relations have sharply deteriorated, and several nations outside the sanctioned nuclear weapon states (China, France, Russia, United Kingdom, United States) have demonstrated maturing weapons capabilities. The possibility of regional nuclear exchanges between these states is merely the most dramatic of the risks arising from this trend. Other risks may include the disruption of U.S. security relationships, the erosion of U.S.-led security policies, especially in the nuclear realm, and security incentives that encourage further proliferation. New regional powers that are less dependent on relationships with the United States may chafe at a nonproliferation regime they perceive as supporting a Western-dominated world order. At the very least, these rising powers will continue to press for greater inclusion in shaping the norms of global governance, including in the area of nuclear nonproliferation.

These developments may coincide with several additional stresses on the global nonproliferation and counterterrorism regime. In particular, certain cases of noncompliance with safeguards agreements could contribute to an erosion of the long-established norms of international institutions. Economic stresses may create new divisions between wealthy and developing countries, undermining willingness to defer to the policy preferences of the former. Energy insecurity and the need for carbon-free energy may fuel a resurgence in civil nuclear power in states whose commitment to nonproliferation is uncertain. Competition to service the growing global nuclear sector may weaken the effectiveness of export control policies, one of the pillars of the nonproliferation regime. Each of these developments may compromise

historical approaches to nonproliferation, and in each case the United States must respond to disruptions in ways that preserve core nonproliferation principles.

The United States is working to regain its leadership role in the civilian nuclear energy industry. A strong domestic civilian nuclear enterprise improves America's national security through the development of safe and secure spent fuel disposition options and provision of safety, safeguards, export control, and security approaches for new reactor types, designs, and concepts. If U.S. leadership of the global nonproliferation regime is supplanted by less capable or less scrupulous powers, the injury to global stability could be dire.

Even as U.S. security policies manage these known concerns, those policies need to be flexible and account for future nuclear threats that have not yet taken shape. Just as the political framework for responding to nuclear proliferation and nuclear terrorism is evolving, so, too, are the technologies that would-be proliferant states and terrorists may exploit in pursuit of nuclear capabilities. The need to anticipate technological advancements and craft strategies to manage disruptive developments while preserving the benefits of these technological advancements to the United States is a continuing challenge.

DOE/NNSA is uniquely poised to rise to these pressing challenges. Its multidisciplinary science and technology base possesses an unparalleled command of nuclear science—a national asset cultivated over more than 70 years of research and experimentation. In the coming decades, DOE/NNSA's national laboratories, plants, and sites will be harnessed to provide solutions to the gravest threats facing the United States, continuing the indispensable role that the nuclear security enterprise has played since the very beginning of the nuclear age.



Prevent, Counter, and Respond—NNSA’s Plan to Reduce Global Nuclear Threats (FY 2020–FY 2024)

Table of Contents

List of Figures.....	xiv
List of Acronyms	xvi
Legislative Language	xix
Chapter 1 Introduction	
<i>Meeting the Challenges of Nuclear/Radiological Proliferation & Terrorism.....</i>	1-1
1.1 Overview: Nuclear/Radiological Threat Reduction is a Core DOE/NNSA Mission.....	1-1
1.1.1 DOE/NNSA Offices Primarily Responsible for Nuclear and Radiological Threat Reduction	1-1
1.2 Characterizing the Current Nuclear Threat Environment	1-3
1.2.1 Global and Regional Nuclear/Radiological Proliferation.....	1-4
1.2.2 Nuclear/Radiological Terrorism	1-4
1.2.3 Emerging, Converging, and Disruptive Technologies.....	1-5
1.2.4 Preparing for the Unanticipated	1-6
1.3 NNSA Core Capabilities	1-7
1.3.1 NNSA Expertise	1-7
1.3.2 NNSA Innovation.....	1-8
1.3.3 NNSA Partnerships and Collaborations.....	1-11
Chapter 2 NNSA’s Plan to Prevent, Counter, and Respond to the Challenges of Nuclear/Radiological Proliferation & Terrorism	2-1
2.1 Prevent: Preventing Nuclear/Radiological Proliferation and Terrorism	2-2
2.1.1 Program Strategy	2-3
2.2 Counter: Countering Nuclear/Radiological Proliferation and Terrorism	2-17
2.2.1 Program Strategy	2-18
2.3 Respond: Responding to Nuclear/Radiological Threats and Terrorism	2-23
2.3.1 Program Strategy	2-23

2.4	Ensuring World Class Infrastructure and Workforce	2-31
2.4.1	Infrastructure Base and the Nuclear Risk Reduction Mission.....	2-32
2.4.2	Infrastructure Challenges.....	2-35
2.4.3	Workforce Base and the Nuclear/Radiological Risk Reduction Mission.....	2-35
2.4.4	Workforce Challenges and Opportunities	2-37
Chapter 3	Conclusion	3-1
Appendix A	Requirements Mapping	A-1
Appendix B	FY 2018 Accomplishments.....	B-1
Appendix C	FY 2020-2024 Planned Activities.....	C-1
Appendix D	Relevant Laws, Policy Directives, and International Agreements.....	D-1
Appendix E	Foreign Contributions and Cost-Sharing Agreements.....	E-1
Appendix F	FY 2020 Future Years Nuclear Security Program Plan.....	F-1
Appendix G	Analysis and Explanation of FY 2018 Uncosted and Unencumbered Balances	G-1

List of Figures

Figure 1-1.	DOE/NNSA Organizational Chart of Offices Primarily Responsible for the Nuclear/Radiological Threat Reduction Mission.....	1-2
Figure 1-2.	Summit Supercomputer	1-6
Figure 1-3.	Technical experts from Nigeria's Centre for Energy Research and Training stand over the miniature neutron source reactor and prepare to load the HEU reactor core into an interim cask.	1-7
Figure 1-4.	DOE/NNSA Emergency Operations Center	1-8
Figure 1-5.	DOE Laboratories, Plants, and Sites.....	1-9
Figure 1-6.	The labs, plants, and sites of the Nuclear Security Enterprise	1-10
Figure 1-7.	Instructors and participants at the IAEA's new international training course on protecting nuclear facilities from cyberattacks (INL)	1-12
Figure 2-1.	DOE/NNSA and Kazakhstan officials train to deter, disrupt, and investigate nuclear materials to counter illicit smuggling.....	2-4
Figure 2-2.	ORS and Medstar Georgetown University Hospital worked together to remove a cesium-137 blood irradiator and replace it with an X-ray irradiator at the hospital's Washington, DC, facility.	2-5
Figure 2-3.	A new melt-casting fabrication process for organic glass scintillators pioneered by Sandia National Laboratories, requiring less than 24 hours and no mechanical polishing after casting, results in new crystals, such as the 2-inch diameter specimen here, capable of providing best-in-class gamma and neutron radiation discrimination capabilities.	2-7
Figure 2-4.	Technical expertise is available to existing and potential Mo-99 producers to assist with the conversion of Mo-99 production processes, to use LEU targets, or to develop non-HEU-based Mo-99 production technologies.....	2-10
Figure 2-5.	SNL designed new radiation detection equipment for New START Treaty monitoring. This new equipment detects neutron levels to confirm that objects are non-nuclear, consistent with the provisions of the treaty. (Photo by Randy Montoya)	2-14
Figure 2-6.	In October 2017, NPAC staff and technical experts from the national laboratories participated with representatives from Norway, Sweden, and the U.K. in the Quad Nuclear Verification Partnership's first live-play exercise. The exercise provided practical experience in designing and applying a nuclear weapon-related verification protocol, a realistic testbed for exercising and evaluating monitoring and verification technologies and procedural verification guidelines that could contribute to future verification scenarios.....	2-16
Figure 2-7.	DOE/NNSA nuclear incident response experts lead a workshop for Indian first responders on response to a "dirty bomb."	2-18
Figure 2-8.	LANL is integrating new analysis capabilities in the Center for Aerosol Forensic Signatures, or CAFE, which will be a powerful resource for explosion, combustion, and nonproliferation forensic analysis.	2-21
Figure 2-9.	The Consolidated Emergency Operations Center is staffed around the clock with emergency operations professionals and provides real-time situational awareness and synchronizes interagency and governmental support to private sector emergency management functions for any all-hazards or national security events.	2-25
Figure 2-10.	The 2018 national-level Eagle Horizon exercise held in May was "Atlantic Fury" and simulated the coordinated response to a Category 3 hurricane impacting Virginia, Maryland, Pennsylvania, Delaware, and the District of Columbia.....	2-27

Figure 2-11. Created almost 50 years ago, the Accident Response Group (ARG) is a group of volunteer emergency responders, like a volunteer fire department, made up of experts at the top of their field. Volunteers are on call on a rotating basis for the initial phase of response. The ARG can expand to a team of about 50 experts for round-the-clock field operations..... 2-28

Figure 2-12. DOE/NNSA emergency response experts participated as observers in Japan’s annual full-scale Nuclear Disaster Preparedness Drill. 2-29

Figure 2-13. The Mid-level Leadership Development Program (MLDP) develops the next generation of DOE/NNSA leadership through a year-long program for future leaders to develop core competencies such as emotional intelligence, conflict resolution, team building, and project management. 2-31

Figure 2-14. SRS’s H-Canyon, operational since 1955, contains a processing area 1,028 feet long, 122 feet wide, and 71 feet tall, and is the only hardened nuclear chemical separations plant still in operation in the United States. 2-32

Figure 2-15. INL’s Advanced Test Reactor makes it possible to study the results of years of intense neutron and gamma radiation on reactor materials and fuels in only weeks to months. 2-33

Figure 2-16. The REAC/TS at the Oak Ridge Institute for Science and Education (ORISE) maintains a collection of radiation emergency medicine information and resources that support the medical response and treatment of victims. Resources include technical reports, pharmaceutical package inserts and videos..... 2-34

Figure 2-18. RAP team members from across the Nation gathered in Las Vegas for in-depth classroom and field training as part of the Radiological Assistance Program Training for Emergency Response (RAPTER)..... 2-36

List of Acronyms

AMS	Aerial Measuring System
ANL	Argonne National Laboratory
CAFE	Center for Aerosol Forensic Signatures
COG	Continuity of Government
COOP	Continuity of Operations
COTM	Communications on the Move
CTBT	Comprehensive Nuclear-Test-Ban Treaty
CTCP	Office of Counterterrorism and Counterproliferation
CWC	Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction (Chemical Weapons Convention)
DBOT	Downblend Offering for Tritium
DFEAT	Disposition and Forensic Evidence Analysis Team
DFO	DOE Forensics Operations
DHS	Department of Homeland Security
DNN	Office of Defense Nuclear Nonproliferation
DNN R&D	DNN Office of Research and Development
DoD	Department of Defense
DOE	Department of Energy
DOJ	Department of Justice
DOS	Department of State
DPRK	Democratic People’s Republic of Korea
DTRA	Defense Threat Reduction Agency
FBI	Federal Bureau of Investigation
FY	fiscal year
GBD	Global Burst Detector
GMS	Office of Global Material Security
GPS	Global Positioning System
HAMMER	Hazardous Materials Management and Emergency Response
HEU	highly enriched uranium
HSPD	Homeland Security Presidential Directive
IAEA	International Atomic Energy Agency
IMP&C	International Material Protection and Cooperation
IND	improvised nuclear device
INF	Intermediate-Range Nuclear Forces
INL	Idaho National Laboratory
INS	Office of International Nuclear Security
IPNDV	International Partnership for Nuclear Disarmament Verification
JTOT	Joint Technical Operations Team
KCNSC	Kansas City National Security Campus

LANL	Los Alamos National Laboratory
LEU	low-enriched uranium
LLNL	Lawrence Livermore National Laboratory
LTBT	Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water (Limited Nuclear Test Ban Treaty)
M ³	Office of Material Management and Minimization
M&O	management and operating
MLDP	Mid-level Leadership Development Program
Mo-99	Molybdenum-99
MT	metric tons
NATO	North Atlantic Treaty Organization
New START	Treaty Between the United States of America and the Russian Federation on Measures for Further Reduction and Limitation of Strategic Offensive Arms (New Strategic Arms Reduction Treaty)
NIRR-1	Nigerian Research Reactor 1
NNMA	National Nuclear Materials Archive
NNSA	National Nuclear Security Administration
NNSS	Nevada National Security Site
NPAC	Office of Nonproliferation and Arms Control
NPCR	<i>Prevent, Counter, Respond—NNSA’s Plan to Reduce Global Nuclear Threats</i>
NPT	Treaty on the Non-proliferation of Nuclear Weapons (Nuclear Non-Proliferation Treaty)
NRC	Nuclear Regulatory Commission
NSC	National Security Council
NSDD	Office of Nuclear Smuggling Detection and Deterrence
NSE	NNSA nuclear security enterprise
NSG	Nuclear Suppliers Group
NSPD	National Security Presidential Directive
ORISE	Oak Ridge Institute for Science and Education
ORNL	Oak Ridge National Laboratory
ORS	Office of Radiological Security
P3	France, the United Kingdom, and the United States
PMDA	Agreement between the Government of the United States of America and the Government of the Russian Federation Concerning the Management and Disposition of Plutonium Designated as No Longer Required for Defense Purposes and Related Cooperation (U.S.-Russia Plutonium Management and Disposition Agreement)
PNNL	Pacific Northwest National Laboratory
PPD	Presidential Policy Directive
PPRA	Agreement between the Government of the United States of America and the Government of the Russian Federation Concerning Cooperation Regarding Plutonium Production Reactors (U.S.-Russian Federation Plutonium Production Reactor Agreement)
RAP	Radiological Assistance Program
RDD	radiological dispersal device

REAC/TS	Radiation Emergency Assistance Center/Training Site
RED	radiological exposure device
SNL	Sandia National Laboratories
SNM	special nuclear material
SPD	Surplus Plutonium Disposition
SPE	Source Physics Experiment
SRS	Savannah River Site
SSP	Stockpile Stewardship Program
Tc-99m	technetium-99m
TTBT	Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Limitation of Underground Nuclear Weapon Tests (Threshold Nuclear Test Ban Treaty)
UCS	Unified Coordination Structure
UK	United Kingdom
U.S.	United States
U.S.C.	United States Code
WMD	weapons of mass destruction
WUNM	weapons-usable nuclear material

Legislative Language

Title 50 of United States Code Section 2575 (50 U.S.C. § 2575), requires that:

The [NNSA] Administrator shall develop and annually update a five-year management plan for activities associated with the defense nuclear nonproliferation programs of the Administration to prevent and counter the proliferation of materials, technology, equipment, and expertise related to nuclear and radiological weapons in order to minimize and address the risk of nuclear terrorism and the proliferation of such weapons.

The specific requirements for the plan, and the location of the corresponding information within this document, are described in Appendix A.

This page left blank intentionally.

Chapter 1: Introduction

Meeting the Challenges of Nuclear/Radiological Proliferation & Terrorism

1.1 Overview: Nuclear/Radiological Threat Reduction is a Core DOE/NNSA Mission

To provide for the safety and security of the United States and its allies and partners, the Department of Energy's National Nuclear Security Administration (DOE/NNSA) must be prepared to address a shifting geopolitical environment and evolving threats from rogue states and terrorists against a backdrop of rapid science and technology innovation. DOE/NNSA strives for a responsive, effective, and resilient nuclear security enterprise positioned to meet its needs. This report provides a detailed description of DOE/NNSA's five-year plan to fulfill its mission responsibilities.

The NNSA *Strategic Vision* documents the core values and enduring objectives that will sustain the nuclear security mission and identifies five mission lines of effort focused on deliverables and milestones over the next five years. "Mission Priority #2: Reduce Global Nuclear and Radiological Security Threats and Strengthen the Nuclear Enterprise" sets goals for nuclear and radiological threat reduction program activities according to three functional areas:

1. **Prevent** would-be proliferant states from developing nuclear weapons or acquiring weapons-usable nuclear material (WUNUM), equipment, technology, and expertise, and prevent non-state actors from acquiring nuclear and radioactive materials that can be used for malicious purposes;
2. **Counter** the efforts of both would-be proliferant states and non-state actors to acquire, develop, disseminate, deliver, or use the materials, expertise, or components of a nuclear or radiological device; and
3. **Respond** to the full spectrum of nuclear and radiological emergencies at home or abroad, including deliberate nuclear and radiological attacks and accidents to minimize the damage from such incidents.

1.1.1 DOE/NNSA Offices Primarily Responsible for Nuclear/Radiological Threat Reduction

As discussed in greater detail in Chapter 2, three offices are primarily responsible for the execution of DOE/NNSA's prevent, counter, and respond missions. As illustrated in **Figure 1-1**, these offices are:

1. The Office of Defense Nuclear Nonproliferation (DNN);
2. The Office of Counterterrorism and Counterproliferation (CTCP); and
3. The Office of Emergency Operations

The programs within these three offices spearhead efforts to reduce the global nuclear threat while working collaboratively with the entire DOE enterprise, the U.S. interagency, state, local, tribal, and territorial entities as well as international partners.

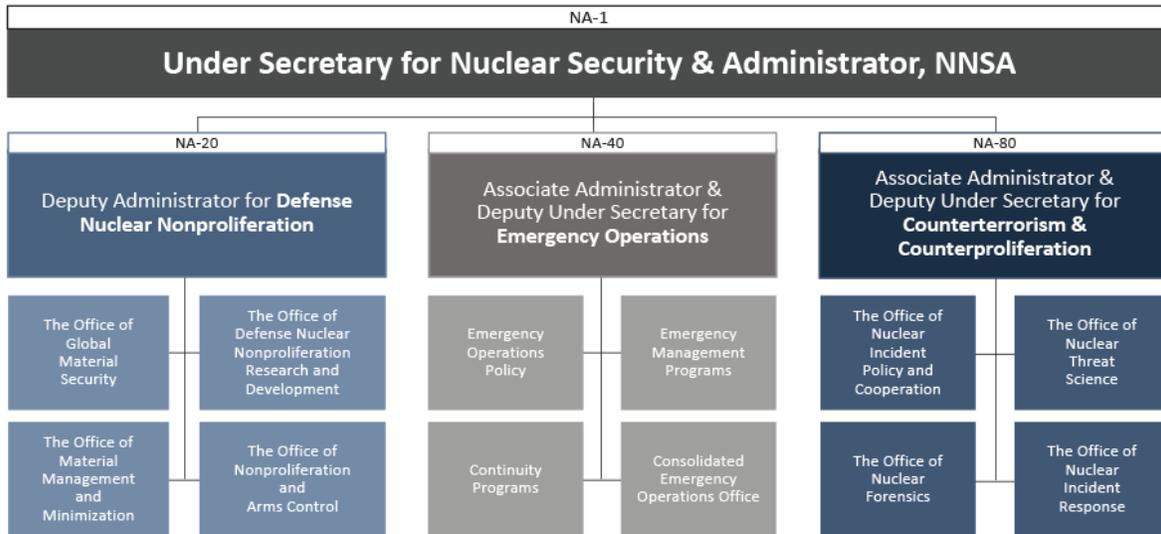


Figure 1-1. DOE/NNSA Organizational Chart of Offices Primarily Responsible for the Nuclear/Radiological Threat Reduction Mission

DNN develops and implements policy, programmatic, and technical solutions to eliminate proliferation-sensitive materials and limit or prevent the proliferation of materials, technology, and expertise related to nuclear and radiological weapons. DNN focuses its capabilities, domestically and internationally, on protecting and safely dispositioning proliferation-sensitive materials; detecting and preventing illicit transfer of nuclear or radioactive materials, technology, information, and expertise; safeguarding nuclear materials, technologies, and facilities; developing technical-based policy solutions to the negotiation and implementation of international agreements and treaty-monitoring regimes; and producing technologies for integration into operational systems by leveraging capabilities at the national laboratories, plants, and sites, as well as at universities and within private industry.

CTCP has primary responsibilities within the counter and respond functional areas, which consist of countering nuclear threats and responding to nuclear incidents and accidents, domestically and abroad. CTCP leads these missions on behalf of DOE/NNSA, conducting scientific evaluations of nuclear materials and threat devices. CTCP identifies potential terrorist or nation-state capabilities to advise U.S. Government policies, agencies, and key Department of Defense (DoD) commands based on these technical insights. CTCP is also prepared to provide an operational response to nuclear threats, incidents or accidents in support of both national security and public health and safety. CTCP is responsible for targeted radiological and nuclear emergency preparedness and response training both domestically and internationally. Finally, CTCP houses the capability to provide nuclear forensics technical analysis for materials found outside of regulatory control and attack attribution.

The Office of Emergency Operations administers and directs the implementation and integration of emergency management programs across DOE, including NNSA. The Office also supports the development, coordination, synchronization, and integration of the Department’s emergency operations policy, plans, preparedness, readiness assurance, and response operations. This includes response to any type of natural or manmade emergency that affects DOE/NNSA sites, facilities, or activities. The Office

enables other DOE program staff to effectively execute emergency management functions by providing program and line management responsibility for all aspects of emergency management including policies, procedures, training, exercises, communications, and communications infrastructure. The responsibilities of the Office of Emergency Operations also include planning and program management related to the DOE/NNSA continuity program, as well as associated continuity of operations (COOP) and continuity of government (COG) activities that ensure that Primary Mission Essential Functions are maintained through any crisis event.

1.2 Characterizing the Current Nuclear Threat Environment

Strategic Environment

(from *NNSA Strategic Vision: Strengthening our Nation through Nuclear Security*)

“The United States faces an increasingly dangerous world that is filled with a broad spectrum of emerging and enduring threats. Rival powers, rogue regimes, and terror groups all threaten the safety, security, and interests of the United States and that of our allies and partners. They are competing with us in multiple ways to challenge our geopolitical advantages and assert their interests and values. This competition exists across all dimensions of power and in all domains. These developments are magnified by rapid technological advancements, blatant disregard for international norms and treaties, and the changing character of war in ways that disadvantage the United States and its allies.

“On the nuclear front, the United States now faces more diverse and advanced nuclear threats and challenges than ever before in an environment that is also increasingly volatile and unpredictable. Significant concerns in today's environment include the potential for further proliferation of weapons of mass destruction (WMD), the missiles to deliver WMD at long range, and evolving nuclear technologies in the hands of a variety of actors, some of which are not friendly to the United States.”

Building upon the Administration's priorities, and informed by the Intelligence Community, DOE/NNSA tailors its program activities to the current and emerging nuclear risk environment, and the threats (events or conditions), vulnerabilities, and consequences that could negatively affect the safety and security of the United States and its allies. To assess the current global nuclear threat environment in relation to mission priorities and goals to inform program activities, DOE/NNSA looks to guidance from national-level strategies such as the *National Security Strategy* (White House 2017), *Nuclear Posture Review* (DoD 2018), *National Strategy for Countering WMD Terrorism* (White House 2018), and the *Worldwide Threat Assessment of the U.S. Intelligence Community* (Director of National Intelligence 2019), as well as other relevant sources of Administration policy, and developments in legislative requirements or international agreements (Appendix D: Relevant Laws, Policy Directives, and International Agreements).

As a result, four areas frame the nuclear/radiological risk environment and inform the DOE/NNSA mission:

1. Global and regional nuclear/radiological proliferation;
2. Nuclear/radiological terrorism;
3. Emerging, converging, and disruptive technologies; and
4. Preparing for the unanticipated.

These risks are consistent with the consensus views of the Intelligence Community and clearly articulated Administration priorities. The fiscal year (FY) 2018 accomplishments highlighted throughout Chapters 1

and 2 of this report illustrate the ways DOE/NNSA has executed programs to manage these risks as they were understood over the previous year. The five-year program activity plans outlined in Chapter 2 indicate the ways DOE/NNSA intends to address these risks as they are currently understood and how the nuclear security enterprise is prepared to meet new and evolving risks.

1.2.1 Global and Regional Nuclear/Radiological Proliferation

“Effective nuclear nonproliferation and arms control measures can support U.S., allied, and partner security by controlling the spread of nuclear materials and technology; placing limits on the production, stockpiling, and deployment of nuclear weapons; reducing misperception and miscalculation; and avoiding destabilizing nuclear arms competition.”

Rick Perry, United States Secretary of Energy

Global and regional nuclear proliferation presents a variety of enduring and emerging risks. For example:

- States with existing nuclear weapons capabilities, such as Russia and China, will continue to modernize their arsenals posing nuclear monitoring challenges and challenges to strategic stability, future arms control, and nonproliferation. Other states with emerging or latent capabilities, such as the Democratic People’s Republic of Korea (DPRK) and Iran, pose other challenges. Such challenges include the need to verify and efficiently implement a potential denuclearization agreement on the Korean peninsula and detecting and characterizing proliferation activities in Iran. The possibility exists of unanticipated state actors pursuing new weapons programs, including states with existing latent capabilities, while seeking to evade international detection. In this environment, the risk of illicit transfers of sensitive nuclear materials, technology, and expertise may increase. Monitoring for such possibilities will continue to stress proliferation detection capabilities and reinforce the need for the United States to maintain nuclear fuel cycle expertise to detect novel signatures of weapons development.
- Russian and Chinese state-owned enterprises are adopting a competitive posture toward unclear reactor exports to the developing world which could challenge the ability of the United States to achieve its nonproliferation objectives and maintain international norms.
- Nuclear crisis escalation, including between the United States and its global competitors such as Russia and China, as well as in regions such as South Asia, will pose risks particularly as weapon stockpiles are modernized or expanded, and as new destabilizing capabilities or use doctrines are introduced. Transparency and confidence building measures will be challenged to attenuate these risks.
- Strains on the nonproliferation and arms control regimes will pose more serious risks, whether considering the future of the U.S.-Russia New START nuclear arms control agreement, Russian material breach of the Intermediate-Range Nuclear Forces (INF) Treaty and consequent U.S. withdrawal from INF, continued Chinese resistance to nuclear transparency and arms control negotiations, or challenges posed to continued success of the nearly 50-year old Treaty on the Non-Proliferation of Nuclear Weapons (NPT) by the newly negotiated Treaty on the Prohibition of Nuclear Weapons.

1.2.2 Nuclear/Radiological Terrorism

“We must prevent nuclear weapons and materials from coming into the hands of terrorists and being used against us, or anywhere in the world...”

Donald J. Trump, President of the United States

The potential for nuclear terrorism continues to pose a serious threat to the United States and to international security and stability. For example:

- Foreign terrorist organizations in dozens of groups and countries threaten local and regional U.S. interests. Despite having experienced significant setbacks in recent years, some of these groups remain intent on striking the U.S. homeland. Prominent terrorists use social media platforms to continue to call for and justify efforts to attack the U.S. homeland. ISIS has conducted WMD attacks using sulfur mustard and toxic industrial chemicals against its opponents in Syria and Iraq. Terrorist organizations have sought nuclear materials in the past, underscoring the importance of DOE/NNSA efforts to keep these materials forever beyond their reach.
- Despite significant U.S.-led efforts to implement sustainable global materials security, the security of nuclear or radioactive materials could nonetheless be at risk, particularly in situations of loss of a state's control of its territory. The presence of terrorist groups magnifies the risk if they sought to acquire materials for a radiological dispersal device (RDD), radiological exposure device (RED), or improvised nuclear device (IND). The breakdown in nuclear security cooperation with the Russian Federation heightens this risk. Political and technical constraints remain an obstacle to removal of WUNM from certain countries.
- Insider threats at nuclear facilities around the world increase the risk of nuclear material falling into the wrong hands. DOE/NNSA remains concerned about cyber vulnerabilities of international nuclear facilities that could enable the theft of nuclear materials.
- Radioactive materials will be increasingly prevalent as many developing countries seek to use peaceful applications of radiation at medical, academic, and industrial facilities. Sustainable radioactive material protection efforts and efforts to identify alternative technologies will need to keep pace.
- Loss of control of a nuclear or radiological weapon would pose a particularly grave risk. Nuclear search, render safe, and consequence management capabilities would be challenged. In the event of a nuclear terrorism incident, rapid and accurate nuclear forensic capabilities would be called upon to support attribution.

1.2.3 Emerging, Converging, and Disruptive Technologies

“Scientific superiority has been essential to U.S. national security since World War II with the efforts of the Manhattan Project and the development of radar...Today, overwhelming scientific and engineering superiority enables us to detect, analyze, and prevent direct challenges, particularly unforeseen challenges, from adversaries drawing on new or emergent technologies.”

Thomas Mason, Laboratory Director, Los Alamos National Laboratory

A number of emerging, converging, and disruptive technologies present both a risk and an opportunity in the DOE/NNSA mission space including additive manufacturing, artificial intelligence, cybersecurity, communication technologies, and advanced reactor designs. For example:

- If additive manufacturing tools become capable of manufacturing proliferation-sensitive items, the multilateral export control regimes will need to consider how to adequately capture these most sensitive capabilities under their controls before the emerging technology becomes globally ubiquitous. As commercial industry-driven additive manufacturing tools spread globally and become capable of manufacturing proliferation-sensitive items, traditional export control approaches may need to be modernized.

- Advances in computing present great opportunities for innovation which DOE's national laboratories are aggressively exploring. For example, Oak Ridge National Laboratory's (ORNL) Summit supercomputer, in **Figure 1-2**, became the world's most powerful in 2018, reclaiming the title from China for the first time in five years. However, as artificial intelligence, including machine learning and deep learning tools, continues to improve and become more widely available to rogue states, advanced computing poses a nonproliferation risk, as these advances may be leveraged to lower the thresholds to proliferation.



Figure 1-2. Summit Supercomputer

- The wider availability and increased sophistication of cyberattack tools in the future could enable attempts to circumvent nuclear safeguards, security, and other protections. Countries with minimal cybersecurity infrastructure could be particularly vulnerable.
 - The continued spread of instantaneous, high-bandwidth, deeply-searchable communication technology in democratic countries could endanger the protection of proliferation-sensitive information from hostile states and U.S. adversaries.
- Continued development, and potential overseas deployment, of advanced reactor designs could present new questions for the nuclear safeguards, export controls, and security regimes. Advanced U.S. nuclear reactor technologies could pose an attractive target for illicit acquisition attempts.
 - The convergence of new technologies, perhaps with other technology trends, may produce new or enhanced proliferation risks that are not readily apparent when examined in isolation.

1.2.4 Preparing for the Unanticipated

"It is incumbent upon us to anticipate our future security challenges and ensure our country is ready to meet them."

Lisa E. Gordon-Hagerty, Under Secretary for Nuclear Security and Administrator, NNSA

Historically, unanticipated events have often occurred that required a re-assessment of some capacity of the U.S. nuclear nonproliferation and security posture. While it may not be possible to fully predict unanticipated events, it is possible to be prepared knowing that dramatic upheavals in technology and the global nuclear threat environment are inevitable and unavoidable. Nuclear and associated material will always be valuable; and now the means to acquire such materials are becoming more varied with technological advancements.

Given the rapid changes and evolutions taking place in the three focus areas of the nuclear threat environment outlined above, it is essential that DOE/NNSA proactively and regularly looks toward the future to identify, characterize, and prepare for newly emerging trends and risks, to position itself to quickly respond to transformational events. To do so, DOE/NNSA leverages the policy and technical expertise and the scientific innovation of the nuclear security enterprise, and collaborates with other

departments and agencies, including the Intelligence Community, to anticipate evolving risks and trends 5 to 10 years out, ensuring that DOE/NNSA is as prepared as possible when unanticipated events occur.

1.3 NNSA Core Capabilities

To address the complex and dynamic challenges of nuclear threat reduction, DOE/NNSA deploys an unmatched combination of world-class technical and policy expertise that inspires cutting-edge innovation in collaboration with its NNSA Defense Programs counterparts, U.S. interagency partners, international agencies and organizations, and foreign governments. This combination makes DOE/NNSA indispensable to reducing the global nuclear threat and safeguarding the United States and its allies.

1.3.1 NNSA Expertise

DOE/NNSA maintains a workforce of world-class scientific and technical expertise spread across Headquarters, laboratories, plants, and sites that make up the nuclear security enterprise. This workforce



Figure 1-3. Technical experts from Nigeria's Centre for Energy Research and Training stand over the miniature neutron source reactor and prepare to load the HEU reactor core into an interim cask.

Figure 1-3. This shipment of material fulfilled a long-sought goal of removing the last known HEU from Nigeria, making it the 33rd country plus Taiwan to become HEU free. To date, DOE/NNSA has removed or confirmed the disposition of more than 6,725 kilograms of HEU or plutonium worldwide, helping to reduce the global threat of nuclear terrorism.

represents an unmatched, unique repository of knowledge and understanding of nuclear weapons, materials, facilities, and security and safeguards technologies. DOE/NNSA staff also has decades of on-the-ground experience in dozens of countries around the world and on assignment with international partners, such as the International Atomic Energy Agency (IAEA). The excellence and unique expertise of DOE/NNSA staff is routinely recognized with requests to serve in senior positions across the U.S. Government to provide nuclear policy alignment and insights as illustrated by these two examples from 2018.

United States and China Collaborated to Remove Nuclear Material from Nigeria

DOE/NNSA has a long history of experience with technical processes and complicated realities of safe and successful material removal. In FY 2019 DOE/NNSA demonstrated this expertise, in partnership with China, to assist Nigeria in mitigating a critical security concern at its Nigerian Research Reactor 1 (NIRR-1). NIRR-1 originally operated using highly enriched uranium (HEU), a weapons-grade material that is highly attractive to terrorists or those seeking to build nuclear weapons. DOE/NNSA technical experts partnered with IAEA safeguards inspectors, and Chinese, Russian, and Czech experts to successfully convert the reactor to the use of low-enriched uranium (LEU), and repatriate more than 1 kilogram of Chinese-origin HEU from the research reactor as show in

Mission Essential Functions for Emergency Management

The Emergency Operations workforce includes prominent technical, logistics, and preparedness experts from across the nuclear security enterprise with many years of experience evaluating and preparing for all types of emergencies. DOE/NNSA's Office of Emergency Operations leverages the experience and expertise of these personnel to prepare for, protect against, respond to, recover from, or mitigate against natural disasters, acts of terrorism, and other man-made disasters to ensure the health and safety of workers and the public, to protect the environment, and ensure the security of the Nation. The Office developed and implements the enterprise-wide, all-hazards approach to emergency management that



Figure 1-4. DOE/NNSA Emergency Operations Center

ensures the Department's crisis response and consequence management assets are fully integrated. This promotes unity of effort and COOP in the event of any emergency as seen in **Figure 1-4**. In 2018, the Office of Emergency Operations refined and revalidated DOE's Mission Essential Functions and Primary Mission Essential Functions to enhance the resilience of the Department and ensure the continued performance of DOE and NNSA Essential Functions, and delivery of essential services under any condition.

1.3.2 NNSA Innovation

DOE/NNSA couples the specialized expertise of its diverse workforce with advanced facilities across its laboratories, plants, and sites to support world-leading innovation, illustrated in **Figure 1-5**. DOE's national laboratories are a cornerstone of the U.S. Government research and development enterprise deploying a full spectrum of scientific activity from basic research to applied sciences and technology to tackle the Nation's most challenging problems such as cybersecurity, artificial intelligence, advanced manufacturing, and biotechnology. Specialized facilities and research programs at the national laboratories, including test facilities capable of handling radioactive and nuclear materials, and the world's fastest and most powerful supercomputers for modeling and simulation, support the execution of nuclear threat reduction programs.

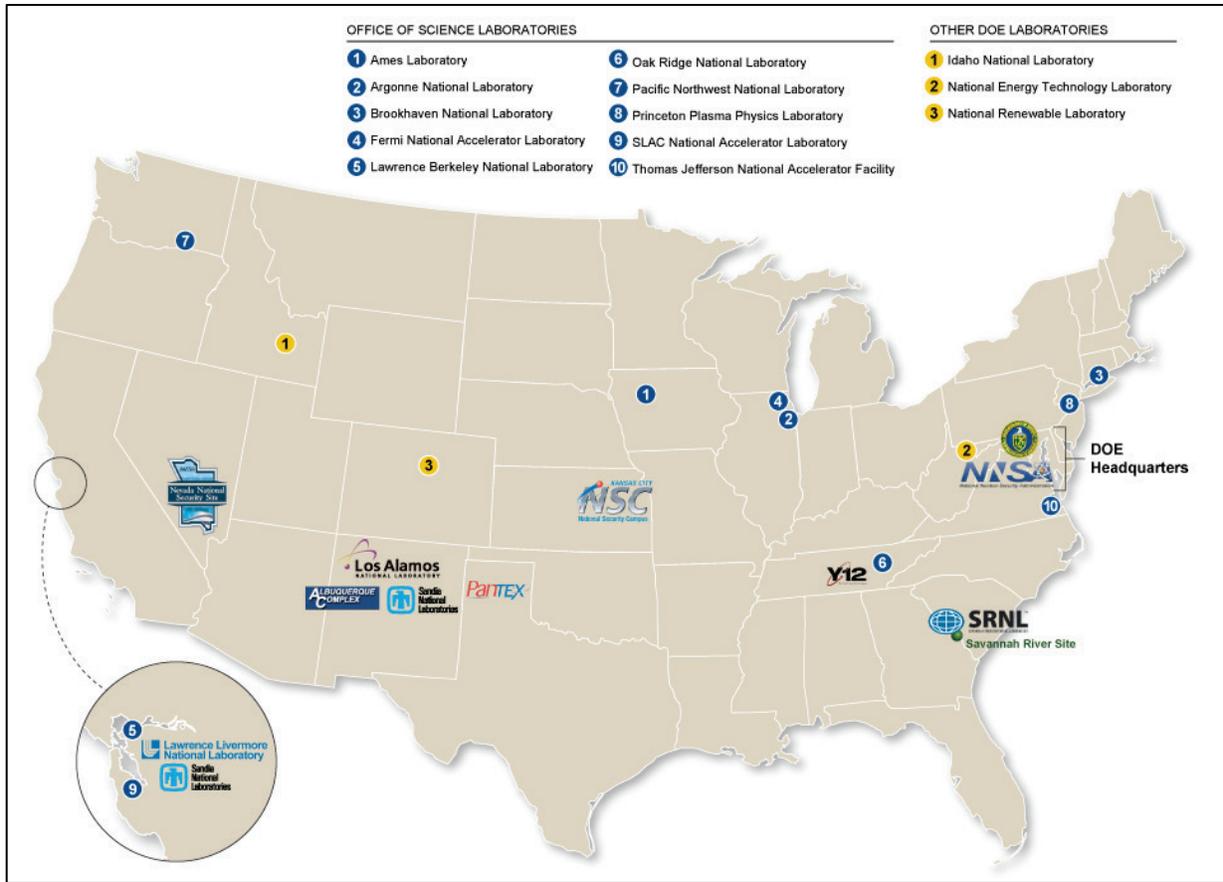


Figure 1-5. DOE Laboratories, Plants, and Sites

As shown in **Figure 1-6**, specialized plants and sites combine with the DOE/NNSA national security laboratories to make up the DOE/NNSA nuclear security enterprise. The laboratories, plants, and sites of the nuclear security enterprise provide unmatched technical expertise in nuclear and radioactive materials and technologies complemented by unique facilities, all of which facilitate the nuclear threat reduction mission.

The three national security laboratories—Lawrence Livermore National Laboratory (LLNL), Los Alamos National Laboratory (LANL), and Sandia National Laboratories (SNL)—are distinct among the national laboratories in primarily applying their unique expertise and capabilities to the DOE/NNSA mission. The plants and sites included in the nuclear security enterprise are as follows:

- **The Kansas City National Security Campus (KCNSC)** is responsible for manufacturing and procuring non-nuclear components for nuclear weapons, including electronic, mechanical, and engineered material components.
- **The Nevada National Security Site (NNSS)** supports the stewardship of the nuclear deterrent, providing emergency response capability and training, and contributing to key nonproliferation and arms control initiatives.

- **The Pantex Plant** supports nuclear weapon life extension programs; nuclear weapons dismantlement; the development, testing, and fabrication of high explosive components; and interim storage and surveillance of plutonium pits.
- **The Savannah River Site (SRS)** operates facilities to supply and process tritium, a radioactive form of hydrogen that is a key component of nuclear weapons, and recycles, extracts, and enriches tritium gas. SRS processes and stores nuclear materials in support of national defense and U.S. nonproliferation efforts.
- **The Y-12 National Security Complex** is the Nation’s only source of enriched uranium nuclear weapon components and provides enriched uranium for the U.S. Navy. It excels in materials science and precision manufacturing and stores enriched uranium.



Figure 1-6. The labs, plants, and sites of the Nuclear Security Enterprise

Finally, the national laboratories, plants, and sites within the DOE/NNSA enterprise house state-of-the-art training facilities to build capacity in nuclear detection, security, safeguards, and incident response domestically and internationally. The nuclear security enterprise’s laboratories, plants, and sites work with DOE/NNSA Headquarters staff to support NNSA *Strategic Vision* “Mission Priority #4: Strengthen Key Science, Technology, and Engineering Capabilities.” DOE/NNSA relies upon the innovation and research and development motivated problem-solving capacity of the nuclear security enterprise to address difficult challenges related to preventing, countering, and responding to the global nuclear threat as illustrated by two examples from 2018.

Space-Based Nuclear Detonation Detection

Space-based nuclear explosion sensors are a vital U.S. capability to both monitor compliance with treaties such as the Limited Test Ban Treaty and the Threshold Test Ban Treaty, and to support the other missions. These systems monitor the entire globe, at all times, for evidence of nuclear detonations providing timely and accurate information to U.S. policymakers and DoD. For over 50 years, DOE/NNSA has drawn on its technical capabilities and expertise and unique research facilities to innovate space-based detection capabilities. To further advance the capabilities of these vital sensor systems in 2018, DNN delivered a new Global Burst Detector (GBD), GBD III-8, to the U.S. Air Force, and also provided ongoing technical support to integrate previously delivered GBDs onto Global Positioning System (GPS) satellites planned for launch in upcoming fiscal years. DOE/NNSA relied on the workforce at SNL and LANL to deliver these innovative technologies.

First Domestic Supply of Mo-99 in over 30 Years

Since 2009, DOE/NNSA has leveraged the technical expertise and specialized facilities of the national laboratories, in collaboration with industry partners, to create a reliable, domestic supply of molybdenum-99 (Mo-99), an isotope that is used to create technetium-99m (Tc-99m), which is the medical radionuclide used in over 40,000 medical procedures in the United States each day. In February 2018, the U.S. Food and Drug Administration approved the first domestically produced, non-HEU-based Mo-99 in over 30 years, produced in partnership with NorthStar Medical Radioisotopes. Until 2018, Mo-99 was exclusively supplied by foreign vendors, most of which use proliferation-sensitive HEU in the production process. The multi-year effort to reestablish this domestic competence relied on the capacity for innovation built into the DOE/NNSA national security enterprise to solve the challenge of domestic Mo-99 supply and further two DOE/NNSA program goals: 1) reducing the amount of HEU available globally to lower the chance that it will be diverted to inappropriate uses; and 2) reducing United States reliance on foreign producers of essential isotopes.

1.3.3 NNSA Partnerships and Collaborations

DOE/NNSA collaborates with numerous strategic partners that enable, contribute to, and benefit from its efforts. Domestically, these partners include DoD, the Department of State, the Intelligence Community, the Nuclear Regulatory Commission (NRC), the Department of Homeland Security (DHS), the Environmental Protection Agency, and the Federal Bureau of Investigation (FBI). This coordination is critical to ensure that nuclear security work throughout the interagency is not duplicative, and to confirm that the full range of capacity building activities are coordinated, including partner country prioritization, outreach, equipment deployment, training, and performance evaluation.

Internationally, DOE/NNSA works closely with relevant international organizations, such as the IAEA, as well as directly with foreign government counterparts and local non-governmental organizations. DOE/NNSA must work collaboratively on the global stage to advance U.S. strategic interests, priorities, and policy in multilateral forums, particularly to achieve its nonproliferation objectives. Similarly, partnerships are vital for capacity building and to advance opportunities to secure, remove, eliminate, and minimize the presence of proliferation-sensitive materials. DOE/NNSA has built deep, sustaining relationships, domestically and internationally, that make it uniquely capable of fulfilling its nuclear threat reduction mission as illustrated by two examples from 2018.

IAEA International Cyber Training Course

DOE/NNSA has identified cyber and cyber-physical security vulnerabilities as an issue of concern in relation to the security of nuclear facilities, materials, and technologies. Working with the technical experts at Idaho National Laboratory (INL) and Pacific Northwest National Laboratory (PNNL), in 2018, DNN collaborated with the IAEA to hold an International Training Course on Protecting Computer-Based Systems in Nuclear Security, shown in **Figure 1-7**. The course brought together more than 40 participants from 13 countries. This was the first in a series of training sessions that involves DOE/NNSA's extensive domestic and international partnerships to build capacity and address emerging security concerns around the globe.

Tabletop Exercise for Nuclear or Radiological Event Prevention and Response Preparedness

CTCP is responsible for ensuring that emergency response personnel are fully prepared to respond to protect the public in the event of a nuclear or radiological event both domestically and abroad. Over the course of 2018, CTCP conducted 19 tabletop exercise events, training over 1,390 emergency response personnel. Part of this effort included the Silent Thunder tabletop series, which CTCP, DNN, and FBI jointly conducted. The Silent Thunder exercise



Figure 1-7. Instructors and participants at the IAEA's new international training course on protecting nuclear facilities from cyberattacks (INL)

series provided additional in-depth training on the technical aspects of nuclear/radiological incident response to ensure that local authorities were prepared to respond quickly and effectively in the event of a nuclear or radiological incident. The exercises included new training for domestic participants on radiation hazards, operations, and communications during a nuclear or radiological incident. The exercises also brought together local partners to successfully implement the Radiological Awareness and Emergency Public Information Office training in Colorado, Arizona, Connecticut, and Wisconsin.

Conclusion: NNSA's Unique Capabilities Make It Indispensable to the Nation's Security against Nuclear Threats

The activities outlined above, as well as many others carried out daily by the dedicated people of DOE/NNSA, make the United States safer and more secure. Threats within the nuclear proliferation and security domain are ever-changing, and DOE/NNSA is committed to staying ahead of these evolving risks and challenges. Whether committed to the stockpile stewardship, naval reactors, or nuclear threat reduction missions, the people of DOE/NNSA work together to ensure the long-term nuclear security of the Nation. Nuclear threat reduction is a critical element of that mission, and DOE/NNSA will continue to serve the Nation, its allies, and its partners.

Chapter 2: NNSA's Plan to Prevent, Counter, and Respond to the Challenges of Nuclear/Radiological Proliferation & Terrorism

The Department of Energy's National Nuclear Security Administration (DOE/NNSA) plays a central and vital role in providing for the safety and security of the United States, and its partners and allies. Nuclear/radiological threat reduction is a core pillar of the DOE/NNSA mission, and *Prevent, Counter, Respond—NNSA's Plan to Reduce Global Nuclear Threats* (NPCR) provides the strategic framework to reduce global nuclear security threats and strengthen the nuclear enterprise. Nuclear and radiological threats are constantly evolving, and it is critical that they be addressed in an integrated, coordinated, and comprehensive effort that draws upon the full range of the scientific talent and technical expertise of the DOE/NNSA enterprise.

The NNSA *Strategic Vision* identifies five mission priorities – lines of effort focused on deliverables and milestones over the next five years to support the Nation's security:

1. Maintain the safety, security, and effectiveness of the Nation's nuclear deterrent;
2. Reduce global nuclear/radiological security threats and strengthen the nuclear enterprise;
3. Provide safe and effective integrated nuclear propulsion systems for the U.S. Navy;
4. Strengthen key science, technology, and engineering capabilities; and
5. Modernize the national security infrastructure.

"Mission Priority #2: Reduce Global Nuclear/Radiological Security Threats and Strengthen the Nuclear Enterprise" provides specific goals to guide the deployment of capabilities and resources to support NNSA's nuclear/radiological threat reduction mission, principally executed by the Office of Defense Nuclear Nonproliferation (DNN), the Office of Counterterrorism and Counterproliferation (CTCP), and the Office of Emergency Operations:

1. **Prevent** would-be proliferant states from developing nuclear weapons or acquiring weapons-usable nuclear material (WUNM), equipment, technology, and expertise, and prevent non-state actors from acquiring nuclear and radioactive materials that can be used for malicious purposes;
2. **Counter** the efforts of both would-be proliferant states and non-state actors to acquire, develop, disseminate, deliver, or use the materials, expertise, or components of a nuclear or radiological device; and
3. **Respond** to the full spectrum of nuclear and radiological emergencies at home or abroad, including deliberate nuclear and radiological attacks and accidents to minimize the damage from such incidents.

The NNSA *Strategic Vision* also describes the following six highlights, of near-term and out-year mission milestones, that illustrate DOE/NNSA programs designed to strengthen U.S. security by reducing the global dangers posed by nuclear/radiological weapons, material, and technology:

- Ensure the readiness, capability, and swift execution of U.S.-led denuclearization efforts in countries of concern, as may be required by the President;
- Complete disposition of 162 metric tons (MT) of surplus U.S. highly enriched uranium (HEU) by the end of fiscal year (FY) 2019;
- Secure 2,346 of the estimated 4,000 known buildings containing high-priority radioactive materials by the end of FY 2019;
- Build capacity of the International Atomic Energy Agency (IAEA) to investigate indications of undeclared nuclear material and activities in states with comprehensive safeguards agreements, and work to universalize the Additional Protocol;
- Meet project baselines to advance, transition, or deploy new early proliferation detection and nuclear security technology for 80 percent of projects, and begin efforts to sustain foundational technical competencies to support future nonproliferation missions; and,
- Continue to assess and improve nuclear/radiological crisis response and consequence management capabilities internally, and in collaboration with key strategic partners at the Federal, state, territorial, tribal, and local levels.

DOE/NNSA achieves these goals through the execution of programs that minimize nuclear and radioactive materials no longer in use; strengthen the international safeguards system to detect and deter diversion of nuclear material from peaceful purposes to nuclear weapons or other nuclear explosive devices; secure nuclear/radiological materials and facilities; prevent and counter the further spread of special nuclear material (SNM), sensitive nuclear technology, and expertise to states of concern and non-state actors; pursue advanced capabilities to understand and detect foreign nuclear weapons production and detonation; and maintain a cadre of technical and scientific specialists trained, organized, and equipped to execute nuclear/radiological crisis response and consequence management missions on a global scale.

DOE/NNSA is uniquely capable to perform the Nation's nuclear/radiological threat reduction mission due to its core competencies including the technical and policy expertise of the DOE/NNSA workforce, the vast capacity for innovation contained within the world-class scientific and research facilities of the nuclear security enterprise, and the commitment of DOE/NNSA to closely coordinate its activities with U.S. departments and agencies, and international partners. The strategic deployment of these core capabilities to address the most pressing and difficult nuclear/radiological threat reduction challenges makes DOE/NNSA indispensable to the safety and security of the Nation. Section Two of this report provides details on the DOE/NNSA plan to prevent, counter, and respond to the global nuclear and radiological threat.

2.1 Prevent: Preventing Nuclear/Radiological Proliferation and Terrorism

For decades, the United States has faced the threat of nuclear attack. During that time, the DOE/NNSA **Office of Defense Nuclear Nonproliferation (DNN)** has worked to stop non-state actors and would-be proliferant states from developing nuclear weapons or acquiring WUNM, equipment, technology, and expertise to create an improvised nuclear device (IND). Failure to do so would be catastrophic for the United States, and its allies and partners. DNN supports this goal by drawing broadly upon the DOE's

policy, scientific and technical expertise, and working with the interagency, multilateral organizations, and international partners.

2.1.1 Program Strategy

DNN implements programs using a set of core competencies to achieve the U.S. Government nonproliferation objectives of detecting proliferation and verifying compliance with nonproliferation and arms control obligations; eliminating and minimizing nuclear and radioactive materials that are no longer in use; and safeguarding nuclear materials and securing nuclear facilities and radioactive materials in use.

DNN comprises four Program Offices that are designed to be flexible and responsive to an enduring and dynamic threat environment: Global Material Security (GMS), DNN Research and Development (DNN R&D), Material Management and Minimization (M³), and Nonproliferation and Arms Control (NPAC). DNN participates in multiple interagency task forces and working groups to coordinate efforts, maximizing the efficiency and effectiveness of programs by ensuring work is not duplicated. In addition to coordinating its activities with domestic partners, DNN sustains relationships with international agencies, including the IAEA, and foreign governments.

The Office of Global Material Security

The **GMS Program Office** supports the DOE/NNSA strategic goal of securing nuclear and radioactive materials, and the interdiction and investigation of the trafficking of those materials to reduce the risk of nuclear proliferation and nuclear and radiological terrorism. GMS executes this mission by working with partner countries to increase the security of nuclear and radioactive materials, as well as to improve the partner countries' abilities to detect, disrupt, and investigate illicit nuclear trafficking. Domestically, GMS secures and disposes radioactive materials to prevent their theft or diversion for use against the homeland. The GMS Program Office is composed of the following three sub-offices.

The Office of International Nuclear Security (INS) works to strengthen the security of nuclear materials and facilities worldwide. This mission is executed with partner countries through nuclear security system upgrades, which include cybersecurity systems as well as related training. INS also provides training and technical exchanges on insider threats, transportation security, regulation development, inspections, and security culture. Through the Nuclear Security Support Centers in Argentina, China, India, Japan, South Korea, and Kazakhstan, INS is collaborating with a growing network of nuclear security professionals. INS works with the IAEA on its nuclear security guidance documents.

The Office of Radiological Security (ORS) works worldwide with domestic and international partners, such as hospitals, universities, industry, and research institutes, to enhance the security of vulnerable radioactive sources that could be used by terrorists in a radiological dispersal device (RDD) or radiological explosive device (RED). This is done through three strategies: protect, remove, and reduce. Radioactive sources needed for vital medical, research, and commercial purposes are protected through physical security enhancement, training to quicken response time to improve security system effectiveness, and collaboration with industry on security-by-design, which incorporates security into the design stage to ensure that radiological devices and facilities are more secure from the beginning. Disused, orphaned, or unwanted sources are removed and placed in secure storage or dispositioned. Finally, ORS seeks to reduce the global use of radioactive sources by promoting the adoption and development of alternative, non-source-based technologies when possible.

The **Office of Nuclear Smuggling Detection and Deterrence (NSDD)** works with partner countries to detect, disrupt, and investigate the smuggling of nuclear and other radioactive materials that could be used in acts of terrorism. Based on an assessment of the smuggling risk, NSDD provides partners with tailored solutions to counter nuclear smuggling within their country and across their borders. NSDD addresses known vulnerabilities and responds to new and emerging threats by providing detection and investigation capability to officials at border crossing points, mobile detection units, patrol and interdiction teams along vulnerable green borders (i.e. the areas between official crossing points), intelligence and law enforcement agencies responding to information alerts and investigations, security agencies at high risk airports, and teams conducting interdiction and inspection of small maritime vessels. NSDD also builds foreign partners' nuclear forensics analytical capabilities and shares best practices to give partners the tools to identify interdicted materials.

NSDD works closely with partners to indigenize capabilities in the following areas: operations, management, training, and maintenance. NSDD's support in promoting these areas includes operator and technical training, topical workshops, drills, exercises, and events designed to test, evaluate, and improve system performance and effectiveness. NSDD works in close collaboration with other U.S. Government agencies, including the Departments of State, Homeland Security (DHS), Defense (DoD), and Justice (DOJ) to maximize the effect of U.S. Government resources, and works with international organizations such as Interpol, the IAEA, and the Global Initiative to Combat Nuclear Terrorism to promote consistency in global efforts to counter nuclear smuggling, an example of which is shown in **Figure 2-1**.

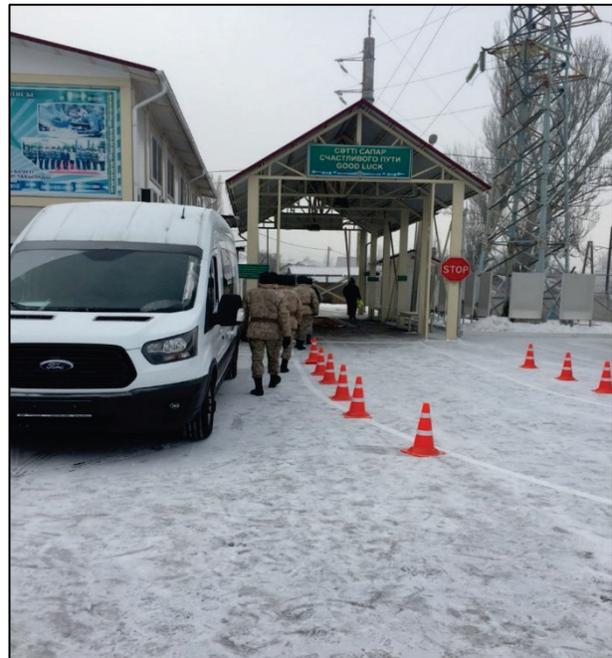


Figure 2-1. DOE/NNSA and Kazakhstan officials train to deter, disrupt, and investigate nuclear materials to counter illicit smuggling.

Program Implementation

Secure nuclear materials and facilities worldwide –

A top priority for GMS is to secure WUNM and other dangerous nuclear materials. GMS also works to secure other materials and facilities that are part of the nuclear fuel cycle, including uranium enrichment and conversion facilities, power and non-power reactors, fresh and spent fuel storage facilities, and reprocessing facilities.

Secure cyber systems at nuclear facilities – Nuclear and radiological facilities worldwide increasingly are adopting digitally-based components into their security, safety, and operational systems. GMS cooperates with bilateral partners and with the IAEA to increase cybersecurity awareness, publish technical guidance, and foster adoption of effective cybersecurity practices.

Secure nuclear/radioactive materials in transport – GMS cooperates with bilateral partners and with the IAEA to increase transport security awareness, foster adoption of effective transport security practices, and provide necessary tools and equipment.

Assess and mitigate evolving threats – Emerging technologies with potential nuclear/radiological security implications constitute an important component of the shifting threat environment. GMS leverages U.S.

national laboratory experts to identify and assess emerging threats, and to prioritize these threats and technologies in terms of state of development, availability, and relevance to nuclear/radiological security.

2020 Cities Initiative –

Accelerates and expands remaining security upgrades for risk significant sources in major U.S. cities by: improving site security at buildings containing cesium-137 and cobalt-60; integrating law enforcement into response planning and training; launching city-wide efforts to reduce the number of cesium-

137 sites through replacement technologies; and expanding partnership collaboration by developing forums for sharing best practices and lessons learned.

Global Cesium Security Initiative – Focuses and accelerates efforts to secure cesium-137 internationally by: working with new partners to complete security enhancements at all buildings; fully implementing security enhancements in the countries with the most cesium-137 or implementing permanent risk reduction solutions; completing national sustainability work in the countries with the most cesium-137; and expanding partnership collaboration by conducting technical exchanges and outreach.

Cesium Irradiator Replacement Project – Work with U.S. facilities that use cesium-137 irradiators to incentivize the conversion to non-radioisotopic alternatives such as X-ray devices, such as those in **Figure 2-2**.

Collaborate with law enforcement and intelligence agencies – An effective defense-in-depth strategy for detecting, disrupting, and investigating nuclear smuggling requires a comprehensive deployment of resources along the borders and in the interior of a country. GMS provides enhanced capabilities to interior law enforcement and intelligence agencies responding to counter smuggling information alerts and investigations.

Green Border Security Initiative – Through this initiative, GMS provides radiation detection and interdiction capability in the areas between official border crossing points, along proven smuggling routes, and near unstable or uncontrolled territories.

Maritime Vectors Partnership – This project provides radiation detection and interdiction capability to maritime security officials as they conduct targeted screening of small maritime vessels from priority source countries.

Strategic Airport Initiative – This initiative provides radiation detection and interdiction capability to airport security officials to conduct targeted screening of passengers from priority source countries.



Figure 2-2. ORS and Medstar Georgetown University Hospital worked together to remove a cesium-137 blood irradiator and replace it with an X-ray irradiator at the hospital's Washington, DC, facility.

GMS – FY 2018 Program Accomplishments and Developments

- Trained over 6,700 law enforcement and responders on alarm response.
- Removed more than 4,490 disused or unwanted sources from locations in the United States for a total of over 63,700 sources.
- Replaced 39 cesium-based irradiators with alternative non-radioisotopic technologies, for a cumulative total of 58.
- Involved over 70 partner countries to build their capabilities to detect, disrupt, and investigate smuggling of nuclear and radioactive materials.
- Secured 87 buildings with high-risk radioactive material in 24 countries, including 42 buildings in the United States. GMS has cumulatively secured 2,283 buildings.
- Conducted over 100 bilateral and multilateral nuclear and radiological security workshops, including a workshop on mitigating insider threats with Argentina, a workshop on design basis threat with Brazil, and the first IAEA International Training Course on cybersecurity for nuclear facilities.

GMS – Future Program Plans

- Remove additional excess and unwanted sealed radioactive sources from locations in the United States.
- Continue ongoing nuclear security capacity building cooperation in at least 20 high-priority countries and annually initiate capacity building cooperation in up to 13 additional countries.
- Develop and implement cybersecurity training courses and technical exchanges to collaborate with international partners on cybersecurity best practices for nuclear and radiological facilities.
- Provide flexible radiation detection systems for targeted screening of small maritime vessels and at high priority airports in the Middle East, Africa, and Asia.
- Expand support for the voluntary replacement of high-activity radioactive sources with non-radioisotopic based technologies. Replace more than 400 radioactive source-based devices with alternative technologies by the end of 2024.
- Work with up to 16 partners to strengthen foreign partner nuclear forensic capabilities.
- Complete development of fundamental material protection, control, and accounting curriculum for a national nuclear security training center in Kazakhstan and complete development of nuclear security training center in Argentina.
- Continue to collaborate with industry on security by design and security standards.

The Office of DNN Research & Development

The **DNN R&D Program Office** promotes innovative research that delivers scientific breakthroughs, extends knowledge of nuclear proliferation activities, and develops prototypes of technologies for integration into operational systems by capitalizing on the capabilities available at the national laboratories and through partnerships with universities and industry. These same capabilities support nuclear arms control treaty verification monitoring and verification, operational interdiction, and other nuclear security missions across DOE/NNSA and the U.S. Government. To ensure NNSA is prepared to respond to unanticipated future nuclear security challenges, DNN R&D is developing efforts to steward

foundational nonproliferation technical competencies. The DNN R&D Program Office comprises the following two sub-offices.

The **Office of Proliferation Detection** strengthens U.S. capabilities to detect and characterize nuclear programs through initiatives that develop new methods and technologies, such as the new crystals photographed in **Figure 2-3**, to detect, locate, and characterize SNM and other nuclear material production; develop new methods and technologies to detect diversion of nuclear material and to detect, locate, and characterize nuclear weaponization activities; and develop new technologies and methods for nuclear and radioactive material security and for nuclear and radiological incident response.

The **Office of Nuclear Detonation Detection** develops and builds space sensors for the Nation's operational nuclear test treaty monitoring and Integrated Threat Warning/Attack Assessment capabilities; conducts R&D to advance analytic forensic capabilities related to nuclear detonations and interdicted samples; and produces and updates the regional geophysical datasets and analytical understanding of waveform and radionuclide signatures to enable operation of the Nation's ground-based nuclear detonation monitoring networks.

Program Implementation

Strengthen U.S. capabilities to detect, locate, and characterize proliferation activities of foreign nuclear programs – DNN R&D develops new methods and technologies to detect, locate, and characterize SNM and other nuclear material production; detect diversion of nuclear material from civilian nuclear power purposes; and detect, locate, and characterize nuclear weaponization efforts.

Advance U.S. capabilities to strengthen nuclear security across the threat spectrum – DNN R&D develops new technologies and methods for nuclear and radiological material security and advances capabilities for nuclear and radiological incident response.

Technology, Methods, and Testbed Development – Demonstrate capability development through field experimentation conducted across a series of testbeds at the Nevada National Security Site (NNSS) and other, primarily DOE, facilities.

Nonproliferation Stewardship – Conduct strategic planning and initial investments to establish a systematic approach within DNN R&D to ensure that foundational technical competencies—including infrastructure, science, technology, and expertise—at DOE's national laboratories, sites, and plants are sufficient to fully support policymakers and U.S. Government missions combating nuclear proliferation in the years ahead. An emphasis on testbeds and other infrastructure that enable R&D and operations will build experience-based, systems-level workforce expertise to support NNSA mission partners.

Technology Transition – Transfer technology into the hands of mission partners in one of four ways: transition of basic R&D from university consortia to national laboratories; use of DNN R&D developed



Figure 2-3. A new melt-casting fabrication process for organic glass scintillators pioneered by Sandia National Laboratories, requiring less than 24 hours and no mechanical polishing after casting, results in new crystals, such as the 2-inch diameter specimen here, capable of providing best-in-class gamma and neutron radiation discrimination capabilities.

capabilities at national laboratories, sites, and plants by mission partners through Strategic Partnership Projects; collaboration with operational components of U.S. national security; and commercialization pathways through the Small Business Innovative Research and Small Business Technology Transfer programs managed by DOE's Office of Science.

Delivery of Nuclear Detonation Detection Sensors to the U.S. Air Force – Design, develop, and deliver operational, space-based, nuclear detonation sensors to the U.S. Air Force in support of the U.S. Nuclear Detonation Detection System. This system provides a near real-time, worldwide, highly survivable capability to detect, locate, and report any nuclear detonations in the Earth's atmosphere or in near space.

DNN R&D FY 2018 Program Accomplishments and Developments

- Successfully executed the first of four underground chemical explosions of Phase II of the Source Physics Experiment (SPE), the only one planned for FY 2018. The SPE is designed to improve our ability to monitor foreign underground nuclear explosions by increasing our understanding of the generation and propagation of seismic and acoustic signatures from underground explosions.
- Completed the Remote Detection Strategic Study—led by Los Alamos National Laboratory (LANL), Sandia National Laboratories (SNL), and Lawrence Livermore National Laboratory (LLNL)—which considered future R&D paths to improve the detection of nuclear proliferation activities via remote detection and remote sensing capabilities.
- In partnership with the United Kingdom, began development of the Advanced Instrumentation Testbed that is designed to test new detection technologies and determine whether antineutrinos, which are produced in abundance by nuclear reactors, can be a useful signature to monitor nuclear reactors.
- Produced and delivered the Global Burst Detector (GBD) III-8 sensor-laden payload to the U.S. Air Force and provided technical support to integrate previously-delivered GBDs onto Global Positioning System (GPS) satellites planned for launch in future fiscal years.
- Completed two month-long field campaigns, as planned, at testbeds designed to test technologies developed to improve U.S. capabilities to detect and monitor foreign nuclear material production.
- Successfully completed the multiyear, multi-laboratory Warhead Measurement Campaign with measurements of the B61, the B83, and the W76 to collect a comprehensive list of signatures that will support a variety of nuclear nonproliferation, arms control, and stockpile stewardship missions.
- Research in radiochemical separations and detection methods were successfully tested as part of a joint operational exercise between LANL and Pacific Northwest National Laboratory (PNNL). Other research in nuclear data, fallout collection and analysis techniques, prompt signal detection, and signature discovery provided outcomes that, with additional testing, will improve U.S. capabilities in monitoring and nuclear forensics.

DNN R&D – Future Program Plans

- Execute the final three underground chemical explosions in Phase II of the SPE being conducted at the NNSS. Phase II of the SPE will be completed in FY 2019, in line with project goals. Phase III of the SPE is being considered for the FY 2023/2024 timeframe.
- Complete three additional field campaigns at testbeds designed to test technologies developed to improve U.S. capabilities to detect and monitor foreign nuclear material production. DNN

conducts a variable number of field campaigns each year depending on R&D progress. In FY 2019, three such campaigns are planned.

- As part of the Integrated University Program, award five-year grants to two new university consortia in FY 2019 focused on conducting basic research in nuclear nonproliferation and developing the next generation of scientists and engineers in the fields of nuclear science, nuclear engineering, and nuclear nonproliferation. DNN R&D plans to fund a new university consortia in FY 2021, and two new consortia in FY 2024.
- Establish a new nonproliferation stewardship initiative by completing strategic planning and initial infrastructure investments.
- Provide technical support to integrate GBD III payloads onto GPS satellites in support of their launches, beginning in FY 2019. DNN R&D plans technical support to two GBD III payloads per year through FY 2022.
- Design, fabricate and deliver the next-generation GBD payload in support of future deliveries for the GPS III satellites. Successfully pass Critical Design Review in FY 2019, sub-system verification reviews in FY 2020-22, System Verification Review in FY 2023, and initial system delivery in FY 2024.

The Office of Material Management and Minimization

The **M³ Program Office** supports the DOE/NNSA strategic goal of minimizing and eliminating excess WUNM to reduce the risk of nuclear proliferation and terrorism. M³ works to convert research reactors and radioisotope production facilities to eliminate the need for HEU, and remove surplus materials for downblending or disposition. M³ also ensures that civilian sites that have nuclear materials manage them responsibly, and provides nuclear materials for peaceful uses. The M³ Program Office comprises the following four sub-offices:

The **Office of Conversion** works with civilian research reactors that use HEU to convert to low-enriched uranium (LEU) fuel through programs in Europe, Asia, Africa, and North America; provides financial and technical assistance to isotope production facilities that use HEU to convert to LEU for producing the isotope molybdenum-99 (Mo-99), which is used to create technetium-99m (Tc-99m) for medical uses; and provides financial and technical support to U.S. companies to establish reliable, commercial, non-HEU-based Mo-99 production in the United States.

The **Office of Nuclear Material Removal** works with facilities in the United States and internationally to remove and/or confirm the disposition of excess nuclear materials through programs that remove and/or dispose of U.S.-origin WUNM; remove and/or dispose of Russian-origin WUNM; remove and/or confirm the disposition of high-risk “gap” nuclear material that qualifies for removal under neither U.S.-origin nor Russian-origin programs; and maintain and develop the capability to rapidly respond, when tasked, to remove nuclear material from any country of concern.

The **Office of Material Disposition** is responsible for the disposition of surplus nuclear material through programs that disposition surplus plutonium; downblend U.S. excess and repatriated U.S.-origin HEU to produce LEU for peaceful uses such as for civilian reactors, research reactors, isotope production, and inventory for the American Assured Fuel Supply; and work with international partners on technical plutonium management strategies to keep plutonium materials secure and out of the hands of terrorists, and to reduce plutonium stocks over time.

The **Office of Nonproliferation Construction and Program Analysis** is responsible for implementing and monitoring the financial and earned value performance of ongoing work; compliance with program

requirements; integration of the planning, programming, budget and evaluation process; project controls and execution plans; quality assurance; records management; contractor performance feedback; internal controls; lifecycle cost estimates for the surplus plutonium disposition (SPD) liability; and DOE budgeting and financial policies. This office serves as the primary interface with the NNSA Offices of Acquisition and Project Management and Cost Estimating and Program Evaluation.

Program Implementation

Convert international research reactors – Cooperates with international partners to convert research reactors in countries including Kazakhstan, Japan, China, Belgium, France, Germany, and Italy. The work includes LEU fuel testing and qualification as well as supporting facilities to meet regulatory requirements and deadlines for safely using LEU fuel.

Convert domestic research reactors – Qualifies LEU fuels to convert reactors at Oak Ridge National Laboratory (ORNL), Idaho National Laboratory (INL), the National Institute of Standards and Technology, University of Missouri, and Massachusetts Institute of Technology.

Convert international medical isotope facilities – Provides funding and technical support to convert a Belgian radioisotope production facility to LEU-based production, which involves qualifying new targets and adjusting chemical processing of the irradiated targets.

Establish domestic Mo-99 production – Supports the establishment of Mo-99 production in the United States by funding competitively awarded cooperative agreements and awarding non-proprietary laboratory assistance to potential domestic market entrants as shown in **Figure 2-4**.

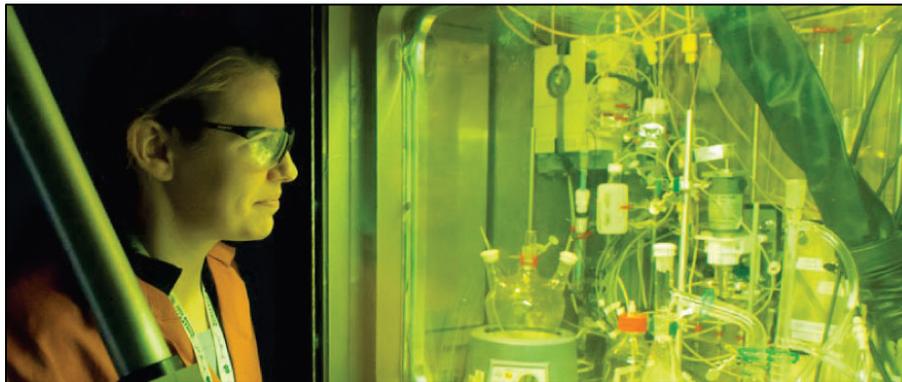


Figure 2-4. Technical expertise is available to existing and potential Mo-99 producers to assist with the conversion of Mo-99 production processes, to use LEU targets, or to develop non-HEU-based Mo-99 production technologies.

Remove or confirm the disposition of HEU and/or separated plutonium – Removes or confirms disposition of excess nuclear material globally.

Conduct emerging threat exercises – Conducts biennial exercises with the interagency and international partners to enhance readiness to quickly and safely recover at-risk WUNM abroad.

HEU Downblending – On-spec disposition

downblends HEU to LEU and comprises the bulk of the HEU Disposition subprogram. The next on-spec disposition campaign is the Downblend Offering for Tritium (DBOT). Although DBOT primarily is a Defense Programs' activity, the HEU disposition subprogram will downblend approximately 2-3 MT of HEU through DBOT through FY 2025. The HEU Disposition subprogram also manages off-spec disposition for material that does not meet the American Society for Testing and Materials standards for commercial nuclear reactor fuel. The subprogram also downblends HEU for research reactors and isotope production facilities around the world that require High-Assay LEU. At the end of FY 2018, 160.4 MT of HEU was dispositioned toward the goal of 186 MT by 2030. By the end of FY 2019, 162 MT of HEU will have been dispositioned.

Surplus Weapon-Grade Plutonium Disposition – Plutonium disposition is one of the largest activities within the DNN portfolio, with a scope that includes construction projects, pit disassembly and conversion operations, downblending and waste characterization activities, and other supporting activities. Near-term priorities include efforts to expedite removal of plutonium from South Carolina, including removal of 1 MT of plutonium by January 2020. DNN is also working on initiatives that will support future expedited removal of additional plutonium from South Carolina, including modifications to the K-Interim Surveillance glovebox to improve the downblend process efficiency; establishing capability at the Savannah River Site (SRS) to characterize and prepare downblended plutonium for shipment from K Area to the Waste Isolation Pilot Plant; and additional incremental shifts for K-Interim Surveillance downblending operations to increase downblend throughputs. The SPD Project design will continue, and, upon congressional approval, the construction and installation of additional gloveboxes and support systems will further increase downblend capability at SRS. The Advanced Recovery and Integrated Extraction System at LANL will be maintained to continue pit disassembly and conversion, and produce plutonium oxide in preparation for future downblend.

M³ – FY 2018 Program Accomplishments and Developments

- Converted an isotope production facility in the Netherlands; M³ funded a portion of Curium’s conversion costs.
- Supported a neutron-capture project by NorthStar to produce the Molybdenum-99 isotope without HEU. In February 2018, the U.S. Food and Drug Administration approved NorthStar’s technology to produce the first domestically-produced, non-uranium based Mo-99.
- Removed or confirmed the disposition of over 352 kilograms of HEU from multiple countries including but not limited to Japan, France, and Canada.
- Completed the lifecycle cost estimate for the dilute and dispose strategy for disposition of U.S. surplus weapon-grade plutonium.
- Dispositioned a cumulative total of 160.4 MT of HEU into LEU;
- Dispositioned 156 items of miscellaneous material forms from Y-12 National Security Complex’s Area 5 and Building 9206, exceeding 135 item discard goal.
- Initiated efforts to remove 1 MT of plutonium from South Carolina by January 1, 2020.

M³ – Future Program Plans

- Continue efforts to qualify LEU fuels to convert high-performance research reactor conversions.
- Test, fabricate, and qualify LEU fuel for research reactor conversions in Kazakhstan, Japan, and Europe.
- Work with the IAEA and China to convert Miniature Neutron Source Reactors in China and other countries.
- Provide technical support for the last remaining global medical isotope production facility in Belgium.
- Convert or verify the shutdown of research reactors and isotope production facilities for a total of 111 facilities converted or verified as shutdown by FY 2024.
- Complete independent validation of the lifecycle cost estimate for the dilute and dispose strategy for disposition of U.S. surplus weapon-grade plutonium.

- Conduct activities associated with expedited plutonium removal, including projects to establish capabilities in K Area, increasing downblend rates by adding downblend operational shifts, and repackaging plutonium.
- Disassemble surplus U.S. nuclear weapon pits and convert the resulting metal into plutonium oxide powder in preparation for future disposition.
- Support the establishment of a reliable, non-HEU supply of Mo-99 in the United States by funding cooperative agreement partners and providing laboratory technical support to the U.S. market entrants as funding is available.
- Remove or confirm the disposition of HEU and/or separated plutonium for a cumulative total of 7,500 kilograms by the end of FY 2024.
- Continue to downblend U.S. surplus HEU into LEU for peaceful use as fuel for commercial or research reactors, reaching a cumulative total of 164.5 MT of surplus HEU downblended or shipped for downblending in FY 2024.
- Complete surplus HEU-legacy material disposal in Building 9206 at the Y-12 National Security Complex in FY 2022.
- Continue work on the SPD project, including: initiating long lead procurements for the SPD project (FY 2020), completing 80 percent of design (FY 2021), and completing 100 percent of final design (FY 2022).
- Complete shutdown of the Mixed Oxide Fuel Fabrication Facility project in FY 2021.

The **Office of Nonproliferation and Arms Control (NPAC)**

The **NPAC Program Office** works to close proliferation pathways to the acquisition of nuclear weapons and weapons of mass destruction (WMD)-related materials, technology, and expertise by executing programs that: build the capacity of the IAEA and partner countries to detect and deter diversion of nuclear materials or illicit use of nuclear facilities; build domestic and international capacity to implement export controls; develop technologies and implement approaches to monitor and verify compliance with nonproliferation and arms control obligations; and develop cross-cutting programs and strategies to address emerging nonproliferation and arms control challenges. The NPAC Program Office comprises four sub-offices:

The **Office of International Nuclear Safeguards** supports activities that build the capacity of the IAEA and partner countries to implement and meet international safeguards standards through programs that develop policies, concepts and approaches, and human capital to strengthen the international safeguards system and provide resources to meet the IAEA's evolving mission; direct the development and testing of tools, technologies, and methods to optimize the effectiveness and efficiency of safeguards implementation and enhance the IAEA's ability to detect non-compliance; strengthen partner country capabilities to fulfill IAEA safeguards obligations; and execute U.S. and international agreements to safeguard and secure U.S.-obligated nuclear material.

The **Office of Nuclear Export Controls** works to build capacity to detect and prevent the illicit or inadvertent transfer of nuclear and dual-use materials, equipment, and technology through programs that strengthen the U.S. Government's ability to prevent and interdict U.S.-origin transfers that would contribute to foreign WMD programs of concern; facilitate legitimate nuclear cooperation; strengthen the ability of bilateral partners to prevent transfers that would contribute to foreign WMD programs of concern; and strengthen dual-use multilateral export control regimes.

The **Office of Nuclear Verification** supports the negotiation and implementation of agreements and associated monitoring regimes to verifiably reduce nuclear weapons and dismantle nuclear programs. The Office develops and strengthens monitoring and verification capabilities for warhead storage, transportation, and dismantlement; plan and implement a comprehensive capability for U.S.-led nuclear dismantlement and verification activities in countries of concern; prepare the United States for future verification and monitoring missions; and lead select fissile material monitoring and verification initiatives undertaken in the United States and in foreign countries.

The **Office of Nonproliferation Policy** works to reduce nuclear dangers through programs that synthesize technical and policy expertise in support of enduring U.S. Government nonproliferation and arms control policy objectives. The Office anticipates and develops strategies to address emerging and persisting threats/challenges to reduce nuclear risks and strengthen the nonproliferation regime; and supports the implementation of bilateral, multilateral, Presidentially-directed, congressionally-mandated or statutorily required nonproliferation and international security initiatives, agreements, and treaties.

NPAC Program Implementation

Safeguards Technology Development – Strengthens international safeguards through development and application of tools, technologies, and methods that improve IAEA effectiveness and efficiency at both facility and state levels, including developing, refining, and adapting existing and emerging technologies for potential specific IAEA safeguards applications; transitioning the technologies from the laboratory into use through demonstration and/or field testing; transferring technologies to the IAEA, partner countries, or commercial vendors, where appropriate; and strengthening safeguards development infrastructure at the National Laboratories.

International Nuclear Safeguards Engagement Program – Works with partner countries and organizations around the world to enhance the implementation of international safeguards in the following areas: reinforce the nuclear nonproliferation/international safeguards regime by promoting IAEA safeguards agreements including universal adherence to the AP; build capacity in foreign partner's State Systems of Accounting for & Control of Nuclear Material; and test tools with advanced partners.

Safeguards Concepts & Approaches – Develops and refines advanced concepts for and approaches to international safeguards that will result in more effective and efficient IAEA verification, often providing a bridge between safeguards policy issues and near-term safeguards technology development. The program develops safeguards approaches for new and prospective nuclear fuel cycle facilities, strengthens safeguards approaches for existing facilities, and examines the safeguards effect on emerging technologies. Priorities include safeguards by design, transit matching, global UF₆ cylinder identification and tracking, and safeguards for geological repositories.

U.S. Voluntary Offer Agreement – Supports implementation of the U.S. Voluntary Offer Agreement through an annual update and maintenance of the U.S. Eligible Facilities List. Oversees safeguards activities at the SRS, including routine inspections and infrastructure upgrades such as seal replacements on IAEA safeguarded material at K Area Materials Storage, and reporting to the IAEA on the progress of ongoing shipments of HEU to the site.

Bilateral Physical Protection Assessments – Oversees U.S. physical protection assessments of foreign facilities holding or expecting to receive U.S.-obligated nuclear material for peaceful purposes and provides foreign partners with recommendations for enhancing security, if necessary. As part of the assessment process, the program leads a U.S. interagency team, which includes representatives from the Nuclear Regulatory Commission (NRC), the Department of State (DOS), and DoD's Defense Threat Reduction Agency (DTRA), to conduct periodic visits to these facilities to verify that their protection

measures are consistent with IAEA guidelines published in IAEA Information Circular/225/Revision 5, *Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities*.

International Export Control Capacity Building – Strengthens global efforts to prevent the illicit or inadvertent transfer of nuclear and dual-use material, equipment, and technology required to manufacture WMD and their means of delivery through involvement with: newcomer/developing partners to help build and strengthen their national export control capacities; advanced partners to share innovation and best practices in the regulation and detection of controlled goods, and to jointly conduct trainings for third countries or regions; and U.S. enforcement agencies to strengthen their capacity to counter illicit WMD-related imports and exports by providing training and ongoing technical reach back through the national laboratories.

Dual-Use Export License Application Reviews – Performs approximately 6,000 statutorily mandated technical reviews of U.S. dual-use export license applications per year for proliferation concerns and returns DOE positions on the applications to the Department of Commerce.

Interdiction Support – Performs approximately 3,000 comprehensive technical analyses per year in support of U.S. agencies overseeing WMD interdiction efforts to help prevent illicit transfers of materials and commodities that could be used in WMD programs of concern.

Arms Control Treaty and Agreement Implementation – Provides policy development, negotiation support, technical capability development and implementation, and compliance analysis for multiple nonproliferation and arms control treaties and agreements, including: the New START Treaty, for which technical capability development is illustrated in **Figure 2-5**, the Chemical Weapons Convention (CWC), the Plutonium Production Reactor Agreement (PPRA); and the Threshold Nuclear Test Ban Treaty (TTBT). The program also provides support to the Comprehensive Nuclear-Test-Ban Treaty (CTBT) Organization and the development and maintenance of the nuclear explosion International Monitoring System and International Data Centre.

Nuclear Verification International Engagement – Works with international partners to identify and assess technical monitoring and verification capabilities for potential future nuclear weapon reduction initiatives, including cooperation with the United Kingdom to develop, exercise, and evaluate monitoring and verification capabilities under the 1958 U.S.-UK Mutual Defense Agreement; work in support of the DOS and Nuclear Threat Initiative-led International Partnership for Nuclear Disarmament Verification (IPNDV); and technical cooperation through the Quad Nuclear Verification Partnership among the United States, United Kingdom, Norway, and Sweden.

Policy Development, Formulation, and Support to U.S. Participation in Multilateral Nonproliferation Regimes – Provides policy and technical support to U.S.-led nonproliferation initiatives and developments



Figure 2-5. SNL designed new radiation detection equipment for New START Treaty monitoring. This new equipment detects neutron levels to confirm that objects are non-nuclear, consistent with the provisions of the treaty. (Photo by Randy Montoya)

in multilateral nonproliferation regimes, including the NPT, Nuclear Suppliers Group (NSG), and Zangger Committee, among others. The program provides technical, policy, and implementation support for U.S. participation in the 2020 NPT Review Cycle in the fields of nonproliferation, disarmament, and the peaceful uses of nuclear energy. The program also provides policy and technical support to U.S. participation in NSG, including the negotiation of updates to the NSG Guidelines, Trigger, and Dual Use lists to capture advanced nuclear technologies, evolution of markets and uses for controlled items, and proliferation developments. The program supports National Security Council (NSC)-led Policy Coordination Committee processes on related nonproliferation, nuclear export control, and disarmament issues. The program also supports DOE/NNSA senior management for their participation in NSC-led senior-level decision making processes.

Regional Engagement – Executes innovative initiatives (Track 1.5 workshops, crisis simulations, and online and media initiatives) to reduce the danger of nuclear war and dissuade the proliferation of nuclear weapons in regions critical to U.S. interests.

123 Agreement Implementation – Provides technical support in the negotiation of all 123 Agreements and leads the implementation of 23 peaceful nuclear cooperation with 48 countries, the IAEA, and the governing authorities on Taiwan and leads negotiations of Administrative Arrangements, which describes the procedures for the implementation of 123 Agreements, including interagency coordination on U.S. nuclear material obligations accountability.

Part 810 Regulation – Administers Part 810 of Title 10 of the Code of Federal Regulations (Part 810) that controls the export of unclassified U.S. nuclear technology and assistance, including transfers of design documents, consulting services, and certain types of software. Part 810 authorizations and 123 agreements are two distinct and different processes based on two separate sections of the Atomic Energy Act. The Part 810 process controls the export of unclassified nuclear technology and assistance. A Part 810 authorization does not authorize the transfer of nuclear material, equipment, or components.

NPAC – FY 2018 Program Accomplishments and Developments

- Cooperated with over 50 countries on effective safeguards implementation.
- Supported Serbia and Liberia in ratification of their APs.
- Worked with six of the 11 states party to the NPT that had not yet brought their Comprehensive Safeguards Agreement into force, including Liberia, who successfully ratified theirs.
- Supported the IAEA in the publication of two safeguards by design guidance documents.
- Provided 17 trainings to U.S. enforcement agencies on export control topics to help prevent the exploitation of the U.S. industrial base for WMD purposes.
- Participated in 65 export control workshops with foreign partners to help strengthen national systems of export control.
- Reviewed close to 6,000 U.S. dual-use license applications for nonproliferation concerns to help facilitate legitimate commerce while preventing proliferation.
- Provided technical analyses of close to 3,000 interdiction cases to help inform U.S. Government interdiction efforts.
- Continued to support policy and technical implementation of multiple arms-control treaties and agreements.

- Successful completion of the U.S.-UK-Norway-Sweden Quad Nuclear Verification Partnership LETTERPRESS arms control verification exercise in the United Kingdom, show in **Figure 2-6**, and continued technical leadership in the IPNDV's Technology Working.



Figure 2-6. In October 2017, NPAC staff and technical experts from the national laboratories participated with representatives from Norway, Sweden, and the U.K. in the Quad Nuclear Verification Partnership's first live-play exercise. The exercise provided practical experience in designing and applying a nuclear weapon-related verification protocol, a realistic testbed for exercising and evaluating monitoring and verification technologies and procedural verification guidelines that could contribute to future verification scenarios.

Sweden in order to meet Sweden's needs for safeguarding future spent nuclear fuel encapsulation.

- Conduct at least six annual physical protection assessment visits to foreign sites holding or requesting to receive U.S.-obligated nuclear material for peaceful purposes.
- Assist the IAEA in the completion of a guidance document to implement the Agency's geological repository safeguards programs.
- Continue diverse and dynamic efforts to promote universal adherence to the IAEA Additional Protocol, IAEA Comprehensive Safeguards Agreements with modified Small Quantities Protocol where applicable, and effective safeguards implementation.

- Conducted eight physical protection assessment visits to foreign sites holding or requesting to receive U.S.-obligated nuclear material for peaceful purposes. Contributed to interagency planning efforts for anticipated near-term on-site deployments of personnel.

- Trained and exercised verification teams on specific facility types and verification tools.

- Reduced processing time for approval of requests to export unclas

- sified U.S. nuclear technology and assistance pursuant to 10 CFR Part 810 by over 40 percent, relative to FY 2017.

- Provided technical assistance to the DOS-led negotiations on the U.S.-UK peaceful nuclear cooperation agreement.

NPAC – Future Program Plans

- Provide technical and technology assistance to support IAEA verification in Iran and, potentially in the Democratic People's Republic of Korea (DPRK).

- Continue implementation of the U.S. – Korea Joint Fuel Cycle Study to evaluate the feasibility of applying safeguards to pyroprocessing.

- Complete spent fuel measurements in safeguarding future spent nuclear fuel

- Complete at least 80 percent or greater of all initial DOE reviews of dual-use export license applications submitted to the Department of Commerce within 25 days of receipt (i.e., five days fewer than required).
- Continue supporting the U.S. Government in the implementation of ongoing arms control and nonproliferation treaties and agreements.
- Demonstrate the U.S.-UK developed Portal Monitor for Authentication and Certification at the Pantex Plant, helping advance potential nuclear weapons monitoring and verification tools for future initiatives.
- Install 2-3 stack monitors at medical isotope producer facilities to understand emissions that may affect global nuclear explosion monitoring.
- Begin to establish independent U.S. nuclear explosion field verification capability.
- Refine detailed specific verification Concept of Operations for potential near-term deployment and train and exercise verification teams on specific verification scenario objectives and verification tools.
- Further streamline the Part 810 review process by implementing new statutory authority for the Secretary of Energy to delegate the approval of certain Part 810 specific authorizations.
- Develop a program to assess and impose civil penalties for violations of the Part 810 regulation.
- Initiate negotiations on NSG controls for fissile material production and separations technologies and advanced nuclear technologies currently not captured by the controls.
- Maintain LLNL's status as a certified analytical laboratory under the international CWC, and maintain its analytical capabilities and readiness for implementation of international CWC verification activities.
- Continue international cooperation to address the long-term technical challenges of verifying nuclear weapons reductions, including through the IPNDV and other bilateral and multilateral initiatives.
- Reinforce DOE's and the broader U.S. Government commitment to the U.S.-ROK 123 Agreement.
- Grow and diversify innovative online initiatives and Track 1.5 activities in South Asia, East Asia, and the Middle East to reduce the danger of nuclear war and dissuade the proliferation of nuclear weapons in regions critical to U.S. interests.

2.2 Counter: Countering Nuclear/Radiological Proliferation and Terrorism

The DOE/NNSA **Office of Counterterrorism and Counterproliferation** (CTCP) has primary responsibility for the “counter” functional area under DOE/NNSA’s nuclear threat reduction mission. CTCP reduces the threat of nuclear proliferation and nuclear and radiological terrorism by applying innovative science, technology, and policy solutions to characterize, detect, and defeat potential nuclear threat devices. By doing so, CTCP counters adversary attempts to acquire the materials, equipment, or expertise needed to develop and use a nuclear or radiological device. CTCP’s counterproliferation efforts also reduce risk across a broad range of proliferation scenarios, including emerging threats.

CTCP leads these missions across DOE/NNSA, generating scientific knowledge that influences a wide range of domestic and international security policies. CTCP also provides liaison offices to key DoD Combatant Commands to coordinate on counterterrorism, counterproliferation, and other issues where DOE/NNSA and DoD share interests. These liaisons ensure that DOE/NNSA’s technical insights and unique capabilities inform DoD contingency planning and support operations.

2.2.1 Program Strategy

CTCP uses specialized knowledge of nuclear threat devices, which includes proliferant weapons, potential IND concepts, and stockpile weapons outside of state control, to inform U.S. and international policy relating to nuclear counterterrorism and counterproliferation. These policies cover a broad spectrum, including security standards for nuclear material storage and transport, search and detection capabilities, nuclear incident response procedures, nuclear forensics methods, and other technical and policy activities in the nuclear threat arena.

One of CTCP’s primary technical responsibilities is to evaluate the vulnerability of nuclear materials and provide the U.S. Government with accurate assessments of nuclear threat device concepts. CTCP develops tools, techniques, and procedures for disabling nuclear threat devices and understanding forensic signatures following a detonation. CTCP’s technical and scientific understanding of nuclear materials and threat devices actively influences emergency response policies at the Federal, state, and local level and contributes to the development of long-term options for disposing of SNM.

CTCP comprises four offices that execute DOE/NNSA’s “counter” and “respond” program strategies under the nuclear threat reduction mission: the Office of Nuclear Incident Policy and Cooperation, the Office of Nuclear Threat Science, the Office of Nuclear Forensics, and the Office of Nuclear Incident Response.

Office of Nuclear Incident Policy and Cooperation

This office develops and implements policy, provides technical solutions, and builds capacity to strengthen domestic and international capabilities in the areas of counterterrorism, counterproliferation, and nuclear incident response. This mission is accomplished through technical assistance, exercises, training, such as the workshop shown in **Figure 2-7**, and operational support for nuclear counterterrorism, emergency preparedness, and incident response activities related to responding to radiological and nuclear incidents, accidents, and terror threats.



Figure 2-7. DOE/NNSA nuclear incident response experts lead a workshop for Indian first responders on response to a “dirty bomb.”

The program office’s strategic objectives are:

- **Advance** U.S. Government nuclear-related strategic objectives at home and abroad, by strengthening and harmonizing global nuclear/radiological incident preparedness and response capabilities.
- **Enhance** international Whole-of-Government preparedness and response coordination, especially highlighting the role of technical expertise in this regard.

- **Expand** insights for domestic operational response capabilities, experience, and approaches through joint exercises and technical studies.
- **Improve** awareness of nuclear/radiological terrorism threats and promote DOE and IAEA 24/7 emergency reach-back resources for all nuclear/radiological emergencies.

Program Implementation

The Office of Nuclear Incident Policy and Coordination strengthens and harmonizes radiological and nuclear incident response policies and practices through international involvement.

Policy Development and Strategic Partnerships – Conducts international and domestic multilateral nuclear incident emergency preparedness and response training, policy development, and capacity building programs.

Domestic and International Engagement – Conducts mutually beneficial engagements to strengthen national, bilateral, and regional capabilities and coordination needed to quickly recognize, characterize, and respond to the broad range of nuclear and radiological threats. Activities include:

- International nuclear/radiological training for emergency response;
- Multilateral nuclear incident preparedness and response policy development;
- Nuclear and radiological technical support and reachback;
- Overseas operational support for major public events and emergencies;
- Radiological medical training for foreign first responders;
- International radiation release predictive modeling capabilities and training;
- International aerial measurement survey equipment, training, and technical workshops; and
- Nuclear incident response and WMD counterterrorism tabletop exercises and senior-level, scenario-based policy discussions.

Preparedness and Operations – Works with interagency and international partners to provide technical support, planning, preparedness, and response training related to major public events as well as nuclear and radiological courses.

Exercises and Interdictions – Leads the Silent Thunder WMD Counterterrorism Tabletop Exercise Program, Eminent Discovery WMD Interdiction Tabletop Exercise Program, and counter nuclear smuggling scenario-based policy discussions in concert with DoD.

FY 2018 Program Accomplishments and Developments

- Conducted five technical exchanges with international partners to advance understanding of radiological and nuclear incident preparedness issues and conducted two national level scenario-based policy discussions focusing on counterterrorism and counter nuclear smuggling with international partners.
- Provided operational support and assistance to international partners for select major public events to enhance radiological and nuclear security activities, protecting U.S. interests.
- Conducted two training courses and tabletop exercises in partnership with U.S. Special Operations Command Pacific to train foreign partner special operations forces to counter transnational radiological and nuclear terrorism threats across the Indo-Pacific region.

Future Program Plans

- Execute international training and tabletop exercises: Conduct new counter-RDD training and tabletop exercises with international technical experts.
- Conduct 19 domestic and international tabletop exercises and scenario-based policy discussions to improve nuclear incident response and counterterrorism capabilities in the United States and worldwide.
- Lead workshops under the Global Initiative to Combat Nuclear Terrorism for health, communications, and law enforcement experts focusing on security best practices to counter nuclear and radiological terrorism threats.

Office of Nuclear Threat Science

This office executes technical activities required to advise and enable all aspects of U.S. Government nuclear counterproliferation and nuclear counterterrorism missions. The Office leverages DOE/NNSA expertise on nuclear weapons design, science, surety, and materials to analyze nuclear threat device concepts. The Office of Nuclear Threat Science also assists and advises the U.S. Government on developing plans and countermeasures against a wide range of nuclear threats and devices, directly supports NSC in developing and implementing nuclear counterproliferation and nuclear counterterrorism policies and leads nuclear threat reduction technical exchange activities with select international partners.

Program Implementation

Threat-based Technical Assessments – Builds scientific and technical (S&T) understanding of nuclear threat devices concepts and develops tools to counter them; strengthens nexus between S&T expertise and national policy, including as it relates to WMD domestic preparedness.

FY 2018 Program Accomplishments and Developments

- Completed a three-year scientific initiative to improve DOE/NNSA capabilities to predict nuclear weapon responses to abnormal environments. Currently transitioning to a sustainment model that enables the response to partner agency requests for assessments, while maintaining and continuing to improve predictive capabilities through modest investments.
- Established new communication infrastructure to support Nuclear Threat Reduction exchanges.

Future Program Plan

- **France, United Kingdom, United States (P3) Activities** – Conduct international exercises and exchanges with P3 partners.
- **Capability Sustainment** – Sustain DOE/NNSA laboratory tools, expertise, and capabilities for specialized nuclear threat assessments.

Office of Nuclear Forensics

This office is the Department's lead organization for nuclear forensics. This discipline involves the technical evaluation of nuclear materials and related items recovered out of regulatory control, with the goal of determining the history and origin of the material or items. The United States maintains effective and dynamic forensics and attribution capabilities to determine the origin of nuclear material or devices used in attempted or actual attacks against U.S. interests. This capability promotes the United States' ability to hold accountable any state, terrorist group, or other non-state actor that supports or enables efforts to employ a nuclear device. This office also sustains nuclear forensic personnel, equipment, key facilities, and operations in support of NSC-sponsored policy initiatives.

Program Implementation

Given the crosscutting nature of nuclear forensics, a number of organizations within the Department make important contributions in this area.

The CTCP Office of Nuclear Forensics is the NNSA office with primary responsibility for nuclear forensics. It maintains the operational capability for pre-detonation device disassembly and forensic examination, provides operational support for forensic response to post-detonation events, and coordinates the forensic analysis of SNM. Pre- and post-detonation nuclear forensics includes the collection of nuclear/radiological materials, devices, and debris, and information on the immediate effects created by

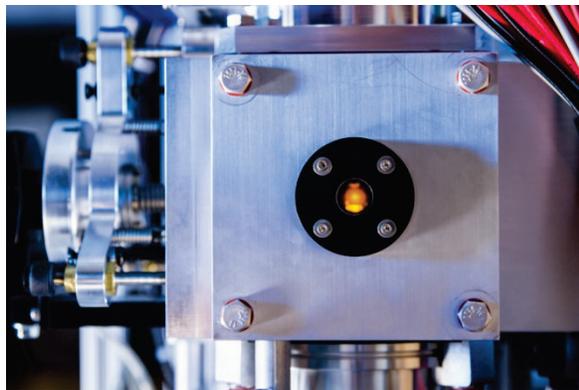


Figure 2-8. LANL is integrating new analysis capabilities in the Center for Aerosol Forensic Signatures, or CAFE, which will be a powerful resource for explosion, combustion, and nonproliferation forensic analysis.

a nuclear detonation, for analysis and evaluation using equipment including the soot-particle time-of-flight aerosol mass spectrometer shown in **Figure 2-8**. To carry out these missions, CTCP maintains a readiness posture to deploy ground sample-collection teams, deploy device disposition and assessment teams, and conduct bulk nuclear material and post-detonation forensics operations.

Other offices within the DOE/NNSA support R&D, international outreach, and intelligence for the forensics mission. DNN R&D conducts research to improve U.S. technical nuclear forensic capabilities. This research is focused on technical areas in which limitations or uncertainties in current techniques exist, as well as areas where emerging technologies may revolutionize nuclear forensic methods. DNN R&D's work in this area supports and is augmented by the threat assessment activities of the CTCP Office of Nuclear Threat Science.

DNN's GMS program works to strengthen foreign partner nuclear forensic capabilities, which are integral to an effective program to deter and counter illicit nuclear smuggling and strengthen the security of nuclear and radioactive material. Finally, the DOE Office of Intelligence and Counterintelligence is responsible for the National Nuclear Forensic Library of the United States.

FY 2018 Program Accomplishments and Developments

- Maintained capability and readiness to respond to pre- and post-detonation events.
- Planned and participated in two Disposition and Forensic Evidence Analysis Team (DFEAT) and two DOE Forensics Operations Team (DFO) nuclear forensics exercises in coordination with DHS, DoD and the Federal Bureau of Investigation (FBI), supporting collection of post-detonation debris.
- The Office of Nuclear Forensics, in coordination with the Office of Nuclear Materials Integration and DOE Office of Intelligence and Counterintelligence, developed a draft program plan for the National Nuclear Materials Archive (NNMA). The NNMA Plan provides technical requirements and evaluation criteria and defines consensus policy on selection prioritization, technical analysis, and anticipated management of NNMA materials.

Future Program Plans

- Conduct two DFEAT exercises and one DFO/Ground Collection Task Force field exercise per year, in support of maintaining nuclear forensics capabilities.
- Continue preventive and corrective facility maintenance at P-Tunnel, NNSS, for support to the Pre-Detonation Device Program, and address broader infrastructure improvements at NNSS.
- Post-detonation Device Assessment: Test, finalize, and operationalize post-detonation device assessment procedures in support of interagency nuclear forensics and attribution.
- Collaborative Materials Exercise-6: Complete analysis of materials to meet Bulk Special Nuclear Material Analysis Program testing requirements and to support International Technology Working Group for Nuclear Forensics.
- NNMA: The Lead Materials Management Organization will determine the initial demand for how many nuclear material types will be required for the NNMA, as well as which forensics characterization tests will be needed, and when they will be conducted. An NNMA Program Plan is being developed for execution beginning in FY 2020.
- Maintain pre- and post-detonation forensics technical and operational readiness and capabilities.

Office of Nuclear Incident Response

The Office of Nuclear Incident Response primarily supports the “respond” function and is described in full in Chapter 2.3, but also has notable accomplishments, developments, and future program plans in support of the “counter” function.

FY 2018 Program Accomplishments and Developments in support of Counter

- Stabilization Operations, in conjunction with the Office of Nuclear Threat Science, has recommended operational deployment of the next generation of capabilities to Level V cities (cities with DOE/DOJ defined equipment and training capabilities) in accordance with the FY 2020 Capability Forward concept.
- Completed Render Safe/Joint Technical Operations Team (JTOT) response posture analysis. A coordinated process with Headquarters and the national laboratories for JTOT 2020 is a collaboration of two nuclear assessment teams, one at LLNL, and one at LANL.
- MC-15 production: The Render Safe programs of the JTOT and Stabilization Operations received and fielded 40 MC-15s, compact, portable neutron multiplicity counters. JTOT provided to the 21st Ordnance Company a sufficient quantity and applicable training to meet the requirements of Phase 2 operational posture. Stabilization Operations has successfully demonstrated MC-15 operations during the Marble Challenge exercise and is in the process of providing this capability to the Level V cities in accordance with interagency coordination.

Future Program Plans in support of Counter

- Exercise a nuclear counterterrorism scenario overseas with DoD partners.
- Sustain capability in existing Stabilization cities, including training and equipment maintenance. CTCP will conduct Stabilization training and operations and begin transitioning to the Capability Forward initiative, under which life-saving responses to a nuclear threat device will be accelerated. Under this initiative, NNSA will provide training, equipment procurement, and technical support to the current 11 Stabilization cities – eventually growing to 14 U.S. cities by FY 2022 – to facilitate FBI teams to execute render safe operations far more quickly and confidently. CTCP will also improve and expand NNSA training facilities to accommodate the increased training requirements associated with regional render safe capabilities.

2.3 Respond: Responding to Nuclear/Radiological Threats and Terrorism

Under DOE/NNSA's nuclear threat reduction mission, CTCP and the Office of Emergency Operations have primary responsibility for the "respond" functional area. Together, these offices coordinate efforts to reduce the risk of nuclear and radiological terrorism and enhance the Department's overall emergency preparedness.

Within CTCP, the Office of Nuclear Incident Response works to diminish the value of nuclear or radiological weapons and devices to terrorist and would-be proliferant states. CTCP's incident response team is the premier technical leader in responding to and successfully resolving nuclear and radiological accidents and incidents worldwide. CTCP's core competencies include specialized knowledge of U.S. nuclear weapons, nuclear threat devices, and RDDs, as well as expertise in spectroscopy, device modeling and assessment, radiography, atmospheric and radiological environmental modeling, dose assessment, and health physics. The Office manages programs and provides on-call personnel and equipment to respond immediately to any type of nuclear or radiological accident or incident worldwide. Response assets support missions in the areas of preventive nuclear and radiological detection, threat-based nuclear search, render safe, and radiological consequence management.

Emergency preparedness includes the ability to manage and/or coordinate other types of emergencies, such as natural disasters affecting DOE/NNSA laboratories, plants, and sites. The Department's Emergency Management Enterprise, which includes CTCP's Nuclear Response Assets and the response and recovery efforts across the Department, initiated phased process improvements that culminated in the achievement of initial operational capability of an enterprise-wide, all-hazards Unified Coordination Structure (UCS) during the first quarter of FY 2017, which is planned to be fully operational by December 2020. The UCS prompts all program offices to retain authorities and responsibilities while integrating into a Headquarters-level, National Incident Management System compliant organization. Such integration ensures a Department-wide coordinated effort as necessary and prudent, particularly in the case of a "cascading event," such as a major hurricane that affects the mission critical activities of NNSA or DOE laboratories, plants, or sites in its path.

The Office of Emergency Operations is the Department's emergency management primary office of interest pursuant to DOE Order 151.1D. In this role, the Office is responsible for administering and directing the implementation and integration of emergency management programs across DOE/NNSA. The Office of Emergency Operations also provides necessary governance and operational support to the Emergency Management Enterprise throughout the improvement process, and ensures the full cooperation, coordination, and involvement of the all-hazards emergency management community in this enduring improvement effort. The Office of Emergency Operations mission includes responsibility for the trainings, exercises, policies, procedures, and supporting infrastructure that enables CTCP and other DOE program staff to carry out emergency management and response duties in a coordinated manner. The Office is also responsible for planning and program management related to the DOE/NNSA continuity program, and associated continuity of operations (COOP) and continuity of government (COG) activities that ensure DOE/NNSA Primary Mission Essential Functions are sustained through any crisis event in accordance with Presidential Policy Directive 40 (PPD-40).

2.3.1 Program Strategy

DOE/NNSA has adopted an integrated enterprise-wide, all-hazards approach to emergency management that focuses on capacities and capabilities that are critical to preparedness for a full spectrum of emergencies or disasters. This approach includes a unified emergency response strategy, common

standards and procedures for emergency preparedness and response, and centralized coordination of DOE/NNSA's various emergency operations components during all-hazards emergencies. While building on the unique capabilities necessary to ensure public health and safety, the Secretary and the Administrator have focused on the implementation of a risk-based, all-hazards strategy that builds those capabilities throughout the complex necessary to prepare for, protect against, respond to, recover from, or mitigate against natural disasters, acts of terrorism, and other man-made disasters.

The Emergency Management Enterprise is closely coordinated with Federal, state, local, tribal, and territorial entities through the efforts of the field offices, sites, and facilities. This coordination is guided by interagency directives, including PPD-8, PPD-40, and Homeland Security Presidential Directive (HSPD) 5. PPD-8 requires the development of National Planning Frameworks that set national strategy and doctrine for emergency preparedness, as well as Federal Interagency Operational Plans, used to integrate and synchronize capabilities across federal agencies. PPD-40 requires preservation of government structure under the United States Constitution, and the continued performance and delivery of essential functions under any conditions. HSPD-5 requires NNSA to use National Incident Management System compliant emergency management procedures to enhance integration across the U.S. Government and with State and Local partners.

The enterprise-wide approach to emergency management improves the Department's ability to respond to emergencies across the all-hazards spectrum. It ensures that DOE/NNSA crisis response and consequence management assets are fully integrated into a UCS to leverage delegated authorities and promote unity of effort. Such integration ensures more effective departmental emergency management in coordination with other national and/or international response elements.

Office of Emergency Operations

The Office of Emergency Operations provides necessary governance and operational support to the Emergency Management Enterprise throughout the improvement process, and ensures the full cooperation, coordination, and involvement of the all-hazards emergency management community. The Office uses the experience and expertise of its workforce combined with technical innovations to provide DOE/NNSA with comprehensive tools in the event of an emergency response. The Office of Emergency Operations also uses partnerships and collaborations to advance its programmatic goals, including close coordination with federal, state, local, tribal, and territorial agencies through the efforts of the NNSA Field Offices, sites, and facilities.

The Office of Emergency Operations comprises four offices:

The Emergency Management Programs Division

The Emergency Management Programs Division is responsible for the development, coordination, integration, and technical support of enterprise-wide emergency management concept for plans, technical guides, procedures, training, exercises, and operations management while complying with DOE policies and requirements. The Division is the lead for the UCS that synchronizes the Department's response support to all-hazards emergencies, incidents, and special events.

The Consolidated Emergency Operations Center

The Consolidated Emergency Operations Center is responsible for the operation, communications, and infrastructure of all Headquarters-level emergency management coordination, control, and communications nodes supporting DOE/NNSA emergency management and operations efforts as illustrated in **Figure 2-9**.

The Consolidated Emergency Operations Center is further responsible for the alert, warning, and dissemination of information received from DOE/NNSA, interagency, or foreign partners. The Consolidated Emergency Operations Center manages and maintains the Emergency Communications Network to provide non-secure and secure voice, video, and data information in support of Departmental emergency response, and national asset support. The Consolidated Emergency Operations Center manages the Watch Office, which is open 24 hours a day.



Figure 2-9. The Consolidated Emergency Operations Center is staffed around the clock with emergency operations professionals and provides real-time situational awareness and synchronizes interagency and governmental support to private sector emergency management functions for any all-hazards or national security events.

The Continuity Programs Division

The Continuity Programs Division coordinates and manages the Department's COOP, COG, and Enduring Constitutional Government Programs, assisting the Secretary of Energy and NNSA Administrator, and their staffs or other designated officials, in executing PPD-40.

The Emergency Operations Policy Division

The Emergency Operations Policy Division develops, coordinates, interprets and maintains the DOE and NNSA emergency management directives, guidance, reports, and procedures in collaboration with national and international level emergency management policymakers and stakeholders.

Program Implementation

The Emergency Operations Policy Division manages several essential systems and programs including:

- DOE's Comprehensive Emergency Management System and policy, requirements, standards, guidance, and corresponding implementation guidance for emergency planning, preparedness, technical planning basis, readiness assurance, and response activities for the DOE/NNSA sites and facilities.
- A comprehensive Homeland Security Exercise and Evaluation Program compliant exercise program.
- The ECN, which is ready to provide non-secure and secure communications in the event of a Departmental emergency response.

The Emergency Operations Policy Division provides subject matter expertise and technical assistance to sites and facilities addressing internally and externally identified findings and opportunities for improvement. Further responsibilities include maintaining a Readiness Assurance Program, involving assessment, operational awareness, issues management systems, and support of validation and verification activities of corrective actions, including limited scope communication drills, and performance tests. The Division also prepares for and supports an integrated enterprise-wide command structure for DOE to manage and synchronize all-hazards emergencies, incidents and special events from response through recovery.

Finally, The Emergency Operations Policy Division coordinates daily with the interagency, DOE/NNSA program offices, and laboratories, plants, and sites across the enterprise to maintain a common operating picture, and is responsible for the operation of the 24/7/365 single point of contact for DOE and NNSA alerts, warnings, and notifications.

Office of Emergency Operations FY 2018 Program Accomplishments and Developments in support of Response

- Provided subject matter expertise support in public information, consequence assessments, atmospheric and meteorological data, threat and hazard identification and risk assessment, and exercise design training throughout the complex.
- Developed, coordinated, and pilot tested the draft standardized Emergency Management Criteria Review and Approach Document and conducted a pilot test process at five DOE/NNSA sites: Hanford Site in Richland, Washington; LANL in Los Alamos, New Mexico; PANTEX Plant in Amarillo, Texas; SNL in Livermore, California; and Y-12 National Security Complex in Oak Ridge, Tennessee, with the cooperation and synchronization of the DOE Offices of Enterprise Assessments, Science, and Environmental Management, and the NNSA Program Office.
- Completed technical revision of DOE Guide 151.1-1A, Emergency Management Fundamental and the Operational Emergency Base Program; initiated revision of DOE Guide 151.1-2, Technical Planning Basis, to align with revised and issued DOE Order 151.1D, Comprehensive Emergency Management System.
- Provided enterprise-wide access to the Emergency Management Knowledge Management System and trained partners on the use of the system.
- Conducted 14 Emergency Management Technical Support Assist Visits throughout the enterprise, accelerating programmatic review of documents and implementation of established emergency operational requirements (Emergency Planning Hazard Assessments, Emergency Management Planning Zones, Emergency Planning Guidance documents, etc.).
- Conducted eight Federal Emergency Management Agency Continuity Course offerings at four Headquarters and field locations, delivering training to 130 DOE/NNSA participants.
- Led active participation in maturing the Department's Independent Emergency Management Oversight Program.
- Led the comprehensive coordination synchronization of the emergency management focused Corrective Action System, the Integrated Safety Management System, and the Lessons Learned System to mature and sustain DOE risk-based approach to emergency management.
- Completed baseline continuity plan assessments for all DOE and NNSA Headquarters and field Federal organizations.

- Completed a comprehensive revalidation of DOE and NNSA Primary and Mission Essential Functions.
- Developed and executed two continuity exercises, Eagle Horizon 2018 (**Figure 2-10**) and Mid-Year Continuity Tabletop Exercise.
- Developed classified and unclassified executive-level continuity program briefings for Secretary, Deputy Secretary, Deputy Chief of Staff, NNSA Administrator, and other senior leadership.
- Continued its emphasis on the successful adoption of an enterprise-wide, all-hazards approach to emergency management. Significant program accomplishments in FY 2018 include the successful integration of the DOE/NNSA COOP Emergency Relocation Group and the Department’s Unified Coordination Group during Eagle Horizon, resulting in economy of scale and unity of effort during a simulated national-level emergency.
- Sustained ECN infrastructure through effective and innovative real estate management, telecommunications strategies, and hardware/software service strategies.
- Sustained a 24/7/365 Emergency Operations Center and restructured the DOE Daily Operational Brief for optimal senior leadership situational awareness.
- In coordination with NNSA’s Office of Management and Budget, managed Alternate Operations Center and Consolidated Emergency Operations Center facility renovations and recapitalizations to meet security and increased use needs.
- Successfully accomplished Outside the Continental United States Mobile Emergency Communications Network deployment test cycle. Test validated mission support readiness to vital, ongoing nuclear nonproliferation planning.
- Extended MECN communications capability to DTRA mission partner, aiding them to meet their mobile requirements.



Figure 2-10. The 2018 national-level Eagle Horizon exercise held in May was “Atlantic Fury” and simulated the coordinated response to a Category 3 hurricane impacting Virginia, Maryland, Pennsylvania, Delaware, and the District of Columbia.

Office of Emergency Operations Future Plan in Support of Response

- Complete revision of the Concept of Operations for the UCS to document how Headquarters will coordinate emergency management activities in an all-hazards environment
- Complete development of an Operations Plan for the UCS to define how the Department will work together and promote unity of effort during the response to an all-hazards incident, event, or emergency.
- Ensure that the Emergency Management Enterprise has an effective and efficient capability to respond to and coordinate an all-hazards incident.
- Synchronize department-wide participation and execution of comprehensive exercises to ensure emergency response preparedness and coordination.
- Provide dedicated continuity communications capabilities that support the DOE/NNSA Mission Essential Functions.

- Continue to provide dedicated redundant communications capabilities that support DOE/NNSA emergency operations (mobile response, Emergency Operations Center/Watch Office) and National Response Framework related efforts. These functions will be accomplished through an available, compliant, confidential, effective, secure, protected, and resilient network.
- Upgrade/Hosting Transfer to a more secure and resilient facility.
- Develop fully trained response coordination teams in support of a scheduled Watch Bill.
- Complete ECN modernization efforts by transferring the applicable data center to a third-party facility and upgrading network equipment on the ECN to meet current and near-term future security, operational, reliability, and expandability efforts.
- Enhance automation and near real time operational awareness of Emergency Management Enterprise Readiness Assurance performance metrics and program implementation.

CTCP's Office of Nuclear Incident Response

The CTCP Office of Nuclear Incident Response manages the Department's incident response assets that support nuclear counterterrorism, counterproliferation, crisis response, and consequence management. The Office directs, organizes, trains, and equips federal, laboratory, plant, and site personnel to respond to any domestic or international nuclear and radiological accident or incident in support of the requesting Federal, state, local, tribal, or foreign government. The Office also maintains a level of operational readiness to meet departmental and national requirements.

Program Implementation

Radiological and Nuclear Search Operations – Provides deployable and reachback scientific and technical resources in support of nuclear or radiological search operations for either threat based or planned law enforcement activity.

Radiological Identification – Provides secure online nuclear and radiological expertise to first responders within 30-60 minutes of receipt of data (DOE Triage).



Figure 2-11. Created almost 50 years ago, the Accident Response Group (ARG) is a group of volunteer emergency responders, like a volunteer fire department, made up of experts at the top of their field. Volunteers are on call on a rotating basis for the initial phase of response. The ARG can expand to a team of about 50 experts for round-the-clock field operations.

Stabilization – Provides scientific and technical support through technical reach back during the initial stages of a RDD or an IND event.

Nuclear Render Safe – Provides scientific and technical support during all aspects of a nuclear or radiological WMD terrorist incident via the Render Safe Stabilization Operations and JTOT.

Nuclear Weapon Incident Response – Provides worldwide support and technical management in resolving accidents or incidents involving U.S. nuclear weapons or weapons components via the ARG highlighted in **Figure 2-11.**

Radiological Monitoring – Provides aviation-based wide-area radiological survey capability via the Aerial Measuring System (AMS) and ground-based capabilities via the Federal Radiological Monitoring and Assessment Center.

Radiation Medicine – Provides 24/7 advice and medical consultation to medical assets treating radiation victims via the Radiation Emergency Assistance Center/Training Site (REAC/TS).

Operations and Exercises – A cadre of exercise planners, controllers, and evaluators provide advisory, technical analysis, and coordination support roles within NNSA and for Federal, state, and local partners in nuclear/radiological response operations and exercise training events. Exercises are also conducted in collaboration with international partners to improve counterterrorism capabilities in the United States and worldwide.

CTCP FY 2018 Program Accomplishments and Developments in support of Response

- Working in concert with other Federal, state, and local departments and agencies, provided radiological detection and analytical support to four planned national level security events, including a National Special Security Event and over 50 regional events.



Figure 2-12. DOE/NNSA emergency response experts participated as observers in Japan’s annual full-scale Nuclear Disaster Preparedness Drill.

- Participated in three major national-level exercises and two outside the continental United States, including one in Japan featured in **Figure 2-12**, aimed at ensuring the nuclear response community is prepared to respond to a nuclear threat.

- Maintained operational readiness to respond to a radiological and nuclear emergency.

- Deployed secure communications kits 28 times, both within and outside the continental United States, in support of exercises, turnover drills, and training evolutions. Added the mobile ad hoc network capability to select kits to provide reliable communications in urban canyon and

underground environments. Outfitted with Communications on the Move (COTM) to support maritime environments.

- Conducted training on medical management of radiation injuries at the REAC/TS domestically and internationally for students from over 25 countries.
- Conducted 19 tabletop exercise training events that trained over 1,390 emergency response personnel, and successfully implemented new training on Radiological Awareness and Emergency Public Information in conjunction with select domestic tabletop exercise events. These activities strengthen and harmonize emergency preparedness and response capabilities for the United States and its partners.

- Provided technical expertise and training to advance the IAEA, Incident and Emergency Center as the global focal point for emergency preparedness and response for nuclear and radiological safety- or security-related incidents, including coordination of international assistance.
- Led workshops in partnership with the IAEA to coordinate response and assistance capabilities focusing on national response planning, radiation detection and monitoring, nuclear security measures at ports, and medical preparedness and response.
- CTCP held the chairmanship of the Emergency Preparedness and Response Standards Committee at the IAEA to review and approve IAEA safety standards in the area of emergency preparedness and response, which are used by Member States to develop and maintain their national emergency preparedness and response systems.
- Provided nuclear incident response expertise to the Global Initiative to Combat Nuclear Terrorism Radiological Emergency Management Exercise for more than 80 players from Argentine and Chilean nuclear regulatory authorities, technical agencies, national police and law enforcement agencies, and included more than 20 observers and facilitators from Russia, Peru, Panama, Mexico, and Nigeria.

CTCP's Future Plan in Support of Response

- In response to a recognized need to maintain cutting-edge and modern equipment for its subject matter experts, CTCP has centralized the process of equipment recapitalization to ensure transparency of costs and prioritization of effort across the organization. CTCP will continue efforts for full recapitalization of critical incident response equipment and aerial measuring system aircraft that are beyond their planned life cycle and transition to a lifecycle equipment replacement approach. Full equipment recapitalization is expected by FY 2027.
- Implement an enterprise equipment recapitalization coordination tool that will ensure schedule and priority for procurement decisions: CTCP has developed a cloud-based tool to allow its response programs to communicate their emerging and ongoing equipment needs to the equipment recapitalization program directly and collaboratively prioritize them. This tool is currently being deployed across the Office of Nuclear Incident Response and will be used to ensure efficient management of currently appropriated funds and provide additional clarity for future year planning.
- In partnership with FBI, initiate a deliberate national decision process on the long-term requirements for Tactical Radiological Nuclear Search Operations
- Increase the Radiological Assistance Program's (RAP) role within the national response framework and promote state and local relationships.
- Develop and implement the Improvement and Lessons Learned Program.
- Exercise a nuclear counterterrorism scenario overseas with DoD partners.
- Exercise CTCP response to a nuclear weapon incident with interagency partners.
- Increase cooperation and coordination between the ARG and the nuclear weapons complex at the federal and laboratory levels.
- Conduct a Joint Assistance Team response exercise in the United States with international partners to exercise a multinational response to a large-scale radiological emergency.
- Conduct Radiological Awareness and Emergency Public Information Office training for first responders and public information officers in the United States focusing on best practices for crisis

communications and communicating risk to the public during and after a nuclear or radiological emergency.

- Conduct six North Atlantic Treaty Organization (NATO) and DoD nuclear/radiological incident response courses and workshops to provide first responders, radiation protection specialists, and emergency personnel with practical information to effectively implement mission planning and respond to radiological incidents and accidents.
- Conduct workshops and training on responding to radiological emergencies, securing major public events from threats, and countering RDDs with international partners.
- Conduct technical exchanges with advanced international partners on aerial measuring.

2.4 Ensuring World Class Infrastructure and Workforce

The infrastructure and human capital base are important areas of focus within DOE/NNSA. Specifically, DOE/NNSA’s vision for the future includes the following two desired outcomes:

1. An adaptive, agile, responsive, and resilient nuclear security enterprise hedged against geopolitical and technological surprise and able to meet evolving military and nonproliferation requirements, and
2. An empowered workforce with a unified leadership that provides innovative, cost-effective, and timely technical solutions to meet challenges with minimized schedule and operational risks.

Even as DOE/NNSA continues to modernize its infrastructure, nearly 60 percent of facilities are more than forty years old. The age and condition of DOE/NNSA facilities impose mission challenges. Accordingly, DOE/NNSA is prioritizing strategies to address infrastructure issues across the enterprise to ensure continuity of mission. DOE/NNSA remains vigilant, working to recapitalize the enterprise to anticipate and plan for the future.

The DOE/NNSA workforce is aging. Forty percent of the laboratory, plant, and site workforce will be eligible for retirement within five years. At the same time as the DOE/NNSA staff will attrite at high rates, the enterprise’s demand for skilled workers is increasing. Filling open positions remains a challenge due to the requirements for obtaining security clearances, difficulty attracting people with the proper technical backgrounds and poor infrastructure that works against recruitment. DOE/NNSA continues to aggressively recruit the next generation workforce, develop staff with programs like those explained in **Figure 2-13**, and prepare succession plans in a corporate wide approach.



Figure 2-13. The Mid-level Leadership Development Program (MLDP) develops the next generation of DOE/NNSA leadership through a year-long program for future leaders to develop core competencies such as emotional intelligence, conflict resolution, team building, and project management.

In September 2018, the NNSA Administrator launched a team with the purpose of developing a nuclear security enterprise workforce strategy to attract and retain the best and brightest from colleges, universities, trade schools, community colleges, and industry to build a capable workforce necessary to sustain our nuclear security missions across all sites.

Each site within the enterprise has a common need to attract and retain a highly talented labor pool across hourly and salaried functions. These functions are the essential bloodline required to support DOE/NNSA’s strategic national security mission. This has become even more important with the aging workforce within the nuclear security enterprise and the loss of those with nuclear weapons design and production expertise and the renewed need to re-establish this capability.

Across the laboratories, plants, and sites of the nuclear security enterprise, the broad array of complex corporate structures, history, legacy, and new entrants has resulted in different systems, processes, and approaches to attracting and retaining employees. Differences in regional hiring expectations, corporate governance oversight, and legacy approaches have resulted in fragmented and isolated systems across the enterprise, added risk and cost, limited pools of candidates, and diluted the identification of the NNSA brand. To change this culture, DOE/NNSA is pursuing shifts in philosophies and behaviors to compete with highly aggressive commercial entities in the current environment for the “best and the brightest”.

DOE/NNSA is working on a framework of a focused approach to attract and retain a talented labor pool across the enterprise and facilitate broader and better recruitment throughout the enterprise. Key initiatives include developing and marketing a “nuclear security enterprise” brand, a unified collaborative recruiting initiative, and strengthening university relationships. In 2019 NNSA instituted Nuclear Security Enterprise Days beginning with four universities identified as being institutions that all sites recruit from for critical hiring in the cyber and engineering fields: Georgia Institute of Technology, Texas A&M, Purdue University, and University of California, Merced.

2.4.1 Infrastructure Base and the Nuclear Risk Reduction Mission

DOE/NNSA programs to prevent nuclear proliferation and nuclear and radiological terrorism rely on a diverse infrastructure, including laboratories, experimental facilities, test beds, high-performance computing, and material disposal facilities. The facilities supporting this programmatic work are often owned and primarily funded by other DOE/ NNSA program offices, with DNN, CTCP, or the Office of Emergency Operations serving as one of many facility users. Many of these assets are at DOE/NNSA’s laboratories, plants, and sites, while others are located at sites operated by other DOE offices, including the Offices of Science, Nuclear Energy, and Environmental Management. Facilities are leveraged to support NNSA’s aligned and integrated missions in nonproliferation, counterterrorism, emergency response, and weapons activities. Examples of some of the most distinctive and specialized experimental facilities supporting the DOE/NNSA mission are described below.



Figure 2-14. SRS’s H-Canyon, operational since 1955, contains a processing area 1,028 feet long, 122 feet wide, and 71 feet tall, and is the only hardened nuclear chemical separations plant still in operation in the United States.

The M³ program receives and stores spent nuclear fuel removed from foreign countries in fuel basins at SRS and INL; receives and downblends Mo-99 HEU Target

Residue Materials to LEU at the H-Canyon chemical separations facility at SRS, shown in **Figure 2-14**; receives and stores plutonium removed from foreign countries at the K-Area Material Storage facility at SRS; receives and stores un-irradiated HEU from foreign countries at the Y-12 National Security Complex; develops LEU fuel for research reactors using the Advanced Test Reactor and the Fuels and Applied Science Building at INL as well as Building 208 at Argonne National Laboratory (ANL); and uses the TA-55 Plutonium Facility at LANL to convert various forms of plutonium to oxide for ultimate disposition.

The NPAC program conducts nonproliferation and safeguards training at a wide variety of laboratory facilities, including the Hazardous Materials Management and Emergency Response (HAMMER) training facility at the Hanford Site, safeguards laboratory at ORNL, and the Advanced Test Reactor, in **Figure 2-15**, and safeguards lab at INL. NPAC also supports a network of national laboratories that provide analytical support for IAEA safeguards. This network includes specialized facilities at LLNL, LANL, ORNL, PNNL, and SRS. The GMS program uses a test bed for radiation portal monitors and physical security components at PNNL, LANL, and ORNL. GMS uses the DOE National Training Center's Integrated Safety and Security Training and Evaluation Complex and the HAMMER facility to train foreign partners on guard force performance, testing best practices and the use of radiation detection equipment. GMS also uses HAMMER and training areas at SNL, LANL, ORNL, PNNL, and the Y-12 National Security Complex for domestic and international training. GMS also provided training on developing and attesting standards, and improving destructive analysis laboratory techniques to make more accurate measurements. Some of the most distinctive and specialized experimental facilities supporting DNN and CTCP missions include:

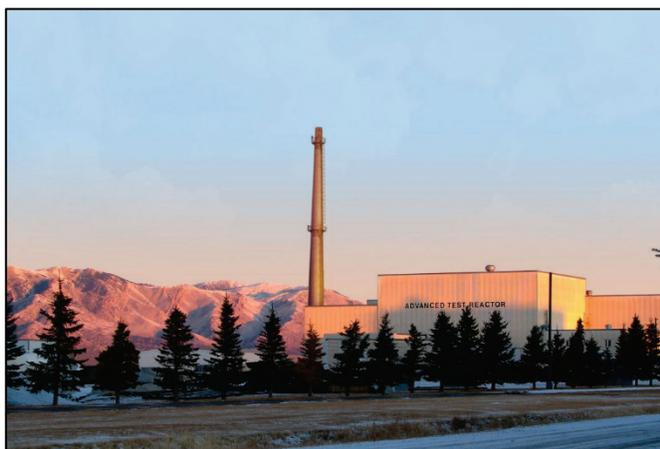


Figure 2-15. INL's Advanced Test Reactor makes it possible to study the results of years of intense neutron and gamma radiation on reactor materials and fuels in only weeks to months.

- LANL gas guns, Ancho Canyon, the Dual-Axis Radiographic Hydrodynamic Test facility, the Los Alamos Neutron Science Center, and the Proton Radiography Facility;
- LLNL Superblock, Contained Firing Facility, Site 300, High Explosives Application Facility, the National Atmospheric Release Advisory Center, and gas guns;
- SNL Z Facility and Thunder Range; and
- NNS National Criticality Experiments Research Center, Joint Actinide Shock Physics Experiment Research gas gun, P-tunnel, the Dense Plasma Focus, the Big Explosives Experimental Facility, and the Baker Compound.

CTCP, through the Office of Nuclear Threat Science, is responsible for developing the scientific and technical knowledge that explores potential nuclear threats. These efforts rely primarily on two types of infrastructure: high-performance computing platforms and experimental facilities to refine and validate predictive models. These assets serve as essential resources for CTCP and provide a prime example of leveraging DOE/NNSA infrastructure for multiple national security missions.

Developing and validating these computational codes depends on specialized experimental facilities, primarily at LLNL, LANL, and SNL. This infrastructure is principally dedicated to and supported by the Stockpile Stewardship Program (SSP), with limited, supplemental funding from CTCP as appropriate.

CTCP taps into a diverse infrastructure base comprised of specialized facilities, vehicles, and equipment that supports the DOE/NNSA incident response and operations mission. These assets help ensure that the U.S. Government has quickly deployable, dedicated resources capable of responding to nuclear or radiological incidents worldwide, and the emergency management infrastructure required to coordinate the response effort.

CTCP uses the DOE/NNSA AMS, housed at NNS Remote Sensing Laboratory facilities, to provide airborne remote sensing in the event of a nuclear or radiological accident or incident within the continental United States, and in support of high-visibility national security events. The National Atmospheric Release Advisory Center, located at LLNL, develops sophisticated radiological contamination models in the event of a nuclear or radiological incident and rapidly disseminates these models to emergency response officials and specialized DOE/NNSA nuclear incident support teams.

The REAC/TS, located in Oak Ridge, Tennessee, maintains 24-hour readiness to respond to incidents of radiological exposure by providing medical consultative assistance or deploying personnel and equipment for direct medical care shown in **Figure 2-16**.



The Emergency Communications Network is a multi-faceted communications system for managing emergency situations that involve DOE assets and interests. The Forrestal Watch Office, located at DOE Headquarters, serves as the 24-hour single point of contact for collecting, processing, and disseminating time-sensitive emergency notifications. Emergency Operations Centers, located at laboratories, plants, and sites across the DOE/NNSA enterprise, are facilities specially designed to support continuous emergency operations for extended periods of time, even under hazardous conditions. Finally, the Emergency Operations Training Academy, located in Albuquerque, New Mexico, provides state-of-the-art training and education for DOE/NNSA to enhance the readiness of personnel in the emergency operations community.

Figure 2-16. The REAC/TS at the Oak Ridge Institute for Science and Education (ORISE) maintains a collection of radiation emergency medicine information and resources that support the medical response and treatment of victims. Resources include technical reports, pharmaceutical package inserts and videos.

2.4.2 Infrastructure Challenges

Effects of Aging Infrastructure

The condition of nearly one-third of NNSA infrastructure is insufficient to meet mission needs. Nearly 60 percent of DOE/NNSA's facilities are over 40 years old, nearly 30 percent date to the early Cold War era, and 10 percent are currently excess and no longer needed.

Effects of Potential Facility Closures on CTCP Programs

Efforts to consolidate infrastructure offer tremendous benefits across the nuclear security enterprise, but they also pose potential challenges to the counterterrorism and counterproliferation missions that must be carefully managed. CTCP relies almost exclusively on infrastructure maintained and primarily used by the SSP, including experimental facilities, computational and modeling assets, and explosives facilities and capabilities. While CTCP may use just a small portion of these assets' total capacity, this limited use supports unique and critical national security efforts. Moreover, while similar experimental facilities may exist at multiple locations, there are often important differences in the capabilities of these facilities that are highly relevant for the CTCP mission. CTCP is coordinating closely within DOE/NNSA to ensure that potential infrastructure consolidation decisions do not adversely impact its mission.

Equipment Recapitalization for Response Assets

The core of DOE/NNSA's emergency response capability is a cadre of deployable personnel who are trained to respond to nuclear or radiological incidents. Effectively equipping these response teams with the necessary, highly specialized equipment, can pose significant challenges.

- The threat of nuclear and radiological terrorism is inherently dynamic, and changes in the threat environment can prompt requirements for new or updated equipment.
- The evolving nature of the cybersecurity environment and national cybersecurity standards can also prompt changes in equipment requirements.
- The nuclear incident response mission is closely coordinated with multiple interagency partners, including FBI. Equipment interoperability across organizations is therefore critical, especially for communications equipment. Such systems must be highly mobile, reliable, and secure. Equipment must be periodically replaced as it reaches the end of its useful life.
- The DOE/NNSA AMS detects, measures, and tracks radioactive material in an emergency to determine contamination levels. The AMS mission has two operational modes with unique requirements: 1) rapid On-Call Response to provide coarse characterization of contamination; and 2) Radiation Mapping, to provide detailed mapping of the contamination. The Aerial Measuring System Recapitalization effort will procure aviation platforms that meet the needs of the program. In accordance with the conclusions of the completed Analysis of Alternatives, three fixed-wing aircraft will be procured in FY 2019, and two rotary-wing aircraft will be procured in FY 2020.

2.4.3 Workforce Base and the Nuclear/Radiological Risk Reduction

Mission

DOE/NNSA's federal workforce carries out numerous critical functions, including negotiating nuclear and radiological security cooperation with foreign countries, carrying out informed technical oversight of management and operating (M&O) activities, budget development, evaluating program effectiveness, managing contracts, and establishing program strategic direction.

To accomplish its mission, DOE/NNSA leverages the workforce at the DOE/NNSA national laboratories, plants, sites, and laboratories run by DOE's Offices of Science, Nuclear Energy, and Environmental Management. Each program draws heavily on DOE/NNSA's scientific and technical expertise base and much of the M&O workforce performs functions for multiple program offices. Significant challenges remain within the DOE/NNSA nuclear security complex and are described in Section 2.4.3.

Through the workforce across the complex DNN, CTCP, and the Office of Emergency Operations have direct, targeted access to experts across a wide variety of fields. For example:

- DNN can work with experts in the physical security of U.S. nuclear facilities to help improve the security of nuclear materials abroad or leverage nuclear fuel development experts to convert research reactors from HEU to LEU fuel. Scientists and technical specialists perform the work needed to characterize, detect, and defeat nuclear threat devices. They also support international nuclear/radiological security and counterterrorism dialogues, WMD counterterrorism tabletop exercises, and nuclear information security policy and practices.
- DNN can work with experts in U.S. nuclear facilities to help improve the U.S. Government's ability to support, negotiate, and implement nuclear weapons and fuel cycle monitoring verification protocols in support of agreements and treaties. Scientists and technical specialists perform the work needed to monitor and verify foreign nuclear programs. They also support international nuclear verification dialogues, tabletop exercises, and policy negotiations.
- CTCP and the SSP rely on many of the same technical competencies, resulting in significant overlap between the workforces supporting the two missions. The technical personnel supporting the CTCP mission generally developed their skills supporting SSP, and many work primarily on SSP, supporting CTCP on a part-time basis.



Figure 2-17. RAP team members from across the Nation gathered in Las Vegas for in-depth classroom and field training as part of the Radiological Assistance Program Training for Emergency Response (RAPTER).

- Many nuclear security enterprise employees work primarily in support of specific DOE/NNSA missions (especially the stockpile stewardship mission) while they maintain readiness to deploy as part of specialized rapid response teams in the event of a nuclear or radiological incident or urgent material recovery mission. DOE/NNSA relies upon the availability of specially trained part-time personnel to field and sustain our premier rapid response capabilities. Federal, laboratory, plant, and site employees volunteer for this additional responsibility, and in some cases, serve on multiple teams. For example, DOE/NNSA maintains regional RAP teams across the country to serve as the Nation's premier first-responder for assessing radiological incidents and advising decision-makers on steps to evaluate and minimize associated hazards shown in **Figure 2-17**. RAP teams are maintained in each of nine regions across the United States, with each team consisting of a Federal lead and five to seven laboratory, plant, and site

support personnel. The RAP teams provide a ready regional resource in the event of any type of nuclear or radiological incident, including searching for lost radiological sources, resolving radiological alarms, providing support to national security events to ensure the venue is safe, and supporting threat-based radiological searches in support of law enforcement. These employees are also a critical part of other response teams, such as the ARG (which responds to U.S. nuclear weapons accidents), Emerging Threats program, and the consequence management teams.

2.4.4 Workforce Challenges and Opportunities

Retiring Workforce

The DOE/NNSA workforce is aging. Over the next five years an estimated forty percent of the federal workforce and the M&O partner workforce across the enterprise will be eligible for retirement. Managing the effect of these retirements will require recruitment of both experienced and entry-level staff. As NNSA backfills retirees with new staff, the organization is seeking, where possible, to fill entry-level positions with staff having advanced policy or technical degrees relevant to those jobs. Key recruitment tools include the NNSA Graduate Fellowship Program, a year-long program for graduate-level students interested in careers in nuclear security and three university-based research consortia, that links leading universities with national laboratories to provide cutting edge research and development related to nuclear nonproliferation.

By 2023, over 40 percent of DOE/NNSA's workforce will be eligible to retire. Analysis of current NNSA workforce statistics reveal an opportunity for future recruitment of diverse talent. The challenges of the mission of reducing nuclear threats in the 21st century necessitate that hiring officials draw on a wide diversity of talent, skills, and experiences. To meet future workforce needs, DOE/NNSA will work to recruit top talent from all segments of society. To effectively manage the workforce and meet the need to fill future positions as employees retire, DOE/NNSA will actively recruit more minorities and women for positions within the fields of science, technology, engineering, and mathematics.

DOE/NNSA is exploring ways to recruit targeted diverse applicant groups through strategic partnerships with colleges and professional associations to yield a greater pool of diverse candidates with the necessary specialized qualifications. DOE/NNSA will target a wide range of unique talents needed for mission success while forming teams that value diversity of thought and foster a welcoming, inclusive, and empowering workplace for the present and the future. DOE/NNSA's efforts to promote a fair, open, cooperative, and supportive workplace will position it as a workplace of choice and will enhance the retention of a world class workforce.

Shortage of Safeguards Experts

Given the lack of new nuclear facility development and design in the United States, few opportunities to work in operational nuclear facilities, and limited IAEA safeguards implementation in the United States, the United States faces a shortage of international safeguards experts in the national laboratory complex as older generations retire. In response, DOE/NNSA established the safeguards Human Capital Development program to cultivate sustainable academic and technical programs that recruit, educate, train, and retain the next generation of U.S. personnel to become international safeguards professionals. This program seeks to both maintain IAEA safeguards knowledge in the national laboratories and also develop a pipeline of qualified and knowledgeable Americans to work at the IAEA on safeguards.

Long-Term Development of Foundational Technical Expertise

Addressing retirements across the DOE/NNSA enterprise and the mission-driven need to develop foundational technical expertise in a broad array of modern proliferant science, technology, and processes requires a long-term, systematic approach. A new nonproliferation stewardship effort in DNN R&D will contribute through long-term investments in testbeds, other infrastructure, and R&D to build expertise in the workforce through sustained research and operational experience. The DOE/NNSA nuclear security enterprise initiative will provide a focused approach to attract and retain a talented labor pool across the enterprise and facilitate broader and better recruitment throughout the enterprise.

Challenges of Managing Matrixed Workforce

Most laboratory, plant, and site employees supporting the nuclear incident response mission do so on a part-time basis with most of their time allocated to the nuclear weapons mission of DOE/NNSA's Office of Defense Programs. This approach offers significant benefits, as it provides access to a wide variety of prominent experts, but also creates challenges that must be carefully managed. DOE/NNSA relies on the availability of specially trained part-time personnel to field and sustain our premier rapid response capabilities, including teams such as the ARG and JTOT. The much larger nuclear weapons stockpile program also commands priority for staff time, making it difficult to access experts, such as weapons modelers and radiochemists, to support incident response functions.

Chapter 3: Conclusion

The Department of Energy's National Nuclear Security Administration's (DOE/NNSA) annual *Prevent, Counter, and Respond—NNSA's Plan to Reduce Global Nuclear Threats* describes the current nuclear and radiological threat environment and details DOE/NNSA's plan to manage and reduce global nuclear/radiological threats to provide for the safety and security of the United States, its partners, and its allies. DOE/NNSA accomplishes its mission to reduce global threats of nuclear proliferation and nuclear and radiological terrorism by *preventing* would-be proliferant states and non-state actors from acquiring nuclear weapons or weapons-usable nuclear material (WUNM), *countering* efforts of both would-be proliferant states and non-state actors to acquire or develop these capabilities, and being prepared to *respond* to nuclear incidents worldwide, whether deliberate terrorist acts or nuclear accidents.

These three functional areas form the overarching framework for the activities of the three DOE/NNSA offices principally responsible for the nuclear/radiological threat reduction mission—the Office of Defense Nuclear Nonproliferation, the Office of Counterterrorism and Counterproliferation, and the Office of Emergency Operations. To successfully address nuclear/radiological threats that are real and constantly evolving, these offices employ integrated, coordinated efforts leveraging the best scientific talent, technical expertise, and policy experience available both at DOE Headquarters and across the laboratories, plants, and sites that comprise the nuclear security complex, as illustrated by the fiscal year (FY) 2018 accomplishments detailed in this report.

To remain responsive to changes in the threat environment, DOE/NNSA must continue to demonstrate the institutional agility and capabilities highlighted by its FY 2018 program activities. DOE/NNSA continuously monitors, reevaluates, and reassesses the global threat environment in partnership with the U.S. interagency, informed by Administration priorities to identify enduring, evolving, and emerging nuclear and radiological risks. DOE/NNSA also seeks input from the laboratories, plants, and sites of the nuclear security complex and from external sources including foreign partners and the international nuclear security community to best align future program activities with global nuclear/radiological security needs. Looking ahead, DOE/NNSA will continue to reduce the global nuclear/radiological threat through programs that:

- Minimize nuclear and radioactive materials no longer in use;
- Strengthen the international safeguards system to detect and deter diversion of nuclear material from peaceful purposes to nuclear weapons or other nuclear explosive devices;
- Secure nuclear materials and secure nuclear facilities, radioactive materials, and radiological devices in use;
- Prevent and counter the further spread of sensitive nuclear materials, technology, and expertise to states of concern and non-state actors;
- Pursue advanced capabilities to understand and detect foreign nuclear weapons production and detonation;
- Maintain a cadre of technical and scientific specialists trained, organized, and equipped to execute radiological and nuclear crisis response and consequence management missions worldwide;

- Support a strong domestic civilian nuclear enterprise in order to facilitate the development of safe and secure spent fuel disposition options and appropriate safeguards, export control, and security approaches for new reactor types, designs and concepts; and
- Support implementation of existing nonproliferation and arms control treaties and agreements, and provide policy analysis, technical capability development, and implementation support for future threat reduction initiatives.

NNSA will remain at the forefront of U.S. efforts to support the global nonproliferation regime through ongoing activities to detect and prevent proliferant activities and ensure the peaceful use of nuclear energy around the world. In the coming year, DOE/NNSA will continue to put its mission first to support the Nation's security and the *Prevent, Counter, and Respond—NNSA's Plan to Reduce Global Nuclear Threats* will be updated and resubmitted annually to reflect changes in programmatic plans, progress, and challenges across the prevent, counter, and respond functional areas.

Appendix A

Requirements Mapping

This *Prevent, Counter, and Respond* report addresses the requirement for NNSA to submit a *Defense Nuclear Nonproliferation Management Plan* in Title 50, Section 2575, of the United States Code (U.S.C).

The reader can locate the information associated with each report requirement in the following matrix:

50 U.S.C. § 2575	NNSA Response
(a) Plan Required. -- The Administrator shall develop and annually update a five-year management plan for activities associated with the defense nuclear nonproliferation programs of the Administration to prevent and counter the proliferation of materials, technology, equipment, and expertise related to nuclear and radiological weapons in order to minimize and address the risk of nuclear terrorism and the proliferation of such weapons.	N/A
(b) Submission to Congress. – (1) Not later than March 15 of each even-numbered year, the Administrator shall submit to the congressional defense committees a summary of the plan developed under subsection (a).	N/A
(2) Not later than March 15 of each odd-numbered year, the Administrator shall submit to the congressional defense committees a detailed report on the plan developed under subsection (a).	N/A
(3) Each summary submitted under paragraph (1) and each report submitted under paragraph (2) shall be submitted in unclassified form, but may include a classified annex if necessary.	N/A
(c) Elements.---The plan required by subsection (a) shall include, with respect to each defense nuclear nonproliferation program of the Administration, the following:	N/A
(1) A description of the policy context in which the program operates, including---	N/A
(A) a list of relevant laws, policy directives issued by the President, and international agreements; and	Appendix D
(B) nuclear nonproliferation activities carried out by other Federal agencies.	Sections 1.3.3, 2.1.1, 2.2.1, and 2.3.1
(2) A description of the objectives and priorities of the program during the year preceding the submission of the summary required by paragraph (1) of subsection (b) or the report required by paragraph (2) of that subsection, as the case may be.	Sections 1.1 and 1.3
(3) A description of the activities carried out under the program during that year.	Sections 2.1.1, 2.2.1, and 2.3.1 and Appendix B

50 U.S.C. § 2575	NNSA Response
(4) A description of the accomplishments and challenges of the program during that year, based on an assessment of metrics and objectives previously established to determine the effectiveness of the program.	Sections 2.1.1, 2.2.1, and 2.3.1 and Appendix B
(5) A description of any gaps that remain that were not or could not be addressed by the program during that year.	Sections 2.1.1, 2.2.1, and 2.3.1
(6) An identification and explanation of uncommitted or uncosted balances for the program, as of the date of the submission of the summary required by paragraph (1) of subsection (b) or the report required by paragraph (2) of that subsection, as the case may be, that are greater than the acceptable carryover thresholds, as determined by the Secretary of Energy.	Appendix G
(7) An identification of funds for the program received through contributions from or cost-sharing agreements with foreign governments consistent [sic] section 2569(f) of this title during the year preceding the submission of the summary required by paragraph (1) of subsection (b) or the report required by paragraph (2) of that subsection, as the case may be, and an explanation of such contributions and agreements.	Appendix E
(8) A description and assessment of activities carried out under the program during that year that were coordinated with other elements of the Department of Energy, with the Department of Defense, and with other Federal agencies, to maximize efficiency and avoid redundancies.	Sections 1.3.3, 2.1.1, 2.2.1, and 2.3.1
(9) Plans for activities of the program during the five-year period beginning on the date on which the summary required by paragraph (1) of subsection (b) or the report required by paragraph (2) of that subsection, as the case may be, is submitted, including activities with respect to the following:	N/A
(A) Preventing nuclear and radiological proliferation and terrorism, including through—	N/A
(i) material management and minimization, particularly with respect to removing or minimizing the use of highly enriched uranium, plutonium, and radiological materials worldwide (and identifying the countries in which such materials are located), efforts to dispose of surplus material, converting reactors from highly enriched uranium to low-enriched uranium (and identifying the countries in which such reactors are located);	Section 2.6.1
(ii) global nuclear material security, including securing highly enriched uranium, plutonium, and radiological materials worldwide (and identifying the countries in which such materials are located), and providing radiation detection capabilities at foreign ports and borders;	Section 2.4.2
(iii) nonproliferation and arms control, including nuclear verification and safeguards;	Section 2.4.3
(iv) defense nuclear research and development, including a description of activities related to developing and improving technology to detect	Section 2.4.4

50 U.S.C. § 2575	NNSA Response
the proliferation and detonation of nuclear weapons, verifying compliance of foreign countries with commitments under treaties and agreements relating to nuclear weapons, and detecting the diversion of nuclear materials (including safeguards technology); and,	
(v) nonproliferation construction programs, including activities associated [sic]Department of Energy Order 413.1 (relating to program management controls).	Sections 2.4.1 and 2.4.2
(B) Countering nuclear and radiological proliferation and terrorism.	Section 2.2
(C) Responding to nuclear and radiological proliferation and terrorism, including through— (i) crisis operations; (ii) consequences management; and, (iii) emergency management, including international capacity building.	Section 2.3
(10) A threat assessment, carried out by the Intelligence Community (as defined in section 3003(4) of this title), with respect to the risk of nuclear and radiological proliferation and terrorism and a description of how each activity carried out under the program will counter the threat during the five-year period beginning on the date on which the summary required by paragraph (1) of subsection (b) or the report required by paragraph (2) of that subsection, as the case may be, is submitted and, as appropriate, in the longer term.	<i>Activity Descriptions:</i> Sections 2.1.1, 2.2.1, and 2.3.1
(11) A plan for funding the program during that five-year period.	Appendix F
(12) An identification of metrics and objectives for determining the effectiveness of each activity carried out under the program during that five-year period.	Sections 2.1.1, 2.2.1, and 2.3.1
(13) A description of the activities to be carried out under the program during that five-year period and a description of how the program will be prioritized relative to other defense nuclear nonproliferation programs of the Administration during that five-year period to address the highest priority risks and requirements, as informed by the threat assessment carried out under paragraph (10).	<i>Description of Activities:</i> Sections 2.1.1, 2.2.1, 2.3.1 <i>Description of Prioritization:</i> Section 1.2
(14) A description and assessment of activities to be carried out under the program during that five-year period that will be coordinated with other elements of the Department of Energy, with the Department of Defense, and with other Federal agencies, to maximize efficiency and avoid redundancies.	<i>Description and Assessment of Activities:</i> Sections 1.3.3, 2.1.1, 2.2.1, and 2.3.1
(15) A summary of the technologies and capabilities documented under section 2576(a) of this title.	Sections 1.1.1, 1.3.2, and 2.1.1 and Appendix B
(16) A summary of the assessments conducted under section 2576(b)(1) of this title.	Sections 2.1.1 and Appendix C
(17) Such other matters as the Administrator considers appropriate.	N/A

This page left blank intentionally.

Appendix B

FY 2018 Accomplishments

***FY 2018 Accomplishments in the PREVENT Function Area:** prevent would-be proliferant states from developing nuclear weapons or acquiring weapons-usable nuclear material, equipment, technology, and expertise, and prevent non-state actors from acquiring nuclear and radioactive materials that can be used for malicious purposes.*

Office of Defense Nuclear Nonproliferation (DNN) Programs FY 2018 Accomplishments			
Global Materials Security	Material Management and Minimization	Nonproliferation and Arms Control	Research & Development
<ul style="list-style-type: none"> ▪ Secured 87 buildings with high-risk radioactive material in 24 countries, including 42 buildings in the United States. GMS has cumulatively secured more than 2,283 buildings and recovered more than 63,700 radiological sources since the program’s inception. ▪ Conducted over 100 bilateral and multilateral nuclear and radiological security workshops, including a workshop on mitigating insider threats with Argentina, a workshop on design basis threat with Brazil, and the first IAEA training course on cybersecurity. 	<ul style="list-style-type: none"> ▪ Removed or confirmed the disposition of over 352 kilograms of HEU from multiple countries including Japan, France, Canada, and other partners. ▪ Continued to downblend, or shipped for downblending, a cumulative total of 160.4 metric tons (MT) of HEU into LEU for peaceful use as fuel for commercial or research reactors. ▪ Supported a neutron-capture project by NorthStar to produce the Molybdenum-99 (Mo-99) isotope without HEU. It entered the market as the first domestic production in 30 years. 	<ul style="list-style-type: none"> ▪ Provided 17 trainings to U.S. enforcement agencies on export control topics to help prevent the exploitation of the U.S. industrial base for weapons of mass destruction (WMD) purposes. ▪ Participated in 65 export control workshops with foreign partners to help strengthen national systems of export control. ▪ Reviewed close to 6,000 U.S. dual-use license applications for nonproliferation concerns to help facilitate legitimate commerce while preventing proliferation. 	<ul style="list-style-type: none"> ▪ Produced and delivered the Global Burst Detector (GBD) III-8 payload to the USAF and provided technical support to integrate previously-delivered GBDs onto Global Positioning System (GPS) satellites planned for launch in future fiscal years. ▪ In partnership with the United Kingdom, began development of the Advanced Instrumentation Testbed, which is designed to test new detection technologies for monitoring nuclear reactor operations.

Office of Defense Nuclear Nonproliferation (DNN) Programs FY 2018 Accomplishments			
Global Materials Security	Material Management and Minimization	Nonproliferation and Arms Control	Research & Development
<ul style="list-style-type: none"> ▪ Worked with over 70 partner countries to build their capabilities to detect, disrupt, and investigate smuggling of nuclear and radioactive materials. ▪ Replaced 39 cesium-based irradiators with alternative non-isotopic technologies for a cumulative total of 58 irradiators replaced. ▪ Trained cumulatively over 6,300 law enforcement and responders on alarm response. 	<ul style="list-style-type: none"> ▪ Converted an isotope production facility in the Netherlands; M³ funded a portion of Curium’s conversion costs. ▪ Confirmed the shutdown of Canada’s National Research Universal reactor by Canada Nuclear Laboratories. ▪ Continued to eliminate surplus HEU by dispositioning 146 legacy items/discards. ▪ Completed the lifecycle cost estimate for the dilute and dispose strategy for disposition of U.S. surplus weapon-grade plutonium. ▪ Initiated efforts to remove 1 MT of plutonium from South Carolina by January 2020. ▪ Continued to disassemble surplus nuclear weapons pits and convert resultant plutonium metal to an oxide form for ultimate disposition. 	<ul style="list-style-type: none"> ▪ Provided technical analyses of close to 3,000 interdiction cases to help inform U.S. Government interdiction efforts. ▪ Continued to support policy and technical implementation of multiple arms-control treaties and agreements. ▪ Successful completion of the U.S.-UK-Norway-Sweden Quad Nuclear Verification Partnership LETTERPRESS arms control verification exercise in the United Kingdom and continued technical leadership in the IPNDV’s Technology Working Group. ▪ Contributed to interagency planning efforts for anticipated near-term on-site deployments of interagency personnel. ▪ Trained and exercised verification teams on specific facility types and verification tools. ▪ Reduced processing time for approval of requests to export U.S. nuclear technology and assistance pursuant to 10 CFR Part 810 by over 40 percent, relative to FY 2017. 	<ul style="list-style-type: none"> ▪ Successfully executed the first of four underground chemical explosions of Phase II of the Source Physics Experiment (SPE). SPE is designed to improve U.S. confidence in monitoring foreign underground nuclear explosions with decreasing yields. ▪ Conducted two month-long field campaigns at testbeds designed to demonstrate improved U.S. capabilities to detect and monitor foreign nuclear material production. ▪ Successfully completed the multi-year, multi-laboratory Warhead Measurement Campaign with measurements of the B61, the B83, and the W76 to collect a comprehensive list of signatures that will support variety of applications across NNSA.

Office of Defense Nuclear Nonproliferation (DNN) Programs FY 2018 Accomplishments			
Global Materials Security	Material Management and Minimization	Nonproliferation and Arms Control	Research & Development
	<ul style="list-style-type: none"> ▪ Initiated contract termination of the Mixed Oxide Fuel Fabrication Facility project and are pursuing the Dilute and Dispose alternative, which will avoid approximately \$30 billion in life-cycle costs. 	<ul style="list-style-type: none"> ▪ Negotiated update to the Nuclear Suppliers Group (NSG) Trigger List controls on reprocessing equipment and technology. ▪ Led efforts to expand NSG industry outreach initiative. ▪ Supported U.S. participation in Nuclear Non-Proliferation Treaty (NPT) review process. ▪ Provided technical support to the negotiation of new 123 Agreements with the United Kingdom and Mexico. ▪ Transferred six safeguards technologies that can be deployed and used in international regimes and other countries, exceeding its FY 2018 goal of transferring five safeguards systems. ▪ Successfully completed a 25-year, four-country effort to produce a plutonium reference material for use by the IAEA Network of Analytical Laboratories. 	<ul style="list-style-type: none"> ▪ Demonstrated separations and detection methods as part of a joint operational forensics exercise between LANL and PNNL to improve U.S. capabilities in monitoring and nuclear forensics.

Office of Defense Nuclear Nonproliferation (DNN) Programs FY 2018 Accomplishments			
Global Materials Security	Material Management and Minimization	Nonproliferation and Arms Control	Research & Development
		<ul style="list-style-type: none"> In coordination with U.S. interagency team, including DOE/NNSA, DOS, Nuclear Regulatory Commission (NRC), and Department of Defense (DoD), completed eight bilateral physical protection consultations with foreign sites holding or expecting to receive U.S.-obligated nuclear material for peaceful purposes and provided foreign partners with recommendations for enhancing security. 	

FY 2018 Accomplishments in the COUNTER Function Area: *counter the efforts of both would-be proliferant states and non-state actors to acquire, develop, disseminate, deliver, or use the materials, expertise, or components of a nuclear or radiological device.*

Office of Counterterrorism and Counterproliferation (CTCP) Programs FY 2018 Accomplishments			
Nuclear Incident Policy and Cooperation	Nuclear Threat Science	Nuclear Forensics	Nuclear Incident Response
<ul style="list-style-type: none"> ▪ Conducted five technical exchanges with international partners to advance understanding of radiological and nuclear incident preparedness and conducted two scenario-based policy discussions focusing on counterterrorism and counter nuclear smuggling ▪ Provided operational support and assistance to international partners for select major public events to enhance radiological and nuclear security activities, protecting U.S. interests. ▪ Conducted two training courses and tabletop exercises in partnership with US special operations Pacific (SOCPAC) to train foreign partner special operations forces to counter transnational radiological and nuclear terrorism threats across the Indo-Pacific region. 	<ul style="list-style-type: none"> ▪ Completed a 3-year scientific initiative to improve DOE/NNSA capabilities to predict nuclear weapon responses to abnormal environments. Currently transitioning to a sustainment model that enables the response to partner agency requests for assessments, while maintaining and continuing to improve predictive capabilities through modest investments. ▪ Established communication infrastructure to support Nuclear Threat Reduction (NTR) exchanges. 	<ul style="list-style-type: none"> ▪ Maintained capability and readiness to respond to pre- and post-detonation events. ▪ Planned and participated in two Disposition and Forensic Evidence Analysis Team (DFEAT) and two DOE Forensics Operations Team (DFO) nuclear forensics exercises in coordination with the Department of Homeland Security, DoD and the Federal Bureau of Investigation (FBI), supporting collection of post-detonation debris. ▪ Developed a draft program plan for the National Nuclear Materials Archive (NNMA) including technical requirements, evaluation criteria, defines consensus policy on selection prioritization, technical analysis, and anticipated management of NNMA materials. 	<ul style="list-style-type: none"> ▪ Completed Render Safe/Joint Technical Operations Team (JTOT) response posture analysis. A coordinated process with Headquarters and the national laboratories for JTOT 2020 is a collaboration of two nuclear assessment teams, one at LLNL, and one at LANL. ▪ Received and fielded 40 MC-15s. JTOT provided to the 21st Explosive Ordnance Disposal Company WMD a sufficient quantity and applicable training to meet the requirements of Phase 2 operational posture. Stabilization Operations has successfully demonstrated MC-15 operations during the Marble Challenge exercise and is in the process of providing this capability to the Level V cities in accordance with interagency coordination.

Office of Counterterrorism and Counterproliferation (CTCP) Programs FY 2018 Accomplishments			
Nuclear Incident Policy and Cooperation	Nuclear Threat Science	Nuclear Forensics	Nuclear Incident Response
			<ul style="list-style-type: none"> Stabilization Operations, in conjunction with NST, has recommended operational deployment of the next generation of capabilities to Level V cities (cities with DOE/Department of Justice (DOJ)-defined equipment and training capabilities) in accordance with the FY20 Capability Forward concept.

FY 2018 Accomplishments in the RESPOND Function Area: *respond to the full spectrum of nuclear and radiological emergencies at home or abroad, including deliberate nuclear and radiological attacks and accidents to minimize the damage from such incidents.*

Office of Emergency Operations Programs FY 2018 Accomplishments			
Emergency Management Programs	Consolidated Emergency Operations Center	Continuity Programs	Emergency Operations Policy
<ul style="list-style-type: none"> ▪ Conducted 14 Emergency Management Technical Support Assist Visits throughout the complex, accelerating programmatic review of documents, and timely implementation of established emergency operational requirements (Emergency Planning Hazard Assessments, Emergency Management Planning Zones, Emergency Planning Guidance documents, etc.). ▪ Conducted eight Federal Emergency Management Agency Continuity Course offerings at four separate Headquarters and Field locations, delivering training to 130 DOE/NNSA participants. ▪ Led active participation in maturing the Department’s Independent Emergency Management Oversight Program. 	<ul style="list-style-type: none"> ▪ Sustained Emergency Communications Network infrastructure through effective and innovative real estate management, telecommunications strategies, and hardware/software service strategies. ▪ Sustained a 24/7/365 Emergency Operations Center and restructured the DOE Daily Operational Brief for optimal senior leadership situational awareness. ▪ Managed Alternate Operations Center and Consolidated Emergency Operations Center facility renovations to meet security and increased use needs. ▪ Successfully accomplished Outside the Continental United States Mobile Emergency Communications Network deployment test cycle. Tested and validated mission support readiness to vital, ongoing nuclear nonproliferation planning. 	<ul style="list-style-type: none"> ▪ During the Eagle Horizon component of National Level Exercise 2018, successfully conducted the integration of the DOE/NNSA Continuity of Operations (COOP) Emergency Relocation Group and the Department’s Unified Coordination Group in an active continuity environment, resulting in economy of scale and unity of effort of limited response resources during a simulated national level emergency. ▪ Completed baseline continuity plan assessments for all DOE and NNSA Headquarters and Field federal organizations. ▪ Completed a comprehensive revalidation of DOE and NNSA Primary and Mission Essential Functions. 	<ul style="list-style-type: none"> ▪ Provided subject matter expertise support in Public Information, Consequence Assessments, Atmospheric and Meteorological Data, Threat and Hazard Identification and Risk Assessment, and Exercise Design Training throughout the complex. ▪ Developed, coordinated, and pilot tested the draft standardized Emergency Management Criteria Review and Approach Document (CRAD), and conducted pilot test process at five DOE/NNSA sites with the cooperation and synchronization of the DOE Offices of Enterprise Assessments, Science and Environmental Management, and the NNSA program office.

Office of Emergency Operations Programs FY 2018 Accomplishments			
Emergency Management Programs	Consolidated Emergency Operations Center	Continuity Programs	Emergency Operations Policy
<ul style="list-style-type: none"> Led the comprehensive coordination synchronization of the emergency management focused Corrective Action System, the Integrated Safety Management System, and the Lessons Learned System to mature and sustain DOE risk based approach to emergency management. 	<ul style="list-style-type: none"> Extended MECN communications capability to Defense Threat Reduction Agency (DTRA) mission partner, aiding them to meet their mobile requirements. 	<ul style="list-style-type: none"> Developed and executed two continuity exercises (Eagle Horizon 2018 and Mid-Year Continuity Tabletop Exercise). Developed classified and unclassified executive-level continuity program briefings for Secretary, Deputy Secretary, Deputy Chief of Staff, NNSA Administrator, and other Senior Leadership. 	<ul style="list-style-type: none"> Completed technical revision of DOE Guide 151.1-1A, Emergency Management Fundamental and the Operational Emergency Base Program; initiated revision of DOE Guide 151.1-2, Technical Planning Basis, to align with revised and issued DOE Order 151.1D, Comprehensive Emergency Management System. Provided complex-wide access to the Emergency Management Knowledge Management System and trained partners on the use of the system.

Office of Counterterrorism and Counterproliferation (CTCP) Programs FY 2018 Accomplishments			
Nuclear Incident Policy and Cooperation	Nuclear Threat Science	Nuclear Forensics	Nuclear Incident Response
<ul style="list-style-type: none"> ▪ Conducted 19 tabletop exercise training events, training more than 1,390 emergency response personnel, and implemented new training on Radiological Awareness and Emergency Public Information in conjunction with domestic tabletop exercise events. ▪ Provided technical expertise and training to advance the IAEA, Incident and Emergency Center as the global focal point for emergency preparedness and response for nuclear and radiological safety- or security-related incidents, including coordination of international assistance. ▪ Led workshops in partnership with the IAEA to harmonize response and assistance capabilities focusing on national response planning, radiation detection and monitoring, nuclear security measures at ports, and medical preparedness and response. 			<ul style="list-style-type: none"> ▪ Provided radiological detection and analytical support to four national-level events, including the Super Bowl and the President’s State of the Union Address, and over 50 regional events, in concert with Federal, state, and local departments and agencies to ensure the safety and security of event participants. ▪ Participated in three major national-level exercises, two outside the continental United States, aimed at ensuring the nuclear response community is prepared to respond to a nuclear threat. ▪ Conducted training on medical management of radiation injuries at The Radiation Emergency Assistance Center/Training Site (REAC/TS) domestically and internationally for students from over 25 countries. ▪ Maintained operational readiness to respond to a radiological and nuclear emergency.

Office of Counterterrorism and Counterproliferation (CTCP) Programs FY 2018 Accomplishments			
Nuclear Incident Policy and Cooperation	Nuclear Threat Science	Nuclear Forensics	Nuclear Incident Response
<ul style="list-style-type: none"> ▪ CTCP held the chairmanship the Emergency Preparedness and Response Standards Committee at the IAEA to review and approve IAEA safety standards in the area of emergency preparedness and response, which are used by Member States to develop and maintain their national emergency preparedness and response systems. ▪ Provided emergency response expertise to the Global Initiative to Combat Nuclear Terrorism Radiological Emergency Management Exercise for more than 80 players from Argentine and Chilean nuclear regulatory authorities, technical agencies, national police and law enforcement agencies, and included more than 20 observers and facilitators from Russia, Peru, Panama, Mexico, and Nigeria. 			<ul style="list-style-type: none"> ▪ Deployed communications kits 28 times, both within and outside the continental United States, in support of exercises, turnover drills, and training evolutions. Added additional mobile ad hoc network capability to a few of the kits to provide reliable communications in urban canyon and underground environments. Outfitted with Communications on the Move (COTM) to support maritime environments.

Appendix C

FY 2020-2024 Planned Activities

Future Program Plans in the PREVENT Function Area: prevent would-be proliferant states from developing nuclear weapons or acquiring weapons-usable nuclear material, equipment, technology, and expertise, and prevent non-state actors from acquiring nuclear and radioactive materials that can be used for malicious purposes.

Office of Defense Nuclear Nonproliferation (DNN) Programs FY 2020-2024 Planned Activities			
Global Materials Security	Material Management and Minimization	Nonproliferation and Arms Control	Research & Development
<ul style="list-style-type: none"> ▪ Remove additional excess and unwanted sealed radioactive sources from locations in the United States. ▪ Continue ongoing nuclear security capacity building cooperation in at least 20 high priority countries, and annually initiate capacity building activities in up to 13 additional countries. Work with up to 16 partners annually to strengthen foreign partner nuclear forensic capabilities. 	<ul style="list-style-type: none"> ▪ Continue efforts to qualify fuels for high performance research reactor conversions. ▪ Continue to optimize and demonstrate the processes and equipment to fabricate U-Mo monolithic on a commercial scale. ▪ Convert or verify shutdown of research reactors and medical isotope production facilities in Belgium, Pakistan, Kazakhstan, Japan and other countries for a cumulative of 111 facilities converted or verified as shut down by FY 2024. ▪ Remove or confirm the disposition of HEU and/or separated plutonium for a cumulative total of 7,500 kilograms by the end of FY 2024. 	<ul style="list-style-type: none"> ▪ Provide technical & technology assistance to support IAEA verification in Iran & potentially in the Democratic People’s Republic of Korea (DPRK). ▪ Implement the 9th year of the Joint Fuel Cycle Study to evaluate the feasibility of applying safeguards to pyroprocessing. ▪ Complete spent fuel measurements in Sweden. ▪ Conduct at least six physical protection assessment visits to foreign sites holding U.S.-obligated nuclear material. 	<ul style="list-style-type: none"> ▪ Execute the final two underground chemical explosions in Phase II of the SPE being conducted at NNSS. ▪ Complete three additional field campaigns at testbeds designed to test technologies developed to improve U.S. capabilities to detect and monitor foreign nuclear material production. ▪ Complete planning and begin execution of the Low Yield Nuclear Monitoring integrated experimental campaign in order to advance nuclear explosion detection capabilities.

Office of Defense Nuclear Nonproliferation (DNN) Programs FY 2020-2024 Planned Activities			
Global Materials Security	Material Management and Minimization	Nonproliferation and Arms Control	Research & Development
<ul style="list-style-type: none"> ▪ Develop and implement cybersecurity training courses, coordinate with international partners on cybersecurity best practices for nuclear and radiological facilities, and improve on these best practices by developing new cybersecurity techniques, procedures, and technologies. ▪ Provide flexible radiation detection systems for targeted screening of small maritime vessels and at high priority airports in the Middle East, Eastern Europe, Africa, and Asia. ▪ Expand support for the voluntary replacement of high-activity radioactive sources with non-radioisotopic based technologies. Replace more than 400 radioactive source-based devices with alternative technologies by the end of 2024. 	<ul style="list-style-type: none"> ▪ Conduct Emerging Threats exercise(s) to enhance readiness to quickly recover at-risk weapons-usable nuclear material (WUNM) from abroad. ▪ Conduct activities associated with expedited plutonium removal, including projects to establish capabilities in K Area, additional operations, and repackaging plutonium in support of removing 1 MT of plutonium from South Carolina by January 2020. ▪ Disassemble surplus U.S. nuclear weapon pits and convert the resulting metal into plutonium oxide powder in preparation for future disposition. ▪ Support Mo-99 cooperative agreement partners; provide technical support to the U.S. private sector and implement the Uranium Lease and Takeback program to accelerate the establishment of a reliable commercial supply of Mo-99 produced without HEU. 	<ul style="list-style-type: none"> ▪ Assist the IAEA in the completion of a guidance documentation to implement the Agency's geological repository safeguards programs. ▪ Conduct diverse and dynamic efforts to promote universal adherence to the Additional Protocol, Comprehensive Safeguards Agreements with modified Small Quantities Protocol where applicable, and effective safeguards implementation. ▪ Press the IAEA to consistently apply State Level Safeguards Approaches in all States, backed by credible guidance for State Evaluation Groups, and using performance metrics to evaluate effectiveness. 	<ul style="list-style-type: none"> ▪ Complete site preparation and begin construction for the Advanced Instrumentation Testbed to develop capabilities for nuclear reactor monitoring. ▪ Award two five-year grants to two new university consortia focused on conducting basic research in nuclear nonproliferation and developing the next generation of scientists and engineers in the fields of nuclear science, nuclear engineering, and nuclear nonproliferation. ▪ Complete fabrication of the Space and Atmospheric Burst Reporting System-3 and Space and Endo-atmospheric Nuclear detonation Surveillance Experimentation and Risk reduction payloads. ▪ Provide technical support to integrate GBD III payloads onto GPS satellites in support of their launches, beginning in FY 2019.

Office of Defense Nuclear Nonproliferation (DNN) Programs FY 2020-2024 Planned Activities			
Global Materials Security	Material Management and Minimization	Nonproliferation and Arms Control	Research & Development
<ul style="list-style-type: none"> ▪ Complete development of fundamental material protection, control, and accounting curriculum for a national nuclear security training center in Kazakhstan, and support the development of a nuclear security training center in Argentina. ▪ Continue to collaborate with industry on security by design and security standards. ▪ Refine and enhance GMS approach to sustaining nuclear security investments & delivering effective training to international partners. 	<ul style="list-style-type: none"> ▪ Downblend additional U.S. surplus HEU into LEU for peaceful use as fuel for commercial or research reactors, reaching a cumulative total of 164.5 MT of surplus HEU downblended or shipped for downblending by the end of FY 2024 ▪ Complete surplus HEU-legacy material disposal in Building 9206 at the Y-12 National Security Complex (FY 2022). ▪ Continue work on the Surplus Plutonium Disposition (SPD) project to increase the dilution capability at SRS, including: initiating long lead procurements for the SPD project (FY 2020), completing 60 percent of design (FY 2020), completing 100 percent of final design, and initiating construction (FY 2022). ▪ Complete shutdown of the Mixed Oxide Fuel Fabrication Facility project in FY 2021. 	<ul style="list-style-type: none"> ▪ Achieve a success rate, in FY 2019, of at least 80 percent or greater (85 percent or greater in the out years) of all initial DOE positions on dual-use export license applications submitted to the Department of Commerce within 25 days of receipt (i.e., five days fewer than required). ▪ Provide training to and participate in technical exchanges with foreign governments to strengthen their capabilities to prevent the illicit or inadvertent transfers of nuclear and dual-use commodities and technologies that can be used in WMD. ▪ Provide training and technical reach back on dual-use commodities to U.S. enforcement agencies to help prevent the exploitation of the U.S. industrial base. ▪ Provide approximately 3,000 comprehensive technical analyses per year in support of U.S. agencies overseeing WMD interdiction efforts. 	<ul style="list-style-type: none"> ▪ Design the next-generation GBD payload, and commence fabrication in FY 2019, in support of future deliveries for USAF GPS IIF satellites.

Office of Defense Nuclear Nonproliferation (DNN) Programs FY 2020-2024 Planned Activities			
Global Materials Security	Material Management and Minimization	Nonproliferation and Arms Control	Research & Development
		<ul style="list-style-type: none"> ▪ Support the U.S. Government in implementation of ongoing arms-control treaties and agreements. ▪ Install 2-3 stack monitors at medical isotope producer facilities to understand emissions that may affect global nuclear explosion monitoring. ▪ Begin to establish independent U.S. nuclear explosion field verification capability. ▪ Refine detailed specific verification CONOPs for potential near-term deployment and train and exercise verification teams on specific verification scenario objectives and verification tools. ▪ Further streamline the Part 810 review process by implementing new statutory authority for the Secretary of Energy to delegate the approval of Part 810 specific authorizations. ▪ Develop a program to assess and impose civil penalties for violations of the Part 810 regulation 	

Office of Defense Nuclear Nonproliferation (DNN) Programs FY 2020-2024 Planned Activities			
Global Materials Security	Material Management and Minimization	Nonproliferation and Arms Control	Research & Development
		<ul style="list-style-type: none"> ▪ Advance negotiations on NSG controls for remaining key fissile material production and separations technologies. ▪ Provide technical, programmatic, and policy support to U.S. participation in the 2020 NPT Review Cycle. ▪ Maintain LLNL readiness of international Chemical Weapons Convention (CWC) analytical capabilities and certified laboratories for U.S. treaty compliance and for implementation of international CWC verification activities. ▪ Continue to execute innovative online initiatives and Track 1.5 activities in South Asia, East Asia, and the Middle East to reduce the danger of nuclear war and dissuade the proliferation of nuclear weapons in regions critical to U.S. interests. ▪ Reinforce DOE's and the broader U.S. Government's commitment to the U.S.-ROK 123 Agreement. 	

Future Program Plans in the COUNTER Function Area: Counter the efforts of both would-be proliferant states and non-state actors to acquire, develop, disseminate, deliver, or use the materials, expertise, or components of a nuclear or radiological device.

Office of Counterterrorism and Counterproliferation (CTCP) Programs FY 2020-2024 Planned Activities			
Nuclear Incident Policy and Cooperation	Nuclear Threat Science	Nuclear Forensics	Nuclear Incident Response
<ul style="list-style-type: none"> ▪ Conduct new counter-Radiological Dispersal Device (RDD) training and tabletop exercises with international technical experts. ▪ Conduct 19 domestic and international tabletop exercises and scenario-based policy discussions to improve nuclear incident response and counterterrorism capabilities in the U.S. and worldwide. ▪ Lead workshops under the Global Initiative to Combat Nuclear Terrorism for health, communications, and law enforcement experts focusing on security best practices to counter nuclear and radiological terrorism threats. 	<ul style="list-style-type: none"> ▪ Conduct international exercises and exchanges with P3 partners (France, United Kingdom, United States). ▪ Sustain DOE/NNSA laboratory tools, expertise, and capabilities for specialized nuclear threat assessments. 	<ul style="list-style-type: none"> ▪ Conduct two DFEAT exercises and one DFO/Ground Collection Task Force field exercise per year, in support of maintaining nuclear forensics capabilities. ▪ Continue preventive and corrective facility maintenance at P-Tunnel, NNSS, for support to the Pre-Detonation Device Program, and address broader infrastructure improvements at NNSS. ▪ Test, finalize, and operationalize post-detonation device assessment procedures in support of interagency nuclear forensics and attribution. ▪ Complete analysis of materials to meet Bulk Special Nuclear Material Analysis Program testing requirements and to support International Technology Working Group for Nuclear Forensics. 	<ul style="list-style-type: none"> ▪ Exercise a nuclear counterterrorism scenario overseas with DoD partners. ▪ Sustain capability in existing Stabilization cities, including training and equipment maintenance. CTCP will conduct Stabilization training and operations and begin transitioning to the Capability Forward initiative, under which life-saving responses to a nuclear threat device will be accelerated. Under this initiative, NNSA will provide training, equipment procurement, and technical support to the current 11 Stabilization cities – eventually growing to 14 U.S. cities by FY 2022 – to prompt FBI teams to execute render safe operations far more quickly and confidently. CTCP will also improve and expand NNSA training facilities to accommodate the increased training requirements associated with regional render safe capabilities.

Office of Counterterrorism and Counterproliferation (CTCP) Programs FY 2020-2024 Planned Activities			
Nuclear Incident Policy and Cooperation	Nuclear Threat Science	Nuclear Forensics	Nuclear Incident Response
		<ul style="list-style-type: none"> ▪ The Lead Materials Management Organization will determine the initial demand for how many nuclear material types will be required for the NNMA, as well as which forensics characterization tests will be needed, and when they will be conducted. An NNMA Program Plan is being developed for execution beginning in FY 2020. ▪ Maintain pre- and post-detonation forensics technical and operational readiness and capabilities. 	

Future Program Plans in the RESPOND Function Area: respond to the full spectrum of nuclear and radiological emergencies at home or abroad, including deliberate nuclear and radiological attacks and accidents to minimize the damage from such incidents.

Office of Emergency Operations Programs FY 2020-2024 Planned Activities			
Emergency Management Programs	Consolidated Emergency Operations Center	Continuity Programs	Emergency Operations Policy
<ul style="list-style-type: none"> ▪ Complete revision of the Concept of Operation for the Unified Coordination Structure (UCS) to document how Headquarters will coordinate emergency management activities in an all-hazards environment ▪ Complete development of an Operations Plan for the UCS to define how the Department will work together and promote unity of effort during the response to an all-hazards incident, event, or emergency. ▪ Ensure that the Emergency Management Enterprise has an effective and efficient capability to respond to and coordinate an all-hazards incident. ▪ Synchronize department-wide participation and execution of comprehensive exercises to ensure emergency response preparedness and coordination. 	<ul style="list-style-type: none"> ▪ Transfer Emergency Communications Network hosting to a more secure and resilient facility. ▪ Upgrade satellite connectivity enabling significantly improved voice and video quality for mission partners. ▪ Complete ECN modernization efforts by upgrading network equipment to meet current and near-term future security, operational, reliability, and expandability efforts. ▪ Enhance automation and near real-time operational awareness of Emergency Management Enterprise Readiness Assurance performance metrics and program implementation. 	<ul style="list-style-type: none"> ▪ Provide dedicated continuity communications capabilities that support the DOE/NNSA Mission Essential Functions. ▪ Continue to provide dedicated redundant communications capabilities that support DOE/NNSA emergency operations (Mobile Response, Emergency Operations Center/Watch Office) and National Response Framework related efforts. These functions will be accomplished through an available, compliant, confidential, effective, secure, protected, and resilient network. 	<ul style="list-style-type: none"> ▪ Provide technical support and lead subject matter expertise in revising Functional Area Qualification DOE STANDARD 1177-2004 in support of the Federal Technical Capability Panel (FTCP). ▪ Complete consolidation and final technical adjudication of DOE O 151.1 Emergency Management Guides (EMGs) into one comprehensive and aligned document. ▪ Consolidate and implement recommended modifications to Emergency Management Criteria Review and Approach Document (CRAD) and conducted pilot test process at five DOE/NNSA sites with the cooperation and synchronization of the DOE Offices of Enterprise Assessments, Science, and Environmental Management, and the NNSA program office.

Office of Emergency Operations Programs FY 2020-2024 Planned Activities			
Emergency Management Programs	Consolidated Emergency Operations Center	Continuity Programs	Emergency Operations Policy
<ul style="list-style-type: none"> Develop fully trained response coordination teams in support of a scheduled Watch Bill. 			<ul style="list-style-type: none"> Enhance Enterprise Data Management System (EDMS) to achieve additional efficiencies in trend analysis, situational awareness, collaboration, and implementation of emergency management requirements.
Office of Counterterrorism and Counterproliferation (CTCP) Programs FY 2020-2024 Planned Activities			
Nuclear Incident Policy and Cooperation	Nuclear Threat Science	Nuclear Forensics	Nuclear Incident Response
<ul style="list-style-type: none"> Conduct a Joint Assistance Team response exercise with international partners exercising multinational response to a large-scale radiological emergency. Conduct Radiological Awareness and Emergency Public Information Office training for first responders and public information officers in the U.S. focusing on best practices for crisis communications and communicating risk to the public during and after a nuclear or radiological emergency. 			<ul style="list-style-type: none"> Continue recapitalization efforts for critical incident response equipment and aerial measuring system aircraft that are beyond their planned life cycle. Sustain capability in existing Stabilization cities, including training and equipment maintenance. Maintain progress to achieve full equipment recapitalization by FY 2027. Initiate a deliberate national decision process on the long-term requirements for Tactical Radiological Nuclear Search Operations, in partnership with FBI.

Office of Counterterrorism and Counterproliferation (CTCP) Programs FY 2020-2024 Planned Activities			
Nuclear Incident Policy and Cooperation	Nuclear Threat Science	Nuclear Forensics	Nuclear Incident Response
<ul style="list-style-type: none"> ▪ Conduct six North Atlantic Treaty Organization (NATO) and DoD nuclear/radiological emergency response courses and workshops to provide first responders, radiation protection specialists, and emergency personnel with practical information to effectively implement mission planning and respond to radiological incidents and accidents. ▪ Conduct workshops and training on responding to radiological emergencies, securing major public events from threats, and countering RDDs with international partners. ▪ Conduct technical exchanges with advanced international partners on aerial measuring. 			<ul style="list-style-type: none"> ▪ Increase the RAP's role within the national response framework and promote state and local relationships. ▪ Develop and implement the Improvement and Lessons Learned Program. ▪ Implement an enterprise equipment recapitalization coordination tool that will ensure schedule and priority for procurement decisions. ▪ Exercise a consequence management scenario with NASA, the State of Florida, and affected counties and jurisdictions in response to a launch anomaly. ▪ Exercise CTCP response to a nuclear weapon incident with interagency partners. ▪ Increase cooperation and coordination between the Accident Response Group and the nuclear weapons complex at the Federal and laboratory levels.

Appendix D

Relevant Laws, Policy Directives, and International Agreements

The nuclear and radiological threat reduction activities of the DOE/NNSA operate within the context of a large number of laws, Presidential Policy Directives (PPD), and international agreements and instruments. The most significant of these are listed below.

Laws

- *American Medical Isotopes Production Act of 2012*, Pub. L. 112-239, Div. C., Title XXXI, Subt. F (.).
- *Atomic Energy Act of 1954, as amended*, 42 U.S.C. §§ 2011 *et seq.*
- *Atomic Energy Defense Act, as amended*, 50 U.S.C. §§ 2501 *et seq.*
- *The Export Control Reform Act of 2018*, Pub. L. 115-232, Div. A, Title XVII, Subt. B., 50 U.S.C. §§ 4801 *et seq.*
- *Henry J. Hyde United States-India Peaceful Atomic Energy Cooperation Act of 2006*, Pub. L. 109-401, Title I.
- National Defense Authorization Acts (Various).
- *National Nuclear Security Administration Act, as amended*, Pub. L. 106-65, Div. C., Title XXXII.
- *Nuclear Non-Proliferation Act of 1978, as amended*, Pub. L. 95-242.

Presidential Policy Directives

- National Security Presidential Directive (NSPD) -51/Homeland Security Presidential Directive (HSPD)-20: National Continuity Policy.
- PPD-8: National Preparedness.
- PPD-25: Guideline for U.S. Government Interagency Response to Terrorist Threats or incidents in the United States and Overseas (classified directive).
- PPD-33 (classified directive).
- PPD-35: United States nuclear Weapons Command and Control, Safety, and Security.
- PPD-42: Preventing and Countering Weapons of Mass Destruction Proliferation, Terrorism, and Use.

International Agreements and Other International Instruments

- Agreement Between the Government of the United States of America and the Government of the French Republic for Cooperation in the Operation of Atomic Weapons Systems for Mutual Defense Purposes.

- Agreement Between the Government of the United States of America and the Government of the Russian Federation Concerning Cooperation Regarding Plutonium Production Reactors, and the Amendment thereto.
- Agreement Between the Government of the United States of America and the Government of the Russian Federation Concerning the Management and Disposition of Plutonium Designated as No Longer Required for Defense Purposes and Related Cooperation, with Annexes and Joint Statement, and Amendments thereto (also known as the U.S.-Russia Plutonium Management and Disposition Agreement or PMDA, currently unilaterally suspended by the Russian Federation).
- Agreement Between the Government of the United States of America and the Government of the Russian Federation on Cooperation in Nuclear- and Energy-Related Scientific Research and Development.
- Agreement Between the Government of the United States of America and the Government of the United Kingdom of Great Britain and Northern Ireland for Cooperation on the Uses of Atomic Energy for Mutual Defence Purposes.
- Agreement between the United States of America and the IAEA for the Application of Safeguards in the United States (and the Protocol Additional Thereto).
- Agreements for Peaceful Nuclear Cooperation pursuant to Section 123 of the *Atomic Energy Act* of 1954, as amended (Numerous).
- Convention on the Physical Protection of Nuclear Material and its 2005 Amendment
- Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency
- Convention on Early Notification of a Nuclear Accident
- Comprehensive Nuclear-Test-Ban Treaty. (Note: The United States has signed this treaty but has not ratified it. The treaty has not entered into force.)
- Convention on the Physical Protection of Nuclear Material and its 2005 Amendment
- Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency
- Convention on Early Notification of a Nuclear Accident
- International Convention on the Suppression of Acts of Nuclear Terrorism.
- Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.
- Nuclear Security Summit Communiqués from 2010, 2012, 2014, and 2016.
- Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water (also known as the LTBT).
- Treaty Between the United States of America and the Russian Federation on Measures for Further Reduction and Limitation of Strategic Offensive Arms (also known as the New Strategic Arms Reduction Treaty, or New START).
- Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Limitation of Underground Nuclear Weapon Tests (also known as the TTBT).
- Treaty on the Non-Proliferation of Nuclear Weapons (NPT).
- United Nations Security Council Resolution 1540.

Appendix E

Foreign Contributions and Cost-Sharing Agreements

The DOE is authorized to accept international contributions for any programs within DNN. During FY 2018, DNN received a total of \$12,101,236 (U.S. dollar equivalent) from four international contributors.

Foreign Government Contributions Received

FY	Program for Cooperation	Partner	Contributions (whole dollars)
2018	Global Material Security (GMS)	Canada	8,192,662
2018	GMS	United Kingdom	3,453,859
2018	GMS	New Zealand	150,000
2018	GMS	Finland	304,715
Total FY 2018			12,101,236

Amount and Use of Foreign Contributions

International Contributor	Amount/Date Received	Use
Global Material Security		
Canada	\$2,336,370 3/13/2018	Contribution to remove, transport, and consolidate disused sealed radioactive sources from vulnerable storage facilities to secure facilities in Kazakhstan.
Canada	\$5,856,291 4/10/2018	Contribution to install radiation detection portal monitors and associated equipment in Peru.
United Kingdom	\$3,453,859 5/14/2018	Funds were used to enhance nuclear and radiological security and to prevent nuclear smuggling in Belarus, Ukraine, Kazakhstan, and several countries in Africa.

International Contributor	Amount/Date Received	Use
Global Material Security		
New Zealand	\$150,000 5/30/2018	Contribution to support a standard operating procedure development workshop with Vietnam focused on operating radiation detection measures and responding to detection alarms.
Finland	\$304,715 6/5/2018	Contribution to install radiation detection equipment at three Ukrainian checkpoints at the Moldovan border in the Transnistria Region and the Donetsk Oblast.

Amounts Retained

During FY 2018, DNN used \$12,101,236 (U.S. dollar equivalent) for designated projects. None of the foreign funding contributions that were received in FY 2018 have been retained.

Appendix F

FY 2020 Future Years Nuclear Security Program Plan

The following section comes directly from the Department of Energy FY 2020 Congressional Budget Request, Volume 1: National Nuclear Security Administration.

Table 1. Defense Nuclear Nonproliferation Funding by Congressional Control

	(Dollars in Thousands)			
	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 vs FY 2019
Defense Nuclear Nonproliferation Appropriation				
Defense Nuclear Nonproliferation				
Material Management and Minimization				
HEU Reactor Conversion	0	0	114,000	+114,000
Nuclear Material Removal	32,925	32,925	32,925	+0
Material Disposition	183,669	225,869	186,608	-39,261
Laboratory and Partnership Support	92,000	35,000	0	-35,000
Total, Material Management and Minimization	308,594	293,794	333,533	39,739
Global Material Security				
International Nuclear Security	46,339	46,339	48,839	+2,500
Domestic Radiologic Security	110,433	127,433	90,513	-36,920
International Radiological Security	78,907	78,907	60,827	-18,080
Nuclear Smuggling Detection	154,429	154,429	142,171	-12,258
International Contributions ^{*(non-add)}	[12,101]	0	0	+0
Total, Global Material Security	390,108	407,108	342,350	-64,758
Nonproliferation and Arms Control	134,703	129,703	137,267	+7,564
Defense Nuclear Nonproliferation R&D				
Proliferation Detection	278,255	281,521	304,040	+22,519
Nuclear Detonation Detection	195,749	195,749	191,317	-4,432
Nonporliferation Fuels Development	82,500	98,300	0	-98,300
Total, Defense Nuclear Nonproliferation R&D	556,504	575,570	495,357	-80,213
Nonproliferation Construction				
99-D-143 Mixed Oxide (MOX) Fuel Fabrication Facility, SRS	335,000	220,000	220,000	+0
18-D-150, Surplus Plutonium Disposition Project	0	0	79,000	+79,000
Total, Nonproliferation Construction	335,000	220,000	299,000	79,000
Total, Defense Nuclear Nonproliferation Programs	1,724,909	1,626,175	1,607,507	-18,668
Nuclear Counterterrorism Incident Response Program	282,360	319,185	372,095	+52,910
Legacy Contractor Pensions	40,950	28,640	13,700	-14,940
Subtotal, Defense Nuclear Nonproliferation Appropriation	2,048,219	1,974,000	1,993,302	19,302
Use of Prior Year Balances	0	-25,000	0	+25,000
Recission of Prior Year Balances	-49,000	-19,000	0	+19,000
Total, Defense Nuclear Nonproliferation Appropriation	1,999,219	1,930,000	1,993,302	+63,302

* The international contributions received by the GMS program shown in the FY 2018 Enacted column are a non-add to the FY 2018 Appropriation. The amount received in FY 2018 totaled \$12,101,233, including \$8,192,659 from Canada, \$304,715 from Finland, \$3,453,859 from the United Kingdom, and \$150,000 from New Zealand. SBIR/STTR:

- FY 2018 Transferred: SBIR: \$8,545; STTR: \$1,202
- FY 2019 Projected: SBIR: \$9,118; STTR: \$1,282
- FY 2020 Request: SBIR: \$8,680; STTR: \$1,221
- FY 2021 - FY 2024 Request: SBIR: \$35,466; STTR: \$4,987

Table 2. Outyears for Defense Nuclear Nonproliferation Funding by Congressional Control

(Dollars in Thousands)

	FY 2021 Request	FY 2022 Request	FY 2023 Request	FY 2024 Request
Defense Nuclear Nonproliferation				
Material Management and Minimization				
Global Material Security	437,401	510,621	514,146	511,736
Nonproliferation and Arms Control	367,290	375,006	382,881	390,921
Defense Nuclear Nonproliferation R&D	138,700	141,508	144,374	147,301
Nonproliferation Construction	487,278	496,089	504,402	514,478
99-D-143 Mixed Oxide (MOX) Fuel Fabrication Facility, SRS	109,382	0	0	0
18-D-150, Surplus Plutonium Disposition Project	65,000	74,750	62,000	62,000
21-D-xxx, LANL Project	16,517	50,000	66,000	82,000
Total, Nonproliferation Construction	190,899	124,750	128,000	144,000
Total, Defense Nuclear Nonproliferation Programs	1,621,568	1,647,974	1,673,803	1,708,436
Nuclear Counterterrorism Incident Response Program	371,703	370,153	371,931	379,320
Legacy Contractor Pensions	11,800	11,800	12,300	12,300
Subtotal, Defense Nuclear Nonproliferation Appropriation	2,005,071	2,029,927	2,058,034	2,100,056
Use of Prior Year Balances	0	0	0	0
Recission of Prior Year Balances	0	0	0	0
Total, Defense Nuclear Nonproliferation Appropriation	2,005,071	2,029,927	2,058,034	2,100,056

This page left blank intentionally.

Appendix G

Analysis and Explanation of FY 2018 Uncosted and Unencumbered Balances

Background

When Congress appropriates annual funding for the DNN appropriation, it generally specifies that the appropriated funds shall “remain available until expended.” This means that funds are available for obligation for an indefinite period of time. Uncosted balances occur when funds have been obligated but costs have not yet been incurred. These balances are necessary and unavoidable given the nature of DNN’s work but are carefully managed and tracked as part of the Department’s financial management system.

In response to Government Accountability Office (GAO) criticism that the Department did not have a standard, effective approach for identifying excess uncosted carryover balances, DOE established percentage thresholds specifying levels of uncosted balances consistent with sound financial management for specific types of financial and contractual arrangements. The thresholds provide program and project managers with the ability to evaluate overall performance based on the variance between target thresholds and actual uncosted balances. A target threshold is defined as an analytical reference point beyond which uncosted obligation balances should be given greater scrutiny. Balances in excess of these thresholds require a more detailed explanation or justification to determine cause and to identify the expectation for full costing. The target thresholds are 13 percent for contractor operating costs; 17 percent for federal operating costs; and 50 percent for capital equipment, minor construction projects, and accelerator improvement projects.

As per the requirements in 50 U.S.C. § 2575(c)(6), DNN reports to Congress annually on any uncommitted or uncosted balances that exceed these thresholds. Encumbrances are a portion of uncosted balances under contract at the Department’s major labs, plants and sites, award of direct contracts to non-M&O contractors, and other liabilities of the major contractor. DNN measures financial performance in terms of the percentage of funds that have been costed and encumbered, rather than just the percentage of funds that have been costed, because a great deal of the program’s work is performed overseas. Sound management and programmatic necessities generally require work to be fully completed and verified before DNN disburses funds in non-U.S. venues. Measuring financial performance only in terms of funds costed would not provide an accurate picture of the program’s progress.

Overview of DNN Balances

At the end of FY 2018, costs plus encumbrances totaled 81.9 percent of total funds available to cost for the DNN appropriation, leaving 18.1 percent of total funds uncosted and unencumbered. This balance was primarily driven by the following DNN congressional controls that had uncosted balances in excess of the established thresholds:

- The International Material Protection and Cooperation (IMP&C) Program (a past program, now reorganized into GMS Program, which has remaining uncommitted prior-year funds on account)

- The Nonproliferation and International Security (NIS) Program (a past program, now reorganized into NPAC Program, which has remaining uncommitted prior-year funds on account)
- The Fissile Materials Disposition (FMD) Program (a past program, now reorganized into MMM Program, which has remaining uncommitted prior-year funds on account)
- The Global Material Security Program (GMS)
- Defense Nuclear Nonproliferation Research and Development (DNN R&D)
- The Material Management and Minimization Program (M³)
- The Nonproliferation and Arms Control Program (NPAC)

Details on the balances for each control, explanations for the balances, and a table showing FY 2018 budget execution data in detail are provided below.

International Material Protection and Cooperation

As of the end of FY 2018, IMP&C year-to-date costs plus encumbrances totaled \$87.3 million, or 80.5 percent of total funds available to cost (all from FY 2015 or prior years); the remaining \$21.1 million in uncosted balances exceeded the DOE threshold by \$6.2 million. This balance will be used in FY 2019 to support multilateral engagement (such as with the IAEA), cyber security engagement, nuclear security training development and other bilateral nuclear security engagement with international partners. The funds will also be used to support radiation detection sustainability efforts, including equipment testing and maintenance, workshops, and exercises in multiple countries.

Nonproliferation and International Security

At the end of FY 2018, NIS year-to-date costs plus encumbrances totaled \$3.1 million, or 75.1 percent of total funds available to cost (all from FY 2015 or prior years); the remaining \$1.0 million in uncosted balances exceeded the DOE threshold by \$0.4 million and will be used in FY 2019 to support the G2 program management information system.

Fissile Material Disposition

As of the end of FY 2018, FMD year-to-date costs plus encumbrances totaled \$13.6 million, or 73.3 percent of total funds available to cost (all from FY 2015 or prior years); the remaining \$4.9 million in uncosted balances exceeded the DOE threshold by \$2.2 million. This balance of \$4.9 million will be used in FY 2019 to continue to support the plutonium and uranium disposition programs.

Global Material Security

As of the end of FY 2018, GMS had year-to-date costs plus encumbrances totaling \$617.5 million, or 74.8 percent of total funds available to cost; the remaining \$207.9 million in uncosted balances exceeded the DOE threshold by \$89.5 million. These balances will be used to support three critical programs within GMS; (1) International Nuclear Security; (2) Radiological Security; and (3) Nuclear Smuggling Detection and Deterrence.

In FY 2018, GMS received a budgetary increase late in the fiscal year. In addition, GMS experienced some delays with foreign partners that resulted in large commitments slipping into FY 2019. Many of those commitments were made early in FY 2019, and as such GMS anticipates a lower uncommitted carryover at the end of FY 2019. Additionally, the bulk of the carryover is allocated to a classified project. GMS is actively working to cost these funds.

The uncosted balances for the International Nuclear Security Program (\$120.5 million) will support accelerated nuclear security engagement with international partners to protect, mitigate vulnerabilities,

and sustain security at nuclear sites, and to support multilateral activities with the IAEA to improve nuclear security globally.

The uncosted balances for the Radiological Security Program (\$47.4 million) will support continued work with domestic and international partners to secure high-risk radioactive materials through protecting sources in place, removing and disposing of disused sources, and reducing the use of technologies with radioactive sources through replacing them with alternative technologies that do not use sources.

The uncosted balances for the Nuclear Smuggling Detection and Deterrence Program (\$40.0 million) will support high-priority activities in FY 2019, including acceptance testing, site assurance visits, workshops and exercises, and maintenance contracts.

Defense Nuclear Nonproliferation Research and Development

As of the end of FY 2018, DNN R&D had year-to-date costs plus encumbrances totaling \$574.2 million, or 80.7 percent of its total funds available to cost; the remaining \$137.4 million in uncosted balances exceeded the DOE threshold by \$17.0 million. The uncosted balances support three programs within DNN R&D: (1) Proliferation Detection; (2) Nuclear Detonation Detection; and (3) Nonproliferation Fuels Development.

The uncosted balances for the Proliferation Detection Program (\$68.0 million) are allocated to long-lead (8–24 months) procurements, major field experiments and demonstrations, major lab equipment purchases, and payment of laboratory salaries. The uncosted balances for the Nuclear Detonation Program (\$38.7 million) are allocated to long-lead (8–24 months) procurements, primarily in the space program, major lab equipment purchases, and payment of laboratory salaries. The uncosted balances for the Nonproliferation Fuels Development Program (\$30.7 million) are allocated to the qualification of a new, U-Mo monolithic low enriched uranium (LEU) fuel; advance fabrication activities for the LEU fuel; advance reactor conversion analysis work; advance cross-cutting activities within the USHPRR Project; and continue project controls, technical integration, risk management, and quality assurance efforts, and the naval reactor activities.

Across all DNN R&D programs, these funds above threshold are allocated to planned work scope primarily at the national laboratories. They are spent at appropriate rates for the types of work conducted, as specified in approved Life Cycle Plans for each project defining their work scope and timeline against funds.

Material Management and Minimization

As of the end of FY 2018, M³ had year-to-date costs plus encumbrances totaling \$328.8 million, or 74.2 percent of total funds available to cost; the remaining \$114.3 million in uncosted balances exceeded the DOE threshold by \$43.0 million. These uncosted balances support three critical programs within M³; (1) Nuclear Material Removal; (2) Material Disposition; and (3) Laboratory and Partnership Support (activities prior to FY 2018 funded under the HEU Reactor Conversion Program).

In FY 2018, a limitation on the work scope congressionally authorized to be completed for the dilute and dispose approach, with no approval for line item funding for the SPD project, and the change in uranium market prices resulted in higher uncosted balances than expected. Additionally, NNSA has faced political challenges working with some countries to remove nuclear material. There are different hurdles facing the implementation of each of these projects; however, the common thread is that any decision to proceed with removing the material would need to be made by senior government officials and such approval has not been granted. Similarly, technical challenges will vary by project but can include issues identifying an appropriate disposition pathway or transport package as well as external factors that can impact the removal schedule, such as the qualification of new low enriched uranium fuel.

The uncosted balances for the Nuclear Material Removal Program (\$38.0 million) will support contractor labor and travel support for future nuclear material removals. More specifically, these balances will be used to execute an Emerging Threats deployment exercise in late FY 2019; multiple removals from Japan, Canada, and Europe in FY 2019, totaling hundreds of kilograms of HEU; and to enable future removals in the outyears. Removal activities are dependent on many factors outside of the Nuclear Material Removal program's control, most importantly foreign partners' willingness and ability to support. The availability of these funds ensures that WUNM can be removed as quickly as possible.

The uncosted balances for the Material Disposition Program (\$67.3 million) will support multiple activities in FY 2019 including continued surveillance and packaging capabilities for surplus plutonium; operations at Los Alamos National Laboratory to disassemble and convert surplus pits to an oxide in preparation for disposition; planning and design activities for the dilute and dispose strategy including independent validation of the Dilute and Dispose Lifecycle Cost Estimate and conduct a National Environmental Policy Act analyses; high priority activities to expedite the removal of surplus plutonium from the State of South Carolina; continued efforts to downblend surplus high enriched uranium (HEU) to low enriched uranium that ultimately supports the tritium program, and continued management of the Uranium Lease and Take-Back program in accordance with the American Medical Isotopes Production Act of 2012. Uncommitted balances will also support lay-up activities in the HB-Line facility previously operated to produce plutonium oxide.

The uncosted balances for the Laboratory and Partnership Support Program (\$9.0 million) will support placements of additional contracts. The program will use these funds for Mo-99 national laboratory technical support and to place key contracts in early FY 2019 to demonstrate the fabrication of a new high-density LEU fuel to convert the remaining HEU research reactors in the United States. These efforts further the M³ goal of reducing the use of HEU in civilian applications worldwide by converting research reactors and isotope production facilities from HEU to low enriched uranium (LEU) and by supporting non-HEU-based domestic production of Mo-99, a critical medical isotope used in 40,000 medical procedures daily in the United States. In addition, these funds will support conversion activities in Japan and Kazakhstan and European fuel development.

Nonproliferation and Arms Control

At the end of FY 2018, NPAC had year-to-date costs plus encumbrances totaling \$141.9 million, or 78.0 percent of total funds available to cost; the remaining \$40.1 million in uncosted balances exceeded the DOE threshold by \$15.2 million. NPAC's uncosted balances are primarily the result of a procurement delay associated with a laboratory subcontract for safeguards technology demonstration activities; verification contracts for activities that take place late in the fiscal year or very early in the following fiscal year; and delays in export control and policy activities resulting from scheduling changes initiated by international partners. This remaining balance supports the four subprograms within NPAC: International Nuclear Safeguards; Nuclear Export Control; Nuclear Verification; and Nonproliferation Policy.

The uncosted balances for International Nuclear Safeguards (\$16.9 million) were used to complete seven major safeguards engagement events during the first quarter FY 2019. Remaining funds will be used to finalize a major laboratory subcontract for safeguards technology demonstration activities during the fourth quarter of FY 2019.

The uncosted balances for Nuclear Export Control (\$8.8 million) were used to support an increase in compliance activities, and events scheduled during the first quarter of FY 2019.

The uncosted balances for Nuclear Verification (\$10 million) supported key contracts for warhead dismantlement and fissile materials placed in early FY 2019. This includes the Chemical Weapons Convention proficiency testing, technology demonstrations at Pantex, as well as the Comprehensive Test

Ban Treaty support personnel. Funds were also used in October for a monitoring visit for nuclear compliance verification activities.

The uncosted balances for Nonproliferation Policy (\$4.7 million) were used to support ongoing activities in the first quarter of FY 2019.

Cost + Commitment Status, End of Fiscal Year 2018		A		B		C		D		E		F		G	
		Data						B + C		D / A		A - D		F / A	
Expens.	Program	Total Funds Available to Cost (TAC)	YTD Cost	Total Uncosted Encumbrances	YTD Costs + Encumbrances	YTD Costs + Encumbrances as a % of TAC	Total Uncosted Encumbrances	Unencumbered as % of Costing Authority							
Operating	<ul style="list-style-type: none"> Elimination of Weapons Grade Plutonium Production Nonproliferation and International Security * Russian Surplus Fissile Materials Disposition Global Threat Reduction Initiative Congressionally Directed Projects - Defense Nuclear Nonproliferation International Material Protection and Cooperation (IMPC) Nonproliferation and International Security (NIS) Highly Enriched Uranium (HEU) Reactor Conversion International Nuclear and Radiological Material Removal and Protection Domestic Radiological Material Removal and Protection Defense Nuclear Nonproliferation Research and Development (DN) Fissile Materials Disposition Global Material Security DNN Research and Development Material Management and Minimization Nonproliferation and Arms Control Legacy Contractor Pensions 	946,351	0	946,351	946,351	100.0%	0	0.0%	8,857	0	100.0%	8,857	0	0.0%	100.0%
		8,857	0	0	0	0.0%	0	0.0%	312,947	312,947	100.0%	312,947	0	0.0%	100.0%
		16,273,735	2,904,509	12,394,325	15,298,834	94.0%	12,394,325	6.0%	4,770	4,770	100.0%	4,770	0	0.0%	100.0%
		108,493,176	57,757,438	29,586,820	87,344,258	80.5%	29,586,820	19.5%	2,294,011	2,294,011	75.1%	2,294,011	1,015,151	24.9%	24.9%
		4,078,639	2,294,011	769,478	3,063,489	75.1%	3,063,489	13.5%	1,501,590	1,501,590	86.5%	1,501,590	1,033,239	13.5%	13.5%
		7,666,755	5,131,926	1,501,590	6,633,516	86.5%	6,633,516	7.2%	4,135,182	4,135,182	93.7%	4,135,182	278,006	6.3%	6.3%
		51,673,702	12,086,504	35,854,413	47,940,916	92.8%	35,854,413	12.2%	1,401,917	1,401,917	87.8%	1,401,917	1,830,686	12.2%	12.2%
		4,413,189	2,733,266	1,401,917	4,135,182	93.7%	4,135,182	26.7%	988,106	988,106	73.3%	988,106	4,942,474	26.7%	26.7%
		14,990,983	12,172,191	988,106	13,160,297	87.8%	13,160,297	25.2%	5,661,211	5,661,211	74.8%	5,661,211	207,865,124	25.2%	25.2%
		18,533,398	7,929,713	5,661,211	13,590,924	73.3%	13,590,924	19.5%	272,159,817	272,159,817	80.5%	272,159,817	135,566,588	19.5%	19.5%
		825,381,944	345,357,003	272,159,817	617,516,820	74.8%	617,516,820	25.8%	83,867,859	83,867,859	74.2%	83,867,859	114,308,921	25.8%	25.8%
		696,608,549	477,174,102	272,159,817	617,516,820	74.2%	617,516,820	22.0%	91,368,773	91,368,773	78.0%	91,368,773	40,129,054	22.0%	22.0%
		443,130,839	237,453,144	13,097,437	141,867,070	100.0%	141,867,070	0.0%	13,097,437	13,097,437	100.0%	13,097,437	0	0.0%	0.0%
		181,996,124	128,769,634	13,097,437	141,867,070	100.0%	141,867,070	0.0%	40,950,000	40,950,000	100.0%	40,950,000	0	0.0%	0.0%
		40,950,000	40,950,000	0	40,950,000	100.0%	40,950,000	0.0%	0	0	100.0%	0	0	0.0%	0.0%
Operating Total		2,415,463,958	1,332,854,985	549,774,269	1,882,629,253	77.9%	549,774,269	22.1%	1,882,629,253	1,882,629,253	77.9%	1,882,629,253	532,834,705	22.1%	22.1%
Construction	<ul style="list-style-type: none"> U.S. Surplus Fissile Materials Disposition Infrastructure and Operations (formerly RTBF) Material Management and Minimization Defense Nuclear Nonproliferation 	3,539,199	3,182,240	356,958	3,539,199	100.0%	356,958	0.0%	22,918	22,918	100.0%	22,918	0	0.0%	0.0%
		22,918	0	22,918	22,918	100.0%	22,918	0.0%	0	0	100.0%	0	-0	0.0%	0.0%
		239,425,991	234,015,861	5,399,517	239,415,377	100.0%	5,399,517	0.0%	269,156,669	269,156,669	99.6%	269,156,669	1,264,582	0.4%	0.4%
		290,000,000	19,578,669	269,156,669	288,735,418	99.6%	269,156,669	0.2%	274,936,142	274,936,142	99.8%	274,936,142	1,275,196	0.2%	0.2%
Construction Total		532,988,108	256,776,770	274,936,142	531,712,912	99.8%	274,936,142	0.2%	824,710,411	824,710,411	81.9%	824,710,411	534,109,900	18.1%	18.1%
Grand Total		2,948,452,066	1,589,631,755	824,710,411	2,414,342,166	81.9%	824,710,411	18.1%	2,414,342,166	2,414,342,166	81.9%	2,414,342,166	1,067,944,605	18.1%	18.1%

This page left blank intentionally.

A Report to Congress

Prevent, Counter, and Respond—NNSA's Plan to Reduce Global
Nuclear Threats (FY 2020-FY 2024)

July 2019

U.S. Department of Energy
National Nuclear Security Administration
1000 Independence Avenue, SW
Washington, DC 20585