U.S. DEPARTMENT OF ENERGY

National Nuclear Security Administration

Prevent, Counter, and Respond—A Strategic Plan to Reduce Global Nuclear Threats

FY 2019–FY 2023

Report to Congress
October 2018

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

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Message from the Administrator

The Department of Energy's National Nuclear Security Administration (DOE/NNSA) *Fiscal Year 2019 Prevent, Counter, and Respond – A Strategic Plan to Reduce Global Nuclear Threats – Biennial Plan Summary* (NPCR) describes DOE/NNSA's plans and programs to prevent the proliferation of nuclear weapons, counter the threat of nuclear terrorism, and respond to nuclear and radiological incidents around the world. The NPCR is a companion to the *Stockpile Stewardship and Management Plan*, which outlines DOE/NNSA's plans to ensure the safety, security, and effectiveness of the U.S. nuclear stockpile and to maintain the scientific and engineering tools, capabilities, and infrastructure that underpin the nuclear security enterprise. In keeping with our commitment to transparency, updated versions of these reports are published each year.

The recently released *Nuclear Posture Review* (DoD 2018) reaffirmed the critical role of the nuclear deterrent in maintaining both U.S. national and global security, while also stressing the vital role of nuclear nonproliferation, counterproliferation, and counterterrorism. Maintaining a safe, secure, and effective U.S. nuclear stockpile and reducing global nuclear threats are closely related and mutually reinforcing priorities. The facilities and scientific knowledge that underpin stockpile stewardship, for example, are harnessed for a range of nonproliferation and counterterrorism missions, from assessing foreign weapons programs and potential terrorist devices to managing the potential proliferation risks associated with global civil nuclear development. Preventing the spread of nuclear weapons around the world yields considerable benefits for the U.S. nuclear posture. Limiting the number of nuclear-capable states and preventing terrorist access to materials and technology that can threaten the United States and its allies enhances global stability and constrains the range of potential threats facing the Nation.

DOE/NNSA's plans and programs encompass both unilateral initiatives as well as cooperative efforts with partner nations, when appropriate. In both environments, DOE/NNSA provides the technical and policy expertise across the entire nuclear fuel cycle and nuclear weapons development spectrum in order to support diplomatic, informational, military, and economic actions to secure the United States and defend against weapons of mass destruction.

The FY 2019 edition of *Prevent, Counter, and Respond* updates last year's report, focusing on major changes in the threat environment and in DOE/NNSA's nuclear and radiological threat reduction programs. These developments, such as continued concerns over Iran's nuclear aims, constitute a very serious challenge to the global nuclear nonproliferation regime, as well as incident preparedness and response planning. Other key developments in the threat environment include the persistence of terrorist threats in Europe and the United States, increasingly frequent and sophisticated cyberattacks, and the emergence of new and potentially proliferation-relevant technologies.

In short, the complex and demanding geopolitical challenges we face are a constant reminder that we must maintain vigilance in our nonproliferation, counterproliferation, and counterterrorism efforts. DOE/NNSA is committed to countering efforts to acquire, transfer, or use nuclear weapons-related technologies, materials, or expertise; responding to nuclear and radiological incidents around the world; countering the threat of nuclear terrorism; and seeking verifiable and enforceable arms control agreements that enhance global security. This report describes DOE/NNSA's role in meeting these objectives.

This report is provided to the following Members of Congress:

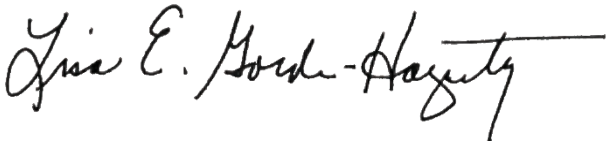
- **The Honorable James Inhofe**
  Chairman, Senate Committee on Armed Services

- **The Honorable Jack Reed**
  Ranking Member, Senate Committee on Armed Services
- **The Honorable Deb Fischer**
  Chairman, Subcommittee on Strategic Forces
  Senate Committee on Armed Services
- **The Honorable Joe Donnelly**
  Chairman, Subcommittee on Strategic Forces
  Senate Committee on Armed Services
- **The Honorable William "Mac" Thornberry**
  Chairman, House Committee on Armed Services
- **The Honorable Adam Smith**
  Ranking Member, House Committee on Armed Services
- **The Honorable Mike Rogers**
  Chairman, Subcommittee on Strategic Forces
  House Committee on Armed Services
- **The Honorable Jim Cooper**
  Chairman, Subcommittee on Strategic Forces
  House Committee on Armed Services
- **The Honorable Bob Corker**
  Chairman, Senate Committee on Foreign Relations
- **The Honorable Bob Menendez**
  Ranking Member, Senate Committee on Foreign Relations
- **The Honorable Edward R. Royce**
  Chairman, House Committee on Foreign Affairs
- **The Honorable Eliot L. Engel**
  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 Rodney P. Frelinghuysen**
  Chairman, House Committee on Appropriations
- **The Honorable Nita M. Lowey**
  Ranking Member, House Committee on Appropriations

- **The Honorable Michael K. Simpson**
  Chairman, Subcommittee on Energy and Water Development
  House Committee on Appropriations
- **The Honorable Marcy Kaptur**
  Ranking Member, Subcommittee on Energy and Water Development
  House Committee on Appropriations

If you have questions about this plan, please contact me or Nora F. Khalil, Associate Administrator for External Affairs, at (202) 586-7332.

Sincerely,



Lisa E. Gordon-Hagerty

Message from the Secretary

Since its creation, the Department of Energy (DOE) has been at the forefront of U.S. national security. Among its missions, both nuclear and non-nuclear, is one of the most critical to the safety and security of the American people — that of preventing, countering, and responding to the threats of nuclear proliferation and nuclear terrorism worldwide. DOE's National Nuclear Security Administration's (NNSA) "prevent-counter-respond" framework comprises a defense-in-depth strategy against the unprecedented range of threats that today's geopolitical environment poses.

Despite the advances made through arms control agreements, export controls, and other efforts, nuclear proliferation and nuclear terrorism remain serious threats to the security of the United States and its allies. The number of nuclear facilities continues to rise as additional countries pursue civil nuclear energy, increasing the quantity of potentially vulnerable nuclear material around the world. Terrorist activity that continues worldwide, the growing sophistication of illicit procurement networks, and ongoing uncertainties in volatile regions of the world make the work performed by DOE/NNSA and its interagency and international partners all the more important. The Department, in close cooperation with its partners, continuously monitors the international security landscape to ensure that the United States adapts to shifting threats, evolving technologies, and other developments.

Our goals are to eradicate global nuclear proliferation threats, reduce the risk of nuclear terrorism, and maintain the ability to quickly respond to nuclear or radiological incidents whenever and wherever they may occur. With continued congressional support, and through diligent, strategic, efforts across the threat spectrum, DOE will continue to protect the Nation, as it has for decades.

Sincerely,

Rick Perry

Rick Perry

Executive Summary

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, its partners, and its allies. The *Fiscal Year 2019 Nuclear Prevent, Counter, and Respond – A Strategic Plan to Reduce Global Nuclear Threats – Biennial Plan Summary* (NPCR) describes DOE/NNSA's plans and programs to prevent, counter, and respond to nuclear nonproliferation, counterproliferation, and nuclear security threats. The NPCR is published annually, either in full report form or as a summary, in response to statutory requirements. The FY 2019 edition is a summary report.

By leveraging the scientific and technical expertise and programming capabilities found throughout the nuclear security enterprise, DOE/NNSA helps to fulfill the strategies on nonproliferation and counterterrorism discussed in the 2018 *Nuclear Posture Review* (DoD 2018). DOE/NNSA pursues programs designed to respond to both current and emerging threats by organizing threat reduction activities into three functional areas – prevent, counter, and respond:

- **Prevent** 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 for an improvised nuclear device (IND) or radiological dispersal device (RDD) (Chapter 2);
- **Counter** the efforts of both proliferant states and non-state actors to acquire, develop, disseminate, transport, or deliver the materials, expertise, or components necessary for a nuclear weapon, IND, or RDD (Chapter 3); and
- **Respond** to nuclear or radiological incidents by searching for and rendering safe threat devices and materials; carrying out nuclear forensic activities; conducting consequence management actions following an event to protect lives, property, and the environment; and preparing for and supporting departmental emergencies through close coordination with the Department's Emergency Management Enterprise system (Chapter 4).

The plans and programs of DOE/NNSA's Office of Defense Nuclear Nonproliferation (DNN) encompass both unilateral initiatives as well as cooperative efforts with partner nations. Programs are carried out globally, including in regions of concern throughout the world. Often working with interagency partners, DNN provides the policy and technical expertise across the entire threat spectrum in order to support diplomatic, informational, military, and economic actions that secure the United States and defend against weapons of mass destruction.

DOE/NNSA has strengthened coordination between the Office of Emergency Operations and the Office of Counterterrorism and Counterproliferation, which has led to several high-visibility efforts, including: the design, development, and conduct of multiple DOE-wide and interagency scenario-based facilitated workshops focused on aspects of the evolving threat environment; several interagency Technical Capabilities Meetings; and continued training and exercises of the DOE Unified Coordination Structure, including the Nuclear Incident Team.

As the DOE/NNSA primary office of interest for the Comprehensive Emergency Management System, the Office of Emergency Operations has increased coordination and led the integration and full engagement of the DOE/NNSA emergency management stakeholder community in implementing enterprise-wide all-hazards policy requirements, responsibilities, and authorities in accordance with DOE Order 151.1.D in preparing for, responding to, and recovering from all-hazards emergencies across the DOE Emergency Management Enterprise.

The FY 2019 edition of the NPCR updates last year's report, focusing on changes in the threat environment and in DOE/NNSA's nuclear and radiological threat reduction programs. There have been several developments since last year's report. Relationships with states of proliferation concern continue to demand attention; as prospects for reducing the nuclear threat on the Korean peninsula are improving, DOE/NNSA also needs to be concerned with potential new challenges in the Middle East. Other key developments in the threat environment include the persistence of terrorist threats in Western Europe and the United States, increasingly frequent and sophisticated cyberattacks, and the emergence of new and potentially proliferation-relevant technologies.

The future is challenging and dynamic. DOE/NNSA is fully committed to ensuring that these critical national security missions will be strategically and effectively executed today and into the future.

Prevent, Counter, and Respond—A Strategic Plan to Reduce Global Nuclear Threats (FY 2019–FY 2023)

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List of Acronyms

AM	Additive Manufacturing
AMS	Aerial Measuring System
ANL	Argonne National Laboratory
CTBT	Comprehensive Nuclear-Test-Ban Treaty
CTCP	Office of Counterterrorism and Counterproliferation
DHS	Department of Homeland Security
DNFSB	Defense Nuclear Facilities Safety Board
DNN	Office of Defense Nuclear Nonproliferation
DNN R&D	Office of Defense Nuclear Nonproliferation Research and Development
DOC	Department of Commerce
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
ETRAC	Emerging Technologies Research Advisory Committee
ETWG	Emerging Technologies Working Group
FBI	Federal Bureau of Investigation
FTE	Full-Time Equivalent
GBD	Global Burst Detection
GMS	Office of Global Material Security
HAMMER	Hazardous Materials Management Emergency Response
HEU	Highly Enriched Uranium
HHS	Department of Health and Human Services
IAEA	International Atomic Energy Agency
IND	Improvised Nuclear Device
INF	Intermediate-Range Nuclear Forces
INL	Idaho National Laboratory
IPNDV	International Partnership for Nuclear Disarmament Verification
ISIS	Islamic State in Iraq ash Sham
JCPOA	Joint Comprehensive Plan of Action
kg	kilograms
LANL	Los Alamos National Laboratory
LEU	Low-Enriched Uranium
LLNL	Lawrence Livermore National Laboratory
LOB	National Laboratory Operations Board
M^3	Office of Material Management and Minimization
M&O	Management and Operating

MDI	Mission Dependency Index
MFFF	Mixed Oxide Fuel Fabrication Facility
Mo-99	Molybdenum-99
MOX	Mixed Oxide
MPC&A	Material Protection, Control, and Accounting
MT	Metric Tons
MVP	Maritime Vectors Partnership
NCTIR	Nuclear Counterterrorism Incident Response
New START	New Strategic Arms Reduction Treaty
NGFP	NNSA Graduate Fellowship Program
NIPC	Office of Nuclear Incident Policy and Cooperation
NNSA	National Nuclear Security Administration
NNSS	Nevada National Security Site
NPAC	Office of Nonproliferation and Arms Control
NPT	Nuclear Non-Proliferation Treaty
NRC	Nuclear Regulatory Commission
NSC	National Security Council
NSDD	Office of Nuclear Smuggling Detection and Deterrence
NSPD	National Security Presidential Directive
NSPM	National Security Presidential Memorandum
NSS	Nuclear Security Summit
P5+1	China, France, Germany, Russia, the United Kingdom, and the United States
PNNL	Pacific Northwest National Laboratory
PPD	Presidential Policy Directive
PPRA	U.S.-Russia Plutonium Production Reactor Agreement
PWG	Plutonium Disposition Working Group
RAP	Radiological Assistance Program
SAI	Strategic Airport Initiative
SNL	Sandia National Laboratories
SNM	Special Nuclear Material
SPD	Surplus Plutonium Disposition
SRS	Savannah River Site
SSP	Stockpile Stewardship Program
UK	United Kingdom
U.S.	United States
USAF	United States Air Force
USNDS	U.S. Nuclear Detonation Detection System
WGPu	Weapons-Grade Plutonium
WIPP	Waste Isolation Pilot Plant
WMD	Weapons of Mass Destruction

Legislative Language

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

> 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.

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

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Chapter 1: Introduction
Meeting the Challenges of Nuclear Proliferation & Nuclear Terrorism

1.1 Strategic Objectives, Priorities, and Implementation Framework

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, its partners, and its allies. DOE/NNSA's responsibility for nuclear threat reduction is described in DOE/NNSA's *Enterprise Strategic Vision* as one of three core mission pillars (Figure 1).

Figure 1. DOE/NNSA Mission Pillars and Crosscutting Capabilities

By leveraging the scientific and technical expertise and programming capabilities found throughout the nuclear security enterprise, DOE/NNSA helps to fulfill the strategies on nonproliferation and counterterrorism discussed in the *2017 National Security Strategy* and the 2018 *Nuclear Posture Review* (DoD 2018). DOE/NNSA pursues programs designed to respond to both current and emerging threats by organizing threat reduction activities into three functional areas – prevent, counter, and respond:

1. **Prevent** 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 for an improvised nuclear device (IND) or radiological dispersal device (RDD);
2. **Counter** the efforts of both proliferant states and non-state actors to acquire, develop, disseminate, transport, or deliver the materials, expertise, or components necessary for a nuclear weapon, IND, or RDD; and
3. **Respond** to nuclear or radiological incidents by searching for and rendering safe threat devices and materials; carrying out nuclear forensic activities; conducting consequence management actions following an event to protect lives, property, and the environment; and preparing for and supporting departmental emergencies through close coordination with the Department's Emergency Management Enterprise system.

Through this framework, DOE/NNSA addresses challenges within a current geopolitical environment that is now presenting an unprecedented range and mix of threats, especially in nuclear and cyber areas, across an ever-evolving threat spectrum (Figure 2).

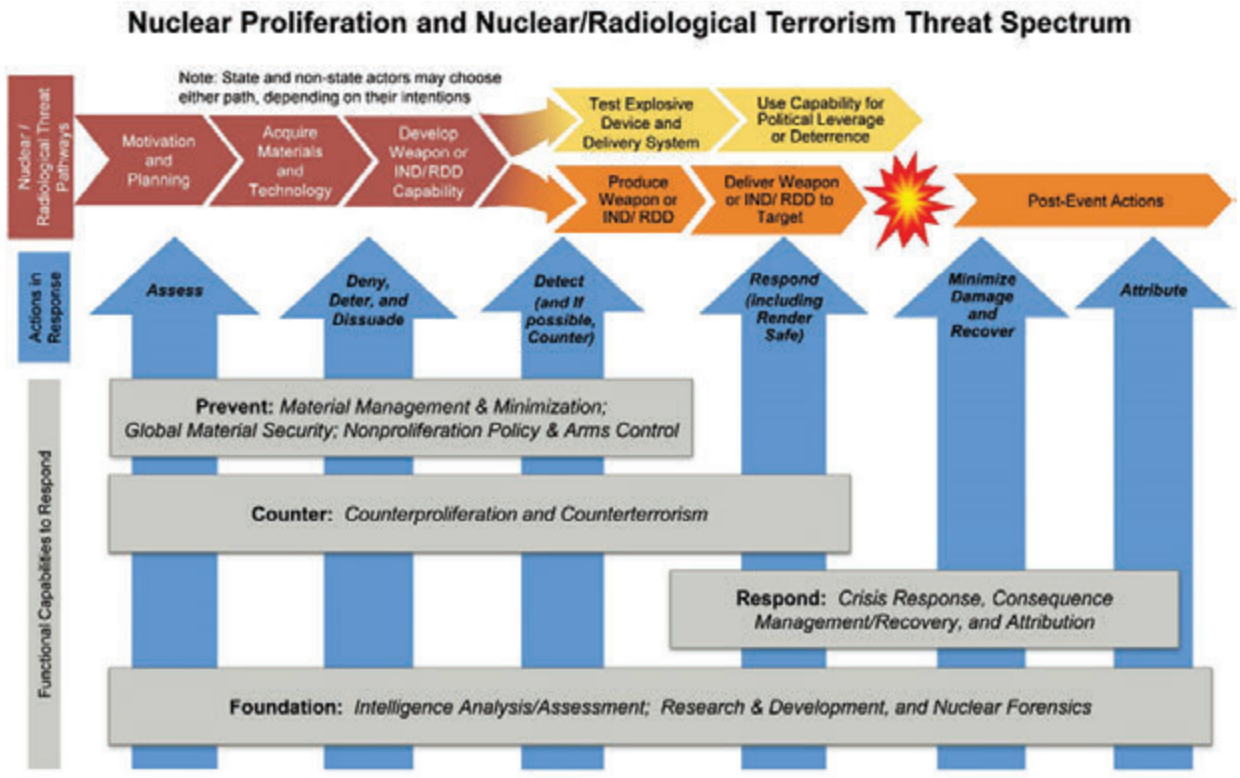

Figure 2. DOE/NNSA Strategic Approach to Reducing Nuclear and Radiological Threats

DOE/NNSA works collaboratively with U.S. interagency partners, including the Department of State (DOS), Department of Defense (DoD), Department of Homeland Security (DHS), and the Federal Bureau of Investigation (FBI). U.S. policy goals established through the interagency process, Intelligence Community assessments and reports, including those provided by DOE's Office of Intelligence and Counterintelligence, and a variety of other factors directly influence DOE/NNSA's risk-informed prioritization process. This prioritization process relies on classic risk assessment calculations (i.e.,

assessed threats, level of vulnerability, probability, and degree of consequences), which are tailored to missions and capabilities and influenced by external considerations (e.g., evolution of threat trends, urgency of a specific threat, windows of opportunity to act, level of long-term political support and cooperation from partners, adequacy of technical capabilities, and availability of resources).

1.2 Characterizing the Threat Environment

As discussed in the *Nuclear Posture Review,* global threat conditions present an ever-changing field of increased uncertainty and risk. While the Democratic People's Republic of Korea (DPRK) has committed to complete denuclearization of the Korean peninsula, much work is still needed to make this objective a reality. Iran retains the technological capability and much of the capacity necessary to develop enough fissile material for a nuclear weapon within one year of a decision to do so. Nuclear terrorism remains a grave potential threat to the United States and to international security and stability more broadly. As the *Nuclear Posture Review* warns, "given the nature of terrorist ideologies, we must assume that they would employ a nuclear weapon were they to acquire one."

Based on these concerns, last year's edition of *Prevent, Counter, and Respond* outlined several key trends in the threat environment, including challenges to state control over nuclear and radioactive materials, strains on the nonproliferation and arms control regimes, challenges associated with civil nuclear power expansion in the developing world, and risks from expanded trade and changing technologies. These trends are consistent with the key judgments on the nuclear threat environment that were included in the classified appendix to last year's report. Since the release of last year's report, certain events have further underscored the significance of these trends.

Challenges to State Control over Nuclear and Radioactive Materials

When countries or regions face internal strife or political instability, effective state control over nuclear and radioactive materials can be challenged. In some cases, this trend has been associated with violent non-state actors, including the Islamic State in Iraq ash Sham (ISIS). Such groups—and the potential for others to develop in unstable regions of the world—represent a significant threat. Security vulnerabilities of radioactive materials exist worldwide, and ISIS and other terrorist groups have conducted attacks in areas well outside their control. There is a significant number of radioactive sources vulnerable to being acquired by terrorists, should they decide to implement an attack with an RDD. If terrorist groups gain additional footholds in unstable regions, they could also gain easy access to radioactive materials, such as those used in medical facilities. DOE/NNSA is concerned with terrorists taking advantage of radioactive materials worldwide, including in areas where terrorists may have greater freedom of operation or where radioactive material is less secure.

DOE/NNSA also remains concerned about the ability of terrorists to conduct large-scale attacks in countries where nuclear material exists. Accordingly, DOE/NNSA strives to ensure nuclear security is sufficient to prevent the theft of material from nuclear facilities.

Additionally, insider threats remain one of the most difficult challenges to maintaining the security of nuclear and radioactive materials. Insiders can exploit their access, privileges, and knowledge of security mechanisms to steal nuclear and radioactive materials for profit or use. Since 1992, there have been roughly two dozen seizures of nuclear material, totaling tens of kilograms seized worldwide that have been identified.

Strains on Nonproliferation and Arms Control Regimes

Events of the past year have reinforced the strains on the nonproliferation and arms control regimes. Persistent and worsening international security conditions have put pressure on the consensus-based

multilateral institutions and democratic alliances that underwrite global nonproliferation efforts. As we approach the 50th anniversary of the Nuclear Nonproliferation Treaty (NPT) in 2020, the United States is seeking to uphold and strengthen the NPT as the cornerstone of the nonproliferation regime. Yet political divisions within the treaty over a lack of perceived progress on disarmament are intensified by some states increasing the numbers and types of nuclear weapons in their arsenals, and increasing the salience of nuclear forces in their strategies and plans. Moreover, states continue to view the nonproliferation, peaceful use, and disarmament components of the NPT as competing elements rather than shared benefits and responsibilities of all States Parties.

The Intermediate-Range Nuclear Forces Treaty also faces continued pressures from Russia's violation of its treaty obligations, which has been documented in the DOS annual *Report on Adherence to and Compliance with Arms Control, Nonproliferation, and Disarmament Agreements and Commitments* since 2014.

Challenges Associated with Civil Nuclear Power in the Developing World

Although recent forecasts predict less dramatic total growth in global nuclear energy generation than previously projected, many states are still planning nuclear energy programs, and the forecast for growth among nuclear newcomers (states that do not currently have civil nuclear power programs and generally have little experience with managing nuclear technologies) has actually increased relative to previous estimates. As shown in Figure 3, current projections to calendar year (CY) 2050 show increasing reliance

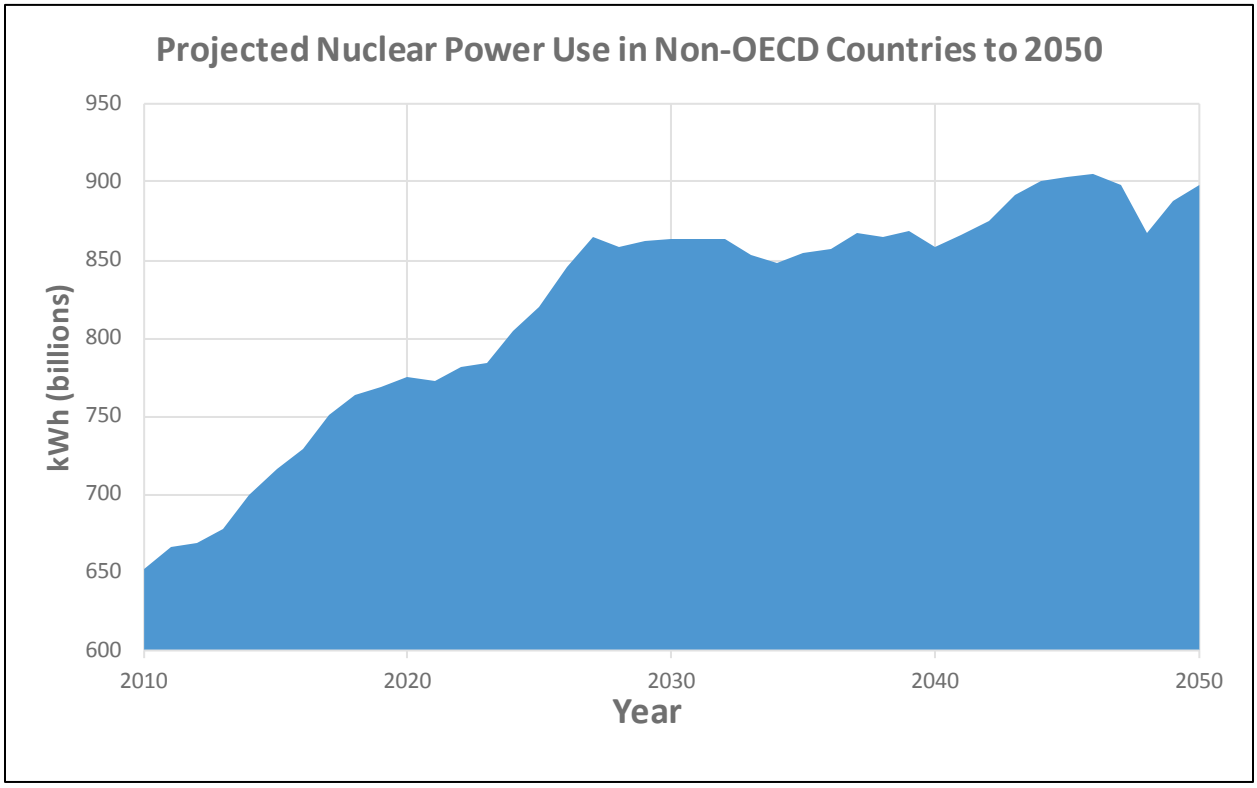

Figure 3. Projected Nuclear Power Use in Non-OECD Countries to 2050 (Source: DOE, Energy Information Administration (EIA), International Energy Outlook 2017)

on nuclear power by those states who are not members of the Organization for Economic Cooperation and Development (OECD). This trend, coupled with decreasing use of nuclear power in the developed world, is expected to continue so that by CY 2038, the majority of nuclear power use worldwide will be

taking place within the developing world. Ensuring that these nuclear newcomers are able to develop safety, security, safeguards, export controls, and emergency response systems to support their emerging nuclear energy programs will require a concerted effort by the international community.

Risks from Expanded Trade and Changing Technologies

The rapid development of emerging technologies poses another potential proliferation risk. Trade in well-established sensitive nuclear and dual-use technologies is regulated using export controls and other tools, but rapidly developing emerging technologies may enable alternative, uncontrolled proliferation pathways. One such technology with potential proliferation implications is additive manufacturing, which is a family of manufacturing technologies that build parts by fusing material together, rather than removing them from a larger part. The additive manufacturing industry is growing rapidly each year and has found applications in medical, aerospace, defense, electronics, and other sectors. As additive manufacturing machines improve, they may eventually become capable of making sensitive proliferation-relevant products that currently require export controlled industrial equipment.

The nuclear technology and proliferation community, including our experts at the national laboratories and at headquarters, are working to understand fully the capabilities of additive manufacturing to reliably produce controlled items, as the lack of an industry standards pose new and challenging paradigms to the formulation of traditional export controls at the national level and among supplier nations.

1.3 Major Developments and Responses

As discussed in the last edition of this report, a number of significant developments continue to impact the nuclear security environment. DOE/NNSA is at the forefront of helping our Nation respond to these developments.

1.3.1 Monitoring Iran's Nuclear Program

On May 8, 2018, the President terminated U.S. participation in the Joint Comprehensive Plan of Action (JCPOA). Consistent with National Security Presidential Memorandum 11 (NSPM-11), the Secretary of Energy has taken all appropriate steps to cease U.S. activities in support of JCPOA implementation. DOE/NNSA continues to support the Administration's strategy to bring pressure on Iran to achieve a new deal that denies Iran a path to a nuclear weapon and comprehensively addresses the full spectrum of Iran's malign activities.

As part of the longstanding and comprehensive support for the International Atomic Energy Agency's (IAEA) broader safeguards mission around the world, DOE/NNSA will continue to provide extensive technical expertise, equipment, and training to support the IAEA's ability to monitor and verify Iran's compliance with safeguards obligations. It is critical that the IAEA continue to use its authorities to verify the exclusively peaceful nature of Iran's nuclear program and to pursue any new safeguards-relevant information, even if that information pertains to past activities.

1.3.2 DPRK's Weapons of Mass Destruction Programs

The U.S. Government is pursuing diplomatic initiatives with the DPRK in order to eliminate the threat posed by the DPRK's weapons of mass destruction (WMD) programs and improve relations between the DPRK and the United States. The final, fully verified denuclearization of the Korean peninsula has been and remains a long-standing U.S. objective.

The assets that DOE/NNSA can apply to this effort include:

- **Detection, Monitoring, and Verification:** DOE/NNSA has improved the United States' capabilities to monitor proliferators' nuclear fuel cycle activities and production of highly enriched uranium (HEU) and weapons-grade plutonium, as well as their ability to weaponize the material.
    - Based on previous on-site monitoring in the DPRK, DOE/NNSA's technical expertise and tools are key to U.S.-led performance of on-site nuclear fuel cycle monitoring and verification of denuclearization activities. Additionally, DOE/NNSA's technical expertise and tools continue to be essential to providing technical support to the IAEA in the event of any future verification mission that could result from a negotiated denuclearization agreement.
    - DOE/NNSA also provides the expertise and tools to monitor and detect underground nuclear explosive testing, develop new algorithms that improve the ability to discriminate between small underground explosions and earthquakes, and improve the ability to collect and analyze the radioactive materials that provide irrefutable evidence of a nuclear explosion.
- **Sanctions Policy and Export Control:** DOE/NNSA provides technical expertise for identifying critical sanctions targets by participating in the DOS-led *Iran, North Korea, and Syria Nonproliferation Act* annual reviews. DOE/NNSA also supports international efforts to identify entities, commodities, and technologies relevant to multiple United Nations Security Council Resolutions on the DPRK, and works with the interagency on interdiction efforts led by DOS. DOE/NNSA also works with DOS and foreign partners to strengthen systems of export control.
- **Nuclear Material Removal:** The Nuclear Material Removal program, part of DOE/NNSA's Office of Material Management and Minimization (M^3), has decades of experience removing nuclear material across the globe.
- **Crisis Operations:** Working together with other departments and agencies, such as DoD, DOS, FBI, and DHS, the Nuclear Counterterrorism Incident Response (NCTIR) mission and program encompass searching for, locating, assessing, and rendering safe nuclear and radioactive materials and devices.
- **Consequence Management:** NCTIR supports incident commanders, with a focus on saving and sustaining lives and mitigating the effects of contamination on both infrastructure and the environment following a nuclear or radiological incident.

1.3.3 International and Domestic Terrorism

Over the last year, terrorist attacks have occurred in locations around the world, including Pakistan, India, Belgium, Egypt, Jordan, Libya, Russia, Somalia, Syria, Turkey, the United Kingdom, and the United States. These attacks, especially those carried out by groups or radicalized individuals in Western Europe and the United States, illustrate the persistence of the terrorist threat to the security of the United States and its allies.

While none of the terrorist events in 2017 involved the use of nuclear or radioactive materials, these incidents underscore the importance of DOE/NNSA's programs to prevent, counter, and respond to nuclear and radiological terrorism. As the President has said, "we must prevent nuclear weapons and materials from coming into the hands of terrorists and being used against us, or anywhere in the world."

Examples of key DOE/NNSA activities to reduce the threat of nuclear and radiological terrorism include:

- Securing, removing, and/or eliminating vulnerable nuclear and radioactive materials domestically and internationally;
- Deploying fixed and mobile radiation detection systems to deter, detect, and interdict illicit trafficking in nuclear and radioactive materials;
- Developing tools and procedures to counter INDs and RDDs by locating them and rendering them safe;
- Maintaining a robust capability to manage and mitigate the public health effects of radiological incidents, thereby denying terrorists the value they seek in employing such weapons;
- Supporting counterterrorism efforts across the U.S. Government and providing support to state and local authorities by contributing to nuclear counterterrorism capabilities maintained by FBI, including pre-National Security Special Event venue screening and threat-based radiological search; and
- Providing technical support to DHS, DoD, and FBI; supporting the Intelligence Community's assessment of nuclear threats; and providing training and equipment to law enforcement and the first responder community.

1.3.4 Threats to Cybersecurity

Cyber threats represent a new challenge to DOE/NNSA's threat reduction mission. Adversaries may seek to take advantage of cyberattacks or combined cyber- and physical attacks on facilities with nuclear or radiological material to achieve a high-consequence event with minimal investment.

Response to the Cyber Threat

DOE/NNSA's threat reduction programs are playing an essential role in helping the United States address the cyber threat challenge. Through nuclear and radioactive material security programs, DNN cooperates with international and domestic partners, and with the IAEA, to increase cybersecurity awareness, publish technical guidance, and foster adoption of effective cybersecurity practices. NNSA has also made advances fostering integration of cyber into physical security assessments at both domestic and international sites (e.g., support for IAEA International Physical Protection Advisory Service missions, and NNSA pilot cyber assessments at participating U.S. facilities).

In 2015, NNSA established a Cyber Support Team (CST) to assist DNN in responding to the changing cybersecurity environment. The CST provides advisory support to DNN and supports DNN offices in addressing cyber risks to program mission, and further integrate cybersecurity into new and existing program implementation activities. In addition, the CST conducts training for NNSA staff, provides vetting and retention processes for nuclear cyber resource management, distributes periodic cyber threat bulletins, and hosts external cyber speaker events to highlight and improve staff awareness of current issues relevant to the cybersecurity of nuclear and radiological facilities.

DNN's Office of International Nuclear Security (INS) conducts technical exchanges on topics such as cybersecurity regulations and delivers cybersecurity courses for bilateral partner countries, including Cybersecurity Fundamentals and Managing Cyber Risks. In addition, INS, in cooperation with the IAEA, plans to conduct an innovative and intensive International Training Course on Cybersecurity in 2018.

DNN's Office of Radiological Security (ORS) provides sites possessing radioactive sources with recommended cyber security best practices, conducts cybersecurity assessments of ORS-developed security equipment, provides recommended contract language to ensure cybersecuirty requirements are

included in security upgrades, and provides cybersecurity training to counter the threat that adversaries could use a cyber vulnerability to facilitate theft of a radioactive source.

In FY 2019, DNN's Nuclear Smuggling Detection and Deterrence (NSDD) program will be evaluating the cyber impacts to program systems and processes to further strengthen the cybersecurity of deployed, mission-critical equipment.

1.3.5 Emerging Technologies

Emerging technologies with potential nuclear proliferation implications constitute an important component of the shifting threat environment. These technologies offer potential benefits to DOE/NNSA, industry, and the academic community but may also pose proliferation and terrorism risks. DOE/NNSA is therefore looking closely at how best to mitigate the risks associated with these technologies while harnessing benefits.

The Emerging Technologies Working Group

In July 2015, DOE/NNSA established the Emerging Technologies Working Group (ETWG) as a formal coordination mechanism across the DOE/NNSA complex to identify and analyze emerging technology developments. The ETWG is responsible for making recommendations to the NNSA Administrator, through the NNSA Management Council, concerning policies and guidance to exploit benefits of emerging technologies while mitigating any potentially negative impacts. The composition of the ETWG reflects the overarching enterprise-wide concerns raised by emerging technologies; the ETWG is co-chaired by DNN and NNSA's Office of Defense Programs and includes representatives from the DOE/NNSA Office of Counterterrorism and Counterproliferation (CTCP), the DOE Office of Intelligence and Counterintelligence, and other key offices within the Department. The ETWG is also supported by subject matter experts at the national laboratories.

Near-Term and Longer-Term Priorities

Additive manufacturing, a dual-use technological challenge with potential proliferation impacts, is currently a key focus of the ETWG. The group is considering policies and guidance for the use of additive manufacturing technologies throughout DOE/NNSA, in order to address the potential proliferation risks of additive manufacturing without inhibiting mission-critical work. In 2016 and 2017, the ETWG worked with DOE's Office of Classification to develop classification guidance for controlling information related to this technology.

The ETWG will continue to work with relevant DOE/NNSA program offices, laboratories, plants, and sites to understand both the risks and opportunities associated with various emerging technologies in addition to additive manufacturing. The ETWG will convene workshops on these technologies as required to facilitate information sharing.

Figure 4. High-Performance Building Produced Using Additive Manufacturing at Oak Ridge National Laboratory

Interagency Coordination

DOE/NNSA also works closely with agencies throughout the government to address concerns over nuclear proliferation and security impacts of emerging technologies. For example, DOE/NNSA:

- Supports National Security Council (NSC) staff-coordinated meetings to develop the President's strategy for addressing the risks to U.S. nuclear nonproliferation goals and policies by increased use of additive manufacturing;
- Contributes to DOS-led interagency discussions on multilateral export controls for AM and other emerging technologies; and
- Sends a representative to the Emerging Technologies Research Advisory Committee (ETRAC) at the Department of Commerce (DOC). ETRAC is a technical advisory committee that advises DOC on emerging technologies of interest and the potential impact of export regulations on research activities.

1.3.6 Evolving Initiatives

DOE/NNSA is undertaking several new efforts in support of the prevent-counter-respond mission.

Cybersecurity. DOE/NNSA implemented courses on cybersecurity essentials for nuclear and radiological material protection with 15 partner countries by the end of FY 2018. DOE/NNSA is continuing to build the cybersecurity program to provide additional areas of engagement with international partners.

Nuclear and Radioactive Material Security and Counter Nuclear Smuggling. Issues pertaining to the security of nuclear and radioactive material are critical, high priority, and at the focus on DOE/NNSA security plans and programs. Among many new initiatives, DOE/NNSA is:

- Partnering with six training centers that are part of the IAEA-hosted International Network for Nuclear Security Training and Support Centers to strengthen sustainable nuclear security practices worldwide;
- Developing a Green Border Security Initiative focused on identifying and addressing the border security gaps of priority partners to increase detection and deterrence capabilities outside of official crossing points;
- Broadening cooperation to include the Maritime Vector Partnership (MVP) and the Strategic Airport Initiative (SAI). MVP is focused on expanding partner countries' capabilities to perform targeted radiation detection screening in unregulated maritime pathways. DOE/NNSA has completed MVP pilot projects in the Republic of Djibouti and Georgia. SAI provides a radiation detection capacity to airport security personnel that enables them to incorporate targeted screening into existing airport security procedures. DOE/NNSA has completed a successful SAI pilot in Thessaloniki, Greece;
- Conducting cooperative physical protection consultation visits at foreign facilities holding U.S.-obligated nuclear material transferred for peaceful uses under civil nuclear cooperation agreements; and
- Building partners' baseline nuclear forensics capabilities for aiding investigations of interdictions of nuclear and other radioactive materials out of regulatory control, commensurate with the partners' existing technology infrastructures.

Detection. During FY 2018, DOE/NNSA executed the first of four underground conventional explosions in support of Phase II of the Source Physics Experiment (SPE). SPE will 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.

DOE/NNSA is partnering with the Air Force Technical Applications Center (AFTAC) to modernize the U.S. National Data Center, the geophysical data acquisition, data processing, reporting, and archiving component of the United States Atomic Energy Detection System operated by AFTAC.

DOE/NNSA also will deliver a nuclear detonation detection sensor, the Global Burst Detector (GBD), to the United States Air Force in support of the U.S. nuclear detonation detection system (USNDS), and provide technical support for integrating two previously delivered GBDs onto global positioning system (GPS) satellites that are planned for launch in FY 2019.

Conversion and Molybdenum-99 (Mo-99). In FY 2017, DOE/NNSA's efforts resulted in the conversion of the Ghana Miniature Neutron Source Reactor (MNSR) from HEU to low-enriched uranium (LEU) fuel, the conversion of NTP Radioisotopes' Mo-99 production processes in South Africa from HEU to LEU, and the shutdown of the Alberta SLOWPOKE reactor in Canada. The Curium isotope production facility in the Netherlands successfully converted to LEU production with financial and technical support from DOE/NNSA, and the National Research Universal Reactor in Canada has shut down permanently, ending its hot standby status to produce Mo-99 in case of global shortages. By the end of October 2018, the Nigeria MNSR will be converted to LEU fuel, an NNSA-supported project that will begin the first domestic production of Mo-99 for patient use since 1989, and two new fuel qualification experiments will begin irradiation to support the conversion of high performance research reactors.

Strengthening International Nuclear Safeguards. DOE/NNSA supports the IAEA in modernizing nuclear verification capabilities and improving its capacity to detect undeclared nuclear activities. In FY 2017, DOE/NNSA conducted the evaluation and development of 323 potential tools for nuclear safeguards applications, which included four extensive scoping studies and the transfer of seven new instruments and methodologies to the IAEA. In FY 2018, DOE/NNSA continued to mature new verification tools and evaluate cutting-edge technologies for future implementation. DOE/NNSA also has engaged representatives from over 60 countries and organizations and trained hundreds of people on international safeguards related topics. Since 2010, in response to the need for highly-skilled technical expertise in the U.S. nuclear workforce, DOE/NNSA has sponsored 35 fellows in California, Georgia, Massachusetts, Michigan, North Carolina, Pennsylvania, Tennessee, and Texas, through the competitive Nuclear Nonproliferation International Safeguards (NNIS) fellowship program. NNIS fellows are technical PhD candidates, committed to research that will have a nonproliferation impact, who go on to serve in the U.S. Government, the DOE/NNSA laboratory complex, and commercial industry.

Chapter 2: Prevent Preventing Nuclear/Radiological Proliferation and Terrorism

2.1 Program Description

NNSA's Office of Defense Nuclear Nonproliferation (DNN) has primary responsibility for the "prevent" functional area within DOE/NNSA's nuclear threat reduction mission pillar. DNN supports this goal by providing policy and technical leadership to prevent or limit the spread of materials, technology, and expertise relating to nuclear and radiological threats; developing technologies to detect nuclear proliferation worldwide; eliminating or securing inventories of surplus weapons-usable materials and infrastructure; and reducing the risk that hostile nations or terrorists could acquire nuclear weapons or weapons-usable material. DNN executes this mission by drawing broadly on the Department's scientific and technical expertise and engaging international partners. DNN programs actively use the science, technology, engineering and manufacturing capabilities of the DOE/NNSA complex to solve the technical challenges of monitoring foreign weapons programs, verifying treaty compliance, and guarding against nuclear technological surprise.

2.2 Plutonium Disposition Path Forward

Plutonium disposition is one of the largest activities within the DNN portfolio, with a scope that includes construction projects, pit disassembly and plutonium conversion, and several supporting activities.

On May 10, 2018, in accordance with Section 3121 of the *National Defense Authorization Act for Fiscal Year 2018* (FY 2018 NDAA) and Section 309 of the *Consolidated Appropriations Act, 2018*, the Secretary of Energy notified Congress that he exercised his authority to waive the requirement to fund construction of the Mixed-Oxide Fuel Fabrication Facility (MFFF) at the Savannah River Site (SRS) in Aiken, South Carolina. On June 7, 2018, the U.S. District Court for the District of South Carolina granted an injunction to stop DOE's decision to terminate and cease construction of the MFFF. On October 9, 2018, the United States Court of Appeals for the Fourth Circuit removed the injunction. On October 10, 2018, the Department issued the notice of contract termination for the MOX contract. The Department remains committed to the disposition of surplus plutonium and will pursue the well-developed dilute and dispose strategy.

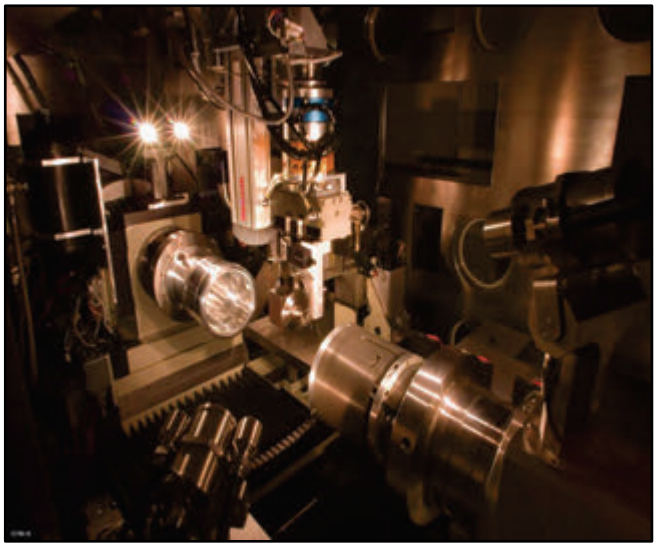

Figure 5. Robotic Lathe Used to Disassemble Pits as Part of the Plutonium Disposition Process

2.3 Nuclear Security Developments

2.3.1 Conference on the Convention on the Physical Protection of Nuclear Material

Representatives from NNSA provided substantive support and expertise to the IAEA's International Conference on Physical Protection of Nuclear Material and Nuclear Facilities in November 2017. The conference promoted the entry into force of the 2005 Amendment to the Convention on the Physical Protection of Nuclear Material (CPPNM). The CPPNM is the only legally binding international instrument that mandates standards for physical protection of nuclear material, with a focus on international transport. The Amendment to the CPPNM, which entered into force in May 2016, expanded this mandate to address protection of nuclear facilities and nuclear material in domestic use, storage, and transport, and requires signatories to cooperate for more effective international response to nuclear events.

The conference fostered discussion of practices and experiences related to the physical protection of nuclear material and facilities among government representatives, facility operators, shippers and carriers, and technical support organizations, with the aim of supporting and strengthening the global nuclear security architecture. This event was a critical milestone in ensuring that global partners have both the tools and commitment to further the prevent-counter-respond mission.

2.3.2 Minimization of Weapons-Usable Nuclear Material

One of the Administration's highest priorities remains the elimination of weapons-usable nuclear material, specifically highly enriched uranium and separated plutonium. NNSA's Office of Material Management and Minimization (M^3) accomplishes this mission in three ways: converting research reactors and radioisotope production facilities to minimize the need for highly enriched uranium (HEU); removing material that is no longer needed; and downblending or disposing of removed material. Key developments in 2018 include:

- Conversion of an HEU-fueled research reactor in Nigeria and an isotope production facility in the Netherlands;
- Establishment of the first non-HEU Molybdenum-99 (Mo-99) production in the United States in nearly 30 years;
- Removal of over 325 kilograms of HEU from multiple countries; and
- Downblending of a cumulative of 160 metric tons (MT) of surplus HEU.

Converting facilities to use low enriched uranium, removing HEU, and downblending excess material greatly reduces the risk that it can be used by terrorists to make an improvised nuclear device (IND).

2.3.3 U.S.-China Peaceful Uses of Nuclear Technology Joint Coordinating Committee

In 1998, to identify cooperative opportunities to advance civilian nuclear energy development while addressing nuclear safeguards, security, and safety risks, the United States and China signed the Peaceful Uses of Nuclear Technology (PUNT) Agreement. The PUNT Joint Coordinating Committee, which implements the Agreement, met in December 2017 in Shanghai. The U.S. delegation, which was co-chaired by the DNN Principal Assistant Deputy Administrator, included representatives from DOE/NNSA, the Departments of State and Commerce, and Argonne National Laboratory (ANL) in Lemont, IL, Oak Ridge

National Laboratory (ORNL), in Oak Ridge, TN, Sandia National Laboratories (SNL) in Albuquerque, NM and Livermore, CA, and Los Alamos National Laboratory (LANL) in Los Alamos, NM. The Chinese delegation included representatives from the National Energy Administration, the Ministries of Foreign Affairs and Environmental Protection, the China Atomic Energy Authority, and Chinese nuclear power companies and research institutions.

2.3.4 Nuclear Security Cooperation with India

NNSA supports technical exchanges with counterparts in India's Department of Atomic Energy, who are responsible for security at India's nuclear facilities. This work with India is coordinated by a Joint Working Group under the auspices of the Indian Global Center for Nuclear Energy Partnership. This bilateral cooperation was formalized at the Nuclear Security Summit in 2010. Collaboration has focused on nuclear and radiological security, nuclear smuggling detection and deterrence, nuclear incident response, and nuclear forensics.

2.3.5 Nuclear Security Support Centers

There is a significant global demand for training, technical, and scientific support for nuclear and radiological security best practices. Beginning with the 2010 Nuclear Security Summit, several countries pledged to establish nuclear security training and support centers to help meet this need. These Nuclear Security Support Centers (NSSCs) promote capacity building, technical support, and scientific support for nuclear and radiological security programs by providing international, regional, and domestic security professionals with training on aspects of nuclear and radiological security such as physical protection, nuclear material accounting and control, transportation security, and nuclear security culture. Many NSSCs also focus on responsibilities such as research and development of nuclear security technologies and testing of nuclear security equipment. These centers are coordinated through the IAEA-hosted International Network for Nuclear Security Training and Support Centers. NNSA is working with the IAEA to develop guidance for establishing and operating NSSCs to assist States in sustaining their nuclear security regime.

2.3.6 Cesium Irradiator Replacement Project

NNSA's Cesium Irradiator Replacement Project (CIRP) provides cost-sharing incentives for users of cesium-based sources for blood irradiation to adopt alternative, non-radioisotopic technologies and to remove and securely dispose of devices with disused cesium-137.

Radioactive sources are used in a variety of industrial, medical, and research applications. These sources also present a security concern because of the potential to be used in a radiological dispersal device, also known as a "dirty bomb." CIRP supports voluntary transition to non-radioactive source-based devices, or alternative technologies. Transitioning to alternative technologies provides permanent risk reduction when paired with permanent disposal of the old radioactive source. Reducing the reliance on high activity radioactive materials also reduces radioactive waste in the long term and advances a sustainable approach to radiological security. NNSA supports these activities via education and outreach on alternatives, collaboration with stakeholders on research, and incentives to remove and replace existing radioactive source-based devices. NNSA promotes alternative technologies in the United States and among partner countries worldwide.

2.3.7 Maritime Vectors Partnership and Strategic Airports Initiatives

NNSA's Office of Nuclear Smuggling Detection and Deterrence (NSDD) has Maritime Vectors Partnership (MVP) and Strategic Airport Initiative (SAI) projects that are focused on increasing security capabilities "one step out" from high risk areas where the United States traditionally has had limited nuclear nonproliferation cooperation, including in India, Pakistan, and Iran. In both of these projects, NNSA provides flexible and relocatable detection tools and training that can be incorporated into existing security procedures by partners at locations that are the next port of call or one direct flight away from a country of concern. This allows partners to more efficiently target security operations and reduces overall cost while increasing threat reduction. NNSA is working to engage with appropriate maritime and airport security organizations to further expand these types of security operations in priority partner countries.

Figure 6. Maritime Security Officials Conduct Scanning of a Dhow/Small Maritime Vessel with Equipment Provided by NNSA Under NSDD's Maritime Vectors Partnership

2.4 Update on Infrastructure and Workforce

NNSA's *Enterprise Strategic Vision* identified supporting the workforce and modernizing the infrastructure as a key crosscut that supports all three DOE/NNSA mission pillars. In 2014, DOE/NNSA's Laboratory Operations Board coordinated the Department's first integrated assessment of general purpose infrastructure across all 17 laboratories, as well as DOE/NNSA plants and sites, using common standards and an enterprise-wide approach. DOE/NNSA is building on the results of this assessment by collecting additional information on each real property asset across the nuclear security enterprise, including the core capabilities that each asset supports, the asset's importance to those capabilities, and the ease or difficulty of replacing the asset. This information is used to calculate a Mission Dependency Index for each asset, which is crucial for risk-informed decision making.

This system makes it possible for DNN and other DOE/NNSA nuclear and radiological threat reduction programs to look across the entire nuclear security enterprise and identify assets that support its mission. In many cases, assets that are critical to the nuclear and radiological threat reduction mission are used by multiple programs. Understanding the importance of such assets to DOE/NNSA's nuclear threat reduction mission can help improve infrastructure management decisions and program planning. Section 2.5.1 provides an overview of some of the most distinctive and specialized assets, and provides an overview of the specialized Federal, lab, plant, and site workforce that supports the DNN mission.

DNN faces significant challenges in the areas of both infrastructure and human capital. Two key examples of such challenges—shortages in the safeguards workforce and issues with nuclear materials management infrastructure—are described in Section 2.5.1. Infrastructure and human capital issues for the other programs in the nuclear threat reduction mission are covered in Sections 3.3 and 4.3.

2.4.1 Key Infrastructure and Challenges

Infrastructure Base

DNN programs to prevent nuclear proliferation and nuclear and radiological terrorism rely on a robust infrastructure, including laboratories, experimental facilities, test beds, high performance computing, and material disposal facilities. Many of these assets are located at DOE/NNSA's laboratories, plants, and sites, but others are located at sites operated by other DOE offices, including the Offices of Science, Nuclear Energy, and Environmental Management. The recapitalization of the infrastructure supporting DOE/NNSA's nuclear enterprise is critical to NNSA's nuclear security missions. Facilities are leveraged to support NNSA's aligned and integrated missions in nonproliferation, counterterrorism, emergency response, and weapons activities. Examples of the most specialized and distinctive assets supporting each DNN program are summarized below:

- M^3 receives and stores spent nuclear fuel removed from foreign countries in fuel basins at SRS and Idaho National Laboratory (INL) in Idaho Falls, ID; receives and downblends Mo-99 HEU Target Residue Materials to low-enriched uranium (LEU) at the H-Canyon chemical separations facility at SRS; receives and stores plutonium removed from foreign countries at the K-area Material Storage facility at SRS; receives and stores unirradiated 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 (Figure 7) as well as Building 208 at ANL; and uses the TA-55 Plutonium Facility at LANL to convert various forms of plutonium to oxide for ultimate disposition.

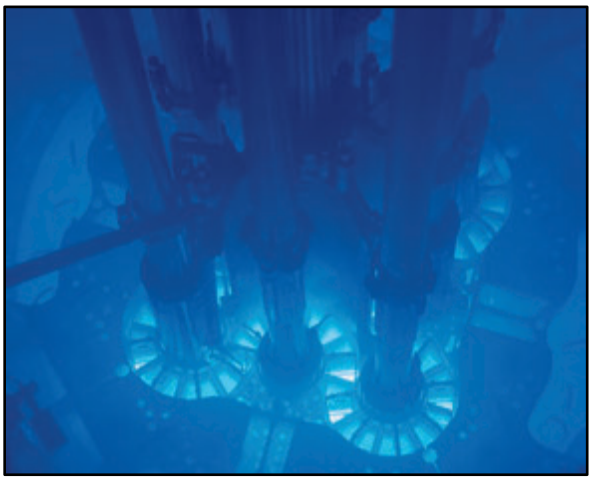

Figure 7. Advanced Test Reactor at Idaho National Laboratory

- The DNN Office of Nonproliferation and Arms Control (NPAC) 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, the safeguards laboratory at ORNL, and the Advanced Test Reactor 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 LANL, ORNL, Lawrence Livermore National Laboratory (LLNL) in Livermore, CA, Pacific Northwest National Laboratory (PNNL) in Richland, WA, and Savannah River National Laboratory (SRNL) in Aiken, SC.

Figure 8. Interdiction Testing and Integration Laboratory at Pacific Northwest National Laboratory

- The Office of Global Material Security (GMS) uses a test bed for radiation portal monitors and physical security components at PNNL (Figure 8), 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, and PNNL, as well as the Y-12 National Security Complex, for international training. Finally, GMS has used the New Brunswick Laboratory at ANL to provide training on how to develop and attest standards as well as improve destructive analysis laboratory techniques in order to make more accurate measurements.

- The Office of Defense Nuclear Nonproliferation Research and Development (DNN R&D) relies on supportive capabilities at a number of laboratories, plants, and sites that enable mission-relevant research and development activities. The Nevada National Security Site (NNSS) hosts a number of test beds used by DNN R&D to demonstrate a set of next-generation nonproliferation technologies for detecting foreign nuclear weapons development activities. For example, DNN R&D has developed test beds for detecting low-yield underground nuclear explosions, and for driving signal to noise improvements for higher detection confidence as yields reduce, signals reduce, and the potential for evasive testing remains. DNN R&D uses the National Criticality Experiments Research Center at NNSS to perform special nuclear material (SNM) irradiation experiments to improve precision measurements of nuclear fission product yields and other nuclear data parameters. The HELIOS High-Explosive Test Bed provides high explosive test validation data for end-to-end simulation capabilities currently under development at LANL, LLNL, and SNL. And at INL, DNN R&D has developed a test bed that offers unique capabilities focused in enhancing U.S. capabilities to detect, locate, and characterize reprocessing activities.

Challenges with Nuclear and Radioactive Materials Management Infrastructure

Much of DOE/NNSA's infrastructure is old, obsolete, and in poor condition. More than 50 percent of facilities are over 40 years old, and nearly 30 percent date to the Manhattan Project era. Ten percent are excess and no longer needed. At the end of FY 2017, NNSA had approximately $2.5 billion in deferred maintenance, and the condition of nearly two-thirds of facilities was rated as less than adequate for performing current missions. In FY 2015-2016, NNSA improved the consistency of deferred maintenance assessment and reporting across all sites and with the support of Congress accomplished a one-time reduction in deferred maintenance of $1.2 billion.

DNN is facing particularly acute challenges in the area of infrastructure for nuclear and radioactive materials management. The Plutonium Facility (PF-4) at LANL is a unique facility that supports many programs of national significance such as plutonium sustainment, surveillance and science, space and defense power systems, and DNN's material disposition program. PF-4 houses the Advanced Recovery

Research to Advance U.S. Nuclear Explosion Monitoring Capability

A key DOE/NNSA goal is to contribute to improving U.S. Government capabilities to detect, locate, discriminate, and characterize underground nuclear explosions in foreign countries. Current nuclear explosion monitoring techniques are limited by our understanding of how seismic waves are generated from the source of an underground disturbance and then propagated through geologic media to a sensor (e.g., a seismometer). DNN R&D is conducting research to understand these effects by conducting unique experiments at NNSS that also leverage data from decades of nuclear testing there. These source physics experiments generate terabytes of data for validating models, testing hypotheses, and improving tools that can be used to increase monitoring confidence at ever decreasing explosive yields. Phase I of these experiments was completed between 2010 and 2016. Phase II is being conducted in 2018-2019 and consists of a series of four underground chemical explosion experiments. The first experiment is this second phase was successfully completed in July 2018.

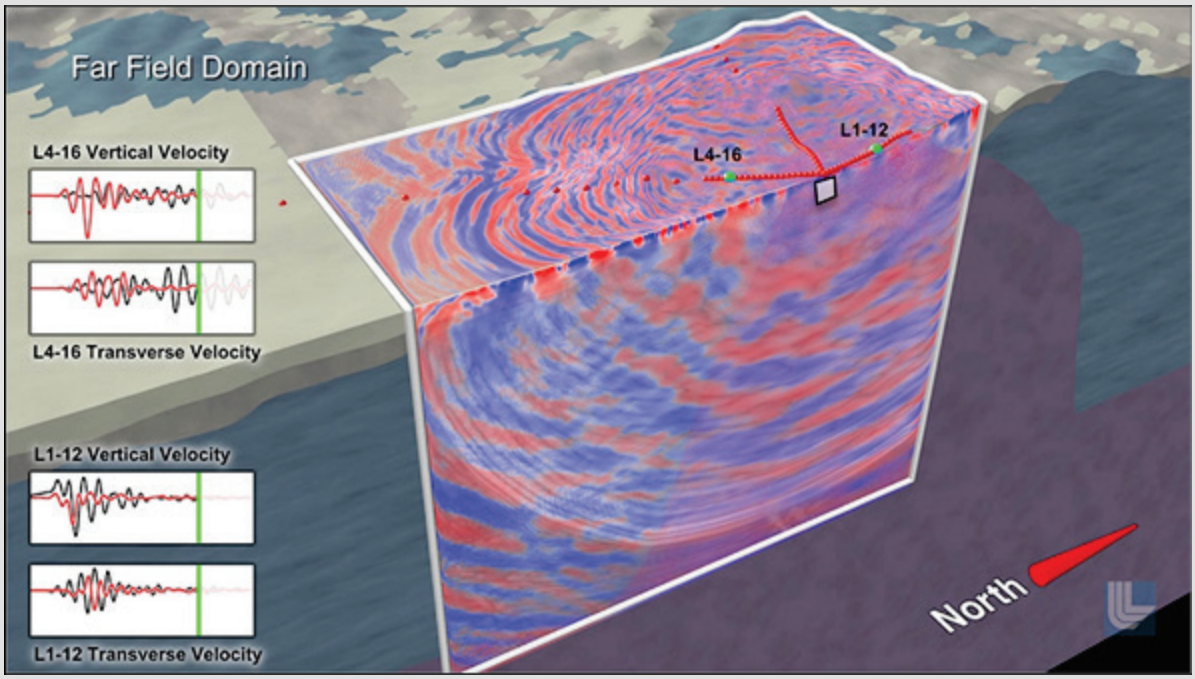

Figure 9. Predictive Model of Acoustic Energy Propagation from Explosive Detonation

and Integrated Extraction System, which disassembles surplus weapons pits and converts the resultant plutonium metal to an oxide form for ultimate disposition. (Pit disassembly and oxide conversion are necessary first steps in the Administration's dilute and dispose alternative to the MOX fuel approach to plutonium disposition.) In June 2013, programmatic operations were paused in PF-4 due to issues related to the conduct of operations, resulting in not achieving annual rates of pit disassembly and conversion over multiple years. Current production rates meet programmatic needs, but long-term operations in PF-4 remain a risk for the program. Disruptions in the operational status of existing nuclear and radiological facilities have the ability to impact DNN mission requirements.

Additionally, several key facilities at SRS, including H-Canyon, L-Basin, and K-Area, support the receipt, storage, and disposition of plutonium and spent nuclear fuel. These facilities directly support meeting nuclear nonproliferation commitments by enabling the removal of HEU spent fuel and separated

plutonium from foreign countries. SRS infrastructure must be maintained to support these critical missions.

In addition to the materials processing capabilities at LANL and SRS, DNN depends on facilities at other sites to receive, store, and dispose of nuclear and radioactive materials. DNN's access to important facilities has been periodically impaired due to disruptions in operations and other state regulatory issues. Ultimately, DNN's ability to achieve permanent risk reduction depends on access to storage and disposal pathways for nuclear and radioactive materials. DNN is working collaboratively with other DOE offices to address these issues. In the area of radioactive source disposal, DNN encourages licensees to set aside funding to transport and dispose of disused radioactive sources. This shifts some of the financial burden for radiological risk reduction from taxpayers to radioactive source users and provides incentives for the transition from radioactive sources to alternative, non-isotopic technologies.

2.4.2 Workforce Summary and Key Challenges

DNN's Workforce

DNN uses the workforce at DOE/NNSA's laboratories, plants, sites, as well as laboratories run by DOE's Office of Science, Office of Nuclear Energy, and Office of Environmental Management to accomplish its many missions. The Management and Operating (M&O) workforce at each laboratory, plant, and site performs work for multiple program offices, allowing DNN to have direct, targeted access to experts across a wide variety of fields.

DNN's Federal workforce carries out a number of critical functions, including supporting the negotiation of nuclear and radiological security cooperation with foreign countries, carrying out informed technical oversight of M&O work activities, developing budgets, evaluating program effectiveness, managing contracts, and establishing program strategic direction. A significant portion of the DNN Federal workforce (just under one quarter) is eligible for retirement within the next five years. Managing the effect of these retirements will require recruitment of both experienced and entry-level staff.

Challenges of the Shortage of Safeguards Experts

Safeguards are technical measures applied to nuclear material and activities, primarily by the IAEA, in order to independently verify that nuclear facilities are not misused and nuclear material is not diverted from peaceful uses. States accept these measures through safeguards agreements. The international safeguards system is under more strain today than at any point in history. Demanding high-profile investigations that require significant expertise, increases in the quantity of nuclear material under IAEA safeguards, and evolving safeguards requirements and approaches all are placing increased burdens on the IAEA's already limited resources. In addition, the workforce supporting international safeguards faces many of the same demographic challenges confronting the nuclear workforce as a whole, with high percentages of retirees expected in the near future. Due to limitations in long-term contracts and mandatory retirement ages for United Nations employees, turnover among senior IAEA safeguards inspectors and staff will reach a critical point within a few years, resulting in a significant shortage of the most senior safeguards inspectors and analysts available to address future proliferation challenges.

In response to these human resource challenges to the international safeguards system, DOE/NNSA, through its NPAC program, established the safeguards Human Capital Development program to foster sustainable academic and technical programs that recruit, educate, train, and retain the next generation of U.S. personnel to become international safeguards professionals. The Human Capital Development program has built a pipeline of new talent into the national laboratories and the IAEA, and now focuses primarily on bringing early, junior, and mid-career personnel from the DOE/NNSA complex into the international safeguards field. Key elements of this effort include university engagement to help promote

the safeguards mission and encourage students to seek opportunities in the field; internship opportunities at DOE's national laboratories; "short courses," for example at the national laboratories, that provide interactive and hands-on approaches in addressing safeguards challenges; and opportunities for professional development and training. Given the Human Capital Development program's success over the last ten years, NPAC is currently considering options to evolve its scope beyond international safeguards to also include other specialized topical areas like export controls, arms control verification, and nuclear fuel cycle policy.

2.5 Updated Future Program Plans

2.5.1 Material Management and Minimization

The M^3 program reduces the risk of nuclear proliferation and terrorism by minimizing and, when possible, eliminating nuclear materials, and ensuring sound management principles for materials that remain. The program's multi-year performance metric goals and other planned milestones are described below and graphically represented in Figure 10.

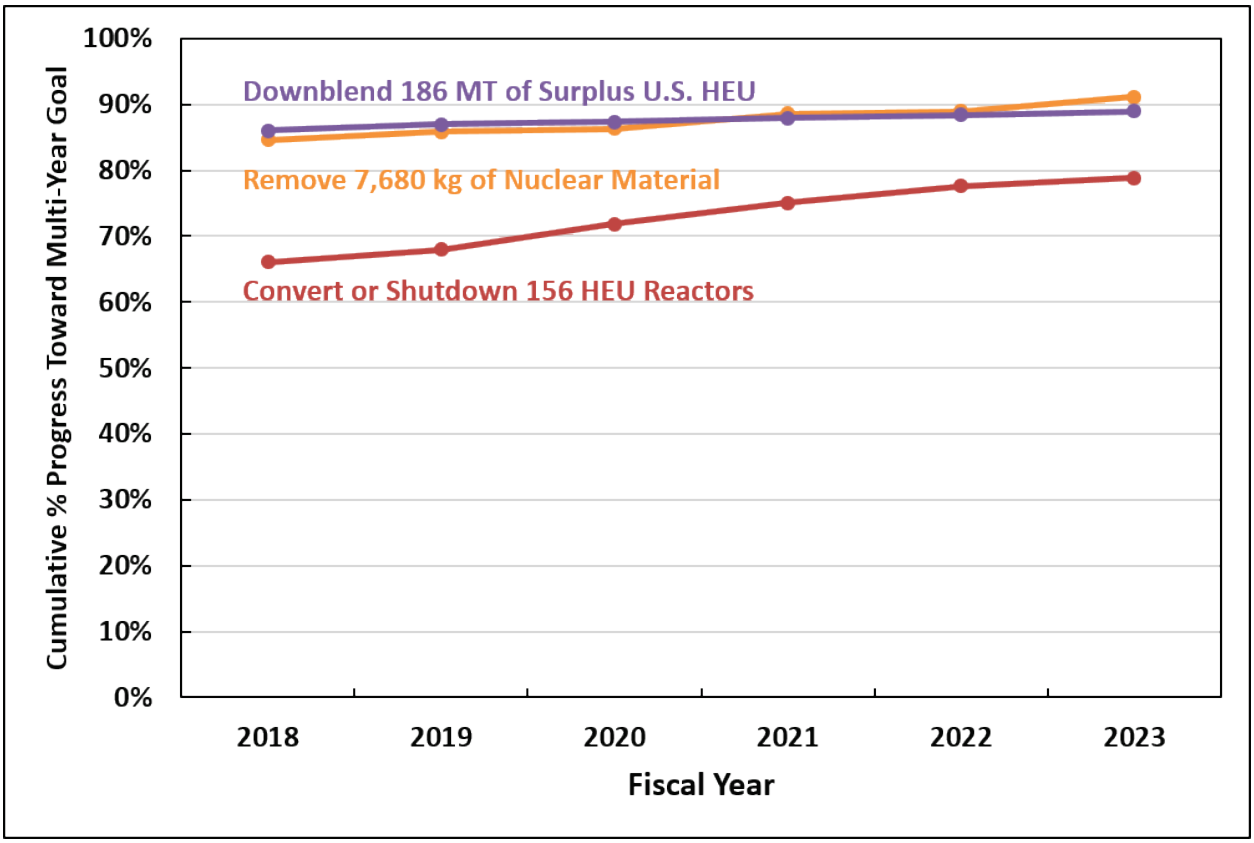

Figure 10. Progress Toward Completing Multi-Year M^3 Goals

Explanation of Multi-Year Goals

Convert or Verify the Shutdown of 156 HEU Reactors and Isotope Production Facilities: This effort began in 1978. The goal reflects all known civilian HEU research reactors and commercial-scale isotope production facilities globally. The projected completion date is 2035.

Remove or Confirm the Disposition of a Cumulative Total of 7,680 kg of HEU and/or Separated Plutonium by the end of FY 2027: This effort began in 1996. The goal reflects an estimate of the total amount of excess nuclear material globally that has been determined to be a likely candidate for removal. This determination is based on the level of risk that the material poses, the availability of a disposal pathway, and the likelihood of securing agreement to remove the material. Additional removals could take place if risk factors change, new disposal pathways become available, new material is declared excess, or political barriers to material removal are resolved.

Downblend 186 MT of Surplus U.S. HEU: This effort began in 1998. The goal reflects the amount of U.S. HEU currently declared excess and planned for downblending. Progress beyond the last official milestone in 2019 (162 MT) is an estimate based on multiple factors and decisions that are not yet concrete. For example, approximately 16 MT of HEU to be downblended is slated for use as high assay LEU for research reactors and medical isotope production, but HEU is not downblended until LEU is requested to ensure it meets the right specifications. The projected completion date is 2030.

Other Planned Milestones

Conversion

- FY 2018 – Established the first non-HEU-based, commercial Mo-99 production capability in the United States.
- FY 2018 – Initiated key irradiation test to support qualification data for high-density LEU fuel to convert U.S. high performance research reactors.
- FY 2018 – Converted or verified the shutdown of one HEU research reactor and two isotope production facilities, for a cumulative total of 102 facilities converted or verified as shutdown.

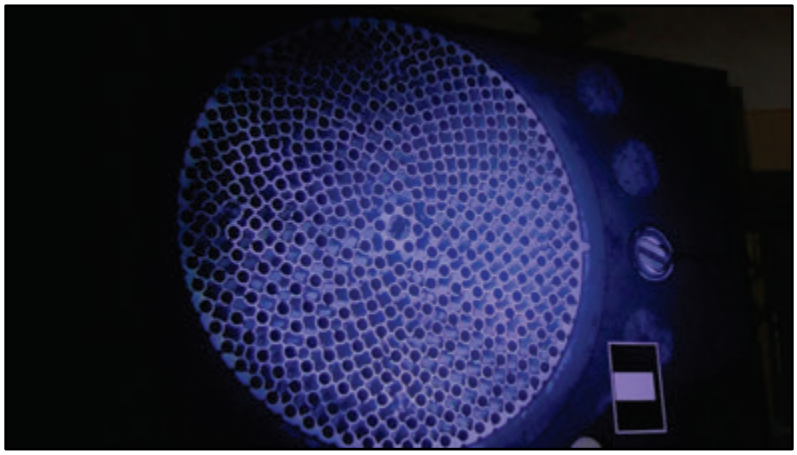

Figure 11: View of Ghana's New LEU Reactor Core after Conversion in July 2017

DOE/NNSA worked with IAEA, Ghanaian, and Chinese counterparts to convert Ghana's Chinese-origin MNSR from HEU to LEU fuel, and subsequently return the HEU to China. This marks the first MNSR converted outside of China.

- FY 2019 – Convert or verify the shutdown of two HEU research reactors and one isotope production facility, for a cumulative of 106 facilities converted or verified as shutdown.
- FY 2019 – Continue to 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.
- FY 2019 – Continue to assist global Mo-99 production facilities to eliminate the use of HEU targets.
- FY 2023 – Continue to convert or verify the shutdown of HEU research reactors, for a cumulative of 123 facilities converted or verified as shutdown.

Nuclear Material Removal

- FY 2018 – Removed or confirmed the disposition of HEU and/or separated plutonium for a cumulative total of 6,725.3 kg.
- FY 2019 – Remove or confirm the disposition of 95 kg of HEU and/or separated plutonium for a cumulative total of 6,594 kg.
- FY 2019 – Conduct Emerging Threats mock deployment.
- FY 2020 – Remove or confirm the disposition of 35 kg of HEU and/or separated plutonium for a cumulative total of 6,629 kg.
- FY 2021 – Remove or confirm the disposition of 171 kg of HEU and/or separated plutonium for a cumulative total of 6,800 kg.
- FY 2021 – Conduct Emerging Threats mock deployment.
- FY 2022 – Remove or confirm the disposition of 33 kg of HEU and/or separated plutonium for a cumulative total of 6,833 kg.
- FY 2023 – Remove or confirm the disposition of 167 kg of HEU and/or separated plutonium for a cumulative total of 7,000 kg.
- FY 2023 – Conduct Emerging Threats mock deployment.

Figure 12. DOE/NNSA's Mobile Uranium Facility and Mobile Plutonium Facility at Naval Air Station Key West during Exercise Corvina Loco in May 2017

Material Disposition

- FY 2018 – Completed the lifecycle cost estimate for the dilute and dispose strategy for disposition of U.S. surplus weapon-grade plutonium
- FY 2018 – Downblended U.S. surplus HEU into LEU for peaceful use as fuel for commercial or research reactors, reaching a cumulative total of 160 MT of surplus HEU downblended or shipped for downblending.
- FY 2018 – Eliminated surplus HEU by dispositioning a total of 135 legacy items/discards.
- FY 2019 – Complete independent validation of the lifecycle estimate for the dilute and dispose strategy for disposition of U.S. surplus weapons-grade plutonium.
- FY 2019 – Continue to disassemble surplus U.S. nuclear weapon pits and convert the resulting metal into plutonium oxide powder in preparation for future disposition.
- FY 2019 – Continue to downblend U.S. surplus HEU into LEU for peaceful use as fuel for commercial or research reactors, reaching a cumulative total of 162 MT of surplus HEU downblended or shipped for downblending by end of FY 2019.
- FY 2022 – Complete surplus HEU legacy material disposal in Building 9206 at the Y-12 National Security Complex.

- FY 2023 – Continue to downblend U.S. surplus HEU into LEU for peaceful use as fuel for commercial or research reactors, reaching a cumulative total of 165.5 MT of surplus HEU downblended or shipped for downblending by end of FY 2023.

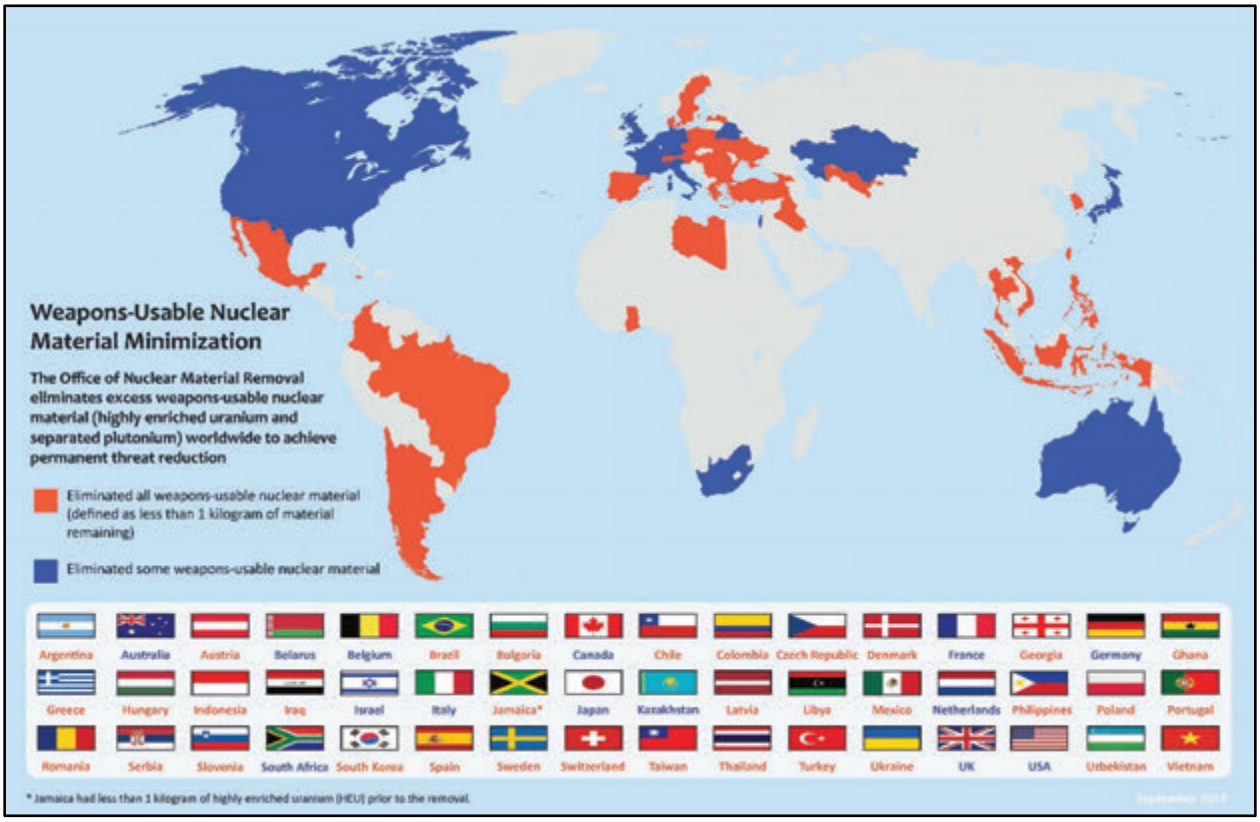

Figure 13. Weapons-Usable Nuclear Material Minimization

2.5.2 Global Material Security

GMS reduces the risk of nuclear proliferation and nuclear and radiological terrorism by working with partner countries to increase the security of vulnerable stockpiles of nuclear weapons, nuclear materials, and radioactive materials, as well as to improve partner countries' abilities to deter, detect, interdict, and investigate illicit nuclear material trafficking. The program's multi-year performance metric goals and other planned milestones are described below and graphically represented in Figure 14.

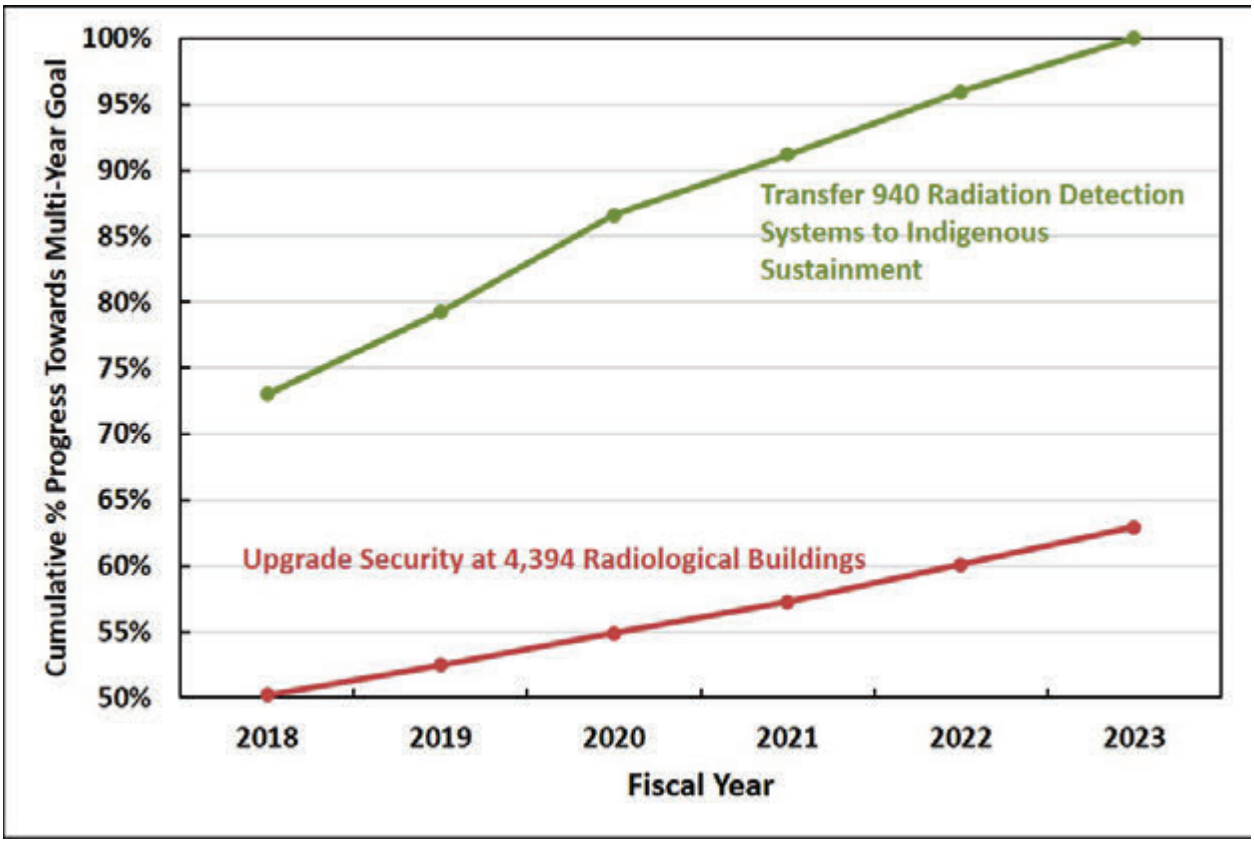

Figure 14. Progress Toward Completing Multi-Year GMS Goals

Explanation of Multi-Year Global Material Security Goals

Upgrade Security at 4,394 Radiological Buildings: This effort began in 2004. The goal reflects the total number of buildings worldwide in eligible partner countries assessed as having high priority radioactive material and needing security upgrades. The projected completion date for this work is 2033.

Equip Radiation Detection Systems at 751 Fixed Sites: This effort began in 1998 by equipping Russian sites in partnership with Russia's Federal Customs Service. The projected completion date for this work is FY 2022. The total number of radiation detection systems to be deployed over the life cycle of the program will depend on the evolving threat environment. For example, NSDD deployment plans have been impacted by factors such as the emergence of new Customs Unions, the changing relationship with Russia, and the rise of the ISIS in the Middle East.

Deploy 227 Mobile Radiation Detection Systems: This effort began in 2008, and the projected completion date for this work is FY 2022. The total number of mobile detection systems to be deployed over the life cycle of the program will depend on the evolving threat environment.

Transfer 1,016 Radiation Detection Systems to Indigenous Sustainment: This effort formally began in 2008, and the projected completion date for this work is FY 2025. The total number of radiation detection systems to be transferred to indigenous sustainment over the life cycle of the program will depend on the evolving threat environment.

Other Planned Milestones

- FY 2019-2023 – Remove additional excess and unwanted sealed radioactive sources from locations in the United States, resulting in a cumulative total of more than 41,000 sources removed.
- FY 2019-2023 – Continue ongoing nuclear security cooperation to secure nuclear materials and facilities in at least 20 high priority countries and annually initiate capacity building engagement in up to 13 additional countries.
- FY 2019-2023 – Develop and implement cybersecurity training courses, engage international partners on cybersecurity best practices for nuclear facilities, and improve on these best practices by developing new cybersecurity techniques, procedures, and technologies.
- FY 2019-2023 – Develop and implement a robust international insider threat mitigation program in support of Information Circular 908 (INFCIRC/908) to raise awareness of how insiders can threaten the security of nuclear and radiological material and facilities while in use, in storage, or during transportation.
- FY 2019-2023 – 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.
- FY 2019-2023 – Engage up to 16 partners annually to strengthen foreign partner nuclear forensic capabilities.
- FY 2019-2023 – Expand support for the voluntary replacement of high-activity radioactive sources with non-radioisotopic based technologies. Replace more than 300 radioactive source-based devices with alternative technologies.
- FY 2020 – Complete development of fundamental material protection, control, and accounting curriculum for a national nuclear security training center in Kazakhstan.
- FY 2022 – Complete development of nuclear security training center in Argentina.

2.5.3 Nonproliferation and Arms Control

NPAC reduces the risk of nuclear proliferation and terrorism by strengthening nonproliferation and arms control regimes. NPAC applies its unique expertise to develop and implement programs and strategies that: strengthen international nuclear safeguards; control the spread of nuclear material, equipment, technology, and expertise; verify nuclear reductions and compliance with nonproliferation and arms control treaties and agreements; and develop programs and strategies to identify nonproliferation and arms control challenges and opportunities. The program's multi-year performance metric goals and other planned milestones are described below and graphically represented in Figure 15.

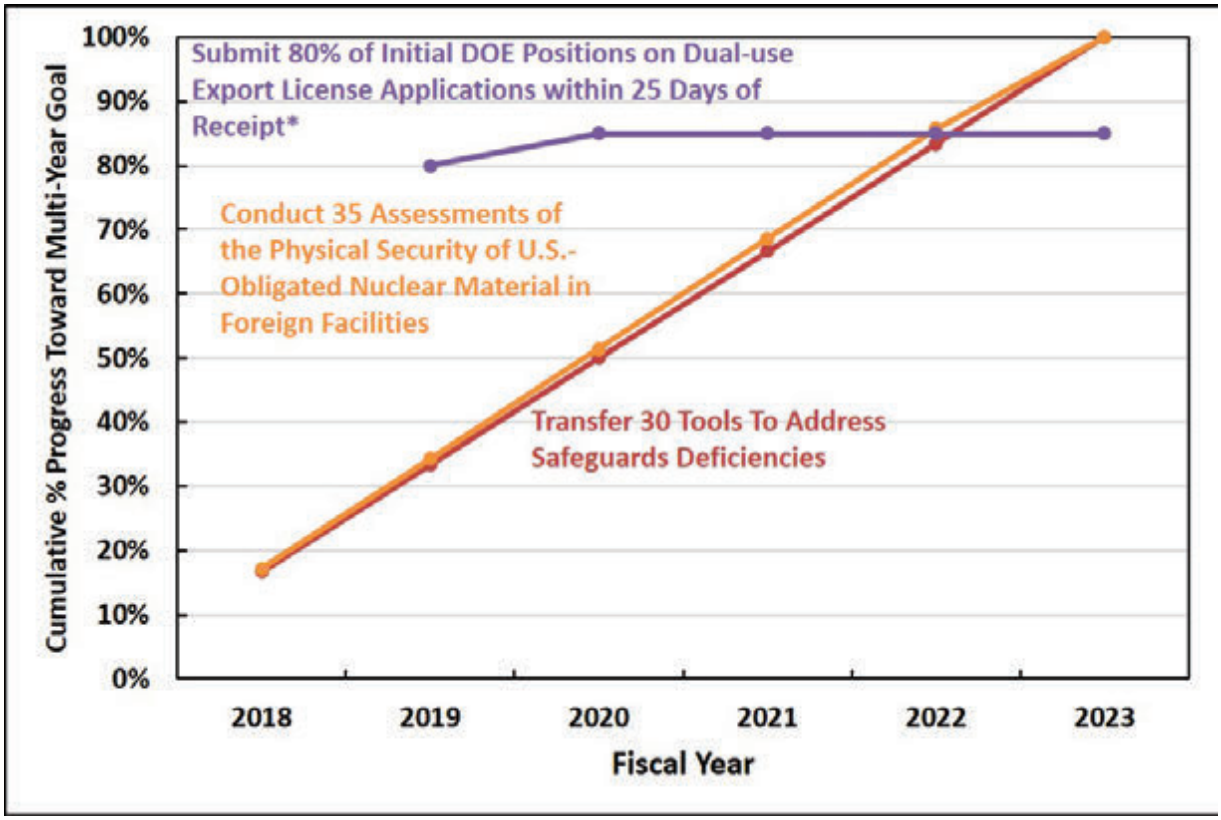

Figure 15. Progress Toward Completing Multi-Year NPAC Goals

***New performance metric for Export Controls effective beginning FY 2019; previous metric reflected Support for Partner Countries in Achieving Export Control Systems that Meet Critical Requirements.**

Explanation of Multi-Year Goals

As of FY 2018, Support 38 Partner Countries in Achieving Export Control Systems that Meet Critical Requirements: This metric reflects progress since FY 2008. Though the program will continue to engage countries on export control activities, NPAC will discontinue this metric after FY 2018.

Submit 80 percent of Initial DOE Positions on Dual-Use Export License Applications to DOC within 25 Days of Receipt: Beginning in FY 2019, this new metric will replace the above metric. As stated in Executive Order 12981, DOE is statutorily mandated to review dual-use export license applications within 30 days of receipt of referral and all of the required information. This new metric focuses on NPAC's implementation of this statutorily mandated work to review dual-use exports within 30 days of receipt of the referral from DOC. The new metric is based on the rate at which DOE submits its positions within 25 days; the shorter than required response time reflects an effort to ensure that nonproliferation and export control reviews are not impeding U.S. commerce. The target for FY 2019 is to complete 80 percent of referrals on the 25-day timeline, rising to 85 percent from FY 2020 through 2023.

Transfer 30 Tools to Address Identified Safeguards Deficiencies: This metric reflects the number of tools that will be transferred from FY 2018 – FY 2023. The transferred tools (e.g., new technologies for gas centrifuge enrichment plant monitoring) are deployed and used in international regimes and other countries to address identified safeguards deficiencies. The goal reflects a planned level of effort of five tools transferred per year from FY 2018 through FY 2023. Support for the international safeguards regime addresses an enduring need and is expected to continue after completion of the multi-year goal.

Conduct 36 Assessments of the Physical Security of U.S.-Obligated Nuclear Material in Foreign Facilities: This metric reflects the number of physical protection assessments conducted at foreign facilities holding or expecting to receive U.S. obligated nuclear material. The goal reflects a planned level of effort of six assessments conducted per year from FY 2018 through FY 2023. This activity addresses a need that will endure as long as there is U.S.-obligated nuclear material located at foreign facilities.

Other Planned Milestones

- FY 2018 – Completed the U.S.-UK-Norway-Sweden "Quad" Nuclear Verification Partnership arms control simulation exercise at the Royal Air Force Base, Honington, United Kingdom.
- FY 2018 – Completed Phase I of the International Partnership for Nuclear Disarmament Verification (IPNDV), and began IPNDV's Phase II program of work.
- FY 2019-2023 – Support IAEA's ability to monitor and verify the safeguards obligations on Iran's nuclear program.
- FY 2019-2020 – Support U.S. implementation of all facets of the *Treaty on the Non-Proliferation of Nuclear Weapons* leading up to the 2020 Review Conference and 50th Anniversary of the Treaty's entry into force.
- FY 2019-2020 – Co-chair the International Partnership for Nuclear Disarmament Verification technology working group and complete Phase II.
- FY 2019-2023 – Field test advanced safeguards approaches for the IAEA for gas centrifuge enrichment plants.
- FY 2019-2023 – Annually perform technical reviews of approximately 6,000 U.S. export licenses.
- FY 2019-2023 – Provide approximately 3,000 technical analyses per year supporting detection and interdiction of nuclear and dual-use commodity transfers to foreign programs of concern.
- FY 2019-2023 – Develop and refine advanced concepts and approaches to international safeguards that will result in more effective and efficient IAEA verification.
- FY 2019-2023 – Annually provide technical and policy support to the multilateral export control regimes, including the Nuclear Suppliers Group (NSG), the Missile Technology Control Regime, and the Australia Group.
- FY 2019-2023 – Annually provide export control assistance to 25-35 countries per year.
- FY 2019-2023 – Annually provide training and technical advice to the U.S. export enforcement community to aid in preventing foreign WMD programs of concern from acquiring proliferation-sensitive, U.S.-origin goods and technologies.
- FY 2019-2023 – Provide continued arms control implementation support, including for the New START Treaty Bilateral Consultative Commission and the Intermediate-Range Nuclear Forces (INF) Treaty Special Verification Commission, as well as for the U.S. Backstopping Committees and the Verification and Compliance Analysis Working Groups for the New START and INF Treaties.
- FY 2019-2023 – Complete annual monitoring visits in Russia under the terms of the U.S.-Russia Plutonium Production Reactor Agreement to ensure the non-weapons use of Russian plutonium oxide and non-operational status of shutdown Russian plutonium production reactors.
- FY 2019-2023 – Develop and assess advanced technologies and concepts for future warhead monitoring and verification regimes that protect U.S. national security interests while enabling U.S. policy objectives.

- FY 2019-2023 – Develop and maintain readiness of U.S. teams, technologies, and capabilities to deploy to foreign nuclear facilities on short notice to implement negotiated nuclear weapons material production verification or monitoring activities.
- FY 2019 – Continue Part 810 Process Improvement procedures, focusing on expanding external outreach and reducing processing times.
- FY 2019 – Continue to implement existing Section 123 Agreements with partner countries, IAEA, and the governing authorities on Taiwan and begin implementing additional agreements with up to two additional countries.
- FY 2019-2021 – Support U.S. participation in the NSG through significant amendments to the NSG Trigger and Dual Use lists and expand NSG outreach to industry.
- FY 2019-2023 – Provide technical assistance to the negotiation of additional Agreements for Cooperation and associated Administrative Arrangements.
- FY 2019-2023 – Process 40–50 Part 810 specific authorization applications and requests for amendments per year and review hundreds of Part 810 general authorization reports for compliance with Part 810 regulations per year.

2.5.4 Defense Nuclear Nonproliferation Research and Development

DNN R&D reduces the threat to national security by advancing U.S. capabilities to detect and monitor foreign nuclear fuel cycle and weapons development activities, special nuclear material (SNM) movement or diversion, and nuclear explosions. These same capabilities support nuclear arms control treaty monitoring and verification, operational interdiction, and other nuclear security missions across DOE/NNSA and the U.S. Government. To address these mission needs, identify gaps, and prioritize research, DNN R&D coordinates with partner DOE and NNSA national laboratories, plants, and sites, in addition to stakeholders and end-users, in the development of long-term strategic roadmaps. DNN R&D also partners with academia and private industry. Through these multiple partnerships and collaborations, DNN R&D advances the technical base for national and homeland security agencies to meet nonproliferation, counterproliferation, and counterterrorism responsibilities. The program's multi-year performance metric goals and other planned milestones are described below and graphically represented in Figure 16.

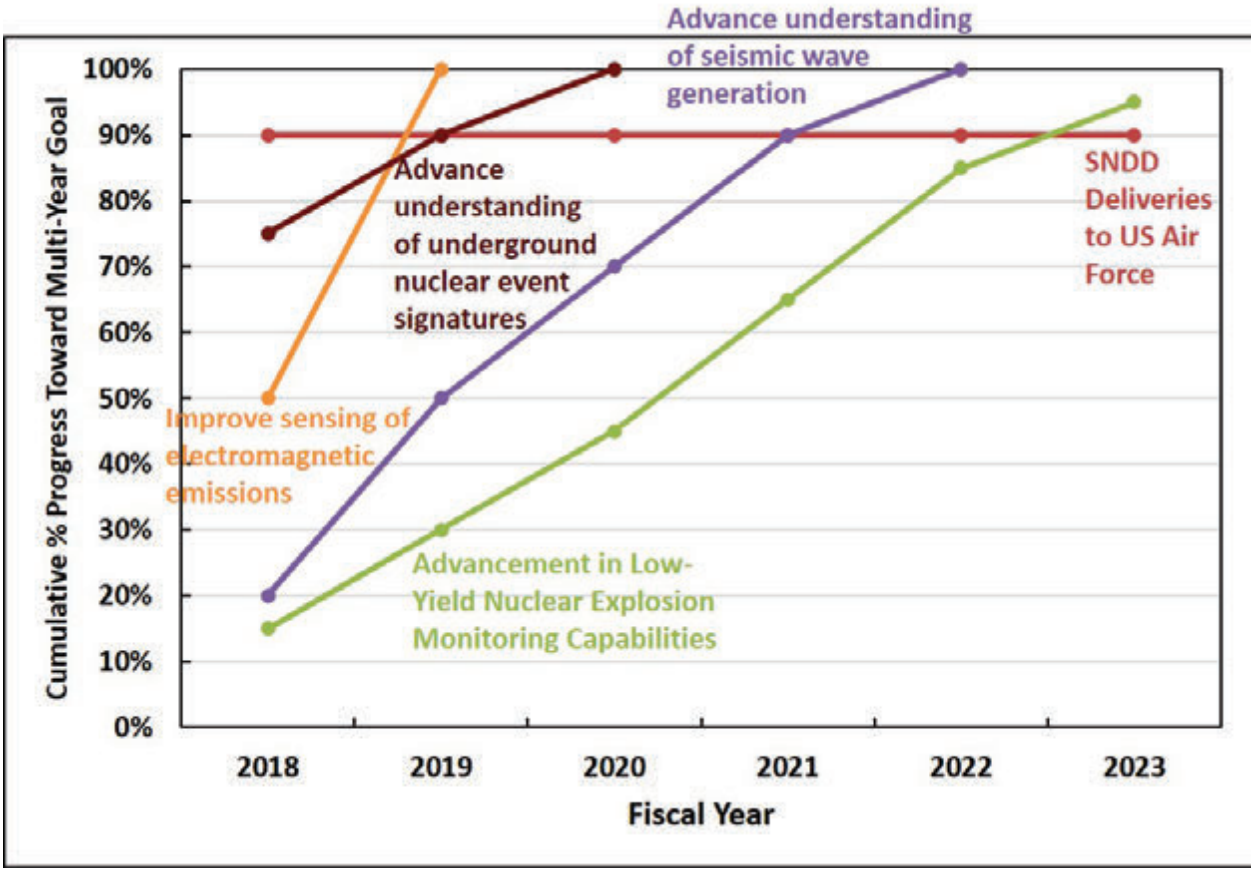

Figure 16. Progress Toward Completing Multi-Year DNN R&D Goals

Explanation of Multi-Year Goals

On-time Delivery of Nuclear Detonation Detection Products to the U.S. Air Force (USAF): DNN R&D designs, develops, and delivers operational, space-based, nuclear detonation sensors to the USAF in support of the U.S. Nuclear Detonation Detection System (USNDS). The USNDS 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 also supports sensor integration on the space vehicles as well as pre- and post- launch testing throughout the operational life of the sensor. DNN R&D, through the national security laboratories, provides a core U.S. capability to understand the performance of nuclear detonation sensors in space environments.

Demonstrate Advancements in Early Proliferation Detection: DNN R&D balances technical and program risk in demonstrating advancement of capabilities for nuclear security applications, including detecting SNM and its movement, incident response, nuclear forensics and nuclear safeguards. DNN R&D accepts moderate (i.e., 20 percent failure) to high technical risk in exchange of potentially significant breakthroughs in capabilities that address enduring and emerging nuclear weapon and security needs.

Demonstrate Advancements in Nuclear Security: DNN R&D improves U.S. technical capabilities to detect earlier, and characterize more accurately, foreign nuclear weapon proliferation activities, particularly SNM production and nuclear weapons development and testing efforts. Early warning and detection of nuclear proliferation is key to providing the United States with more effective opportunities to disrupt proliferation activities. DNN R&D balances technical and program risk in demonstrating advancement of these capabilities through moderate (i.e., 20 percent failure) to high technical risk in exchange of

potentially significant breakthroughs in capabilities that address enduring and emerging nonproliferation needs.

Developing Sensing Technologies and Analytical Methods to Advance Simulation and Characterization of High Explosive Tests

Aspiring nuclear states may rely on a combination of overt nuclear, industrial (dual-use) conventional military and clandestine facilities to conduct nuclear weapons research, development, and testing. These states carry out non-nuclear explosives testing to develop confidence in nuclear weapon designs and their weapon components without using fissile material. These tests, which vary in purpose, materials, and energy yield, generate unique signatures and observables that serve as clues.

The Helios Venture, funded by DNN R&D, aims to increase the United States' ability to detect and characterize high explosive testing carried out in support of nuclear weapons development. In order to do this, Helios will develop predictive models that will allow the United States to more effectively manage risks associated with nuclear test ban treaty compliance and nuclear weapons development across the globe.

Figure 17. Three Different Detonations from Helios' PYROIS High Explosive Campaign Conducted at Nevada National Security Site's Big Explosive Experimental Facility in spring 2017

Other Planned Milestones

- FY 2019+ – Maintain USNDS by designing, producing and delivering sensor payloads to USAF, in accordance with the negotiated schedule, and supporting pre- and post-launch testing.
- FY 2019+ – Develop and demonstrate advanced nonproliferation detection testbeds in full coordination with the requirements and timelines of the nonproliferation stakeholder community
- FY 2019 – Complete Phase II of the Source Physics Experiment

2.5.5 Nonproliferation Construction

The Nonproliferation Construction program consolidates the line-item construction costs for DOE/NNSA nuclear nonproliferation programs, which primarily are the construction projects associated with U.S. plutonium disposition efforts.

On May 10, 2018, the Secretary waived the requirement to construct the MFFF at SRS. Pursuant to the requirements under Section 3121(b) of the FY 2018 NDAA, the Secretary's certification:

- Confirmed that the Department of Energy is committed to removing plutonium intended to be disposed of in the MOX facility from South Carolina and ensured an enduring mission for SRS;
- Certified that an alternative option for carrying out the plutonium disposition program for the 34 MT intended to be disposed of in the MOX facility exists and the remaining lifecycle costs for the alternative option will be less than half of the estimated remaining lifecycle cost of the MOX fuel program; and
- Stated that the Department is seeking a permit modification that would address the capacity of the Waste Isolation Pilot Plant for receipt of transuranic waste, including waste that would result from the dilute and dispose option.

On June 7, 2018, the U.S. District Court granted the State of South Carolina's motion for a Preliminary Injunction and required the Department to continue construction.

Explanation of Multi-Year Goals

Multi-year goals and associated performance targets are currently being adjusted to reflect the recent court order.

Other Planned Milestones

- FY 2019 – Upon approval, develop a termination plan for the MFFF project.
- FY 2019 – Complete the Critical Decision 1 package for the SPD Project at SRS in support of the dilute and dispose strategy.
- FY 2019 – Implement termination plan for the MOX project.
- FY 2020 – Initiate long lead procurements for the SPD project.
- FY 2021 – Complete shutdown of the MFFF project.
- FY 2023 – Complete 100 percent of final design for the SPD project and initiate construction.

Chapter 3: Counter *Countering Nuclear/Radiological Proliferation and Terrorism*

3.1 Program Description

The 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 the range of nuclear threat devices that a non-state actor could potentially construct. CTCP also provides liaison officers to key DoD Combatant Commands to coordinate on counterproliferation, counterterrorism, 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. Additionally, CTCP's counterproliferation efforts 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 uses specialized knowledge of nuclear threat devices, which includes potential improvised nuclear devices (INDs), proliferant weapons, 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 tools, 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 that could be exploited for use in an IND and provide the U.S. Government with accurate assessments of how various theoretical IND configurations would function. CTCP develops tools and procedures for rendering safe an IND and understanding forensic signatures following the detonation of an IND. CTCP's technical and scientific understanding of nuclear threat devices and nuclear materials 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.

The following offices comprise CTCP.

- **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 counterproliferation, counterterrorism, and nuclear incident response. This mission is accomplished through technical assistance, exercises, and training on nuclear counterterrorism, emergency preparedness, and incident response activities.
- **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 devices and constituent materials, including potential INDs, proliferant state weapons, and devices outside of a foreign state's control. 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 the National Security Council (NSC) in developing and implementing nuclear counterproliferation and nuclear counterterrorism policies, and leads nuclear threat reduction technical exchange activities with selected international partners.

- **Office of Nuclear Forensics:** In addition to serving as the Department's lead for nuclear forensics technical activities, this office sustains nuclear forensic personnel, equipment, key facilities, and operations in support of NSC-sponsored policy initiatives.
- **Office of Nuclear Incident Response**: This office manages the Department's incident response assets that support nuclear counterproliferation, counterterrorism, 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.

Figure 18. Aerial Measuring System Helicopter Conducts Aerial Radiation Background Survey during the 2018 Super Bowl

3.2 Changes to Programs and Capabilities

3.2.1 CTCP as the Department's Lead for Nuclear Forensics

Figure 19. Participants in an International Nuclear Forensics Workshop

CTCP's Office of Nuclear Forensics 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 robust 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 allows the United States to hold accountable any state, terrorist group, or other non-state actor that supports or enables efforts to employ a nuclear device.

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 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. To carry out these missions, CTCP maintains a readiness posture to deploy ground sample-collection teams, deploy device disposition and assessment teams, and conduct laboratory operations in support of bulk nuclear material and post-detonation forensics.
- DNN R&D conducts research to improve the U.S. technical nuclear forensic capability. 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 IND assessment activities of the CTCP Office of Nuclear Threat Science.
- GMS works to strengthen foreign partner nuclear forensic capabilities, which are integral to a robust program to deter and counter illicit nuclear smuggling and strengthen the security of nuclear and radioactive material.
- The DOE Office of Intelligence and Counterintelligence is responsible for the National Nuclear Forensic Library of the United States.

Focus on Cooperative Activities: Collaboration among CTCP, DNN, and FBI on WMD Training

The Office of Nuclear Incident Policy and Cooperation (NIPC) within CTCP conducts tailor-made tabletop exercises to increase WMD nuclear and radiological awareness and capabilities, both domestically and internationally. Since 1999, the WMD counterterrorism tabletop exercise program has trained over 13,000 Federal, state, local, and foreign officials. To maximize participation and practical value to participants, these exercises are unclassified and not formally evaluated or scored.

NIPC coordinates closely with DNN's GMS program when conducting domestic Silent Thunder tabletop exercises for locations with civil nuclear material or radioactive sources. This collaboration combines the collective expertise of the two organizations to provide integrated nonproliferation and WMD training. Prior to the exercises, GMS provides voluntary security enhancements to reduce the potential for theft or misuse of radioactive materials that could be used in a dirty bomb. These voluntary upgrades are in addition to security enhancements required by the Nuclear Regulatory Commission and state governments since 2006 and can include training in how to respond to security incidents. After these GMS security enhancements are complete, NIPC collaborates with FBI to hold a tabletop exercise at the facility examining and refining security alarm response and whole-of-government crisis and consequence management capabilities in the event of a WMD incident. The NIPC exercise counters the nuclear and radiological terrorism threat by providing the facility owner and Federal, state, and local officials an opportunity to develop an in-depth understanding of specific responsibilities in the event of a terrorist WMD incident, and serves as a "capstone" to the GMS-funded security upgrades. DOE/NNSA and FBI jointly conduct eight Silent Thunder exercises per year at domestic locations across the United States.

Figure 20. *Silent Thunder* Exercise at the Massachusetts Institute of Technology

3.3 Update on Infrastructure and Workforce

3.3.1 Key Infrastructure and Challenges

Infrastructure Base

As described in Section 2.3, DOE/NNSA's workforce and infrastructure crosscutting capability supports all DOE/NNSA mission pillars. Like the programs that support the "prevent" and "respond" functional areas, CTCP draws heavily on DOE/NNSA's science and technical base.

CTCP, through the Nuclear Threat Sciences program, is responsible for developing the scientific and technical knowledge that explores the "realm of the possible" with regard to IND configurations. CTCP carries out this technical work using predictive models validated through experimental campaigns. These campaigns rely primarily on two types of infrastructure: high performance computing platforms to design predictive models concerning nuclear threat device performance and experimental facilities to refine and validate these models. Computer platforms and codes supporting these functions include those developed specifically for the CTCP mission as well as others developed for the Stockpile Stewardship Program (SSP). These assets serve as an essential resource 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 SSP, with limited supplemental funding from CTCP as appropriate. CTCP relies on these experimental facilities to carry out a number of functions, including formulating and characterizing material samples, performing precision measurements from small to large-scale explosives, hydrodynamic testing to establish material properties and chemistry, and measuring nuclear data.

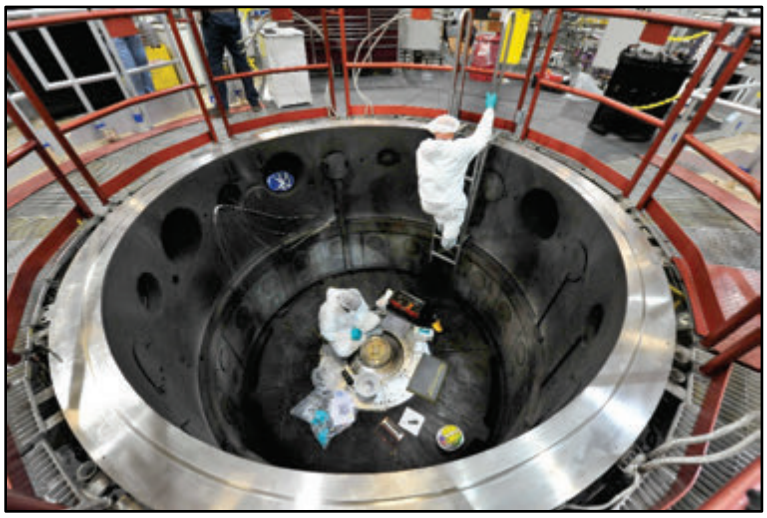

Figure 21. Z Facility at Sandia National Laboratories

DOE/NNSA is deploying new tools to track real property assets in the nuclear security enterprise and identify the key mission or missions supported. Based on this data and other inputs, some of the most distinctive and specialized experimental facilities supporting the CTCP mission are described below:

- PF-4, Los Alamos Neutron Science Center, Dual-Axis Radiographic Hydrodynamic Test facility, gas guns, Ancho Canyon, and the Proton Radiography facility at LANL;
- The Superblock, Contained Firing Facility, High Explosives Application Facility, and gas guns at LLNL;
- The Z Facility (Figure 21) and Thunder Range at SNL; and
- The National Criticality Experiments Research Center, Joint Actinide Shock Physics Experiment Research gas gun, the Big Explosives Experimental Facility, and the Baker Compound at NNSS.

Challenges of Potential Facility Closures on the CTCP Mission

Efforts to consolidate infrastructure offer tremendous benefits across the nuclear security enterprise, but also pose potential challenges to the CTCP mission 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 affect CTCP's mission.

3.3.2 Workforce Summary

CTCP's Workforce

The scientists and technical specialists at DOE/NNSA's laboratories, plants, and sites perform the work needed to characterize, detect, and defeat nuclear threat devices. CTCP also supports international nuclear security and counterterrorism dialogues, WMD counterterrorism tabletop exercises, and nuclear information security policy and practices. The CTCP mission and the SSP have significant overlap between the workforces supporting both missions. The technical personnel who support the CTCP mission generally developed their skills supporting the SSP. Many work primarily on the SSP and support CTCP on a part-time basis.

3.4 Updated Future Program Plan

The multi-year performance goals and other planned milestones for CTCP are described below and graphically represented in Figure 22.

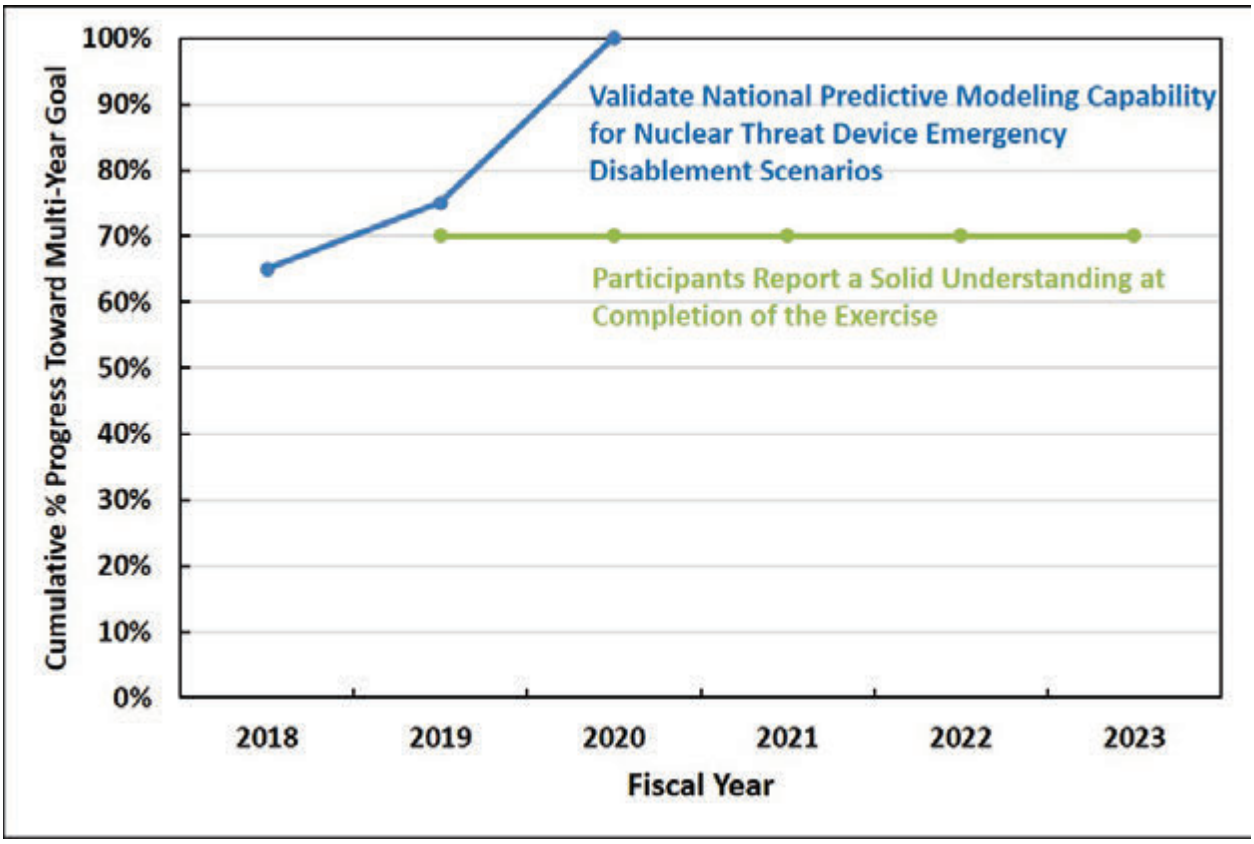

Figure 22. Progress Toward Completing Multi-Year CTCP Goals

Explanation of Multi-Year Goals

In FY 2019, the CTCP Response and Capacity Building program's endpoint metric will change from total officials trained to percentage of all participants reporting a solid understanding at the strongly agree or agree level at the completion of the exercise. The goal will be 70 percent of participants reporting either agree or strongly agree.

Other Planned Milestones

- FY 2019–2021 – Annually, conduct eight domestic *Silent Thunder* WMD counterterrorism tabletop exercises, at least four foreign *Eminent Discovery* tabletop exercises or WMD Threat Awareness workshops, and at least one classified Counterterrorism Security Dialogue to address evolving and emerging terrorism threats to nuclear materials and facilities.
- FY 2019–2021 – Continue the activities supporting the scientific understanding of nuclear threat devices and management of classified threat device information.
- FY 2019–2021 – Continue planned activities for modeling, experiments, and simulations of a variety of technical topics, to include threat devices, nuclear materials attractiveness, high explosives, post-detonation, and render safe tool development and testing.

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Chapter 4: Respond
Responding to Nuclear/Radiological Threats and Terrorism

4.1 Program Description

Under DOE/NNSA's nuclear threat reduction mission, the Office of Counterterrorism and Counterproliferation (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 terrorists and 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 radiological dispersal devices (RDD), 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, radiological consequence management, and nuclear forensics.

Emergency preparedness includes the ability to manage and/or coordinate other types of emergencies, such as natural disasters impacting DOE/NNSA laboratories, plants, and sites. The Department's Emergency Management Enterprise, which includes CTCP's Nuclear Response Assets; the response and recovery efforts of the Office of Cybersecurity, Energy Security, and Emergency Response; the Incident Management Team staffed by the Office of Management and the Office of Environment, Health, Safety, and Security; the Office of Intelligence and Counterintelligence; the Office of the Chief Information Officer; the Office of Environmental Management; and the Office of Science; initiated phased process improvements that culminated in the achievement of an enterprise-wide, all-hazards initial operational capability of a Unified Coordination Structure (UCS) during the first quarter of FY 2017. The UCS allows all program offices to retain all authorities and responsibilities while integrating into a Headquarters level, National Incident Management System compliant organization that ensures a coordinated effort as necessary and prudent, particularly in the case of "cascading events" such as a major hurricane impacting the mission critical activities of NNSA or DOE sites or laboratories in its path.

The DOE/NNSA 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 of Emergency Operations provides necessary governance and operational support to the Emergency Management Enterprise throughout the improvement process, and ensures the full engagement, coordination, and involvement of the all-hazards emergency management community in this enduring improvement effort. The mission of the Office of Emergency Operations includes responsibility for the policies, trainings, exercises, 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 of Emergency Operations is also

responsible for planning and program management related to the DOE/NNSA continuity program, and associated continuity of operations and continuity of government activities that ensure DOE/NNSA Primary Mission Essential Functions are sustained through any crisis event.

The Department's Emergency Management Enterprise is closely coordinated with Federal, state, tribal, and local agencies. This coordination is guided by interagency directives, including Presidential Policy Directive 8, which requires the development of National Planning Frameworks that set national strategy and doctrine for emergency preparedness, as well as Federal Interagency Operational Plans, which integrate and synchronize capabilities across Federal agencies.

4.2 Changes to Programs and Capabilities

4.2.1 Adoption of Enterprise-Wide Approach to Emergency Management

The Department has adopted an enterprise-wide, all-hazards approach to emergency management. This approach includes a unified emergency response strategy directed by Departmental leadership, common standards and procedures for emergency preparedness and response, and centralized coordination of the Department's various emergency operations components during all-hazards emergencies. All-hazards emergencies include health-, safety-, and/or security-related events that have the potential to overwhelm the resources or assets of the relevant response organizations; involve multiple sites or programs; or cascade across specific hazards, threats, or locales.

Reasons for Adoption of Enterprise-Wide Approach

The Department's decision was discussed and clarified within the Department's formal response to a September 2014 recommendation by the Defense Nuclear Facilities Safety Board (DNFSB).[1] Recommendation 2014-1 alerted the Secretary to "the need to take actions to improve the emergency preparedness and response capability at DOE's defense nuclear facilities" by the end of 2016.

In April 2015, the Department submitted the implementation plan, committing to "rectify this situation by enforcing line management chain of command and accountability for the implementation of and oversight of the Emergency Management Enterprise." The enterprise-wide approach to emergency management, supported by the newly restructured Office of Emergency Operations, is a key means of addressing this issue.

In addition to the DNFSB recommendation, historical high-profile events also served to confirm the need for the Department's adoption of an enterprise-wide approach to emergency management. These included the Deepwater Horizon oil spill, the Fukushima disaster, Hurricane Sandy, and the truck fire and radioactive material release at the Waste Isolation Pilot Plant. These incidents indicated a need to improve the Department's ability to respond to both natural and manmade events. The incidents also demonstrated the need to strengthen the Department's ability to communicate situational and technical information during emergencies, including communication laterally within the enterprise, vertically to senior policymakers, and externally to key stakeholders.

[1] DNFSB is an independent organization within the executive branch responsible for providing recommendations and advice to the President and the Secretary of Energy regarding public health and safety issues at DOE defense nuclear facilities.

Deepwater Horizon Oil Spill
(April 2010)

Fukushima Earthquake and Tsunami
(March 2011)

Hurricane Sandy
(October 2012)

Waste Isolation Pilot Plant Truck Fire and Radioactive Release
(February 2014)

Figure 23. Historical Incidents Impacting the Department's Approach to Emergency Management

Benefits of an Enterprise-Wide Approach

The enterprise-wide approach to emergency management improves the Department's ability to respond to emergencies across the all-hazards spectrum and ensures that crisis response and consequence management assets are fully integrated into a unified command structure. Such integration ensures more effective departmental emergency management in coordination with other national and/or international response elements.

4.3 Update on Infrastructure and Workforce

4.3.1 Key Infrastructure and Challenges

Infrastructure Base

A diverse infrastructure base comprising specialized facilities, vehicles, and equipment 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, as well as the emergency management infrastructure required to coordinate the response effort.

The nation's nuclear incident response teams need the ability to communicate to DoD and FBI partners classified technical assessments in deployed environments using secure means. Information requirements encompass both nuclear design information and intelligence assessments. The existing DOE/NNSA deployable communications network is not capable of directly sharing highly classified data with interagency partners, jeopardizing the ability to provide time-sensitive technical advice to support decision making during incident response operations. DOE/NNSA is investing in hardware and highly specialized personnel to improve the capabilities of field-deployable secure communications and ensure interoperability with our interagency partners. This effort uses the DoD's extensive infrastructure and experience in providing a common deployable secure communications platform.

DOE/NNSA is deploying new tools to track each real property asset in the nuclear security enterprise and identify the missions that they support. Based on these data and other inputs, some of the most distinctive assets supporting the emergency response and operations mission are described below:

Figure 24. Aerial Measuring System Helicopter

- The Aerial Measuring System (AMS) (Figure 24) is a specialized airborne radiation detection system based at Nellis Air Force Base in Nevada and Joint Base Andrews in Maryland.
- The National Atmospheric Release Advisory Center, located at LLNL (Figure 25), develops sophisticated radiological contamination models in the event of a nuclear or radiological incident and rapidly disseminates them to emergency response officials and specialized DOE/NNSA emergency response teams.
- The Radiation Emergency Assistance Center/Training Site, 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.
- The Emergency Communications Network is a multi-faceted communications system for managing emergency situations that involve DOE assets and interests. The system provides classified and unclassified voice, video, and data communications between DOE Headquarters and approximately 55 remote sites and mobile units via dedicated leased lines and satellite transmission. Emergency Communications Network upgrades are being scheduled over the next several years in concert with DoD and FBI communications improvements.
- The Forrestal Watch Office, located at DOE Headquarters in Washington, DC, serves as the 24-hour single point of contact for collecting, processing, and disseminating time-sensitive emergency notifications. The facility includes

Figure 25. National Atmospheric Release Advisory Center

an uninterruptible power supply and independent air supply system filtered to protect against biological and radiological agents.

- Emergency Operations Centers, located at laboratories, plants, and sites across the nuclear security enterprise, are facilities specially designed to support continuous emergency operations for extended periods of time, even under hazardous conditions.
- 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.

Challenges with Equipment Recapitalization for Response Assets

The nature of the cybersecurity environment and national cybersecurity standards, as well as the inherently dynamic threats of nuclear and radiological terrorism, help inform requirements for new or updated equipment and software, along with improved cybersecurity practices. The emergency response mission is also closely coordinated with a number of interagency partners, and equipment must be interoperable across organizations, especially communications equipment. Such systems must also be highly mobile, reliable, and secure. All of this equipment must be periodically replaced as it reaches the end of its useful life. The DOE/NNSA emergency response program is investing in equipment recapitalization, but it has been necessary to defer some planned procurements to support other funding needs.

AMS provides airborne remote sensing in the event of a nuclear or radiological accident or incident within the continental United States, as well as in support of high-visibility national security events. AMS aerial surveys map the deposition of radioactive material following a release, providing incident response managers with important information to make decisions necessary for immediate protection and safety of the public. Situational awareness provided by AMS data also enables informed risk decisions to protect emergency responders. The AMS program maintains three fixed-wing and two rotary-wing aircraft to accomplish this mission. Fixed-wing aircraft provide a quick assessment of the extent of the radioactive contamination. Rotary-wing aircraft provide more detailed mapping capability.

In January 2017, CTCP completed an Analysis of Alternatives that was used to make the determination that recapitalization of the aging aircraft fleet was necessary. New airframes would ensure the sustained capability to collect critical exposure and contamination data and provide information to Federal, state, and local officials following an accident or incident to support critical and timely protective action decisions. New airframes will also minimize the risk of mission failure due to unscheduled maintenance and reduce future maintenance costs. CTCP intends to replace the three fixed-wing aircraft in FY 2019, and obtain a funding profile to replace two rotary aircraft in FY 2020.

4.3.2 Workforce and Key Challenges

Emergency Response Workforce

DOE/NNSA maintains regional Radiological Assistance Program (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. 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 radioactive 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 Accident Response Group (which responds to U.S. nuclear weapons accidents), and the consequence management teams.

Challenge of Managing a Matrixed Workforce

Most laboratory, plant, and site employees supporting the emergency response mission do so on a part-time, volunteer basis with most of their time allocated to the military application mission of DOE/NNSA's Office of Defense Programs. While this approach offers the significant benefits of providing on-demand access to a wide variety of world-class experts, the structure of the emergency response workforce also creates certain challenges that must be carefully managed. In particular, DOE/NNSA relies upon the availability of highly qualified part-time personnel to field and sustain our premier incident response capabilities, including teams such as the Accident Response Group and Joint Technical Operations Team. Additionally, the much larger nuclear weapons stockpile programs command priority for staff time, and it can be difficult to access experts, such as weapons modelers and radiochemists, to support incident response functions.

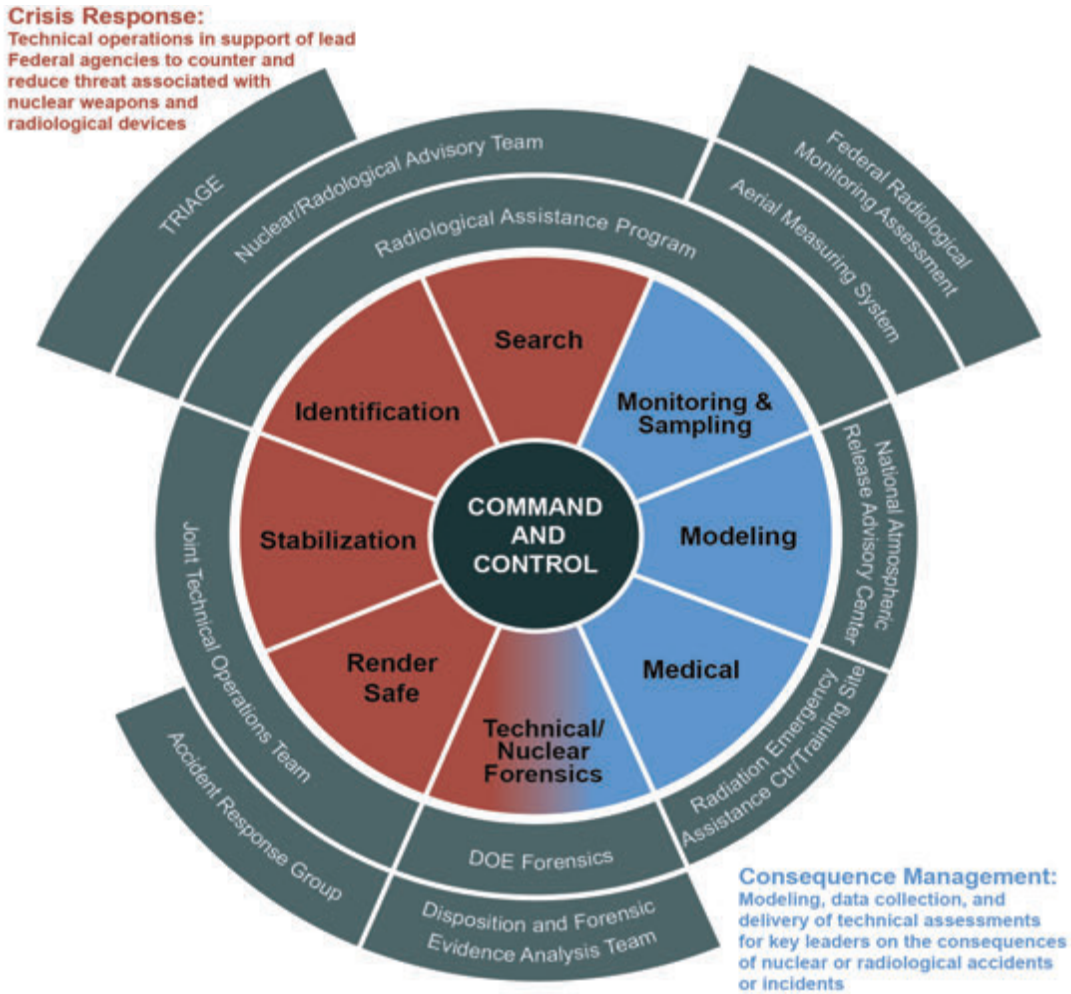

Figure 26. DOE/NNSA Emergency Response Assets

4.4 Updated Future Program Plan

The multi-year performance metric goals and other planned milestones for the emergency response mission are described below.

- FY 2019-2023 – Continue to enhance the Department's comprehensive emergency management system through institution of a complex wide all-hazards concept.
- FY 2019-2023 – Complete development of three fully trained teams to support DOE/NNSA Headquarters coordination of complex wide all-hazards emergencies, events, and incidents.
- FY 2019-2023 – Promote an integrated strategy to promptly address emergency management challenges at DOE/NNSA sites.
- FY 2019-2023 – Administer integrated emergency management policy, preparedness, and response activities within DOE/NNSA.
- FY 2019-2023 – Maintain a readiness assurance program to help minimize the impacts of emergencies on worker and public health and safety, the environment, and national security.
- FY 2019-2023 – Sustain reliable capability and functions to support Departmental command, control, communications, Geographic Information System data and situational intelligence requirements on a continuous basis.
- FY 2019- 2021 – Continue recapitalization efforts for critical incident response equipment that is beyond its planned life cycle.
- FY 2019–2021 – Sustain the capability in existing stabilization cities, including training and equipment maintenance. Deploy to additional cities and upgrade infrastructure and specialized technical equipment, as needed, according to the joint DOE-FBI plan.
- FY 2019-2021 – Conduct two Disposition and Forensics Evidence Analysis Team exercises and two Ground Collection Task Force field exercises per year, in support of maintaining nuclear forensics capabilities.
- FY 2019-2021 – Continue preventative and corrective facility maintenance at P-Tunnel, NNSS, for support to the Pre-Detonation Device Program, and address broader infrastructure improvements at NNSS.
- FY 2019-2023 – Test and implement Post-Detonation Device Assessment within interagency Concept of Operations.

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Chapter 5: Conclusion

DOE/NNSA's annual *Prevent, Counter, and Respond* report describes the nuclear and radiological threat environment as well as DOE/NNSA's strategic approach to achieving risk reduction. DOE/NNSA accomplishes its mission to reduce the threats of nuclear proliferation and nuclear and radiological terrorism by preventing the acquisition of nuclear weapons or weapons-usable materials, countering efforts to acquire such weapons or materials, and responding to nuclear or radiological incidents. DOE/NNSA programs reduce risks across the entire spectrum by:

- Minimizing and, when possible, eliminating excess weapons-usable nuclear material, ensuring sound management principles for remaining nuclear materials, and supporting peaceful uses of nuclear energy by making nuclear materials available for such purposes;
- Achieving adequate security, protection, control, and accounting for all nuclear and radioactive materials worldwide (in accordance with internationally accepted recommendations and best practices);
- Preventing the illicit trafficking of nuclear weapons and nuclear and radioactive materials;
- Preventing the proliferation of WMD—as well as relevant dual-use materials, equipment, technology, and expertise—by state and non-state actors through nuclear safeguards and export controls and by strengthening the nonproliferation and arms control regimes;
- Developing effective technologies to detect nuclear weapons proliferation and nuclear detonations and support the monitoring and verification of foreign commitments to treaties and other international agreements and regimes;
- Strengthening nuclear counterproliferation and counterterrorism capabilities by developing scientific and technical capabilities to understand nuclear threat devices, designs, and concepts (including INDs) and to address risks arising from lost or stolen foreign nuclear weapons and their components;
- Reducing the terrorist value of nuclear or radiological weapons by maintaining the capability to respond to, manage, avert, and contain the consequences of nuclear and radiological incidents in the United States or elsewhere in the world;
- Responding to nuclear and radiological terrorist acts by searching for and rendering safe threat devices and materials; carrying out nuclear forensic activities; conducting consequence management actions following an event to protect lives, property, and the environment; and providing emergency services through close coordination with the Department's Emergency Management Enterprise system; and,
- Improving the Department's all-hazards emergency preparedness and response capability for complex, cascading, and enduring incidents

DOE/NNSA programs play a central role in developing and coordinating U.S. interagency policy and programs, leveraging other expertise and capabilities within the U.S. national security interagency to accomplish the prevent-counter-respond mission. DOE and NNSA representatives serve as the U.S. leads or co-leads on a wide set of bilateral, multilateral, and international nuclear security groups and forums,

demonstrating DOE/NNSA's leadership in global nuclear security and the global fight against nuclear proliferation and terrorism.

As DOE/NNSA assesses the evolution of nuclear threat trends over the FY 2019-2023 timeframe, strategic studies will be conducted to validate that efforts remain focused on addressing current nuclear threats and anticipating emerging and evolving threat trends as far in advance as possible. Armed with these studies, and with insights from external sources such as the U.S. interagency, foreign partners, and the international nuclear security community, DOE/NNSA will work with the national laboratories, production facilities, and sites in conducting both cross-program and program-specific risk assessment and prioritization assessments. These assessments will assist DOE/NNSA to make corporate decisions across the prevent-counter-respond mission space that align future program and investment priorities to address the greatest dangers to global nuclear security. The *Prevent, Counter, and Respond – A Strategic Plan to Reduce Global Nuclear Threats (FY 2019-FY 2023)* will be updated annually to reflect program plans, progress, and challenges across the three mission areas.

Appendix A
Requirements Mapping

This *Prevent, Counter, and Respond–A Strategic Plan to Reduce Global Nuclear Threats (FY 2019-FY 2023)* report is provided as per the requirement for DOE/NNSA to submit a Defense Nuclear Nonproliferation Management Plan in Title 50, Section 2575, of the United States Code (U.S.C), as amended by the *National Defense Authorization Act for Fiscal Year 2018*, Sec. 3133.

This appendix maps the statutory and congressional requirements to the respective chapter and section in the "Prevent, Counter, and Respond – A Strategic Plan to Reduce Global Nuclear Threats (FY 2019-FY 2023)."

50 U.S.C. § 2575	FY 2019 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.	All Chapters
(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 on the plan developed under subsection (a).	All Chapters
(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.	All Chapters
(c) Elements.---The [plan] shall include, with respect to each defense nuclear non-proliferation program of the Administration, the following:	All Chapters
(1) A description of the policy context in which the program operates, including---	All Chapters
(A) a list of relevant laws, policy directives issued by the President, and international agreements; and	Appendix E
(B) nuclear nonproliferation activities carried out by other Federal agencies.	Appendix G
(2) A description of the objectives and priorities of the program during the year preceding the submission of the [plan].	Section 1.1
(3) A description of the activities carried out under the program during that year.	Appendix B

50 U.S.C. § 2575	FY 2019 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.	Appendix B
(5) A description of any gaps that remain that were not or could not be addressed by the program during that year.	Section 2.4, 3.4, and 4.4
(6) An identification and explanation of uncommitted or uncosted balances for the program, as of the date of the submission of the [plan] that are greater than the acceptable carryover thresholds, as determined by the Secretary of Energy.	Appendix F
(7) An identification of funds for the program received through contributions from or cost-sharing agreements with foreign governments…during the year preceding the submission of the [plan] and an explanation of such contributions and agreements.	Appendix C
(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 efficiencies and avoid redundancies.	Appendix G
(9) Plans for activities of the program during the five-year period beginning on the date on which the [plan] 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 HEU, plutonium, and radioactive materials worldwide (and identifying the countries in which such materials are located), efforts to dispose of surplus material, converting reactors from HEU to LEU (and identifying the countries in which such reactors are located);	Section 2.6.1
(ii) global nuclear material security, including securing HEU, plutonium, and radioactive 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 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,	Section 2.4.4
(v) nonproliferation construction programs, including activities associated with Department of Energy Order 413.1 (relating to program management controls).	Section 2.4.5

50 U.S.C. § 2575	FY 2019 Response
(B) Countering nuclear and radiological proliferation and terrorism.	Section 3.4
(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 4.4
(10) A threat assessment, carried out by the intelligence community (as defined in section 3113(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 [plan] is submitted and, as appropriate, in the longer term.	*Activity Descriptions:* Sections 2.4, 3.4, and 4.4
(11) A plan for funding the program during that five-year period.	Appendix D
(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 2.4, 3.4, and 4.4
(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).	*Description of Activities:* Sections 2.4, 3.4, and 4.4 *Description of Prioritization:* Section 1.1
(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.	Appendix G
(15) Such other matters as the Administrator considers appropriate.	N/A

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Appendix B
FY 2017 Accomplishments and Challenges

Accomplishments and Challenges in the "Prevent" Functional Area

FY 2017 Key Accomplishments	Challenges
Global Material Security	
International Nuclear Security	
• Continued capacity building activities with six nuclear security support centers in various regions of the world and continued engagements with over 20 countries with nuclear material and/or facilities. • Conducted semi-annual International Atomic Energy Agency (IAEA) Physical Protection International Training Course at SNL. • Conducted initial engagements with several prospective partners in high-threat regions. • Continued to expand cybersecurity curriculum and delivered basic and intermediate cyber security training courses for over 12 international counterparts.	• Lack of interest or political support in some countries to engage with the United States on sensitive nuclear security topics. • Achieving acceptance throughout the international community of the credibility of the insider threat, the importance of material accounting and control as an element of an effective nuclear security program, and the need for active enhancement of nuclear security culture.
Radiological Security	
• Completed security upgrades at a cumulative total of 2,189 buildings worldwide with high-priority radioactive sources. • Recovered more than 2,000 radioactive sources from locations in the United States, resulting in the cumulative total of more than 37,000 sources removed. • Continued development of advanced detection, delay, and tracking tools to support the radiological security mission at home and abroad.	• Needs for appropriate security at locations where radioactive materials are used and stored must be balanced with the need for regular access to these materials for legitimate commercial purposes. • Potential for domestic and international sites to fail to volunteer for security assistance, resulting in inability to engage certain high priority sites. • Achieving sustainment of effective radiological security regimes by international partners, particularly when those partner countries suffer from a lack of personnel and resources. • Limited availability of disposal pathways for disused radioactive sources. • Balancing the expanding use of radioactive sources worldwide in medical, industrial, and research fields with promotion of alternative, non-isotopic technologies where economically and technically feasible.

FY 2017 Key Accomplishments	Challenges
Nuclear Smuggling Detection and Deterrence (NSDD)	
• Deployed fixed radiation equipment to 30 high-priority sites and provided 26 additional mobile and man-portable systems for use at land borders and internal checkpoints. • Continued to build capacity through more than 120 operator and maintenance trainings; supported 47 workshops, exercises and drills; and transitioned 92 sites to indigenous sustainability. • Advanced engagements to build nuclear forensic capabilities through specific actions and activities in 11 countries, including Belarus, China, Georgia, Kazakhstan, and South Africa.	• Evolving smuggling threats, including emerging adversary groups such as the Islamic State of Iraq and the Levant, and evolving geopolitical realities, such as the U.S. relationship with Russia and the advent of Customs' Unions in areas where NSDD has completed deployments. • Achieving sustainment of counter-nuclear-smuggling efforts by international partners, particularly when those partner countries suffer from a lack of personnel and resources. • Shortage of technical experts available to support capacity-building efforts in nuclear forensics.
Material Management and Minimization	
Nuclear Material Removal	
• Removed or confirmed the disposition of an additional 268.1 kilograms of weapons-usable nuclear material in FY 2017 for a cumulative total of 6372.9 kg of highly enriched uranium (HEU) and plutonium removed since 1996. This work exceeded both the annual and cumulative metric targets for FY 2017. • Conducted a full-scale Emerging Threats exercise in cooperation with the U.S. Army.	• Achieving political engagement on material removal plans with some countries.
Conversion	
• Converted a research reactor in Ghana from HEU to low enriched uranium (LEU) fuel, a radioisotope production facility in South Africa from HEU to LEU targets, and verified the shutdown of a reactor in Canada for a cumulative total of 100 research reactors and isotope production facilities converted or verified as shutdown worldwide.	• Unable to engage on conversion activities with Russian Federation. • Difficulty finding disposition path for Uranium Lease Take Back program that is technically, politically, and economically feasible.
Material Disposition	
• Dispositioned 157.9 MT of surplus U.S. HEU out of a total of 186 MT by 2030. • Continued plutonium oxide production in support of the U.S. plutonium disposition program.	• Impact of limited disposition pathways (both in the United States and abroad) on efforts to eliminate vulnerable HEU and plutonium in foreign countries. • Challenges of sustaining operations in a high hazard radiological facility and increasing workforce attrition rates. • Volatility in the market price of uranium created challenges for dispositioning surplus HEU.

FY 2017 Key Accomplishments	Challenges
Nonproliferation Construction	
• Continued construction activities on the mixed oxide fuel fabrication facility (MFFF) project as directed in the *Consolidated Appropriations Act, 2017*. • Completed the Analysis of Alternatives and conceptual design in support of a Critical Decision-1 package for the Surplus Plutonium Disposition project to support the dilute and dispose strategy.	• Delay of a decision on the path forward for plutonium disposition.
Nonproliferation and Arms Control	
Nuclear Verification	
• Monitored shutdown of Russian plutonium production reactors, under terms of the U.S.-Russian U.S.-Russia Plutonium Production Reactor Agreement, to ensure the reactors remain shut down and that the plutonium oxide produced from the last three operating Russian production reactors is not used in weapons. • Supported implementation of New Strategic Arms Reduction Treaty (START) with Russia, and led negotiations to secure agreement through the Bilateral Consultative Commission to deploy new U.S. radiation detection equipment during inspections. • Worked with the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty (CTBT) Organization to ensure effective operation of the international monitoring and verification system for the CTBT, strengthening the U.S. and international capability to detect nuclear explosions. • Completed detailed planning with team of international experts for execution of the FY 2018 U.S.-U.K.-Norway-Sweden "Quad" Nuclear Verification Partnership arms control simulation exercise, hosted by the U.K. to demonstrate and assess nuclear weapons monitoring and verification capabilities and approaches. • Co-chaired the technical working group and completed Phase I of the International Partnership for Nuclear Disarmament Verification. • Supported completion of the *Nuclear Posture Review*, representing DNN throughout working group deliberations.	• Russia's continued violation of obligations under the Intermediate-Range Nuclear Forces Treaty.

FY 2017 Key Accomplishments	Challenges
Nuclear Controls	
• Conducted 5,998 technical reviews of U.S. export licenses and completed 2,985 technical analyses supporting U.S. detection and interdiction of WMD-related commodity transfers to foreign programs of concern.	• Building the capacity of some international partners to absorb bilateral and multilateral export control engagement, in order to strengthen national systems of export control. • External challenges to the nonproliferation regime, including technological advancement, political unpredictability, and countries of concern actively pursuing WMD. • Emergence of suppliers outside the multilateral export control regimes (e.g., Democratic People's Republic of North Korea (DPRK)). • Expansion from state-based, sanctioned, or complicit transfers to privatized suppliers, brokers, front companies, and franchises in states with weak controls.
Nuclear Safeguards	
• Continued to build nuclear safeguards capacity by conducting more than 60 safeguards-related training courses and technical exchanges with foreign partners. • Completed eight physical protection assessments at foreign facilities holding U.S.-obligated material. • Conducted over 11 field trials and demonstrations of advanced nuclear safeguards technologies and tools in partner facilities. • Tested and transferred seven safeguards tools to the IAEA and foreign partners to make safeguards measurements more effective and efficient.	• Potential resource demands that could be imposed by sudden, transformative events. • Fundamental difficulty in detecting undeclared (covert) nuclear facilities and activities at an early stage. • Increasing amount of nuclear materials under IAEA safeguards outpacing the IAEA's resources in an era of a flat (or zero-growth) budget. • Inherent difficulty and expense of safeguarding enrichment plants and reprocessing facilities (the two main pathways to acquiring fissile material to produce nuclear weapons). • Accelerated retirement of the nonproliferation/safeguards workforce.

FY 2017 Key Accomplishments	Challenges
Nonproliferation Policy	
• Concluded negotiations and achieved entry into force for a new civil nuclear cooperation agreement (123 Agreement) with Mexico. Also supported negotiations on a 123 Agreement with the United Kingdom. • Continued to implement a Part 810 process improvement plan and e810 online authorization system to further improve and modernize the 810 process. • Executed social media and Track 1.5 engagement activities in South Asia, East Asia, and the Middle East to address emerging challenges and opportunities in nonproliferation and arms control.	• Managing the balance between the nonproliferation objectives of Title 10, Part 810 of the Code of Federal Regulations, governing unclassified nuclear technology and assistance exports, and the benefits of U.S. commercial participation in foreign civil nuclear power programs. • External challenges to the nonproliferation regime, including global change, technological advancement, political unpredictability, and countries of concern actively pursuing WMD. • Challenges to the current nonproliferation architecture, including the negotiation of the Treaty on the Prohibition of Nuclear Weapons.
Defense Nuclear Nonproliferation Research and Development (DNN R&D)	
Proliferation Detection	
• Successfully executed a High Explosive campaign from April 17 - May 19, 2017 at NNSS Big Explosive Experimental Facility. An eight lab effort, this collaboration represents an expansion of predictive capabilities into the generation of unique High Explosive testing signatures and observables. • The Nuclear Science and Security Consortium (NSSC) completed a five-year award to support nuclear security and nuclear science missions (2011-2017). During this time, NSSC, led by the University of California at Berkeley (comprising seven academic institutions and four national laboratories), matriculated 307 students and postdoctoral scholars of which 103 participants transitioned to careers in national laboratories and related national security service. • The sixth and final underground conventional explosion of the Source Physics Experiment (SPE) Phase I occurred at NNSS in October 2016. The Source Physics Experiment is designed to improve the Nation's capability to detect and characterize underground nuclear explosions while developing an advanced capability for the United States to monitor low-yield nuclear testing. By conducting the experiments near the location of previous underground nuclear tests, researchers are able to better compare data from conventional and nuclear explosions. The end result is an improved U.S. capability to differentiate low-yield nuclear test explosions from other seismic activity, such as mining operations and small earthquakes.	• Transfer and integration of United States High-Performance Research Reactor efforts from under Material Management and Minimization to DNN R&D.

FY 2017 Key Accomplishments	Challenges
Nuclear Detonation Detection	
• Delivered two Global Burst Detector (GBD) sensor-laden payloads to the USAF and provided technical support to integrate one previously-delivered GBD onto a global positioning system (GPS) satellite that is planned for launch in FY 2019. • Co-sponsored (with DOE/NNSA's Office of Defense Programs) the development, commissioning, and initial use of the Neutron Silicon Telescope Array for Reaction Studies (NeutronSTARS), the largest neutron detector in the United States for experimental measurements of cross sections of nuclear reactions that emit neutrons.	• Making deliveries for GBD nuclear detonation detection capabilities on GPS block III satellites in accordance with the negotiated schedule with USAF, including mitigating potential supply chain interruptions on key procurements. • Implementing a long-term satellite host platform that addresses the requirement to maintain current nuclear detonation detection capabilities at geosynchronous altitude.

Accomplishments and Challenges in the "Counter" Functional Area

FY 2017 Key Accomplishments	Challenges
Nuclear Counterterrorism and Incident Response	
Nuclear Counterterrorism Assessment Program	
• Sustained threat device modeling and experiments, and developed and tested render safe tools.	• Maintaining, in the current budget environment, availability of key nuclear security enterprise experimental facilities for the duration of current nuclear and energetic materials roadmap needs.
Counterterrorism Response and Capacity Building	
• Developed, designed, organized, and conducted specialized emergency management training courses and programs to meet the specific emergency management needs of partner nations. • Provided technical assistance and training to IAEA and foreign government emergency programs to address nuclear and radiological incidents and accidents, including lost radioactive sources.	• Synchronizing and executing internal activities, and coordinating effectively with both interagency and key international partners to meet current or emerging demands imposed on the DoD Combatant Commands, DoD and FBI National Mission Force, and other government agencies. • Maintaining support from U.S. Government and international partners to sustain program results.

Accomplishments and Challenges in the "Respond" Functional Area

FY 2017 Key Accomplishments	Challenges
Nuclear Counterterrorism and Incident Response	
Emergency Response	
• Sustained render safe capabilities for an identified critical mission area in support of Principal Operational Partner. These efforts include predictive capability. • Sustained capability for ten stabilization cities (including training and equipment maintenance), rolled out eleventh stabilization city. Expansion to additional cities, and improved capabilities, will be in accordance with the joint DOE-FBI plan.	• Difficulty in developing, training, and maintaining a cadre of individuals with expertise in the areas necessary to support emergency response operations, especially given the fact that limited funding and full time equivalent (FTE) levels prohibit having a personnel resource pool to immediately fill vacant positions resulting from retirements, promotions, and other departures. • Infrastructure replacements at the Nuclear Response Group Readiness Operations Complex to ensure a safe, effective, and sustainable facility for deployment, equipment maintenance, and storage. • Equipment recapitalization, including aerial measuring system (AMS) aircraft, and handheld and vehicle-borne radiation detection equipment, such as: high resolution spectroscopic identification systems, correlated neutron detectors, high-energy radiography equipment, and contamination survey meters.
National Technical Nuclear Forensics	
• Maintained capability and readiness to respond to pre- and post-detonation events. • Planned and participated in two Disposition and Forensic Evidence Analysis Team and two DOE Forensics Operations nuclear forensics exercises in coordination with DoD and FBI, supporting collection of post detonation debris.	• Maintaining laboratory staff expertise, capability, and readiness, as well as supporting measurement proficiency testing. • Infrastructure improvements at NNSS to ensure a safe, effective, and sustainable facility for disposition operations.
Emergency Management and Operations Center	
• Conducted activities to promote consistent emergency management practices at DOE sites and implement emergency planning for severe events. • Continued maintenance and operation of the Emergency Communications Network to meet the National Security Mission requirements and to support the DOE/NNSA Network vision. • DOE/NNSA has revised its Emergency Preparedness Order (DOE O 151.1D), which designates DOE/NNSA's Emergency Operations Office as the office of primary interest for emergency management program activities. • DOE/NNSA's Emergency Operations Office revived the Emergency Management Advisory Committee	• Communications networks and capabilities that are fragmented, outdated, and cumbersome in the ability to move data and keep multiple organizations informed of activities from field-level to executive-level. Differing levels of classification, along with organizational rules on use of communications systems, also make it difficult to move data from one system to another.

FY 2017 Key Accomplishments	Challenges
and implementing an emergency management technical assistance program. • Assisted in the design and development of and participated in the National Level Exercise 2017, which contained several component exercises, notably- Eagle Horizon, NUWAIX 17, and Marble Challenge 2017. • Designed, developed, and delivered six internal DOE/NNSA Unified Coordination Structure Exercises.	

Appendix C
Foreign Contributions and Cost-Sharing Agreements

The DOE is authorized to accept international contributions for any programs within DNN. During FY 2017, DNN received a total of $892,463 (U.S. dollar equivalent) from three international contributors.

Foreign Government Contributions Received

FY	Program for Cooperation	Partner	Contributions (whole dollars)
2017	Global Material Security (GMS)	Finland	286,523
2017	GMS	United Kingdom	493,440
2017	GMS	New Zealand	112,500
Total FY 2017			**892,463**

Amount and Use of Foreign Contributions

International Contributor	Amount/Date Received	Use
Global Material Security		
Finland	$286,523 1/17/2017	Contribution to support work to install radiation portal monitors at three border crossings in Ukraine.
United Kingdom	$493,440 3/22/2017	Contribution to support work to install radiation portal monitors at three additional border crossings in Ukraine.
New Zealand	$112,500 7/14/2017	Contribution to build capacity for operating, maintaining, and managing radiation detection systems and conducting nuclear forensics investigations in Jordan and Cambodia.

Amounts Retained

Of the foreign funding contributions that were received in FY 2017, $112,500 was retained as unobligated carryover. This amount has been allocated and the associated tasks completed in FY 2018.

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Appendix D
FY 2019 Future Years Nuclear Security Program Plan

The following section comes directly from the Department of Energy FY 2019 Congressional Budget Request, Volume 1: National Nuclear Security Administration.

Table 1. Defense Nuclear Nonproliferation Funding by Congressional Control

(Dollars in Thousands)

	FY 2017 Enacted	FY 2018 Enacted	FY 2019 Enacted
Defense Nuclear Nonproliferation Appropriation			
Defense Nuclear Nonproliferation			
Material Management and Minimization			
HEU Reactor Conversion	75,615	0	0
Nuclear Material Removal	68,902	32,925	32,925
Material Disposition	143,833	183,669	225,869
Laboratory and Partnership Support	0	92,000	35,000
Total, Material Management and Minimization	**288,350**	**308,594**	**293,794**
Global Material Security			
International Nuclear Security	66,027	46,339	46,339
Domestic Radiological Security	87,199	110,433	127,433
International Radiological Security	68,907	78,907	78,907
Nuclear Smuggling Detection and Deterrence	144,975	154,429	154,429
International Contributions* [non-add]	[892]	0	0
Total, Global Material Security	**367,108**	**390,108**	**407,108**
Nonproliferation and Arms Control	**124,703**	**134,703**	**129,703**
Defense Nuclear Nonproliferation R&D			
Proliferation Detection	251,558	278,255	281,521
Nuclear Detonation Detection	165,448	195,749	195,749
Nonproliferation Fuels Development	52,744	82,500	98,300
Total, Defense Nuclear Nonproliferation R&D	**469,750**	**556,504**	**575,570**
Nonproliferation Construction			
99-D-143, Mixed Oxide (MOX) Fuel Fabrication Facility, SRS	335,000	335,000	220,000
Total, Nonproliferation Construction	**335,000**	**335,000**	**220,000**
Total, Defense Nuclear Nonproliferation Programs	**1,584,911**	**1,724,909**	**1,626,175**
Nuclear Counterterrorism and Incident Response Program	**271,881**	**282,360**	**319,185**
Legacy Contractor Pensions	**83,208**	**40,950**	**28,640**
Subtotal, Defense Nuclear Nonproliferation Appropriation	**1,940,000**	**2,048,219**	**1,974,000**
Use of Prior Year Balances	**-38,000**	**0**	**-25,000**
Rescission of Prior Year Balances	**-22,262**	**-49,000**	**-19,000**
Total, Defense Nuclear Nonproliferation Appropriation	**1,879,738**	**1,999,219**	**1,930,000**

* The international contributions received by the GMS program shown in the FY 2017 Enacted column are a non-add to the FY 2017 Appropriation. The amount received in FY 2017 totaled $892,463, including $286,523 from Finland, $493,440 from the United Kingdom, and $112,500 from New Zealand.

SBIR/STTR:

- FY 2017 Transferred: SBIR: $7,958; STTR: $1,119
- FY 2018 Annualized CR: SBIR: $7,963; STTR: $1,120
- FY 2019 Request: SBIR: $8,186; STTR: $1,151
- FY 2020 - FY 2023 Request: SBIR: $34,481; STTR: $4,850

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

(Dollars in Thousands)

	FY 2020 Request	FY 2021 Request	FY 2022 Request	FY 2023 Request
Defense Nuclear Nonproliferation				
Material Management and Minimization	**357,333**	**354,300**	**361,371**	**368,146**
Global Material Security	**346,850**	**367,290**	**375,006**	**382,881**
Nonproliferation and Arms Control	**132,267**	**133,700**	**136,508**	**139,374**
Defense Nuclear Nonproliferation R&D	**475,017**	**460,028**	**469,689**	**479,552**
Nonproliferation Construction				
99-D-143, Mixed Oxide (MOX) Fuel Fabrication Facility, SRS	220,000	220,000	204,250	217,000
18-D-150, Surplus Plutonium Disposition Project	59,000	59,000	74,750	62,000
Total, Nonproliferation Construction	**279,000**	**279,000**	**279,000**	**279,000**
Total, Defense Nuclear Nonproliferation Programs	**1,590,467**	**1,594,318**	**1,621,574**	**1,648,953**
Nuclear Counterterrorism and Incident Response Program	**331,893**	**329,503**	**333,853**	**342,331**
Legacy Contractor Pensions	**12,848**	**11,250**	**10,500**	**9,750**
Subtotal, Defense Nuclear Nonproliferation Appropriation	**1,935,208**	**1,935,071**	**1,965,927**	**2,001,034**
Use of Prior Year Balances	**0**	**0**	**0**	**0**
Rescission of Prior Year Balances	**0**	**0**	**0**	**0**
Total, Defense Nuclear Nonproliferation Appropriation	**1,935,208**	**1,935,071**	**1,965,927**	**2,001,034**

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Appendix E
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 (Jan. 2, 2013).
- *Atomic Energy Act of 1954, As Amended*, 42 U.S.C. §§ 2011 *et seq*.
- *Atomic Energy Defense Act, As Amended*, Pub. L. 107-314, Div. D., as renumbered by Pub. L. 108-136, Div. C., Title XXXI (Nov. 24, 2003).
- *The Export Administration Act of 1979*, Pub. L. 96-72 (Sept. 29, 1979), as Continued by the President under the *International Emergency Economic Powers Act* pursuant to Executive Order 13222 as Amended by Executive Order 13637, as well as Executive Order 12981.
- *Henry J. Hyde United States-India Peaceful Atomic Energy Cooperation Act of 2006*, Pub. L. 109-401, Title I (Dec. 18, 2006).
- National Defense Authorization Acts (Various).
- *National Nuclear Security Administration Act, As Amended*, Pub. L. 106-65, Div. C., Title XXXII (Oct. 5, 1999).
- *Nuclear Non-Proliferation Act of 1978*, As Amended, Pub. L. 95-242 (Mar. 10, 1978).

Presidential Policy Directives

- National Security Presidential Directive (NSPD) 51/Homeland Security Presidential Directive 20.
- PPD-8: National Preparedness.
- PPD-25 (classified directive).
- PPD-33 (classified directive).
- PPD-35.
- PPD-42.

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 Defence Purposes, as amended.

- Agreement Between the Government of the United States of America and the Government of the Russian Federation Concerning Cooperation Regarding Plutonium Production Reactors, as amended.
- 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
- Comprehensive Nuclear-Test-Ban Treaty. (Note: The United States has signed this treaty but has not ratified it. Also, the treaty has not entered into force.)
- International Convention on the Suppression of Acts of Nuclear Terrorism.
- The Joint Comprehensive Plan of Action.
- Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.
- NSS Communiques 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 Offensives 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 Elimination Of Their Intermediate-Range And Shorter-Range Missiles (INF Treaty).
- 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 F
Analysis and Explanation of FY 2017 Uncosted and Uncommitted Balances

Background

Obligations that have not been costed by the end of the fiscal year are carried over into the following fiscal year. These carry-over balances are necessary and unavoidable given the nature of the Department's work, but are carefully managed and tracked as part of the Department's financial management system.

As part of the financial management system, DOE established percentage thresholds specifying levels of uncosted balances (as a percentage of total obligated funds) 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, general plant projects, and accelerator improvement projects.

As per the requirements in the *National Defense Authorization Act for Fiscal Year 2016*, Sec. 3132(b)(6) (50 U.S.C. § 2575(c)(6)), DNN reports to Congress annually on any uncommitted balances that exceed these thresholds. Uncommitted balances include funds that are neither costed nor committed. Funds are committed through the award of direct contracts to non-M&O contractors, the award or issuance of subcontracts or purchase orders by M&O contractors to third parties, or certain other encumbering actions by M&O contractors. DNN measures financial performance in terms of the percentage of funds that have been costed and committed, rather than just the percentage of funds that have been costed, because a great deal of the program's work is performed overseas, and 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 therefore not provide an accurate picture of the program's progress.

Overview of DNN Balances

At the end of FY 2017, the aggregate program costs plus M&O sub-contracts for DNN were 80.7 percent of total costing authority, leaving 19.3 percent. The following DNN congressional controls had balances above established thresholds:

- International Material Protection and Cooperation (IMP&C) program (a past program, now reorganized into GMS program, which has remaining uncommitted prior-year funds)
- Global Material Security Program (GMS)
- Material Management and Minimization Program (M^3)

- Nonproliferation and Arms Control Program (NPAC)
- Defense Nuclear Nonproliferation Research and Development (DNN R&D)

Details on the balances for each budget element, explanations for the balances, and a table showing FY 2017 budget execution data in detail are provided below.

International Material Protection and Cooperation

IMP&C costs and M&O sub-contracts totaled $207.3 million, or 68.4 percent of total FY 2017 available funds (all from FY 2015 or previous years' appropriations); the remaining $95.9 million in uncosted uncommitted balances (31.6 percent of available FY 2017 funds) exceeded the DOE threshold by $53.4 million. The uncosted uncommitted balance of $95.9 million will be used in FY 2018 to support multilateral engagement (such as with the International Atomic Energy Agency), cybersecurity engagement, nuclear security training development and other bilateral nuclear security engagement with over 20 international partners. Some funds will be used to close out remaining work with Russia. The funds will also be used to support radiation detection sustainability efforts, including equipment testing and maintenance, workshops, and exercises in Armenia, Bulgaria, Kazakhstan, Ukraine, Malaysia, and Jordan.

Global Material Security

GMS had costs plus M&O sub-contracts totaling $452.2 million, or 69.5 percent of its total FY 2017 available funds; the remaining $198.4 million in uncosted uncommitted balances (30.5 percent of available FY 2017 funds) exceeded the DOE threshold by $107.4 million. The uncosted uncommitted balance reflects the slow pace of multi-year upgrade efforts, as well as technical document and training development with multi-lateral and bilateral partners. A small portion of international contributions have specific conditions and take longer to spend down. Several contracts were delayed due to issues with specific partners related to the overall political situation, protracted negotiations, and travel restrictions. Uncommitted funds will be used to support high-priority activities in FY 2018, including acceptance testing, site assurance visits, workshops and exercises, and maintenance contracts.

Material Management and Minimization

M^3 had costs plus M&O sub-contracts totaling $320.1 million, or 69.9 percent of total FY 2017 available funds; the remaining $137.7 million in uncosted uncommitted balances (30.1 percent of available FY 2017 funds) exceeded the DOE threshold by $76.9 million. The uncosted uncommitted balances support three critical programs within M^3; (1) highly enriched uranium (HEU) Reactor Conversion; (2) Nuclear Material Removal; and (3) Material Disposition.

The uncosted uncommitted balances for the HEU Reactor Conversion program ($21.5 million) will support placements of additional contracts. The program used these funds for Mo-99 national laboratory technical support and to place key contracts in FY 2018 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 M^3 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.

Due to political and technical challenges that have delayed implementation of several removal efforts, the uncosted uncommitted balances for the Nuclear Material Removal program ($64.1 million) will support upcoming removal projects from Kazakhstan in the Russian-Origin Removal program; and ongoing removal activities and project close-out work for removals from Europe, Africa, and Asia in the Gap

Removal program. In addition, these balances will support the Emerging Threats Program's mission readiness, procurement of more efficient systems, and planning efforts for a future mock deployment exercise of the Mobile Plutonium Facility and the Mobile Uranium Facility. The FY 2018 President's Budget Request included a reduction of new funds requested for the Nuclear Material Removal program taking into account the use of these uncosted balances.

The uncosted uncommitted balances for the Material Disposition Program ($52.0 million) will support the continuation of oxide production, surplus pit surveillance and monitoring, procurements of shipping containers for pit shipments, and program integration activities for the U.S. plutonium disposition subprogram. In addition, these funds will continue to support the level of effort needed to downblend surplus HEU to LEU in the U.S. HEU Disposition subprogram and will be used to alleviate the funding shortage due to the continuing decline of uranium market prices. This downblending advances a number of important goals, including providing support for the tritium program.

Nonproliferation and Arms Control

NPAC had costs plus M&O subcontracts totaling $140.3 million, or 80.8 percent of its total FY 2017 available funds; the remaining $33.3 million in uncosted uncommitted balances (19.2 percent of available FY 2017 funds) exceeded the DOE threshold by $10.5 million. The $33.3 million in FY 2017 uncosted uncommitted balances are due primarily to the following factors: lower than anticipated number of cases submitted to the United Nations Joint Comprehensive Plan of Action Procurement Working Group requiring technical and end-user export control reviews; unavoidable delays originating from the host country for several safeguards and export control projects; and the need to have funding in place at the national laboratories to support projects performed during the last quarter of FY 2017 and the first quarter of FY 2018 (especially important given the realities of operating under a Continuing Resolution of uncertain extent). All uncommitted balances are obligated to M&O contracts and assigned and planned for specific projects.

Defense Nuclear Nonproliferation Research and Development

DNN R&D had costs plus M&O subcontracts totaling $506.3 million, or 83.8 percent of its total FY 2017 available funds; the remaining $97.6 million in uncosted uncommitted balances (16.2 percent of available FY 2017 funds) exceeded the DOE threshold by $7.5 million. The $97.6 million in FY 2017 uncosted uncommitted balances are due primarily to two factors. First, there was a delay in receiving full funding for the United States High Performance Research Reactor Program (USHPRR) when the Continuing Resolution ended. Because funding responsibility for the USHPRR program shifted from the M^3 program to the DNN R&D program in the *Consolidated Appropriations Act, 2017*, all costs against FY 2017 funds and remaining FY 2017 funding within the M^3 program had to be transferred to the DNN R&D program. Second, delays in receiving the full FY 2017 funding level caused holdups in procurement requisitions, sub-contract awards and interagency agreements due to need for all funds on-hand prior to initiating contracts. In FY 2018, uncommitted balances will allow continuation of payments for Lab salaries and for long-lead (8–24 months) procurements, primarily in the space and field testing programs, as well as major lab equipment purchases.

Cost + Commitment Status, End of Fiscal Year 2017	A	B	C	D B + C	E D / A	F A - D	G F / A
Expens Program	Costing Authority (Obligated Funds)	YTD Cost	Total Uncosted Encumbered Obligations	Current Costs + Encumbrances	Costed or Encumbered as a % of Costing Authority	Total Uncosted Unencumbered Obligations	Unencumbered as % of Costing Authority
⊟Operating							
⊟Elimination of Weapons Grade Plutonium Production	1,002,300	0	1,002,300	1,002,300	100.0%	0	0.0%
⊟Russian Surplus Fissile Materials Disposition	788,355	466,281	274,442	740,723	94.0%	47,632	6.0%
⊟Global Threat Reduction Initiative	23,737,092	8,453,485	14,218,992	22,672,477	95.5%	1,064,615	4.5%
⊟Congressionally Directed Projects - Defense Nuclear Nonproliferation	23,161	0	23,161	23,161	100.0%	0	0.0%
⊟NN50 International Material Protection and Cooperation (IMPC)	303,195,127	150,642,857	56,657,059	207,299,916	68.4%	95,895,212	31.6%
⊟NN40 Nonproliferation and International Security (NIS)	9,207,290	5,430,866	2,490,942	7,921,808	86.0%	1,285,482	14.0%
⊟NN91 Highly Enriched Uranium (HEU) Reactor Conversion	33,788,401	26,393,196	6,660,895	33,054,091	97.8%	734,310	2.2%
⊟NN92 International Nuclear and Radiological Material Removal and Protection	88,077,821	34,531,704	45,379,752	79,911,456	90.7%	8,166,365	9.3%
⊟NN93 Domestic Radiological Material Removal and Protection	18,740,791	15,934,142	2,206,617	18,140,759	96.8%	600,031	3.2%
⊟NN20 Defense Nuclear Nonproliferation Research and Development (DNN R&D)	33,493,284	23,582,416	3,552,456	27,134,872	81.0%	6,358,412	19.0%
⊟NN60 Fissile Materials Disposition	47,299,134	28,935,271	11,919,542	40,854,813	86.4%	6,444,321	13.6%
⊟DN10 Global Material Security	650,571,854	227,570,383	224,613,709	452,184,092	69.5%	198,387,762	30.5%
⊟DN20 DNN Research and Development	570,427,767	419,551,123	59,600,001	479,151,124	84.0%	91,276,643	16.0%
⊟DN30 Material Management and Minimization	457,788,239	248,989,374	71,116,505	320,105,878	69.9%	137,682,361	30.1%
⊟DN40 Nonproliferation and Arms Control	173,622,932	126,252,659	14,075,703	140,328,362	80.8%	33,294,570	19.2%
⊟DN80 Legacy Contractor Pensions	83,208,000	83,208,000	0	83,208,000	100.0%	0	0.0%
Operating Total	2,494,971,549	1,399,941,756	513,792,077	1,913,733,834	76.7%	581,237,715	23.3%
⊟Construction							
⊟NN62 U.S. Surplus Fissile Materials Disposition	4,856,787	607,153	4,249,634	4,856,787	100.0%	0	0.0%
⊟NN60 Fissile Materials Disposition	1,631,595	0	-0	-0	0.0%	1,631,595	100.0%
⊟DP09 Infrastructure and Operations (formerly RTBF)	22,918	0	22,918	22,918	100.0%	-0	0.0%
⊟DN30 Material Management and Minimization	534,494,448	295,079,071	237,296,339	532,375,409	99.6%	2,119,038	0.4%
Construction Total	541,005,747	295,686,223	241,568,891	537,255,114	99.3%	3,750,633	0.7%
Grand Total	3,035,977,296	1,695,627,980	755,360,968	2,450,988,948	80.7%	584,988,348	19.3%

Appendix G
Coordination within DOE and the U.S. Interagency

With the largest global nuclear security program in the U.S. Government, DOE/NNSA plays a primary role in implementing the U.S. nuclear nonproliferation agenda. DOE/NNSA coordinates closely with other elements of DOE, especially the Office of Environmental Management, Office of Nuclear Energy, and Office of Science.

As part of the whole-of-government policy development process, DOE/NNSA also actively participates in White House-led interagency policy meetings (at all levels) on nuclear nonproliferation, counterterrorism, and emergency response, which are routinely held to develop consistent interagency policy positions and implementation strategies. DOE/NNSA also works in partnership with other U.S. Government agencies involved in nuclear nonproliferation and nuclear counterterrorism, especially the DOS (to include receiving some funding for foreign capacity-building efforts) and DoD. Key DOS programs in this area are located in the Bureau of International Security and Nonproliferation and include the Nonproliferation and Disarmament Fund as well as the Offices of Cooperative Threat Reduction, Counterproliferation Initiatives, Export Control Cooperation, and WMD Terrorism. DOE/NNSA's Office of Counterterrorism and Counterproliferation (CTCP) provides liaison offices to key DoD Combatant Commands to coordinate on counterterrorism, counterproliferation and whole of DOE/NNSA shared equities. The liaisons ensure that DoD is aware of DOE/NNSA's technical insights and unique capabilities in order to inform U.S. Government contingency planning and support operations. Within DNN, the primary DoD interface is with DoD's Defense Threat Reduction Agency (DTRA), including DTRA's Global Nuclear Security and Proliferation Prevention Programs. Other agencies that work closely with DOE/NNSA on nuclear nonproliferation and nuclear counterterrorism include the Department of Homeland Security (DHS), the Department of Justice (DOJ), the Nuclear Regulatory Commission (NRC), and the intelligence community.

DOE/NNSA nuclear and radiological threat reduction activities that are coordinated with other offices within DOE and other Federal agencies include:

- Radioactive source disposal activities (coordinated with DOE Office of Environmental Management, which maintains disposal facilities that are used for certain types of radioactive sources);
- Nuclear Smuggling Detection and Deterrence activities (coordinated with DOS, FBI, and DHS);
- Research and development for nuclear detonation detection (coordinated with DoD, DOS, FBI, DHS, and other government agencies);
- Proliferation detection research and development activities (coordinated with DHS, DOS, DoD, DOE Office of Nuclear Energy, NRC, and other government agencies);
- Nuclear material removal disposition activities (coordinated with DOE Office of Environmental Management, which maintains infrastructure for the receipt, storage, and disposition of nuclear material);

- Reactor conversion and nuclear material removal and transportation activities within the United States (coordinated with the NRC, which is responsible for licensing some of the converted reactors for operation and helping ensure the safe transport of nuclear materials within the United States);
- Activities to establish reliable supplies of the medical isotope Molybdenum-99 produced without HEU (coordinated with DOS, NRC, and the Department of Health and Human Services [HHS]);
- Activities relating to the disposition of 34 MT of surplus weapons-grade plutonium (coordinated with DOE Office of Environmental Management, DOS);
- International and domestic export control outreach and training activities (coordinated with DOS, DHS, the DOC, and the Export Enforcement Coordination Center, an interagency body coordinated and run by DHS);
- Reviewing requests for authorization to transfer unclassified nuclear technology (pursuant to Part 810 of Title 10, Code of Federal Regulations) and assisting with foreign atomic energy activities (coordinated with DOS, DoD, NRC, DOC, and the Office of the Director of National Intelligence, all of which play a role in reviewing these requests as per statutory requirements);
- Supporting the negotiation of agreements for civil nuclear cooperation with foreign countries pursuant to Section 123 of the U.S. Atomic Energy Act of 1954, as amended (AEA) (DOE provides technical assistance on the negotiations, under the AEA; DOS leads the negotiations with the technical support of DOE and NRC consultation);
- Management of access, dissemination, and use of IND information (coordinated with DOE Office of Classification, DoD, DOJ/FBI, DHS, DOS, NRC, and the Intelligence Community);
- Domestic and international nuclear forensic activities (coordinated with FBI, DHS, DoD, and the Intelligence Community);
- International outreach on nuclear forensic activities (coordinated with DOS);
- Domestic and international counterterrorism training activities (coordinated with the FBI and DoD, which collaborates with DOE/NNSA to administer these trainings);
- Capabilities for radiological environmental monitoring and assessment in the event of a nuclear or radiological incident (coordinated with DHS's Federal Emergency Management Agency (FEMA), the Environmental Protection Agency, HHS, DoD, and other Federal agencies, which collaborate through CTCP's Federal Radiological Monitoring and Assessment Center);
- Responding to nuclear or radiological incidents (coordinated with the FBI and DHS, for domestic incidents; DoD, for incidents abroad; and DOS, which has the overall responsibility for the U.S. response to international terrorist events); and,
- Capabilities to respond to accidents or incidents involving U.S. nuclear weapons (coordinated with DoD and FBI).

In addition to coordinating specific programs and activities, DOE/NNSA also works with other agencies to ensure effective overall coordination of nuclear and radiological threat reduction activities. DOE/NNSA and the Office of the Secretary of Defense hold Assistant Secretary-level coordination meetings regarding their cooperative nuclear nonproliferation activities and discuss areas where DOE/NNSA and DoD program strengths and unique capabilities may complement each other. A similarly focused coordination forum was created among DOS, DoD, and DOE to "map" their nuclear nonproliferation program plans in specific foreign countries to better coordinate the three departments' activities. In addition, DOE/NNSA's

emergency management priorities (including response to nuclear proliferation and terrorist threats) are informed by, and aligned with, national security priorities as defined by counterterrorism and incident management lead agencies. These national security priorities include interagency strategic and operational plans developed by FBI, FEMA, DOS, and DoD. Finally, DOE/NNSA coordinates closely with DOS headquarters and overseas posts on bilateral, regional, and multilateral cooperation and engagement, and in support of international travel.

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A Report to Congress

Fiscal Year 2019 Prevent, Counter, and Respond—A Strategic Plan to Reduce Global Nuclear Threats

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