U.S. DEPARTMENT OF ENERGY

National Nuclear Security Administration

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

FY 2022-FY 2026

Report to Congress
December 2021

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) is pleased to submit *Prevent, Counter, and Respond—NNSA's Plan to Reduce Global Nuclear Threats (FY 2022–FY 2026)*. This report, along with DOE/NNSA's *Stockpile Stewardship and Management Plan*, describes our planning and programmatic activities to assure U.S. national security and advance global nuclear security.

President Biden reaffirmed in the 2021 Interim National Security Strategic Guidance that "the proliferation of nuclear weapons and other weapons of mass destruction… [poses] profound, and in some cases, existential danger" and pledged America's commitment to "arms control arrangements and renewed American nonproliferation leadership." DOE/NNSA has an opportunity to embark on new levels of cooperation with our interagency and international partners to mitigate the dangers posed by nuclear weapons while enabling the development of nuclear energy and other peaceful uses of nuclear technology that will help support the efforts to combat climate change. We achieved a major diplomatic milestone with the successful extension of the Treaty Between the United States of America and the Russian Federation on Measures for Further Reduction and Limitation of Strategic Offensives Arms (New START), and we will continue to focus on strengthening strategic stability with Russia, China, and others to reduce the threat of all nuclear weapons. We remain committed to locking down fissile and radioactive materials worldwide to prevent nuclear and radiological terrorism. While we have made important progress in this task, more work remains to be done, and we will continue to evolve our approach to keep pace with today's security environment.

DOE/NNSA, through its integrated strategy to prevent, counter, and respond to the threats of nuclear proliferation and nuclear terrorism, makes a vital contribution to strengthening U.S. national security. At DOE/NNSA, we are pursuing an *Innovate, Collaborate, and Deliver* approach to our three enduring missions, which include nuclear threat reduction along with maintaining a safe, secure, and effective nuclear deterrent and providing naval nuclear propulsion. Our nuclear threat reduction activities also play a key role in efforts to pursue a clean energy transformation, supporting the peaceful expansion of nuclear energy, science, and technology by advancing the highest nonproliferation and nuclear security standards.

DOE/NNSA's strength and resilience as an organization is rooted in the strong institutional relationships between DOE/NNSA and its laboratories, plants, and sites, as well as with other federal agencies. Since the last report, we have confronted unprecedented challenges posed by the global COVID-19 pandemic. We have expanded our scope to include management of this emergency event across the nuclear enterprise, while ensuring resilience against all-hazard threats, including nuclear and radiological incident response, and advancing our global nonproliferation and nuclear and radiological security missions. Despite the disruptions of the pandemic, DOE/NNSA has continued to invest in research and development and pursue innovative approaches that will enable us to keep pace with evolving threats and challenges.

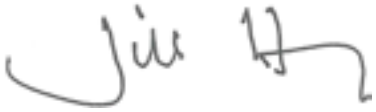
This report will highlight some of today's most pressing national security challenges and how DOE/NNSA provides cross-cutting capabilities to address them. As with our other DOE/NNSA mission areas, our nuclear threat reduction work is enabled by the important foundational activities of advancing science, technology, and engineering; supporting our people and modernizing our infrastructure; and developing a management culture that promotes a safe and secure nuclear enterprise that is diverse, equitable, inclusive, and accessible. I place the highest priority on recruiting and training the next generation of nuclear security professionals to further our nonproliferation and counterproliferation mission.

This report is provided to:

- **The Honorable Jack Reed**
  Chairman, Senate Committee on Armed Services
- **The Honorable James Inhofe**
  Ranking Member, Senate Committee on Armed Services
- **The Honorable Adam Smith**
  Chairman, House Committee on Armed Services
- **The Honorable Mike Rogers**
  Ranking Member, House Committee on Armed Services
- **The Honorable Angus King**
  Chairman, Subcommittee on Strategic Forces
  Senate Committee on Armed Services
- **The Honorable Deb Fischer**
  Ranking Member, Subcommittee on Strategic Forces
  Senate Committee on Armed Services
- **The Honorable Jim Cooper**
  Chairman, Subcommittee on Strategic Forces
  House Committee on Armed Services
- **The Honorable Mike Turner**
  Ranking Member, Subcommittee on Strategic Forces
  House Committee on Armed Services
- **The Honorable Patrick Leahy**
  Chairman, Senate Committee on Appropriations
- **The Honorable Richard Shelby**
  Vice Chairman, Senate Committee on Appropriations
- **The Honorable Dianne Feinstein**
  Chairman, Subcommittee on Energy and Water Development
  Senate Committee on Appropriations
- **The Honorable John Kennedy**
  Ranking Member, Subcommittee on Energy and Water Development
  Senate Committee on Appropriations
- **The Honorable Rosa L. DeLauro**
  Chairwoman, House Committee on Appropriations
- **The Honorable Kay Granger**
  Ranking Member, House Committee on Appropriations
- **The Honorable Marcy Kaptur**
  Chairwoman, Subcommittee on Energy and Water Development
  House Committee on Appropriations
- **The Honorable Michael K. Simpson**
  Ranking Member, Subcommittee on Energy and Water Development
  House Committee on Appropriations

If you have questions about this report or the underlying activities it describes, please contact Dr. Howard Dickenson, Acting Associate Administrator for External Affairs, at (202) 586-7332.

Sincerely,



Jill Hruby
Under Secretary for Nuclear Security
Administrator, NNSA

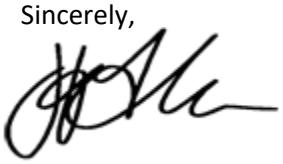
Message from the Secretary

The Nation is facing accelerating global challenges, including climate change, China and Russia modernizing their nuclear arsenals, evolving nuclear proliferation threats, and potential malign actors who may seek to engage in nuclear terrorism. The Department of Energy's National Nuclear Security Administration (DOE/NNSA) has been at the forefront of efforts to mitigate these global nuclear threats, beginning with cooperative threat reduction programs to secure nuclear weapons, materials, facilities, and expertise following the collapse of the Soviet Union. Today, DOE/NNSA continues to provide critical science, technology, and policy solutions to prevent, counter, and respond to a wide range of nuclear and radiological threats in collaboration with other U.S. federal agencies and the Nation's close allies and partners around the globe. DOE/NNSA will seek to expand nuclear power's potential to provide clean energy and life-saving medical technologies, while maintaining the highest standards for nonproliferation and nuclear security.

To date, DOE/NNSA has eliminated thousands of kilograms of weapons-usable nuclear material (WUNM) from almost 50 countries and eliminated the need for WUNM at more than 100 civilian research reactors and isotope production facilities, to achieve permanent threat reduction. DOE/NNSA also provided technical support to the diplomatic efforts to extend New START before its February 5, 2021 expiration, and is positioned to support future arms control treaty negotiations with well researched, tested, and evaluated technologies and techniques that can strengthen confidence in verification of treaty obligations. DOE/NNSA will continue to reduce the threat of nuclear proliferation and nuclear terrorism while maintaining an around-the-clock emergency response capability.

DOE/NNSA is committed to investing in science and technology and developing and maintaining a world-class workforce to help ensure that we retain a qualitative edge over our adversaries and stay ahead of evolving proliferation threats. We will accomplish our vital nuclear security missions by leveraging the unique expertise and incredible dedication of our federal and nuclear security enterprise workforce.

Sincerely,



Jennifer Granholm
Secretary of Energy

Executive Summary

Prevent, Counter, and Respond—NNSA's Plan to Reduce Global Nuclear Threats (FY 2022-FY 2026) is an annual report outlining the Department of Energy's National Nuclear Security Administration's (DOE/NNSA) activities to address the risk of nuclear terrorism and proliferation.

Presidential guidance, including the 2021 Interim Nuclear Security Strategic Guidance, reinforces the important work of DOE/NNSA's nonproliferation programs to "address the existential threat posed by nuclear weapons." DOE/NNSA's nuclear threat reduction activities extend the nation's defenses far beyond America's borders. These activities help keep the United States safe by:

- ***Preventing*** adversaries from acquiring nuclear weapons or weapons-usable materials, technology, and expertise;
- ***Countering*** efforts to acquire such weapons or materials; and
- ***Responding*** to nuclear or radiological incidents and accidents domestically and abroad.

This report describes DOE/NNSA's nuclear and radiological threat reduction activities within the prevent, counter, and respond strategic framework, and delineates key objectives, priorities from the fiscal year (FY) 2022 budget request, future plans for FY 2023-FY 2026[1], and key accomplishments from FY 2019-FY 2021.

By limiting the number of nuclear-capable states and preventing terrorist access to materials and technology that can threaten the United States and its allies, DOE/NNSA plays a critical role in enhancing global stability and constrains the range of potential threats facing the nation, its allies, and partners.

DOE/NNSA provides cross-cutting capabilities to underpin the U.S. Government's responses to the most urgent nuclear proliferation threats and challenges. DOE/NNSA priorities include:

- Supporting existing and new arms control agreements;
- Addressing nuclear noncompliance by Iran and the Democratic People's Republic of Korea;
- Protecting U.S. technology from illicit acquisition by China, while maintaining nonproliferation and nuclear security efforts;
- Strengthening international partnerships to increase the impact of NNSA's efforts;
- Harnessing civil nuclear technology to achieve energy transformation while maintaining the highest nonproliferation standards; and
- Contributing to nuclear forensics capabilities.

In carrying out its nuclear threat reduction activities, DOE/NNSA depends on the scientific, technical, project management, and policy expertise of the Department and its national laboratories; diverse and cutting-edge infrastructure to assure operational effectiveness; the capacity for outreach to partner countries and cooperation with multilateral institutions, U.S. interagency, state, and local government counterparts.

[1] The FY 2022 President's Budget did not include program-based NNSA budget levels beyond the budget year. Instead, the NNSA topline estimates for FY 2023-2026 reflect inflated FY 2022 levels, not policy judgments.

Legislative Language

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

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

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



CHAPTER 1

Strategic Framework for Reducing Global Nuclear Threats

Consistent with national guidance, DOE/NNSA is positioned to meet present and future challenges through its enduring missions to prevent nuclear weapons proliferation and reduce the threat of nuclear and radiological terrorism around the world.

1.0 Strategic Framework for Reducing Global Nuclear Threats

1.1 Mandate, Authority, and Policy Drivers

The Department of Energy's National Nuclear Security Administration (DOE/NNSA) draws its mission and authorities from the *Atomic Energy Act,* as amended, (codified at Title 42 United States Code [U.S.C] § 2011 *et seq*.), the *National Nuclear Security Administration Act,* as amended (50 U.S.C. § 2401 *et seq*.), and the *Atomic Energy Defense Act*, as amended (50 U.S.C. § 2501 *et seq.*). DOE/NNSA directly supports the security and safety of the United States through three enduring mission pillars: maintaining a safe, secure, and effective nuclear weapons stockpile; reducing the threat of nuclear proliferation and nuclear terrorism; and providing naval nuclear propulsion. This report, *Prevent, Counter and Respond—NNSA's Plan to Reduce Global Nuclear Threats*, focuses on the strategy to implement the second mission pillar. DOE/NNSA pursues a set of nuclear threat reduction objectives to keep the United States safe by preventing adversaries from acquiring nuclear weapons or weapons-usable materials, technology, and expertise; countering efforts to acquire such weapons or materials; and responding to nuclear or radiological incidents and accidents domestically and abroad.

Presidential and DOE strategy documents also provide policy guidance for DOE/NNSA's missions. These documents draw from the vision outlined in President Biden's February 2021 speech to the Munich Security Conference and reaffirmed in the *Interim National Security Strategic Guidance* (March 2021). DOE/NNSA's missions will also be informed by the Nuclear Posture Review that is currently underway. These documents, which recognize the need to "address the existential threat posed by nuclear weapons" and pledge U.S. commitment to "arms control arrangements and renewed American nonproliferation leadership," guide DOE/NNSA dedication to diplomacy and global partnerships to address global nuclear threats.

The United States faces accelerating global challenges, confronting strategic competition with powers such as Russia and China, rogue regimes, and hostile non-state actors posing threats to its safety, security, and interests. *Prevent, Counter and Respond—NNSA's Plan to Reduce Global Nuclear Threats* fulfills the requirement in 50 U.S.C. § 2575 and outlines DOE/NNSA's integrated strategy to meet present and future challenges through its enduring missions to prevent nuclear weapons proliferation and reduce the threat of nuclear and radiological terrorism around the world. The United States will continue to work with partners and allies to mitigate risks caused by state and non-state proliferation of nuclear and radioactive materials, technology, and expertise.

> "And we cannot focus only on the competition among countries that threaten to divide the world, or only on global challenges that threaten to sink us all together if we fail to cooperate. We must do both, working in lockstep with our allies and partners."
>
> *President Biden at the 2021 Virtual Munich Security Conference*

1.2 The Threat Environment

DOE/NNSA aligns its program activities to the current and emerging nuclear and radiological threat environment and the likely events or conditions that could negatively affect the safety and security of the United States and its allies. Several sources characterize the threat environment, e.g., the Intelligence Community's annual worldwide threat assessment and periodic "Global Trends" reports, related assessments and military power reports from the Defense Intelligence Agency, annual Department of

State (DOS) reports on arms control compliance, reports from the International Atomic Energy Agency (IAEA) and relevant United Nations (UN) Security Council bodies, and civil nuclear assessment reports from the Energy Information Agency and International Energy Agency, among others.

FIGURE 1: THREAT ASSESSMENT REPORTS

Three categories frame the threat environment: nuclear-armed states, states seeking nuclear weapons or associated capabilities, and non-state actors. In addition, the threat includes the risks posed by emerging, converging, and disruptive technologies that must be considered.

Nuclear Armed States: Modernization, Expansion, Platform Diversification

States with existing nuclear weapons capabilities, such as Russia and China, are continuing to modernize and selectively expand and diversify their arsenals, which poses nuclear monitoring challenges and threatens strategic stability. Russia is developing novel nuclear weapons systems–including a nuclear-powered, nuclear-armed cruise missile ("Burevestnik"); an unmanned nuclear-powered, nuclear-armed underwater drone ("Poseidon"); and an air-launched ballistic missile ("Kinzhal") – and has a sizeable non-strategic nuclear weapons stockpile—none of which are captured by the current arms control and verification treaty regime. China appears to be shifting away from its longstanding minimalist nuclear force posture, and its nuclear stockpile is likely to more than double in size over the next decade.

Russia's material breach of the Intermediate-Range Nuclear Forces Treaty and continued Chinese resistance to nuclear transparency and arms control negotiations pose serious risks to the future of arms control agreements like the Treaty Between the United States of America and the Russian Federation on Measures for Further Reduction and Limitation of Strategic Offensives Arms (New START). Arms race

pressure and threats of inadvertent nuclear escalation, including between the United States and global competitors such as Russia and China, as well as in regions such as South Asia, pose additional risks. This is particularly true as weapon stockpiles are modernized or expanded, and as new destabilizing capabilities or nuclear use doctrines are introduced.

Ongoing developments continue to erode the international nonproliferation regime and hamper nuclear security best practices. Although DOE/NNSA and the U.S. Government worked with Russia for many years on cooperative threat reduction programs to secure nuclear weapons, materials, facilities, and expertise, there remains a concern about Russia's sustainment of those nuclear security efforts. Russian and Chinese state-owned enterprises have also adopted a competitive posture toward nuclear reactor exports to the developing world, which might threaten international norms for nuclear security and nonproliferation. The Treaty on the Non-proliferation of Nuclear Weapons (NPT), the cornerstone of the nonproliferation regime for over 50 years, is being destabilized by the Treaty on the Prohibition of Nuclear Weapons and other developments.

States Seeking Nuclear Weapons: Emerging and Latent Proliferant Programs

Other states with emerging or latent capabilities, such as the Democratic People's Republic of Korea (DPRK) and the Islamic Republic of Iran, pose different challenges. These challenges include the need to verify and implement a potential denuclearization agreement on the Korean peninsula and to detect and characterize proliferation activities in Iran should its government return to compliance with the Joint Comprehensive Plan of Action (JCPOA). In the interim, both countries have resumed nuclear activities of concern.

It is also possible that unanticipated state actors, including those with existing latent nuclear capabilities, could pursue new weapons programs while seeking to evade international detection and nuclear safeguards. In this environment, the risk of illicit transfers of sensitive nuclear materials, technology, and expertise may increase. Monitoring for such possibilities makes robust proliferation detection capabilities more vital and reinforces the need for the United States to maintain nuclear fuel cycle expertise to detect novel signatures of weapons development.

Non-State Actors: The Potential for Nuclear and Radiological Terrorism

The potential for nuclear and radiological terrorism continues to pose a serious threat to the United States and to international security and stability. Unsecured nuclear or radioactive materials could potentially be acquired for use in a radiological dispersal device, radiological exposure device, or improvised nuclear device (IND). DOE/NNSA must continue to be prepared in the event that motivated and capable non-state actors gain access to nuclear or radioactive materials, technology, or expertise due to weakened security, the support of insiders, cybersecurity vulnerabilities, or other enablers.

Terrorist organizations have sought nuclear materials in the past, underscoring the importance of placing these materials beyond their reach. DOE/NNSA proactively reduces the risk of non-state actors acquiring nuclear material for an IND by working with partners to minimize the need for, presence of, or production of weapons-usable nuclear material (highly enriched uranium [HEU] or separated plutonium) around the world. Further, U.S.-led

efforts continue to implement sustainable global material security efforts to mitigate risks, particularly in situations in which a state might lose control of territory.

Emerging, Converging, and Disruptive Technologies: Rapid Evolution and Spread, Uncertain Impacts

The rapid development and global dispersion of new technologies—such as additive manufacturing, artificial intelligence/machine learning, quantum computing, 5G networking, Internet of Things, autonomous systems and vehicles, commercial satellite imagery—and their combination with new or existing technologies, could improve U.S. capabilities to detect proliferation or, alternatively, could be used by adversaries to lower the barriers to proliferation or enable new proliferation pathways. For example, additive manufacturing can offer significant benefits in rapid prototyping and design optimization for detection systems, but these tools could also become ever more capable of manufacturing proliferation-sensitive items, challenging the multilateral export control regimes to keep pace as the technology becomes globally ubiquitous. The unexpected convergence of new technologies with other technology trends may produce new or enhanced proliferation risks that are not readily apparent when examined in isolation. Furthermore, most of these technologies are being competitively developed for commercial applications, hindering attempts to impose strict government controls, and are also the subject of technology acquisition attempts in this era of strategic competition with Russia and China. DOE/NNSA will need to maintain a proactive, analytic posture to continuously identify emerging technology developments, characterize the risks and opportunities presented, and prepare solutions in response. DOE/NNSA's Strategic Outlook Initiative is a pilot, enterprise-wide analytical effort examining "over the horizon" technological developments that may impact DOE/NNSA's mission, in order to help facilitate the development of such a posture.

1.3 Strategic Implementation Framework

DOE/NNSA is organized to deploy world-class technical and policy expertise and to work in close collaboration with U.S. interagency partners, multilateral institutions, and foreign governments to reduce the global nuclear threat and safeguard the United States and its allies. This whole-of-government approach provides policy and technical leadership with the means to prevent or limit the spread of weapons of mass destruction (WMD)-related materials, technology, and expertise; develop technologies to detect nuclear proliferation; secure or eliminate inventories of nuclear weapons-related materials and infrastructure; and ensure that technically trained emergency management personnel are available to respond to nuclear and radiological incidents and accidents domestically and overseas. The DOE/NNSA strategic framework is implemented in the following three areas:

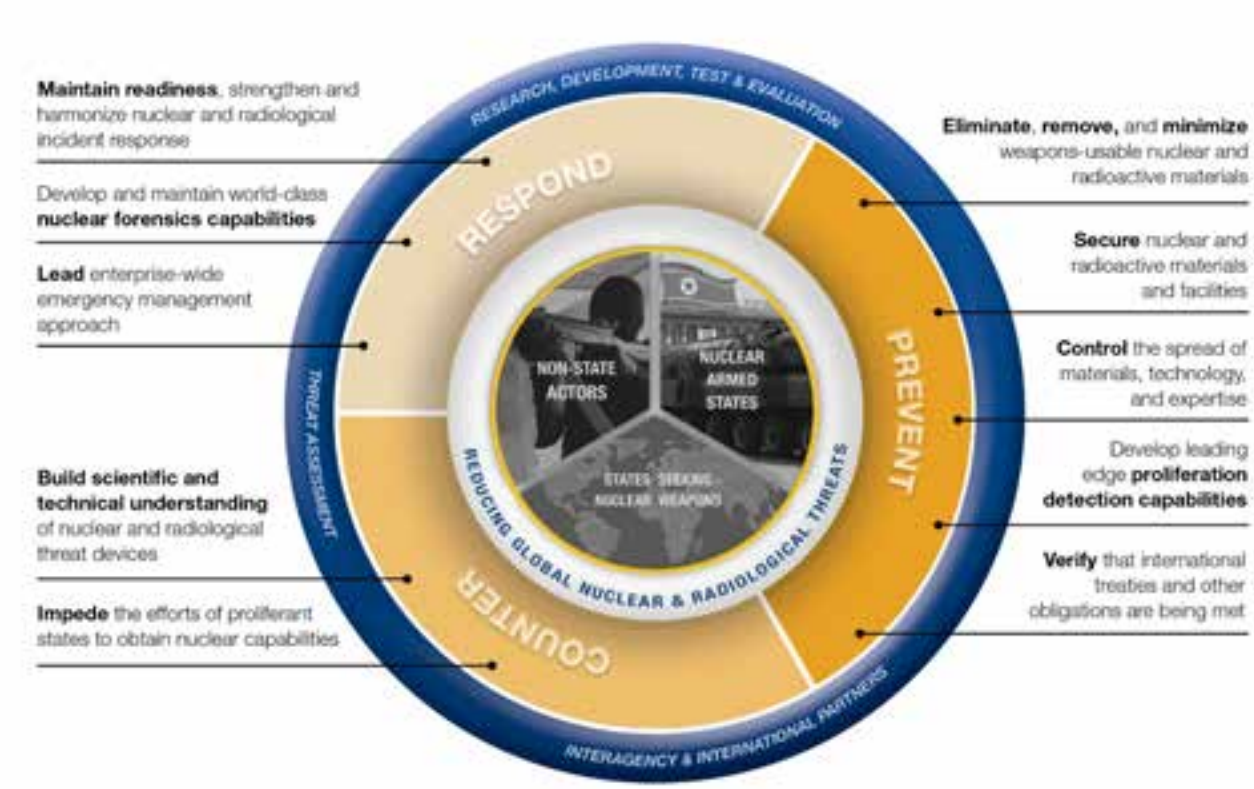
1 ***Prevent*** proliferant states from developing nuclear weapons or acquiring weapons-usable nuclear materials, equipment, technology, and expertise, and prevent non-state actors from acquiring nuclear and radioactive materials that can be used for malicious purposes;

2 ***Counter*** the efforts of both proliferant states and non-state actors to acquire, develop, disseminate, deliver, or use the materials, expertise, or components of a nuclear or radiological device; and

3 ***Respond*** to the full spectrum of nuclear and radiological emergencies at home or abroad, including deliberate attacks and accidents, to minimize the damage from such incidents.

This report places DOE/NNSA's nuclear threat reduction activities into context by situating the prevent, counter, and respond framework within the current strategic environment, delineating the core capabilities and program activities, highlighting recent accomplishments, and outlining future plans to adapt in order to prevent, counter, and respond to the threat of nuclear proliferation and nuclear and radiological terrorism now and for the foreseeable future.

FIGURE 2: PCR THREAT REDUCTION FRAMEWORK



DOE/NNSA pursues the following ten objectives, discussed in detail in Chapters 2, 3, and 4. Activities conducted to achieve each objective represent the core competencies that DOE/NNSA brings to bear when working to reduce global nuclear and radiological threats.

- Eliminate, remove, and minimize weapons-usable nuclear and radioactive materials;
- Secure nuclear and radioactive materials and facilities;
- Control the spread of materials, technology, and expertise;
- Develop leading edge proliferation detection capabilities;
- Verify that international treaty and other obligations are being met;
- Build scientific and technical understanding of nuclear and radiological threat devices;
- Impede the efforts of proliferant states to obtain nuclear capabilities;
- Maintain readiness; strengthen and harmonize nuclear and radiological incident response;
- Develop and maintain world-class nuclear forensics capabilities; and
- Lead enterprise-wide emergency management approach.

1.4 Key Priorities and Responses

The rapidly changing proliferation landscape and availability of nuclear material and WMD-related commodities, technology, and expertise call for innovative science, technology, and policy solutions. DOE/NNSA provides cross-cutting capabilities to underpin the U.S. Government's responses to the most urgent nuclear proliferation threats and challenges. This section outlines DOE/NNSA priorities, which align to directly address current proliferation trends.

Priorities Include:

- Supporting existing and new arms control agreements;
- Addressing nuclear noncompliance: Iran and DPRK;
- Protecting U.S. technology from illicit acquisition by China, while maintaining nonproliferation and nuclear security efforts;
- International partnerships: increasing the impact of NNSA's efforts;
- Harnessing civil nuclear technology to achieve clean energy transformation while maintaining the highest nonproliferation standards; and
- Contributing to nuclear forensics capabilities.

FIGURE 3: DOE/NNSA SUPPORT TO STRATEGIC ARMS CONTROL NEGOTIATIONS AND IMPLEMENTATION

DOE/NNSA provided support on U.S. policy development, treaty negotiations, and implementation for the following agreements, among others:

- **Intermediate-Range Nuclear Forces Treaty** *(1987-2019)*
- **Strategic Arms Reduction Treaty** *(1991-2009)*
- **Strategic Offensive Reductions Treaty or "Moscow Treaty"** *(2002-2011)*
- **New START Treaty** *(Feb 2011-Feb 2026)*

Agreements to date have limited strategic and intermediate-range delivery systems and deployed nuclear warheads on strategic systems. Arms control provides stability and predictability for Department of Defense (DoD) and DOE/NNSA stockpile planning.

1.4.1 Supporting Existing and New Arms Control Agreements

As outlined in the *Interim National Security Strategic Guidance* (March 2021), the United States is committed to advancing international arms control by engaging in diplomacy and advocating for risk reduction measures to reduce and ultimately eliminate the threat of nuclear weapons and WMD. Earlier this year, DOE/NNSA supported diplomatic efforts to successfully extend New START with Russia in advance of the February 5, 2021 expiration, continuing to place limits on strategic nuclear delivery systems and the number of warheads deployed on those systems. The Administration will continue to focus on strengthening strategic stability with Russia, China, and others to reduce the threat of all nuclear weapons. DOE/NNSA delivers significant technical capabilities and expertise to support the negotiation and implementation of arms control treaties and other government-to-government agreements and arrangements focused on nuclear weapons limitations and weapons material monitoring and verification. This technical support includes:

- Assistance with negotiation and implementation of weapon limitation and reduction initiatives;
- Development and exercise of U.S. capabilities to monitor and verify compliance; and
- Support for the U.S. Government compliance analysis process for treaties and agreements.

In FY 2022, DOE/NNSA will invest in enhancing these technical efforts, focusing on:

- Developing a nuclear test site verification team to build readiness for future U.S.-led on-site monitoring and verification activities;
- Supporting U.S. Government efforts to develop future arms control agreements and strategic dialogue initiatives with Russia and potentially others;
- Improving the ability to verify warhead declarations under future arms control treaties by investigating new methods to verify treaties and improving assessments to expand U.S. technical options and flexibility in future negotiations; and
- Continuing research and experimental testbed activities to advance technology in support of the Nation's treaty verification and monitoring needs.

FIGURE 4: SIGNIFICANT TECHNICAL ADVANCES IN FY 2021

In FY 2021, DOE/NNSA made significant technical advances to underpin future arms control agreements, including:

- Improving characterization of low-yield underground nuclear tests.
- Deploying space sensors for the Nation's operational nuclear test treaty monitoring and related capabilities.
- Identified future needs for arms control monitoring and verification through a series of six laboratory-led workshops to inform long-term investment in research and development.

1.4.2 Addressing Nuclear Noncompliance: Iran and DPRK

The United States is committed to renewed American leadership on nonproliferation and, working with allies and partners, is pursuing principled diplomacy to reduce the threat posed by Iran and DPRK's nuclear and related missile programs. DOE/NNSA played a significant role in the negotiation and implementation of the JCPOA and supports negotiations to address Iran's nuclear program now and into the future. The final, fully verified denuclearization of the Korean peninsula remains a long-standing U.S. objective. DOE/NNSA has a multi-decade history of supporting U.S. Government threat-reduction and nonproliferation initiatives with respect to DPRK, supporting the negotiation of the "Agreed Framework" in 1994, providing technical expertise to support the "Six Party Talks," and maintaining a continuous onsite presence at Yongbyon between 2007 and 2009 to monitor and verify the disablement of the Magnox reactor, the fuel fabrication facility, and the reprocessing plant. DOE/NNSA is prepared to deliver and implement both policy and technical solutions to support the Administration's Iran and DPRK policies.

DOE/NNSA Capabilities to Address Nuclear Noncompliance:

DOE/NNSA has the expertise and tools to support U.S. policy aims involving states' nuclear noncompliance with NPT obligations, IAEA safeguards commitments, and applicable UN Security Council resolutions. It plays a key role in supporting negotiations to limit or eliminate nuclear-related facilities and materials and maintains special capabilities to meet a range of denuclearization and verification scenarios. DOE/NNSA leverages its work on safeguards, export controls, sanctions, and verification to support a whole-of-government approach to address nuclear noncompliance challenges.

In FY 2022, DOE/NNSA priorities for strengthening its toolset to address nuclear noncompliance include:

- **Safeguards Support:** 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. DOE/NNSA is also establishing a multilateral nonproliferation enrichment testing and training capability to strengthen the IAEA's capabilities to safeguard enrichment activities and to detect and deter undeclared uranium enrichment activities.
- **Enhanced Detection, Monitoring, and Verification Capabilities:** DOE/NNSA continues to develop advanced technology solutions and capabilities leveraged across the U.S. Government to enable early detection of foreign proliferation activities. It also maintains detailed generic and country-specific Concepts of Operations for implementing verification measures of a variety of possible denuclearization scenarios (i.e., a freeze; monitored operations; disablement, dismantlement, and production history assessment) for nuclear material processing/handling facilities and nuclear weapons test sites. DOE/NNSA maintains standing teams of technical experts on the nuclear fuel cycle and nuclear weapon testing verification ready for short-notice deployments in support of a negotiated agreement or other arrangement. DOE/NNSA will continue to develop expertise and tools to monitor and detect nuclear explosive testing.
- **Sanctions Policy and Export Control:** DOE/NNSA works with the U.S. interagency to review dual-use export licenses, interdiction cases, and sanctions cases. One example is the expert technical analysis provided in support of identifying sanctionable transactions under the Iran, North Korea, and Syria Nonproliferation Act. It works through the multilateral export control regimes and strengthens international partners' export control capacity to limit the threat posed by DPRK's missile and nuclear development efforts and thwart DPRK's procurement efforts for its nuclear and missile programs.

1.4.3 Protecting U.S. Technology from Illicit Acquisition by China, while Maintaining Nonproliferation and Nuclear Security Efforts

In line with Secretary of State Antony Blinken's speech on March 3, 2021, DOE/NNSA works within the U.S. interagency process to be competitive with China when necessary, collaborative when appropriate, and adversarial when absolutely required. DOE/NNSA's activities focus on protecting U.S. technology from illegal acquisition by China for military or other unauthorized purposes and continuing engagement on nonproliferation where possible and beneficial.

Protecting U.S. Technology: DOE/NNSA works with the interagency to close gaps in the U.S. regulatory framework and establish stringent measures to protect U.S. technology from illegal acquisition by China.

- **Exports of Unclassified Civil Nuclear Technology:** DOE/NNSA administers the regulations contained within Part 810 of Title 10 of the Code of Federal Regulations, which implement the Secretary of Energy's authority to control exports of unclassified civil nuclear technology and nuclear assistance. In this capacity, DOE/NNSA works with DOS, the Department of Defense (DoD), the Department of Commerce (DOC), the Nuclear Regulatory Commission, and the Office of the Director of National Intelligence to review export requests. DOE/NNSA also works with these agencies to implement the *2018 U.S. Policy Framework on Civil Nuclear Cooperation with China* to prevent China's illegal diversion of U.S. civil nuclear technology exports for military or other unauthorized purposes.
- **Implementation Activities for the U.S.-China 123 Agreement:** DOE/NNSA works with DOS to ensure China's compliance with its civil nuclear energy cooperation commitments under the 2015 U.S.-China 123 Agreement, which provides a legal framework for significant transfers of nuclear material, equipment, major components, and technology from the United States to China. DOE/NNSA leads U.S. efforts to implement the U.S.-China 123 Agreement by managing follow-on implementation mechanisms, which include an administrative arrangement, a joint training plan, and coordination with Chinese regulatory counterparts.
- **Strengthening Export Control Regulations to Prevent Diversion:** DOE/NNSA is one of four U.S. agencies reviewing dual-use export licenses and recommending approval or denial of license applications based on proliferation risk. DOE/NNSA works with the interagency to strengthen export control regulations by closing gaps, identifying military end-users of concern, providing extensive technical assessments to the interagency on emerging technologies of proliferation concern, providing training and technical support to the enforcement agencies investigating illicit acquisition, and placing Chinese entities on the Entity List based on threats to U.S. national and economic security.
- **Reviewing Foreign Funded Projects at the U.S. National Laboratories:** In January 2017, the Department instituted a process (DOE Order 485.1) for DOE/NNSA and other DOE offices to review all foreign funded projects at the national laboratories to ensure that such cooperative agreements are consistent with U.S. Government goals and objectives.

Nonproliferation Cooperation with China: The United States works with China to advance U.S. interests in nonproliferation and nuclear security. Working through an interagency process, DOE/NNSA:

- Engages with General Administration of China Customs (GACC) to develop a program to train officers to detect and prevent illicit and inadvertent transfer of nuclear and other WMD-related commodities; and encourages GACC to establish management policies to effectively maintain its radiation detection portal monitors to prevent smuggling of nuclear and radioactive materials.
- Cooperates with the China Atomic Energy Authority, under the *2011 Memorandum of Understanding for Joint Development of the Nuclear Security Center of Excellence,* to advance China's domestic nuclear security capabilities and encourage China's contributions to global nuclear security efforts.

- Works with China's Ministry of Ecology and Environment on domestic radioactive material security and encourages China to contribute to global efforts to strengthen radioactive source security.
- Assists, wherever possible, in converting the remaining HEU-fueled Miniature Neutron Source Reactors and assists with repatriation of HEU to China.

1.4.4 International Partnerships: Increasing the Impact of DOE/NNSA Efforts

The threat of nuclear proliferation and nuclear terrorism requires international partnerships and cooperation. In addition to its bilateral engagement, training, and capacity-building efforts with a significant number of countries, DOE/NNSA uses its long-standing participation and formalized partnerships with regional and multilateral organizations to extend and enable its nonproliferation and threat reduction efforts. Examples include:

IAEA	Technical and policy cooperation with the IAEA to improve nuclear safeguards, security, and safety
CTBTO	Technical and policy cooperation with the Preparatory Commission Comprehensive Nuclear-Test-Ban Treaty Organization's International Monitoring System and International Data Centre to improve monitoring capabilities for nuclear explosions
IPNDV	Development of technologies and procedures for multilateral nuclear disarmament verification through the 25-member International Partnership for Nuclear Disarmament Verification
JOINT RESEARCH CENTRE	Collaborative efforts on nuclear nonproliferation between DOE/NNSA and the European Commission's Joint Research Centre via the 2010 Agreement in the Field of Nuclear Material Safeguards and Security Research and Development
	International exercises and exchanges among the P3 (France, United Kingdom, United States) in support of DOE/NNSA counterproliferation and counterterrorism activities
	More than 10 years of nonproliferation and nuclear security collaboration with Japan through the U.S.-Japan Nuclear Security Working Group and more than 30 years of DOE/NNSA nonproliferation cooperation with the Japan Atomic Energy Agency
	Long-standing nonproliferation and nuclear security collaboration with the Republic of Korea
	The more than 60-year-old U.S.–UK Mutual Defense Agreement, which provides for the exchange of defense information relevant to nuclear weapons, naval nuclear propulsion, and nuclear threat reduction
	DOE/NNSA and the Atomic Energy of Canada Ltd Memorandum of Understanding for Cooperation and Exchange of Information in Nuclear Security, Safeguards, and Nonproliferation Matters
NSG MTCR WA	Export Control Regimes, which include the Nuclear Suppliers Group, the Missile Technology Control Regime, the Australia Group, and the Wassenaar Arrangement
INTERPOL	Technical and policy engagement with international enforcement agencies such as the World Customs Organization and the International Criminal Police Organization (INTERPOL)
GICNT	Key contributions and participation within the Global Initiative to Combat Nuclear Terrorism (GICNT), and the 30-member country Global Partnership Against the Spread of Weapons and Materials of Mass Destruction
FIFA WORLD CUP Brasil	Support to major public events such as the Olympics and FIFA World Cup by providing emergency preparedness and response advice and assistance

1.4.5 Harnessing Civil Nuclear Technology to Achieve Clean Energy Transformation While Maintaining the Highest Nonproliferation Standards

Civil nuclear power is an integral part of U.S. efforts to achieve clean energy transformation. A key priority in U.S. nonproliferation efforts is ensuring that the global expansion of civil nuclear power maintains the highest global security, safeguards, and safety standards. DOE/NNSA has a multi-pronged approach supporting the peaceful expansion of civil nuclear technology, which includes strengthening U.S. regulatory frameworks, providing technical advancements in preventing proliferation, and supporting the global nonproliferation architecture.

Establishing a Robust U.S. Regulatory Infrastructure

- Through its Part 810 process, DOE/NNSA conducts rigorous reviews of proposed transfers of U.S. nuclear technology and assistance to foreign atomic energy agencies to prevent diversion by proliferators.
- Under 123 Agreements for peaceful nuclear cooperation, DOE/NNSA ensures there is a robust legal framework for significant exports of complete nuclear reactors, reactor components, equipment, and material.
- DOE/NNSA conducts dual-use license reviews to prevent illicit transfers of nuclear or other WMD-related commodities to end-users or programs of concern. It also provides expertise to the interagency to close potential gaps in existing U.S. regulations to ensure proliferators are not exploiting these gaps for nefarious purposes. This includes consideration of emerging proliferation and national security threats in areas such as 5G and semiconductor industries, as well as in emerging and foundational technologies.
- DOE/NNSA streamlines these rigorous review processes, thus mitigating risk without hindering legitimate U.S. industry exports.

Enhancing Nonproliferation in Civil Nuclear-related Technologies

- Through collaborations with U.S. industry, DOE/NNSA develops technologies to improve safeguards, security, and proliferation resistance.

FIGURE 5: ARGONNE'S VAN DE GRAAFF ACCELERATOR

Argonne National Laboratory's (ANL) Support for Molybdenum-99 (Mo-99) *– Argonne's Van de Graaff accelerator is an excellent test bed for radiation stability testing because it can be used to generate high radiation doses without producing fission and activation products. In this image, the setup used for determining the radiation stability of a key reagent in the low-enriched uranium Modified Cintichem process is being properly aligned along one of the Van de Graaff's beamlines.*

- DOE/NNSA is demonstrating the ability to optimize the proliferation resistance of research reactor designs by incorporating facility features that inherently slow or prevent the production and/or extraction of nuclear materials that could be used for weapons purposes, while maximizing reactor performance for peaceful use missions.
- DOE/NNSA minimizes the use of HEU in civilian facilities worldwide and downblends HEU into high assay low-enriched uranium (HALEU) to ensure the United States can supply fuel and targets for research reactors and medical isotope production facilities that use HALEU.
- DOE/NNSA partners with U.S. industry on Security by Design for advanced and small modular reactors to improve the security of U.S. exports, make U.S. advanced nuclear reactor designs more competitive, and make future markets more resilient to evolving risks.
- DOE/NNSA is working to incorporate Safeguards by Design elements into U.S. advanced reactor designs, by engaging with nuclear industry stakeholders to improve opportunities for international deployment.

Strengthening the Global Nonproliferation Architecture

- DOE/NNSA works to ensure all countries engaging in peaceful uses of nuclear energy have brought into force a comprehensive safeguards agreement and Additional Protocol with the IAEA.
- DOE/NNSA customizes training and outreach to more than 45 foreign partners to enable effective and efficient IAEA safeguards.
- DOE/NNSA provides policy and technical support to the multilateral export control regimes to ensure international guidelines and control lists keep pace with emerging technology developments and proliferation trends.
- DOE/NNSA provides tailored capacity building to partner countries around the globe to strengthen export control implementation and prevent transfers of WMD-related commodities that could contribute to nuclear or other WMD programs of concern.

1.4.6 Enhancing Nuclear Forensics Capabilities

DOE/NNSA's nuclear forensic capabilities, first developed for nuclear test monitoring and treaty verification purposes during the Cold War, are now developed and maintained for a wide range of national security and law enforcement missions including:

- Determining the origin of nuclear materials outside of regulatory control, such as those seized from nuclear smugglers;
- Identifying the origin of an interdicted nuclear threat device;
- Analyzing the debris and signals from a detonated device to identify the source of the nuclear material and device design;
- Supporting U.S. national strategy to deter state-supported nuclear terrorism; and
- Resolving ambiguities around other nuclear events such as accidents at nuclear facilities, weapons mishaps or accidental detonations, or limited nuclear weapons use scenarios.

Key elements of DOE/NNSA's efforts include:

- Research and development to continually improve technical analysis capabilities at the national laboratories to determine the origin of nuclear materials or devices and support time-critical decision-making in the event of a nuclear or radiological incident.
- Activities to strengthen partner countries' capabilities to detect, disrupt, and investigate illicit trafficking of nuclear and radioactive material focused on isotopic identification and forensic analysis during investigations of nuclear and radioactive material smuggling cases. DOE/NNSA also collaborates with international organizations such as INTERPOL, the IAEA, the International Technical Working Group on Nuclear Forensics, the Border Monitoring Working Group, the World Customs Organization, and the GICNT to counter nuclear smuggling.
- Coordination of nuclear forensics capabilities and policy and sustainment of personnel, equipment, facilities, and operations in support of interagency policy initiatives; and management of the National Nuclear Material Archive, an NNSA-led program to identify, analyze, and preserve nuclear material samples of value to the nuclear forensics mission.
- Support to post-detonation material ground collection by DOE's Forensics Operations team composed of technical experts from across DOE's national laboratory complex for nuclear forensics analysis in support of the interagency attribution process.
- Disassembly, assessment, and disposition of radiological dispersal or nuclear threat devices by the Disposition and Forensic Evidence Analysis Team of scientists and technical personnel in support of national investigations.

1.5 Key Enablers: Workforce, Infrastructure, and Operational Resilience

DOE/NNSA's threat reduction activities rely on its ability to recruit and retain a highly skilled workforce of nuclear security and policy specialists that is diverse, equitable, and inclusive, and to maintain a nuclear enterprise that is resilient and capable of addressing national security challenges today and into the future. Investing in these key enablers is essential for retaining America's technical edge over adversaries.

Over the past year, DOE/NNSA faced an unprecedented set of challenges in meeting mission requirements during the COVID-19 pandemic. DOE/NNSA adapted its way of doing business to place the highest priority on the health and safety of its workforce while maintaining operational resiliency in implementing its threat reduction missions wherever possible.

FIGURE 6: EXAMPLES OF DOE/NNSA'S KEY ENABLERS

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

Savannah River Site's (SRS) K-area, including its storage, characterization, and dilution capabilities, is essential to NNSA's mission to dispose of 34 metric tons (MT) of surplus plutonium.

Inside view of the Criticality Control Overpack (CCO) Characterization and Storage pad, which adds the capability to store and characterize CCO drums of diluted plutonium prior to their shipment to the Waste Isolation Pilot Plant.

1.5.1 Workforce

DOE/NNSA's world-class workforce—from doctorate-level scientists and engineers to managers and support staff to machinists and technicians—is essential to the execution of its enduring nuclear threat reduction mission. Given the rapid pace of emerging technology development, DOE/NNSA continues to invest in highly qualified experts covering a range of disciplines needed to address new proliferation risks and challenges, including artificial intelligence and machine learning, quantum information science, and high-performance computing.

The DOE/NNSA Federal workforce carries out program management and oversight functions for DOE/NNSA's management and operating (M&O) partners. The M&O workforce at DOE/NNSA's laboratories, plants, sites, as well as laboratories run by DOE's Offices of Science, Nuclear Energy, and Environmental Management provide the deep scientific and engineering expertise to support DOE/NNSA's nuclear and radiological risk reduction activities. The nuclear security enterprise must continue to invest in and develop a steady pipeline of the next generation of technical and policy professionals to enable cutting-edge scientific innovation and maintain a qualitative edge over adversaries. Key challenges include:

- An aging and retiring workforce;
- Recruitment and retention of staff in a competitive economy;
- Maintaining a sustainable pipeline of nuclear safeguards experts;
- Need for ongoing training to support emerging skills requirements; and

DOE/NNSA has developed a long-term strategy for a sustainable and diverse pipeline of top talent to support its national security missions, including 11 DOE/NNSA-sponsored university programs. Several university and workforce development programs closely support DOE/NNSA's nuclear security mission areas:

- **Defense Nuclear Nonproliferation, Integrated University Program:** DOE/NNSA partnered with its national laboratories to establish three university consortia, engaging more than 250 undergraduate and 500 graduate students as part of its efforts to develop the nation's intellectual capital and support nuclear security and nonproliferation research and development. This has resulted in more than 140 new career placements in the DOE/NNSA national laboratories.
- **NNSA Graduate Fellowship Program:** This program is one of the main succession pipeline programs to cultivate the next generation of DOE/NNSA and national security leaders, placing 50-65 fellows per year in DOE/NNSA programs, DOE/NNSA field offices, and other U.S. agencies.
- **Nuclear Nonproliferation International Safeguards Graduate Fellowship Program:** This program, administered by the South Carolina Universities Research and Educational Foundation, promotes the development of safeguards professionals. To date, 32 students have completed their PhDs with research in a safeguards-related field, with many taking positions in the nuclear security enterprise and the IAEA.
- **Minority Serving Institution Partnership Program:** This program provides a sustainable science, technology, engineering, and math pipeline that prepares a diverse workforce through partnerships between DOE/NNSA laboratories, plants, and sites and 41 institutions that include 18 Historically Black Colleges and Universities, 5 Tribal Colleges and Universities, and 18 Hispanic serving institutions.

- **Mid-Level Leadership Development Program:** This year-long program enhances the knowledge and skills of future DOE/NNSA leaders, including 360-degree assessments, training on a range of governance and management topics, a capstone project, and a 60-day rotational assignment.

1.5.2 Infrastructure

DOE/NNSA relies on a diverse array of infrastructure, including laboratories, experimental facilities, test beds, high-performance computing, and material disposal facilities, to execute its nuclear threat reduction mission. Many of these assets are at DOE/NNSA's laboratories, plants, and sites, while others are located at sites operated by other DOE offices, including the Offices of Science, Nuclear Energy, and Environmental Management. These facilities and assets are used to support NNSA's three mission activities: stockpile management, nuclear threat reduction, and naval nuclear propulsion. In some cases, DOE/NNSA's nuclear security programs leverage facilities and infrastructure that primarily support DOE/NNSA stockpile management efforts. Examples include component manufacturing, detector test and evaluation, realistic test beds, modeling and simulation, personnel training, and nuclear materials handling and processing.

Key challenges:

- The nuclear security enterprise is aging, with more than half of the facilities in poor condition.
- The rapid development of emerging technologies and changing nuclear and radiological threats call for effective, cutting-edge technologies and capabilities that are both reliable and secure.
- Lack of dedicated infrastructure to support future nonproliferation competency sustainment.

DOE/NNSA-wide efforts are underway to modernize and recapitalize key facilities, and notable progress is being made to improve facility condition across the enterprise. DOE/NNSA employs science-based infrastructure stewardship tools on all modernization efforts to make data-driven, risk-informed infrastructure investments and decisions. DOE/NNSA's infrastructure-related priorities in FY 2022 for supporting its nuclear threat reduction activities focus on ensuring and enhancing its operational effectiveness, including:

- Developing a new testbed to support field experiments designed to improve U.S. capabilities to characterize low yield and evasively conducted underground nuclear explosions.
- Supporting targeted, long-term activities as part of the Nonproliferation Stewardship Program to ensure the Nation is prepared to meet future nonproliferation goals and anticipate threats through relevant science and technology, testbeds and research environments, and modern expertise needed for high-priority nonproliferation applications, including nonproliferation competencies in uranium and weaponization sciences and engineering.
- Upgrading nuclear forensics laboratory facilities for state-of-the-art instrumentation to greatly reduce the post-detonation nuclear forensics timeline, with upgrades at the National Criticality Experiments Research Center at the Nevada National Security Site (NNSS) outside Las Vegas, Nevada, operated by Los Alamos National Laboratory (LANL) to capture emerging short-lived signatures, and dedicated equipment that will improve the accuracy, precision, timeliness, robustness, and discriminating power of forensics signatures.
- Continuing infrastructure upgrades and hardware initiatives to create a comprehensive, physics-based computational model that can predict the output of an entire uranium enrichment system based on the specific design of a single machine.
- Providing a nuclear test site verification capability to build readiness for future U.S.-led on-site monitoring and verification activities.
- Supporting U.S. Government efforts to develop future arms control agreements with Russia and possibly others.

- Completing early site preparations and final design to support Critical Decision (CD)-2, *Approve Performance Baseline,* and CD-3, *Approve Start of Construction,* for the Surplus Plutonium Disposition project, which will add glovebox capacity at SRS, near Aiken, South Carolina, to support the mission to disposition 34 MT of surplus plutonium and aid in the removal of plutonium from South Carolina.
- Revitalizing key infrastructure supporting DOE/NNSA's nuclear and radioactive material management activities, including phasing out mission dependency on Building 9212 at the Y-12 National Security Complex, in Oak Ridge, Tennessee and delivering the Uranium Processing Facility by the end of 2025.
- Coordinating within DOE/NNSA to ensure that potential infrastructure consolidation decisions for managing DOE/NNSA's weapons activities do not adversely affect DOE/NNSA's counterterrorism and counterproliferation activities, which use much of the same infrastructure including computational and modeling assets, and explosives facilities and capabilities.

FIGURE 7: U.S. NATIONAL LABORATORIES, PLANTS, AND SITES

DOE/NNSA applies the unique and specialized assets of the nuclear security enterprise to prevent, counter, and respond to nuclear and radiological threats by:

Prevent

- Receiving and downblending or dispositioning HEU from foreign countries at SRS and Y-12; downblending Mo-99 HEU Target Residue Materials to low-enriched uranium at H-Canyon chemical separations facility.
- Training safeguards experts at the Volpentest Hazardous Materials Management and Emergency Response Federal Training Center at Hanford Site, the safeguards lab at Oak Ridge National Laboratory (ORNL) in Oak Ridge, Tennessee, and the Advanced Test Reactor and Safeguards Lab at Idaho National Laboratory, in Idaho Falls, Idaho.
- Providing analytical support to the IAEA through a network of national laboratories, including specialized facilities at Lawrence Livermore National Laboratory, in Livermore, California; LANL; ORNL; Pacific Northwest National Laboratory (PNNL), in Richland, Washington; Brookhaven National Laboratory in Upton, New York; and Savannah River National Laboratory near Aiken, South Carolina.
- Utilizing a test bed for radiation portal monitors and physical security components at PNNL.
- Hosting a number of testbeds at the NNSS near Las Vegas, Nevada to demonstrate a set of next-generation nonproliferation technologies for detecting foreign nuclear weapons development activities.

Counter

- Developing scientific and technical knowledge regarding potential nuclear threats using high-performance computing platforms and experimental facilities to refine and validate predictive asserts. These assets are principally dedicated to supporting DOE/NNSA's Stockpile Stewardship Program and provides a good example of how DOE/NNSA's threat reduction missions draw on those same resources for its nuclear threat reduction mission activities.

Respond

- Using the Aerial Measuring System at NNSS Remote Sensing Laboratory facilities to respond to radiological emergencies by rapidly scanning large areas for air and ground contamination to inform decisionmakers and protect public health.
- Effectively equipping DOE/NNSA's nuclear and radiological incident response teams with interoperable, secure equipment.

1.5.3 Improving Operational Resilience During the COVID-19 Pandemic

During the COVID-19 pandemic, DOE/NNSA adapted to a changing and challenging landscape. Through innovative and resilient practices, DOE/NNSA improved operational resilience and is better prepared for any contingency, including future large-scale or localized events. Initial challenges during the transition to full-time telework included:

- Work/life balance during telework;
- On-boarding new staff and maintaining sense of DOE/NNSA team;
- Maintaining institutional knowledge and training;
- Developing skills to lead teams and manage people in a virtual environment; and
- Building relationships with new interagency and foreign partners.

While some areas of in-person work (e.g., experimental laboratory work, nuclear materials handling, access to classified facilities, in-person engagements and collaborations with U.S. and foreign partners, large-scale tests and exercises) were more difficult during the COVID-19 pandemic, DOE/NNSA discovered that much of its mission work was able to continue as staff uncovered innovative, productive approaches that will likely be adopted going forward.

Organizational Successes

- Developed several innovative solutions to retain for the future, e.g., hybrid delivery of international partner engagements, enterprise-wide emergency management situational awareness;
- Identified staff flexibility as a DOE/NNSA core capability;
- Adapted quickly to meet mission requirements, while adjusting project plans and schedules, was impressive;
- Operations "down time" enabled nuclear handling facility upgrades and greater reliance on foreign partners for maintenance and sustainment of radiation detection systems;
- Telework yielded operational benefits, such as improved staff productivity;
- Leadership communication, guidance, and direction was essential, especially to help balance multiple, high-priority efforts in a challenging, new environment; and
- Past continuity program planning, training and exercises were key to rapid pandemic operations transition.

<u>Bottom line</u>: DOE/NNSA is more resilient and prepared for future disruptive events.

For example, DOE/NNSA blended virtual and in-person engagements with domestic and international partners that achieved mission requirements while also extending the reach and participation of such engagements. Experts from DOE/NNSA and the national laboratories have been able to continue international technical collaborations, such as on IAEA safeguards activities and on capabilities to monitor and verify nuclear weapon and facility dismantlement. Headquarters program reviews were also held via a virtual format, enabling continued coordination and collaboration with external mission partners. DOE/NNSA partnerships with U.S. cities to reduce the danger of radiological terrorism have adopted virtual training and assessment tools, and DOE/NNSA test facilities explored more remote monitoring and data sharing capabilities. DOE/NNSA is exploring improved connectivity tools, and capabilities to improve access to sensitive information. DOE/NNSA has found that more people are able to attend events when there are no travel requirements and increased seating capacity. Lessons learned during the pandemic can be used to be more effective and better prepared for future disruptive events.

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CHAPTER 2

Preventing Nuclear and Radiological Terrorism and Proliferation

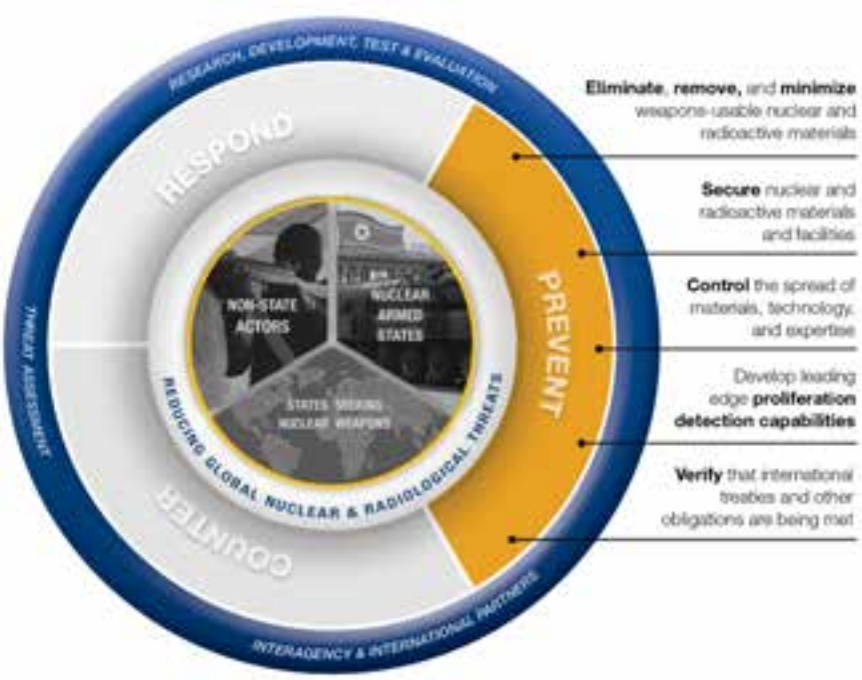
DOE/NNSA works globally to prevent the proliferation of nuclear weapons, radioactive materials, technology, and expertise by state and non-state actors.

2.0 Preventing Nuclear and Radiological Terrorism and Proliferation

As the United States faces new national security challenges, the Administration is committed to pursuing a robust nuclear security, arms control, and nuclear nonproliferation agenda. DOE/NNSA works globally to prevent state and non-state actors from developing nuclear weapons or improvised nuclear devices (IND) or acquiring weapons-usable nuclear or radiological materials, equipment, technology, and expertise. By limiting the number of nuclear-capable states and preventing terrorist access to materials and technology, DOE/NNSA plays a critical role in enhancing global stability and reduces the range of potential threats facing the United States and its allies and partners.

This chapter details how DOE/NNSA develops and executes programs designed to advance the following key objectives to prevent nuclear and radiological terrorism and proliferation:

2.1 Eliminate, remove, and minimize nuclear and radioactive materials



DOE/NNSA achieves permanent threat reduction by minimizing and, when possible, eliminating weapons-usable nuclear material (WUNM) around the world and ensuring sound management of materials that remain. In doing so, DOE/NNSA directly reduces the likelihood that terrorists could acquire sufficient material to build a nuclear weapon, IND, radiological exposure device (RED), or radiological dispersal device (RDD). DOE/NNSA continues efforts to convert research reactors and isotope production facilities from the use of highly enriched uranium (HEU) to low-enriched uranium (LEU) fuel or targets and verify the shutdown of HEU-using facilities worldwide. In support of this effort, DOE/NNSA is developing and qualifying high-density LEU fuels to convert high performance research reactors that cannot convert using existing LEU fuels. DOE/NNSA is also improving proliferation resistance in reactor designs, which minimizes special nuclear material (SNM) production and/or extraction and maximizes reactor

performance for peaceful use missions. DOE/NNSA works domestically and internationally to protect radioactive sources used in medical, research, and commercial applications; remove and dispose of disused sources; and promote the use of non-radioisotopic alternative technologies. DOE/NNSA also partners with U.S. industry to establish a reliable non-HEU-based domestic supply of molybdenum-99 (Mo-99), a critical isotope for medical procedures.

DOE/NNSA conducts activities to remove and consolidate excess WUNM and maintains a mobile packaging capability, including rapidly deployable equipment and highly-trained teams that undertake full-scale training exercises to ensure readiness for the safe and secure removal of nuclear material worldwide. In addition to its traditional nuclear material removal efforts, DOE/NNSA is also developing an innovative solution to address HEU that does not have a current disposition pathway via its Mobile Melt-Consolidate system, a capability that allows DOE/NNSA to dilute and consolidate HEU without returning it to the United States.

Along with addressing WUNM overseas, DOE/NNSA dispositions HEU and U.S. inventories of weapons-usable plutonium, in various metal and non-metal forms, declared surplus to defense needs. NNSA is responsible for the disposition of 34 metric tons (MT) of surplus plutonium, consistent with U.S. policy and international commitments, using the dilute and dispose strategy, with dilution occurring at Savannah River Site (SRS) before being transported to the Waste Isolation Pilot Plant (WIPP), in Carlsbad, New Mexico, for final disposal. DOE/NNSA places high priority on efforts to address inventories of plutonium that were consolidated at SRS.

2.1.1 Future Plans

Over the next five years, DOE/NNSA will continue cooperation with international partners to minimize the need for, presence of, or production of WUNM around the world by converting research reactors and isotope production facilities to LEU fuels and production processes, removing or confirming the disposition of additional inventories of HEU and plutonium abroad, and disposing of excess WUNM. DOE/NNSA also will continue to support industry partners in establishing a reliable, domestic supply of non-HEU-based Mo-99 produced in the United States.

NNSA is pursuing the dilute and dispose strategy at K-Area Facility at SRS to remove plutonium from the State of South Carolina by providing processing, characterization, and storage capabilities to efficiently and permanently dispose of 34 MT of plutonium, thereby eliminating excess nuclear weapons materials. DOE/NNSA's Surplus Plutonium Disposition program will begin waste characterization operations in K-Area at SRS and aim to resume shipments to WIPP from the newly completed storage and waste characterization pad in K-Area in fiscal year (FY) 2022.

Key priorities for FY 2022 include:

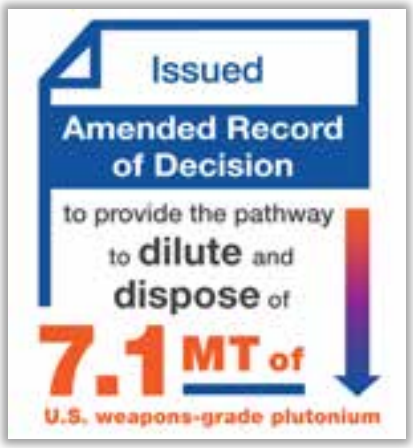
- Converting one additional research reactor or isotope production facility from the use of HEU fuel to LEU fuel or targets, or verify its shutdown, for a cumulative total of 109 facilities.
- Providing laboratory technical assistance to U.S. industry partners to establish a reliable commercial supply of Mo-99 without the use of HEU.
- Removing or confirming the disposition of an additional 60 kg of HEU from partner countries in Asia, Europe, and North America.
- Conducting a full-scale Mobile Packaging removal exercise.

- Continuing activities to initiate shipments of diluted plutonium to WIPP for permanent disposal, furthering efforts to remove plutonium from South Carolina and fulfill the United States' commitment to dispose of 34 MT of surplus plutonium.
- Continuing to engage organizations to volunteer to transition away from cesium blood irradiators to alternative technologies, reducing radiological risk by eliminating the need for high-activity sources.

2.1.2 Key Accomplishments

To date, DOE/NNSA has eliminated approximately 320 nuclear bombs worth of WUNM and monitored the downblending of approximately 20,000 nuclear bombs worth of HEU to LEU under this objective. Below are a few of the key accomplishments in FY 2019-2021 that helped eliminate, remove, and minimize nuclear and radioactive materials from around the world:

- Achieved significant progress towards NNSA's mission to dispose of 34 MT of surplus plutonium consistent with international commitments through completing modifications to increase the efficiency of the existing K-Area Interim Surveillance glovebox at SRS, issuing an Amended Record of Decision to provide the pathway for the downblending and disposition of 7.1 MT of U.S. weapons-grade plutonium, and completing construction of a Criticality Control Overpack (CCO) Characterization and Storage Pad, where CCOs containing diluted plutonium will be characterized and stored before being transported to WIPP for permanent disposal underground.



- Completed two multi-year removal campaigns from Canada totaling more than 367 kg of HEU removed via 171 shipments.
- Downblended 2.9 kg of HEU from the Impulse Graphite Reactor research reactor to LEU, resulting in the elimination of all unirradiated HEU in Kazakhstan.
- Announced new cooperative HEU minimization efforts with the Netherlands and Norway, including a commitment to study technical solutions to enable the downblending of challenging fuel types.
- Partnered with commercial U.S. industry to support domestic production of Mo-99 without the use of HEU, including the selection of companies to negotiate new cooperative agreements in 2021 (*See call out box on next page*).
- Completed a cumulative 180 Cesium Irradiator Replacement Project removals from U.S. hospitals and universities, thereby keeping on target to remove all cesium-based blood irradiators in the United States by 2027.

Collaboration with U.S. Industry to Support Domestic Production of Mo-99

As part of DOE/NNSA's mission to minimize the use of HEU, a proliferation-sensitive material, and as directed in the *American Medical Isotopes Production Act of 2012*, as amended, DOE/NNSA partners with U.S. industry to support domestic production of Mo-99 without the use of HEU. DOE/NNSA has implemented this by competitively awarding 50 percent/50 percent cost-shared cooperative agreements to commercial entities and providing funds to the DOE national laboratories to support development of non-HEU Mo-99 production technologies.

A scientist at Argonne National Laboratory working on a Mo-99 experiment in a shielded recovery glove box.

Mo-99 and its decay product, technetium-99m, are used in over 40,000 medical procedures in the United States each day to diagnose heart disease and cancer, to study organ structure and function, and to perform other critical medical applications. The majority of Mo-99 supplied to U.S. patients has been historically produced using HEU and is currently provided mostly by foreign producers. In 2021, DOE/NNSA selected American companies for awards of $85 million in cooperative agreements. These agreements are a continuation of DOE/NNSA's support for U.S. industry in developing domestic Mo-99 production capabilities without the use of HEU. As part of its partnership with American companies, DOE/NNSA aims to increase Mo-99 produced by American companies and get commercial scale quantities of this critical medical isotope to market by the end of 2023.

DOE/NNSA currently manages cooperative agreements in support of this mission with three American companies, developing four diverse Mo-99 production technologies:

- NorthStar Medical Radioisotopes, LLC (Beloit, Wisconsin)
  - NNSA partners with NorthStar on two technologies
- SHINE Medical Technologies, LLC (Janesville, Wisconsin)
- Niowave, Inc. (Lansing, Michigan)

DOE/NNSA's collaboration with U.S. industry has achieved historic results. In November 2018, NorthStar Medical Radioisotopes began the first domestic production in nearly 30 years, using a neutron capture technology with molybdenum-98 targets.

2.2 Secure nuclear and radioactive materials and facilities

DOE/NNSA implements programs to improve the security of vulnerable materials and facilities. DOE/NNSA focuses on building long-term sustainability of its capacity-building support by working with partners to develop their own regulations and inspections processes, training infrastructure, maintenance approaches, exercise and performance testing programs, life-cycle planning, and nuclear security culture. Given the expansion of civil nuclear energy, evolving adversary capabilities, and the availability of new

and disruptive technologies, DOE/NNSA is exploring innovative approaches, technologies, and tools to adapt nuclear security efforts to emerging threats.

Radioactive materials are a critical and beneficial component of global medical, industrial, and academic industries, but could pose a threat to U.S. national security if not properly secured. DOE/NNSA works with domestic and international partners to reduce the risk of radiological terrorism by securing and eliminating materials that could be used in a RDD, RED, or so-called "dirty bomb." DOE/NNSA pursues a three-pronged strategy to prevent radiological terrorism at home and abroad by protecting high-risk radioactive sources, removing disused or orphaned sources, and reducing the reliance on radioactive sources wherever possible. To enhance its reach and effectiveness, DOE/NNSA works to strengthen global nuclear and radiological security in partnership with multilateral organizations such as the International Atomic Energy Agency (IAEA) and the International Criminal Police Organization (INTERPOL), with countries in bilateral partnerships, and with a range of domestic stakeholders, including the U.S. interagency, state and local law enforcement, and U.S. private industry.

2.2.1 Future Plans

DOE/NNSA will continue to prioritize engagement with the international community to protect and secure nuclear and radioactive materials over the next five years, deepening bilateral relationships with countries to strengthen security of vulnerable materials and facilities. As demand for civil nuclear power continues to grow, DOE/NNSA will partner with the IAEA to conduct outreach on nuclear security best practices for nuclear newcomers. DOE/NNSA will continue to collaborate with U.S industry on Security by Design activities to enhance security of advanced reactor designs. Through a rigorous risk analysis process, DOE/NNSA will refine risk mitigation strategies for a range of fuel cycle facilities, including advanced reactors and small modular reactors, and for emerging nuclear security challenges, such as drones, cyber security, and artificial intelligence.

Domestically, DOE/NNSA will cooperate with industry partners, state regulators, and the Nuclear Regulatory Commission to protect high-activity radioactive sources in the United States, providing state-of-the-art security solutions at volunteer sites. Through the RadSecure 100 Initiative, DOE/NNSA focuses on increasing the capacity of law enforcement in 100 U.S. cities to protect against radioactive theft or diversion, using the same scalable radiological security trainings and activities that DOE/NNSA brought to the 20 largest metropolitan areas under the 2020 Cities Initiative from 2016 to 2020. DOE/NNSA will also continue to expand its collaboration with U.S. industry to develop new technical solutions for making radioactive sources inherently more secure in the manufacturing process.

Key FY 2022 priorities include:

- Aiding partner countries in enhancing nuclear security and improving responses to emerging threats to nuclear security (e.g., mitigation of insider threats, cyber threats, counter unmanned aerial systems, transport security, etc.).
- Completing security upgrades at research reactors in four high-threat countries, and at an additional 55 buildings located at universities, hospitals, and industrial locations with high-priority radioactive sources (28 domestic sites and 27 international sites).

2.2.2 Key Accomplishments

Over the last two years, there have been dozens of success stories of securing nuclear and radioactive material by DOE/NNSA. In FY 2019-2021, DOE/NNSA:

- Implemented nuclear security upgrades in Ukraine, Belarus, Armenia, Morocco, and Nigeria.
- Conducted a series of virtual regional transport security technical exchanges with over 100 participants in South America and Europe, and a virtual regional cyber security workshop for more than 60 counterparts from Africa.
- Played a lead role working with foreign partners to establish an international working group steering committee for insider threat mitigation in support of the IAEA Information Circular 908 (INFCIRC/908), "Joint Statement on Mitigating Insider Threats."

Mitigating Insider Threats

The insider threat is one of the greatest risks to nuclear security. In consideration of this challenge, DOE/NNSA played a lead role working with foreign partners to establish an international working group steering committee for insider threat mitigation in support of Information Circular 908 (INFCIRC/908), "Joint Statement on Mitigating Insider Threats." The steering committee will advance the two pillars of the INFCIRC/908: (1) Commitment to support the IAEA to develop and implement an advanced, practitioner-level training course on insider threat mitigation; and (2) Implementation of measures to mitigate insider risk through a risk-informed, graded approach.

The INFCIRC/908 Side Event on February 11, 2020 was co-hosted by Belgium and the United States

2.3 Control the spread of materials, technology, and expertise

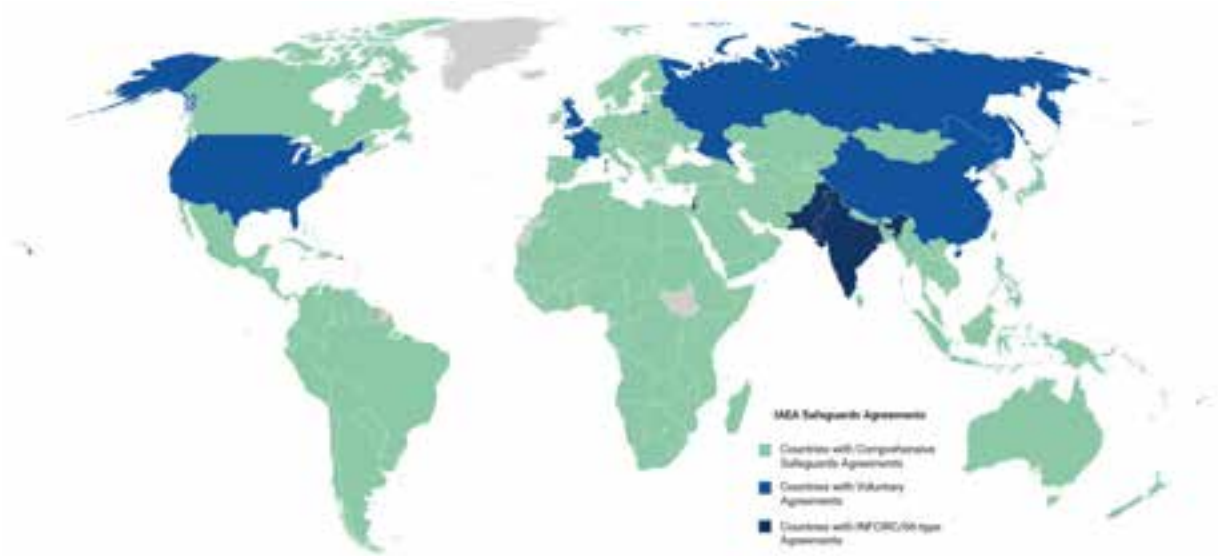
DOE/NNSA works to strengthen the nonproliferation and arms control regimes through innovative policy development and technical approaches to prevent proliferation, ensure peaceful nuclear uses, and enable verifiable nuclear reductions. These activities support IAEA and partner countries' efforts to implement international nuclear safeguards, build domestic and international capacity to implement export control

obligations, support the negotiation and implementation of agreements and associated monitoring regimes to verifiably reduce nuclear weapons and nuclear programs, and develop approaches and strategies to address emerging nonproliferation and arms control challenges and opportunities.

DOE/NNSA facilitates peaceful nuclear cooperation while preventing technology, material, and commodities from being exploited or diverted by adversaries for non-peaceful purposes. To achieve this, DOE/NNSA works to strengthen domestic and international capacity to detect and prevent the illicit or inadvertent transfer of nuclear and dual use materials, equipment, and technology to programs of concern. With the rapid pace of emerging technology development, DOE/NNSA is working with the U.S. interagency and international partners to identify emerging technologies of potential proliferation concern and considering ways to mitigate them.

DOE/NNSA conducts technical analysis and end-user evaluations of U.S. export license applications for proliferation concerns and provides technical and policy support to U.S. agencies leading weapons of mass destruction (WMD) interdiction efforts. DOE/NNSA also strengthens capacities of U.S. enforcement agencies to counter illicit WMD-related related imports and exports by providing training and technical reach-back[2] analysis and advice through the national laboratories. DOE/NNSA directly contributes to strengthening international nonproliferation norms and practices, providing technical support to the multilateral nonproliferation export control regimes and working with partner countries through training and technical exchanges to strengthen their abilities to prevent transfers that would contribute to foreign WMD programs of concern.

FIGURE 8: IAEA NUCLEAR SAFEGUARDS AGREEMENTS



[2] Capabilities and procedures for frontline enforcement officials or operators of detector systems to rapidly "reach back" to appropriate subject matter experts, such as at the national laboratories, to help resolve anomalies or alarms and thus identify items of concern while minimizing the impact to legitimate commerce.

DOE/NNSA provides critical mission support to the IAEA, including strengthening the international safeguards system and supporting the IAEA's ability to verify peaceful uses of nuclear material and facilities and detect non-compliance with safeguards agreements. This support includes developing, refining, and adapting existing and emerging technologies for IAEA safeguards applications and transferring those technologies to the IAEA, partner countries, or commercial vendors.

DOE/NNSA also undertakes capacity building efforts around the world aimed at enhancing the implementation of international safeguards and reinforcing the nuclear nonproliferation regime. DOE/NNSA also analyzes, develops, and refines policies and concepts for, and approaches to, international safeguards to improve implementation at both the facility and state-level, while adapting to changes in the nuclear industry.

DOE/NNSA provides statutorily mandated technical support in the negotiation of 123 Agreements and leads the implementation of the resulting peaceful nuclear cooperation with 48 countries, the IAEA, and the governing authorities on Taiwan, helping to ensure that global civil nuclear energy development takes place in accordance with the highest nonproliferation standards. DOE/NNSA administers Part 810 of Title 10 of the Code of Federal Regulations, which controls the export of unclassified U.S. nuclear technology and assistance, including transfers of design documents, consulting services, and certain types of software.[3]

FIGURE 9: WMD COMMODITY IDENTIFICATION TRAINING

Participants in Vietnam view their DOE/NNSA and DOS counterparts on the screen during their July 2020 discussion to formulate a path for the launch and sustainment of Vietnam's national Weapons of Mass Destruction (WMD) Commodity Identification Training.

DOE/NNSA implements innovative initiatives (track 1.5 workshops, crisis simulations, and online and media initiatives) to advance U.S. interests by reducing the danger of nuclear war and dissuading the proliferation of nuclear weapons in regions critical to U.S. interests.[4] As part of these efforts, DOE/NNSA engages the next generation of policy makers and experts to build foundational expertise in nonproliferation and arms control.

DOE/NNSA strengthens counter nuclear smuggling capabilities worldwide by building partner countries' sustainable capacity to detect, disrupt, and investigate illicit trafficking of nuclear and radioactive material through critical smuggling pathways. This cooperation includes partnerships with over 70 countries and international organizations such as the IAEA, INTERPOL, Global Initiative to Combat Nuclear Terrorism, World Customs Organization, and United Nations (UN) Office on Drugs and Crime.

[3] The Part 810 process controls the export of unclassified nuclear technology and assistance. A Part 810 authorization does not authorize the transfer of nuclear material, equipment, or components.

[4] Track 2 diplomatic initiatives are defined as unofficial interactions between private citizens not employed by a government, commonly for the purposes of sharing expertise, gaining common understanding, or resolving conflict. Track 1.5 activities involve both official and non-official participants.

2.3.1 Future Plans

In FY 2022 and over the next five years, DOE/NNSA will continue to meet its statutory obligations and authorities, including export license reviews and interdiction case technical reviews. DOE/NNSA will continue international capacity building and engagement in export controls. DOE/NNSA will also continue to provide assessments of emerging technologies of proliferation concern and other emerging strategic risks and develop related training and other engagement tools to support international and domestic partners' efforts to prevent technology acquisition by adversaries that undermine U.S. and allied security interests.

DOE/NNSA will implement its statutory and treaty/agreement obligations and authorities related to nuclear safeguards, including physical assessment visits for U.S.-obligated material at foreign facilities, U.S safeguards obligations under the U.S. Voluntary Offer Agreement/Additional Protocol (AP), and international safeguards trainings and outreach to more than 45 international partners. DOE/NNSA will support IAEA safeguards of Iran's nuclear program in accordance with its IAEA safeguards commitment and applicable UN Security Council resolutions. It will continue to develop and test technologies and approaches for transfer to the IAEA. It also will maintain its human capital development efforts to ensure a pipeline of highly qualified experts in safeguards, nonproliferation, and arms control. With the creation of the Advanced Reactor International Safeguards Engagement program, DOE/NNSA will strengthen the IAEA safeguards system through technical and policy initiatives to prepare for the evolving safeguards challenges posed by advanced reactors and associated fuel cycle facilities. DOE/NNSA will continue to collaborate with the U.S. industry on Safeguards by Design activities to enhance safeguards of U.S. advanced reactor designs and future exports.

In FY 2022, DOE/NNSA anticipates issuing and implementing a new rule in the Federal Register allowing the imposition of monetary civil penalties for violations of the Part 810 regulation. If finalized, the new rule would, in combination with the existing criminal penalties under the *Atomic Energy Act* (AEA), provide DOE with a full range of enforcement authorities to address the range of possible Part 810 violations and support the U.S. goal of reducing the theft of U.S. technology by foreign competitors. DOE/NNSA also will continue to monitor and analyze advanced reactor developments, including small modular and micro-reactors and the use of high assay low-enriched uranium (HALEU) fuel, to identify any necessary updates to the Part 810 regulation or to existing guidance to exporters.

Leveraging assessments of high-risk smuggling pathways and operational environments, DOE/NNSA will address counter-nuclear smuggling capability gaps worldwide by working with partner countries to strengthen radiation detection capabilities at high-priority points of entry, frontier areas including blue and green borders (i.e., land border crossings between two official points of entry and borders demarcated by bodies of water), and within the interior of states.

Key FY 2022 priorities include:

- Enhancing the development of a nonproliferation enrichment testing and training platform to develop and test technologies and approaches for transfer to the IAEA in collaboration with select foreign partners.
- Working to ensure that the nuclear export controls and safeguards regimes are prepared for the development and export of advanced nuclear reactors and fuel.
- Implementing a foreign partner export control engagement strategy that combines elements of in-person and remote engagement.

- Providing technical and policy expertise within DOE, working with DOE's Office of Science, and with the interagency to identify and control access to emerging technologies of potential proliferation and national security concern.
- Providing technical and policy expertise for U.S. national security priorities to close regulatory loopholes to prevent proliferators and adversaries from exploiting U.S. dual-use technologies.
- Building and enhancing global counter nuclear smuggling capability, to include tailored training, maintenance support, technical peer-to-peer exchanges, and radiation detection/interdiction equipment deployments with international partners.

2.3.2 Key Accomplishments

DOE/NNSA continues to find new and innovative ways to control the spread of materials, technology, and expertise and employed those with great success over the last two years. In FY 2019-2020, DOE/NNSA:

- Engaged more than 110 foreign partners to strengthen global safeguards capacity to detect and deter diversion of nuclear material and advance universal adoption of the IAEA AP.
- Transferred at least five nuclear safeguards technology tools annually, including nine in FY 2020, to bolster the capability of the IAEA and international partners to detect and deter nuclear material diversion.
- Conducted export control training events for U.S. enforcement agencies and foreign partners, such as Kenya, Vietnam, and Brazil, to strengthen their ability to identify WMD-related dual-use commodities and prevent their illicit or inadvertent transfer.
- Reviewed thousands of nuclear and dual-use export license applications and interdiction cases each year to mitigate the risk of nuclear and dual-use materials, equipment, technologies, or information being diverted to non-peaceful purposes.
- Reduced processing times for applications to export unclassified U.S. civil nuclear technology by nearly 50 percent, while still maintaining strong nonproliferation controls on such transfers.
- Reached a total of 72 partner countries with 884 counter nuclear smuggling systems deployed, of which 86 percent are maintained by partners.

2.4 Verify international treaty and other obligations are being met

DOE/NNSA reduces proliferation concerns through its support for the negotiation and implementation of agreements and associated monitoring regimes to verifiably reduce nuclear weapons and dismantle

nuclear programs. DOE/NNSA supports multiple nonproliferation and arms control treaties and agreements, including: the Treaty Between the United States of America and the Russian Federation on Measures for Further Reduction and Limitation of Strategic Offensives Arms (New START), the Chemical Weapons Convention (CWC), the Plutonium Production Reactor Agreement (PPRA), and the Threshold Nuclear Test Ban Treaty. DOE/NNSA conducts applied technology development, testing, evaluation, maintenance, and deployment of monitoring technologies and develops monitoring and verification approaches that are informed by analysis of the potential effects of initiatives on DOE and NNSA national laboratories, plants, and sites.

DOE/NNSA also provides policy development, formulation, and support to U.S. participation in multilateral nonproliferation regimes, including the Treaty on the Non-proliferation of Nuclear Weapons (NPT), Nuclear Suppliers Group, and Zangger Committee, among others. DOE/NNSA also maintains technical readiness to negotiate and implement future nuclear fuel cycle transparency agreements and conducts U.S.-led missions to monitor, verify, disable, and dismantle proliferant nuclear fuel cycle programs around the world.

2.4.1 Future Plans

In FY 2022 and over the next five years, DOE/NNSA will fulfill ongoing treaty/agreement obligations and authorities to implement the PPRA, CWC, and NPT. DOE/NNSA will continue to meet its obligations under the NPT to share the peaceful uses of nuclear technology and to work towards disarmament, while promoting strong nonproliferation standards for other NPT States Party, including the highest standard of IAEA safeguards agreements (i.e., a Comprehensive Safeguards Agreement with an AP and a modified Small Quantities Protocol, if applicable). It will support compliance analysis and implementation of New START and other arms control agreements. DOE/NNSA will maintain technical and operational readiness for future U.S.-led monitoring and verification of denuclearization activities by conducting regular verification team exercises and trainings. Also, it will continue development of a U.S. field verification capability for identifying underground nuclear explosions and assessing key parameters of the suspect event.

Key FY 2022 priorities include:

- Developing a nuclear test site verification team to build readiness for future U.S.-led on-site monitoring and verification activities.
- Supporting U.S. Government efforts to develop future arms control agreements and strategic dialogue initiatives with Russia and possibly others.
- Promoting the peaceful uses benefits of the nonproliferation regime through targeted peaceful uses projects, including in sub-Saharan Africa and South and Central America.

2.4.2 Key Accomplishments

There are dozens of examples of DOE/NNSA's successful work to verify that international treaties and other agreement obligations are being met. In FY 2019-2021, DOE/NNSA:

- Completed the Warhead Measurement Campaign that collected high fidelity, archival, radiation signature measurements of the W76, B61 and B83 in support of future arms control treaty negotiations.
- Supported diplomatic efforts to successfully extend New START with Russia before its February 5, 2021, expiration.

2.5 Develop Leading Edge Proliferation Detection Capabilities

DOE/NNSA nonproliferation research and development (R&D) drives the innovation of U.S. technical capabilities to detect nuclear detonations; foreign nuclear weapons programs' activities; and the presence, movement, or diversion of SNM. The program sustains and develops foundational nonproliferation technical competencies that ensure the technical agility needed to support a broad spectrum of U.S. nonproliferation missions and anticipate threats. DOE/NNSA leverages the unique facilities and scientific skills of DOE, academia, and industry to perform research, conduct technology demonstrations, develop prototypes, and produce and deliver sensors for integration into operational systems.

2.5.1 Future Plans

DOE/NNSA will support planned activities for early detection of proliferation-related R&D and continued production of nuclear detonation detection satellite payloads as well as support continued efforts to sustain and develop foundational nonproliferation technical competencies by providing targeted, long-term support for enabling infrastructure, science and technology, and an expert workforce. The Nonproliferation Stewardship Program will continue to ensure foundational technical competencies at DOE/NNSA are sustained and available to support the Nation's nonproliferation missions. The new National Technical Nuclear Forensics R&D Program will also continue developing and maintaining advanced technical nuclear forensics analysis capabilities at the national laboratories that can support time-critical decisions in the event of a nuclear or radiological incident and assist in determining the origin of interdicted materials or nuclear devices.

FIGURE 10: SPACECRAFT READY FOR SHIPMENT

Space and Missile System Center Space Test Program Satellite 6 spacecraft is readied for shipment at the Northrup Grumman Dulles Campus.

Key FY 2022 priorities include:

- Strengthening U.S. technical capabilities to detect and characterize foreign nuclear programs and deliver space-based nuclear detonation detection capabilities to the U.S. Air Force.
- Informing the prioritization of nuclear work based on a scientific understanding of nuclear threat devices.
- Ensuring R&D nuclear forensics support to the Nuclear Emergency Support Team's nuclear forensics capabilities and operations.
- Working through three university consortia, partnering with DOE/NNSA national laboratories, to conduct research and development in nuclear science, engineering, nuclear forensics, and other disciplines, to address research shortfalls and train the next generation of experts needed to support nuclear nonproliferation, nuclear security, and treaty compliance monitoring.

2.5.2 Key Accomplishments

DOE/NNSA continues to deliver on its objective to develop proliferation detection capabilities. Key FY 2021 accomplishments follow:

- Completed three field campaigns in conjunction with interagency partners at testbeds designed to test technologies developed to improve U.S. capabilities to detect and monitor foreign nuclear material production.
- Supported the launch and on-orbit testing of two Global Burst Detector (GBD) payloads on GPS Block III satellites. The GBD uses X-ray, radiofrequency, and optical sensors to detect nuclear explosions as part of the U.S. Nuclear Detonation Detection System.
- Developed advanced analysis methods for intelligence data that leverage artificial intelligence models to reveal novel pattern-of-life indicators that could provide advance warning of proliferation activities. This methodology has been shared with and adopted by interagency partners to provide new insights regarding the capabilities and intents of state and non-state actors.



3

CHAPTER 3

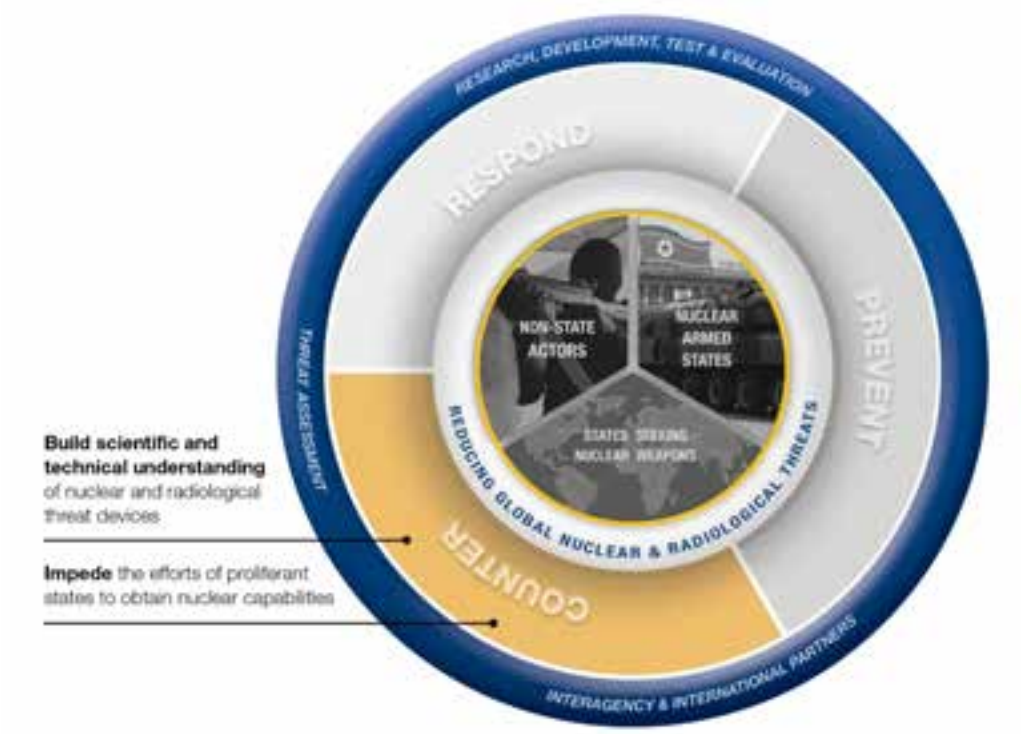
Countering Nuclear and Radiological Terrorism and Proliferation

DOE/NNSA is responsible for countering nuclear threats and advancing nuclear forensic science and operational capabilities.

3.0 Countering Nuclear and Radiological Terrorism and Proliferation

The Department of Energy's National Nuclear Security Administration (DOE/NNSA) is responsible for countering nuclear threats from both proliferant states and non-state actors. These programs advance the nation's technical capabilities to understand and defeat nuclear threat devices, including improvised nuclear devices (IND) and lost or stolen nuclear weapons. They also advise on the protection and storage requirements for nuclear materials and facilitate U.S. collaboration with international partners to prevent and counter nuclear terrorism and nuclear proliferation at home and abroad.

This chapter details how DOE/NNSA develops and executes programs designed to advance key objectives to counter nuclear or radiological terrorism and proliferation:

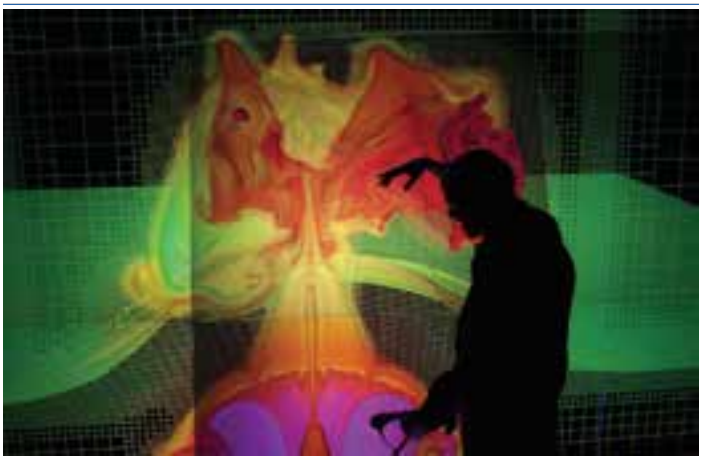


3.1 Build scientific and technical understanding of nuclear and radiological threat devices

DOE/NNSA conducts technical activities required to advise and enable all aspects of U.S. Government nuclear counterproliferation and nuclear counterterrorism missions as well as operational nuclear incident response capabilities while supporting DOE's all-hazards emergency management system. DOE/NNSA provides the nation's technical capability to understand and defeat nuclear devices, including INDs and lost or stolen foreign nuclear weapons; advises on protection requirements for nuclear materials; and conducts a series of exchanges with the United Kingdom and France to prevent and counter

nuclear terrorism and nuclear proliferation. It also advances our understanding of the science behind explosive and nuclear material behaviors. This nuclear weapons design and materials expertise is subsequently used to analyze nuclear threat device concepts and develop plans and countermeasures against a wide range of nuclear threats and devices. Once understood, this knowledge informs U.S. Government policies, regulations, and key Department of Defense (DoD) mission partners on terrorist and proliferant state nuclear threats and related contingency planning. DOE/NNSA also conducts international and domestic nuclear incident emergency preparedness and response training, policy development, and capacity building programs.

FIGURE 11: VR CAVE SIMULATION



A highly resolved 3D calculation of a supersonic jet deflecting off a ball that simulates an experiment fielded on the OMEGA laser at the University of Rochester. With access to some of the world's largest supercomputers, NNSA uses these calculations to better understand nuclear threats and inform U.S. policy makers and federal response teams.

3.1.1 Future Plans

DOE/NNSA will continue development of highly specialized nuclear threat science assessments, while improving predictive capabilities in support of crisis operations. DOE/NNSA will conduct scientific studies and integrated experiments to ensure that material security and risk management policies and missions are informed by rigorous assessment of potential threats. DOE/NNSA will perform technical assessments to support the Design Basis Threat that governs DOE's nuclear material security posture. The results of these assessments will also inform DOE/NNSA's international nuclear security inputs for risk prioritization. DOE/NNSA will also implement technical work plans to enable the sharing of best practices to reduce nuclear terrorism and nuclear proliferation risks through bilateral and trilateral channels.

Fiscal year (FY) 2022 priorities include:

- Advancing the nation's technical capability to: understand and defeat nuclear threat devices, including INDs, radiological dispersal devices, and lost or stolen nuclear weapons; advise on protection requirements for nuclear materials; and prevent nuclear terrorism through a series of exchanges with the United Kingdom and France.
- Conducting integrated experiments and increasing focused science on explosive and nuclear material behaviors to support technical assessments of nuclear materials and nuclear threat devices based on U.S. Government priorities in coordination with operational partners and the intelligence and security communities.
- Strengthening U.S. national security by increasing partner capabilities to counter and respond to nuclear and radiological incidents and accidents worldwide through policy, training, exercises, technical exchanges, and equipment provisioning.

3.1.2 Key Accomplishments

DOE/NNSA continues to deliver on its objective to build scientific and technical understanding of nuclear and radiological threat devices. In FY 2021, DOE/NNSA conducted more than 10 experiments to increase

DOE/NNSA's confidence and accuracy in predictive modeling capabilities and new energetic disablement tools in support of the nuclear render safe mission.

3.2 Impede the efforts of proliferant states to obtain nuclear capabilities

DOE/NNSA delivers expert analysis and technical solutions in support of U.S. Government efforts to delay, degrade, or deny proliferant state nuclear weapons programs. DOE/NNSA contributes to the development and implementation of strategic policy initiatives pertaining to nuclear-armed counterparts, whether considered partner, competitor, or adversary; as well as initiatives pertaining to countries aspiring to obtain nuclear capabilities, with the aim of reducing nuclear threats to the United States and preventing the proliferation of nuclear weapons worldwide. Applying its science-based understanding of nuclear threat devices, DOE/NNSA provides risk-informed support for a variety of counterproliferation missions. These technical capabilities and expertise, alongside close collaboration with DoD and Intelligence Community partners, allows for more optionality to achieve counterproliferation objectives and increased confidence for mission effectiveness. DOE/NNSA also administers a substantial portfolio to enable U.S. Government export control and interdiction activities, working in close coordination with foreign government and multilateral regimes and U.S. law enforcement to curb the spread of proliferation-relevant technology and equipment worldwide.

3.2.1 Future Plans

DOE/NNSA will integrate policy, planning, and operations toward counterproliferation priorities supporting urgent needs and proactively pursuing opportunities to prevent nuclear threats.

FY 2022 priorities include:

- Enhancing collaboration with interagency partners to ensure appropriate consideration of nuclear threats in national security policy development and implementation.
- Expanding support to partner agencies to slow, halt, and prevent incipient proliferators from advancing nuclear weapons-related efforts.
- Establishing a laboratory-based cadre of experts to provide nuclear expertise to the U.S. Government counterproliferation mission.

3.2.2 Key Accomplishments

In FY 2020-2021, DOE/NNSA:

- Enhanced intra-agency integration of ongoing counterproliferation efforts.
- Increased contributions to National Security Council-led strategic counterproliferation initiatives and policy planning.
- Executed more than a dozen threat-relevant experiments to increase confidence in technical assessments supporting DoD operational planning.



CHAPTER 4

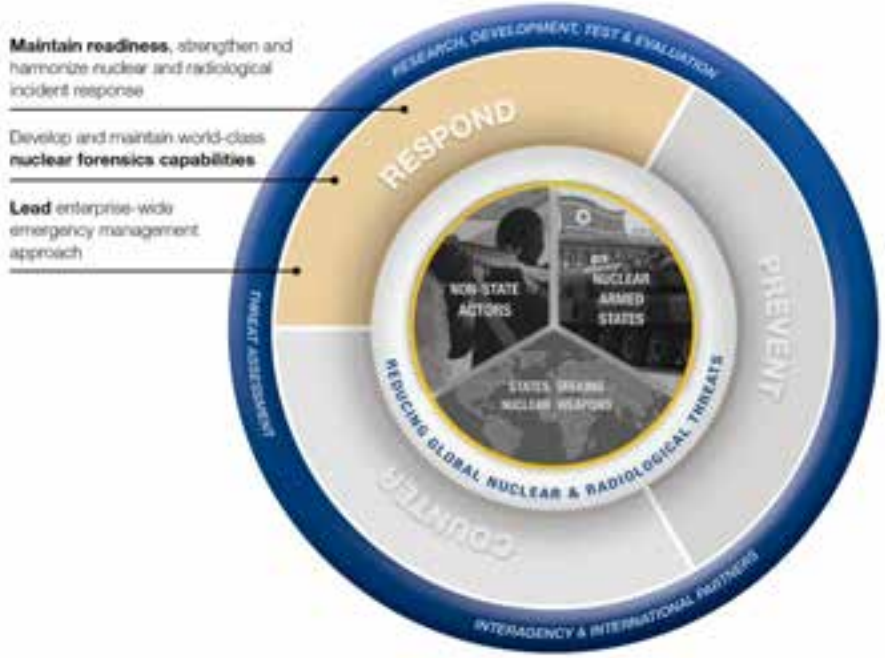
Responding to Nuclear and Radiological Terrorism and Proliferation

DOE/NNSA maintains the capacity to respond to all potential nuclear or radiological incidents and accidents in the United States and abroad.

4.0 Responding to Nuclear and Radiological Terrorism and Proliferation

The Department of Energy's National Nuclear Security Administration (DOE/NNSA) maintains the capacity to respond to all potential nuclear or radiological incidents and accidents in the United States and abroad. DOE/NNSA maintains a cadre of highly skilled technical and scientific specialists trained, organized, and equipped to execute nuclear and radiological crisis response and consequence management missions worldwide, while also administering and directing the implementation and integration of emergency management programs across DOE/NNSA.

This chapter details how DOE/NNSA develops and executes programs designed to advance the following key objectives to respond to nuclear or radiological proliferation and terrorism:



4.1 Maintain readiness; strengthen and harmonize nuclear and radiological incident response

DOE/NNSA, through the incident response assets of the Nuclear Emergency Support Team (NEST), serves as the Nation's last line of defense against a nuclear or radiological incident or accident. Leveraging the unique technical expertise within the nuclear security enterprise, NEST provides a flexible, scalable, and tailorable capability to prevent, respond to, and mitigate nuclear or radiological incidents both domestically and abroad. DOE/NNSA maintains a robust infrastructure for command, control, coordination, and communications of NEST's nuclear incident response assets, ensuring that response personnel are trained and equipped for rapid deployment in response to an incident or accident anywhere in the world. Specialized NEST response teams are prepared to support a variety of national security and public health and safety efforts, including threat-based nuclear search; searching for and recovering nuclear material outside of regulatory control; providing preventive nuclear and radiological detection

support to federal, state, and local public safety organizations for major public events; and radiological consequence management.

DOE/NNSA strengthens preparedness for all nuclear and radiological incidents, accidents, and terror threats posing a risk to the United States, its interests, the American people, and the international community. Domestically, DOE/NNSA partners with federal, state, and local officials to bolster their capabilities to respond to a nuclear or radiological threat or incident. As part of a robust strategy to protect the United States from any potential nuclear or radiological threat, DOE/NNSA also cooperates with partner countries and international organizations worldwide to strengthen their capacity to effectively address nuclear or radiological threats in their regions. To achieve this objective, DOE/NNSA organizes technical exchanges, joint technical experiments, workshops, exercises, technical assistance and support, policy development, and training with partners to address the full spectrum of nuclear or radiological threats. DOE/NNSA develops and maintains robust assessments of global security trends, risks, and requirements on an annual basis to plan, prioritize, and implement its counterterrorism and response activities.

FIGURE 12: NEST EQUIPMENT

NEST equipment used by regional CWMD teams to characterize and defeat nuclear and radiological threat devices

4.1.1 Future Plans

In fiscal year (FY) 2022 and over the next five years, DOE/NNSA will continue to address NEST's capability needs to sustain and enhance its readiness to respond to the full range of nuclear incident response missions to ensure national security and public health and safety. DOE/NNSA will continue to implement the "Capability Forward" initiative, providing training, equipment, and technical support to enhance the capabilities of the Federal Bureau of Investigation's (FBI) regional counter-weapons of mass destruction (CWMD) teams, accelerating life-saving responses to nuclear threats. The number of FBI regional CWMD teams in major American cities featuring these enhanced capabilities has grown from 12 to 14 teams in FY 2021.

DOE/NNSA will continue its NEST equipment recapitalization efforts, including continuing the procurement process to replace two aging Aerial Measuring System rotary-wing aircraft. It will also continue to invest in field-deployable secure communications and specialized personnel to ensure interoperability with CWMD mission partners.

DOE/NNSA will continue to advance U.S. nuclear threat reduction and emergency preparedness policy objectives through engagements with international organizations and foreign partners with the objective of bolstering global response capabilities and reinforcing mechanisms for cooperation. DOE/NNSA will conduct 50 virtual or in-person training events on topics including crisis communication, nuclear incident response, medical response, and security of major public events domestically and internationally to advance nuclear and radiological emergency preparedness and response capabilities.

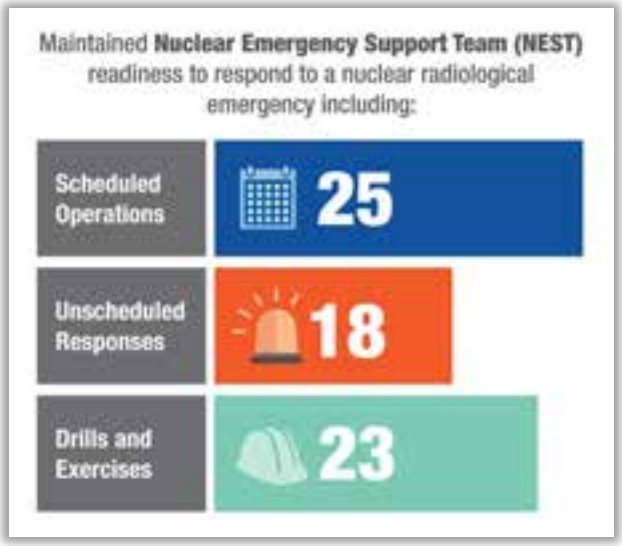
FY 2022 priorities include:

- Enhancing DOE/NNSA facilities to accommodate increased training requirements, including hazards associated with enhanced toolsets to defeat weapons of mass destruction, and integrating toolsets more effectively with FBI field team training.
- Increasing the number and scope of priority international training and outreach activities to continue to strengthen global capabilities to respond to a full range of nuclear and radiological threats and incidents.

4.1.2 Key Accomplishments

Despite the COVID-19 pandemic, DOE/NNSA was able to meet key objectives, maintain readiness, and strengthen and harmonize nuclear and radiological incident response. A key FY 2020 accomplishment follows:

- Continued to maintain NEST readiness to respond to a nuclear radiological emergency despite COVID-19 constraints, which included 25 scheduled operations, 18 unscheduled responses, and 23 drills and exercises.



4.2 Develop and maintain world-class nuclear forensics capabilities

Nuclear forensic capabilities encompass the scientific disciplines and operational assets that are used to determine the origin of nuclear materials interdicted outside of regulatory control or used in a nuclear device. The technical ability to attribute the source of illicit nuclear material constitutes an essential element of the U.S. Government's strategy to reinforce nuclear security norms, deter state support for nuclear terrorism, and hold adversaries accountable for nuclear incidents. The U.S. Government's nuclear forensic analytical capability resides primarily within the DOE national laboratories.

DOE/NNSA develops and maintains technical capabilities to analyze pre-detonation nuclear materials and devices and provides operational support to the post-detonation program and the Bulk Special Nuclear Materials Analysis Program. DOE/NNSA is prepared to respond with national laboratory expertise and deployable field teams when nuclear materials or devices are interdicted or a nuclear detonation occurs, providing technical analysis in support of the attribution process. DOE/NNSA contributions to the interagency National Technical Nuclear Forensics (NTNF) mission include training and exercises for responders; procurement, maintenance, logistics, and technical integration of equipment; readiness to deploy pre- and post-detonation response teams and device assessment teams; and laboratory analysis of nuclear or radiological material. DOE/NNSA also maintains the National Nuclear Material Archive (NNMA) to ensure historical samples of nuclear materials of value may be identified, prioritized, stored, and analyzed; this supports NTNF comparative analysis of interdicted materials and thus enhances technical nuclear forensics capabilities for attribution.

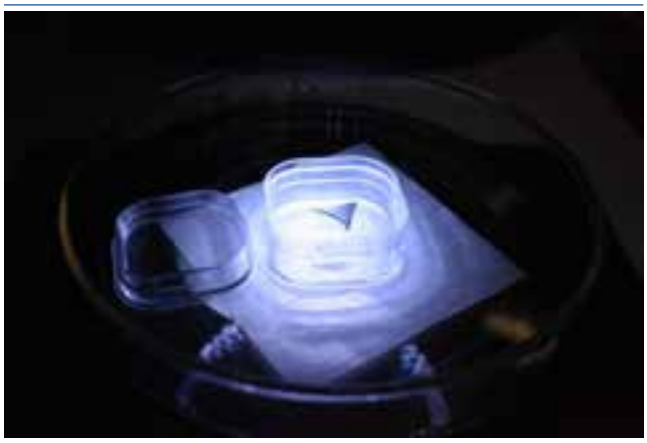
4.2.1 Future Plans

DOE/NNSA expects to assume the remaining nuclear forensics missions currently performed by the Department of Homeland Security's CWMD Office. This scope of work includes coordinating all interagency nuclear forensics activities through the National Nuclear Forensics Center and maintaining an expertise development pipeline to ensure the program continues to cultivate expert personnel in the future.

FY 2022 priorities include:

- Leading coordination of the U.S. Government agencies supporting response and assessment for technical nuclear forensics.
- Identifying, prioritizing, consolidating, and analyzing historical nuclear material samples of value to the technical nuclear forensics program within the NNMA.

FIGURE 13: NNMA SAMPLE



NNMA sample under microscope

4.2.2 Key Accomplishments

DOE/NNSA has seen tremendous success developing and maintaining its world-class forensics capabilities. A few key accomplishments from FY 2019-2021 follow:

- Participated in five nuclear forensics training exercises necessary to maintain the nation's capability to respond to and attribute WMD threats. Safely and successfully accomplished these demanding events in the face of COVID-19.
- Revised and implemented a new NNMA strategy to identify, analyze, and preserve specimens of forensics value and identified initial nuclear material inventory items needed for the NNMA at DOE/NNSA locations.
- Developed and implemented an NNMA specimen management system that tracks specimens as they progress through the three NNMA phases of identify, analyze, and preserve.
- Purchased additional nuclear forensics analysis equipment to increase the analytical capacity for NNMA specimens.

4.3 Lead an enterprise-wide emergency management approach

DOE/NNSA's Emergency Operations provides the structure and processes to prevent, prepare for, protect from, respond to, recover from, and mitigate all-hazards emergencies that threaten life and property, or the environment. In addition, DOE/NNSA provides the framework for building, assessing, and improving organizational resilience to ensure uninterrupted performance and delivery of the Department's Essential Functions in accordance with Presidential Policy Directive (PPD) 8, National Preparedness; PPD-40, National Continuity Policy; Executive Order 13961, Governance and Integration of Federal Mission Resilience; and the *National Nuclear Security Administration Act*.

Tasked to ensure a comprehensive and integrated approach to emergency management and continuity of operations, DOE/NNSA Emergency Operations:

- Develops and implements emergency management policy, directives, guidance, and plans for DOE and NNSA.
- Assists headquarters, field elements, and facility contractors in implementing effective emergency management programs in compliance with DOE policies.
- Leads exchange of management and operating partner best practices via the Emergency Management Issues Special Interest Group.
- Implements, manages, and coordinates a readiness assurance program to ensure DOE is prepared to respond to any all-hazards emergency.
- Develops, leads, and evaluates national level emergency management exercises;
- Performs periodic oversight functions on behalf of Field Element Managers in accordance with DOE/NNSA's Chief of Defense Nuclear Safety.
- Facilitates cross-cutting emergency management related collaboration via the Federal Officials Emergency Management Advisory Committee.

Emergency Operations at a Glance

- Provides both the structure and processes to ensure a comprehensive and integrated Enterprise approach to emergency management and continuity of operations
- Safeguards the health and safety of workers and the public, protects the environment, and enhances the resilience of the Department and the Nation
- Assists headquarters, field element and facility contractors in implementing effective emergency management programs in compliance with DOE policies
- Serves as DOE/NNSA's nucleus for 24/7 information exchange and collaboration vital to the management, direction, and response to all-hazards emergencies
- Assists the Secretary of Energy and NNSA Administrator in executing National Continuity Policy

As DOE/NNSA's conduit for several unique and mandated Emergency Management and Continuity capabilities, Emergency Operations:

- Operates and manages the Secretary's primary emergency operations center, (referred to as the Consolidated Emergency Operations Center [CEOC]).
- Ensures senior DOE and NNSA officials, and Field and Site Managers are kept fully and currently informed about emergency matters.
- Serves as Unified Coordination Structure Activation and Coordination Element.
- Executes DOE and NNSA Continuity of Operations (COOP), Continuity of Government (COG), and Enduring Constitutional Government programs to advance the National Continuity Policy and recently promulgated Federal Mission Resilience Strategy.
- Ensures availability and interoperability of continuity communications systems across DOE/NNSA and the interagency.

- Deploys continuity capabilities during with-notice or no-notice emergencies and National Special Security Events, including the Presidential Inauguration and State of the Union Address.
- Advances implementation of the Federal Mission Resilience Strategy across the DOE/NNSA enterprise.

4.3.1 Future Plans

DOE/NNSA Emergency Operations constitutes a major element of DOE's current and future all-hazards emergency management capability and is an integral part of both the National Preparedness and National Continuity Systems. Encompassing a range of roles and responsibilities, Emergency Operations will ensure DOE, including NNSA, can respond promptly, efficiently, and effectively to any emergency involving or affecting DOE or NNSA laboratories, plants, sites, offices, or activities while promoting unity of effort and a coordinated Federal response to events of such magnitude as to be capable of impacting the resilience of the Department or the Nation.

FY 2022 priorities include:

- Promulgating emergency management personal qualification standards and expanding technical qualification programs.
- Updating and validating emergency management and COOP directives, guides, and technical planning basis standards.
- Developing and maintaining Enterprise Threat and Hazard Risk Profile.
- Maturing the Emergency Management Readiness Assurance Reporting Program.
- Leading the design and development of DOE's participation in the continuity exercise Eagle Horizon 2022.
- Ensuring interoperability of continuity communications systems across DOE/NNSA and with interagency partners.
- Leading, managing, and operating the DOE/NNSA CEOC, improving integration of, and coordination with, the various DOE and NNSA operations centers and the interagency.
- Institutionalizing and integrating the December 2020 Federal Mission Resilience Strategy into departmental day-to-day operations.

FIGURE 14: FEDERAL MISSION RESILIENCE

Existing Continuity Policy	Evolving Continuity/Resilience	Federal Mission Resilience
A rapid and effective **response to and recovery from** a catastrophic emergency.	Proactive COOP efforts that reduce risk to essential functions and COG.	Continuity and risk management incorporated into all aspects of preparedness planning, operations, and day-to-day mission performance.
A planning model that uses the **existing geographic dispersion** of the executive branch.	Plans and agreements that leverage Federal executive branch geographic dispersion to reduce risk.	Routine and seamless transfer of Federal executive branch essential functions and services and decision support without the need to relocate personnel.
The ability to be **fully operational at alternate locations as soon as possible, but not more than 12 hours after COOP activation.**	The ability to reduce downtime of essential functions and services to near zero, through the better use of existing locations and/or sustained use of devolution sites.	The ability to ensure uninterrupted decision-making authority, continuously provide essential functions and services, and deliver uninterrupted decision support services to the President.
Budget resources are required to meet continuity requirements.	Establish fiscal policy for Federal Mission Resilience that includes continuity, preparedness, and risk management.	Established Federal executive branch fiscal policy that enables risk management decisions based on impacts to National Essential Functions.
Implementation **based on warning with a bias toward kinetic incidents.**	Account for non-kinetic impacts to critical infrastructure and communications.	Multiple geographically and technologically diverse communication nodes form a resilient mesh.

4.3.2 Key Accomplishments

DOE/NNSA worked in concert with laboratories, plants, and sites across the enterprise to improve overall readiness and resilience of the Emergency Management System. In the face of the COVID-19 pandemic, DOE/NNSA successfully integrated an enterprise-wide emergency management approach. Key accomplishments from FY 2020 and FY 2021 follow:

- Led DOE/NNSA's COVID-19 pandemic emergency management response and recovery efforts.
- Acted as a key participant in the NNSA Enduring Organizational Improvement Initiative tasked to identify and implement long-term improvements to the NNSA's efficiency and effectiveness based upon COVID-19 lessons learned.
- Led Federal Mission Resilience efforts across the Department and the interagency to ensure the Federal Executive Branch has the capacity to perform essential functions and services regardless of threats or conditions.
- Activated continuity communications systems across DOE/NNSA and with interagency partners during several National Special Security Events, validating the resilience and redundancy of numerous tiers of communications capabilities.
- Revised and updated emergency management and continuity orders, directives, guides, and technical planning basis standards, rapidly and effectively translating revisions into national-level guidance into updated DOE/NNSA guidance documents.

Leading DOE/NNSA's COVID-19 pandemic emergency management response and recovery planning

On March 13, 2020, the President of the United States declared the Coronavirus Pandemic a National Emergency.

Based upon information provided to DOE/NNSA senior leadership in the weeks prior to the Presidential Declaration, on February 27, 2020, DOE/NNSA Emergency Operations convened the DOE/NNSA Unified Coordination Group, developed the Department's initial Pandemic Response Lines of Effort, and established and steered priority actions of the DOE COVID-19 Pandemic Task Force.

Following conclusion of priority Task Force actions, and successful distribution of Departmental day-to-day operations to a telework environment, the DOE/NNSA Deputy Under Secretary and Associate Administrator for Emergency Operations directed establishment of a steady state Pandemic situational awareness and information sharing capability. Over the ensuing months, Emergency Operations:

- Established and led the DOE/NNSA COVID-19 Workplace Recovery Working Group;
- Provided medical threat and risk reporting to the DOE Threat Working Group;
- Provided supporting medical threat analysis to the DOE Biological Event Monitoring Team;
- Produced and provided over 500 Infectious Disease Threat Assessments, Pandemic Situation Reports, and COVID-19 Senior Leadership Briefings;
- Developed and delivered a comprehensive COVID-19 Common Operating Picture to all headquarters elements, laboratories, plants, and sites, and the interagency;
- Authored the *COVID-19 Pandemic, Interim Events Reconstruction Report*;
- Authored the COVID-19 Workforce Safety and Well-Being Checklist;
- Authored the COVID-19 Workspace Readiness Checklist;
- Developed and delivered the DOE Reopening Reporting Criteria, informing the Department's national Return-to-Workplace posture;
- Developed the National Capitol Region Phase Line Recovery Report, informing the Department's Return-to-Workplace posture in the National Capitol Region; and,
- Drafted substantial portions of DOE/NNSA's COVID-19 Recovery Plan.



CHAPTER 5

Conclusion

5.0 Conclusion

The *Prevent, Counter,* and *Respond* functional areas described in this plan form the overarching framework for the activities that DOE/NNSA pursues to address global nuclear and radiological threats in support of U.S. Government policies and priorities. Looking ahead, DOE/NNSA will continue to reduce these threats through programs that:

- Eliminate, remove, and minimize weapons-usable nuclear and radioactive materials;
- Secure nuclear and radioactive materials and facilities;
- Control the spread of materials, technology, and expertise;
- Develop leading edge proliferation detection capabilities;
- Verify that international treaty and other obligations are being met;
- Build scientific and technical understanding of nuclear and radiological threat devices;
- Impede the efforts of proliferant states to obtain nuclear capabilities;
- Maintain readiness; strengthen and harmonize nuclear and radiological incident response;
- Develop and maintain world-class nuclear forensics capabilities; and
- Lead enterprise-wide emergency management approach.

DOE/NNSA also will focus on arms control and other challenges posed by Russia and China, monitoring nuclear noncompliance by the Democratic People's Republic of Korea and Iran, and harnessing civil nuclear technology to achieve a clean energy transformation while minimizing proliferation risks.

Maintaining a world-class workforce and infrastructure—at DOE headquarters, and across the laboratories, plants, and sites of the nuclear security enterprise—with renewed resilience post-COVID-19 will be key to continuing NNSA's record of mission accomplishment. Strong partnerships, both domestically with U.S. industry and other government agencies and internationally with bilateral, regional, and multilateral organizations such as the International Atomic Energy Agency, will be catalysts for future success.

Historically, unanticipated events have occurred that required a realignment of the U.S. nuclear nonproliferation and national security posture. By adopting a proactive, analytic posture that regularly looks to identify, characterize, and prepare for emerging trends and risks, DOE/NNSA will be as prepared as possible to quickly respond to unanticipated events when they occur.



CHAPTER 6

Appendices

6.0 Appendices

Appendix A: Table of Figures

Appendix B: List of Acronyms

ANL	Argonne National Laboratory
AP	Additional Protocol
BNL	Brookhaven National Laboratory
CCO	Criticality Control Overpack
COG	Continuity of Government
COOP	Continuity of Operations
CTBTO	Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization
CWC	Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction (Chemical Weapons Convention)
CWMD	Counter-Weapons of Mass Destruction
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
DOS	Department of State
DPRK	Democratic People's Republic of Korea
FBI	Federal Bureau of Investigation
FY	fiscal year
GACC	General Administration of China Customs
CBD	Global Burst Detector
GICNT	Global Initiative to Combat Nuclear Terrorism
GMS	Global Material Security
HALEU	High Assay low-enriched uranium
HEU	highly enriched uranium
IAEA	International Atomic Energy Agency
IND	improvised nuclear device
INF	Intermediate-Range Nuclear Forces Treaty
INL	Idaho National Laboratory
INTERPOL	International Criminal Police Organization
JCPOA	Joint Comprehensive Plan of Action
LANL	Los Alamos National Laboratory
LEU	low-enriched uranium
LLNL	Lawrence Livermore National Laboratory
LTBT	Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water (Limited Nuclear Test Ban Treaty)
M3	Material Management and Minimization
M&O	management and operating
Mo-99	Molybdenum-99

MT	metric tons
New START	Treaty Between the United States of America and the Russian Federation on Measures for Further Reduction and Limitation of Strategic Offensives Arms (New Strategic Arms Reduction Treaty)
NEST	Nuclear Emergency Support Team
NNMA	National Nuclear Material Archive
NNSA	National Nuclear Security Administration
NNSS	Nevada National Security Site
NPAC	Nonproliferation and Arms Control
NPT	Treaty on the Non-proliferation of Nuclear Weapons (Nuclear Non-Proliferation Treaty)
NRC	Nuclear Regulatory Commission
NTNF	National Technical Nuclear Forensics
ORNL	Oak Ridge National Laboratory
P3	France, United Kingdom, United States
PMDA	Agreement between the Government of the United States of America and the Government of the Russian Federation Concerning the Management and Disposition of Plutonium Designated as No Longer Required for Defense Purposes and Related Cooperation (U.S.-Russia Plutonium Management and Disposition Agreement)
PNNL	Pacific Northwest National Laboratory
PPD	Presidential Policy Directive
PPRA	Agreement between the Government of the United States of America and the Government of the Russian Federation Concerning Cooperation Regarding Plutonium Production Reactors (U.S.-Russian Federation Plutonium Production Reactor Agreement)
R&D	research and development
RDD	radiological dispersal device
RED	radiological exposure device
SNL	Sandia National Laboratories
SNM	special nuclear material
SRS	Savannah River Site
TTBT	Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Limitation of Underground Nuclear Weapon Tests (Threshold Nuclear Test Ban Treaty)
UK	United Kingdom
UN	United Nations
U.S.	United States
U.S.C.	United States Code
WIPP	Waste Isolation Pilot Plant
WMD	weapons of mass destruction
WUNM	weapons-usable nuclear material

Appendix C: Requirements Mapping

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

50 U.S.C. § 2575	NNSA Response
(a) Plan Required. -- The Administrator shall develop and annually update a five-year management plan for activities associated with the defense nuclear nonproliferation programs of the Administration to prevent and counter the proliferation of materials, technology, equipment, and expertise related to nuclear and radiological weapons in order to minimize and address the risk of nuclear terrorism and the proliferation of such weapons.	N/A
(b) Submission to Congress. – (1) Not later than March 15 of each even-numbered year, the Administrator shall submit to the congressional defense committees a summary of the plan developed under subsection (a).	N/A
(2) Not later than March 15 of each odd-numbered year, the Administrator shall submit to the congressional defense committees a detailed report on the plan developed under subsection (a).	N/A
(3) Each summary submitted under paragraph (1) and each report submitted under paragraph (2) shall be submitted in unclassified form, but may include a classified annex if necessary.	N/A
(c) Elements.---The plan required by subsection (a) shall include, with respect to each defense nuclear nonproliferation program of the Administration, the following:	N/A
(1) A description of the policy context in which the program operates, including---	N/A
(A) a list of relevant laws, policy directives issued by the President, and international agreements; and	Appendix D
(B) nuclear nonproliferation activities carried out by other Federal agencies.	Sections 2.3.2, 2.4.2, 2.5.2, 3.2.2, 4.3.2
(2) A description of the objectives and priorities of the program during the year preceding the submission of the summary required by paragraph (1) of subsection (b) or the report required by paragraph (2) of that subsection, as the case may be.	Sections 1.4, 1.4.1, 1.4.2, 1.4.3, 1.4.4, 1.4.5, 1.4.6
(3) A description of the activities carried out under the program during that year.	Sections 2.1.2, 2.2.2, 2.3.2, 2.4.2, 2.5.2, 3.1.2, 3.2.2, 4.1.2, 4.2.2, 4.3.2
(4) A description of the accomplishments and challenges of the program during that year, based on an assessment of metrics and objectives previously established to determine the effectiveness of the program.	Sections 1.2, 1.5, 1.5.1, 1.5.2, 1.5.3, 2.1.2, 2.2.2, 2.3.2, 2.4.2, 2.5.2, 3.1.2, 3.2.2, 4.1.2, 4.2.2, 4.3.2,
(5) A description of any gaps that remain that were not or could not be addressed by the program during that year.	Section 1.5.3

50 U.S.C. § 2575	NNSA Response
(6) An identification and explanation of uncommitted or uncosted balances for the program, as of the date of the submission of the summary required by paragraph (1) of subsection (b) or the report required by paragraph (2) of that subsection, as the case may be, that are greater than the acceptable carryover thresholds, as determined by the Secretary of Energy.	Appendix G
(7) An identification of funds for the program received through contributions from or cost-sharing agreements with foreign governments consistent [sic] section 2569(f) of this title during the year preceding the submission of the summary required by paragraph (1) of subsection (b) or the report required by paragraph (2) of that subsection, as the case may be, and an explanation of such contributions and agreements.	Appendix E
(8) A description and assessment of activities carried out under the program during that year that were coordinated with other elements of the Department of Energy, with the Department of Defense, and with other Federal agencies, to maximize efficiency and avoid redundancies.	Sections 2.3.2, 2.4.2, 2.5.2, 3.2.2, 4.3.2
(9) Plans for activities of the program during the five-year period beginning on the date on which the summary required by paragraph (1) of subsection (b) or the report required by paragraph (2) of that subsection, as the case may be, is submitted, including activities with respect to the following:	N/A
(A) Preventing nuclear and radiological proliferation and terrorism, including through—	N/A
(i) material management and minimization, particularly with respect to removing or minimizing the use of highly enriched uranium, plutonium, and radiological materials worldwide (and identifying the countries in which such materials are located), efforts to dispose of surplus material, converting reactors from highly enriched uranium to low-enriched uranium (and identifying the countries in which such reactors are located);	Section 2.1.1
(ii) global nuclear material security, including securing highly enriched uranium, plutonium, and radiological materials worldwide (and identifying the countries in which such materials are located), and providing radiation detection capabilities at foreign ports and borders;	Sections 2.2.1, 2.3.1
(iii) nonproliferation and arms control, including nuclear verification and safeguards;	Sections 2.3.1, 2.4.1
(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	Sections 2.4.1, 2.5.1
(v) nonproliferation construction programs, including activities associated [sic]Department of Energy Order 413.1 (relating to program management controls).	Sections 1.5.2, 2.1.1

50 U.S.C. § 2575	NNSA Response
(B) Countering nuclear and radiological proliferation and terrorism.	Sections 2.2.2, 2.3.2, 3.1.1, 3.1.2, 4.1.2, 4.2.2
(C) Responding to nuclear and radiological proliferation and terrorism, including through— (i) crisis operations; (ii) consequences management; and, (iii) emergency management, including international capacity building.	Sections 4.1.1, 4.2.1, 4.3.1
(10) A threat assessment, carried out by the Intelligence Community (as defined in section 3003(4) of this title), with respect to the risk of nuclear and radiological proliferation and terrorism and a description of how each activity carried out under the program will counter the threat during the five-year period beginning on the date on which the summary required by paragraph (1) of subsection (b) or the report required by paragraph (2) of that subsection, as the case may be, is submitted and, as appropriate, in the longer term.	Section 1.2
(11) A plan for funding the program during that five-year period.	Appendix F
(12) An identification of metrics and objectives for determining the effectiveness of each activity carried out under the program during that five-year period.	Section 1.3, 2.1, 2.2, 2.3, 2.4, 2.5, 3.1, 3.2, 4.1, 4.2, 4.3
(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).	Sections 1.2, 2.1.1, 2.2.1, 2.3.1, 2.4.1, 2.5.1, 3.1.1, 3.2.1, 4.1.1, 4.2.1, 4.3.1
(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.	Sections 2.2.1, 2.3.1, 2.4.1, 2.5.1, 3.1.1, 3.2.1, 4.1.1, 4.2.1, 4.3.1
(15) A summary of the technologies and capabilities documented under section 2576(a) of this title.	Section 2.5.2
(16) A summary of the assessments conducted under section 2576(b)(1) of this title.	Section 2.5.1
(17) Such other matters as the Administrator considers appropriate.	N/A

Appendix D: Relevant Laws, Policy Directives, and International Agreements

The nuclear and radiological threat reduction activities of the Department of Energy's National Nuclear Security Administration (DOE/NNSA) operate within the context of many laws, Presidential Policy Directives (PPD), and international agreements and instruments. The most significant of these are listed below.

Laws

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

Presidential Policy

- PPD-8: National Preparedness.
- NSPM-35: National Technical Nuclear Forensics.
- NSPM-36: Guidelines for United States Government Interagency Response to Terrorist Threats or Incidents in the United States and Overseas (classified directive).
- PPD-33: Detection of Nuclear Proliferation (classified directive).
- PPD-35: Weapons Command and Control, Safety, and Security.
- PPD-40: National Continuity Policy.
- PPD-42: Preventing and Countering Weapons of Mass Destruction Proliferation, Terrorism, and Use.

International Agreements and Other International Instruments

- Agreement Between the Government of the United States of America and the Government of the French Republic for Cooperation in the Operation of Atomic Weapons Systems for Mutual Defense Purposes.
- Agreement Between the Government of the United States of America and the Government of the Russian Federation Concerning Cooperation Regarding Plutonium Production Reactors, and the Amendment thereto.
- Agreement Between the Government of the United States of America and the Government of the Russian Federation Concerning the Management and Disposition of Plutonium Designated as No

Longer Required for Defense Purposes and Related Cooperation, with Annexes and Joint Statement, and Amendments thereto (also known as the U.S.-Russia Plutonium Management and Disposition Agreement or PMDA, currently unilaterally suspended by the Russian Federation).

- Agreement Between the Government of the United States of America and the Government of the Russian Federation on Cooperation in Nuclear- and Energy-Related Scientific Research and Development.
- Agreement Between the Government of the United States of America and the Government of the United Kingdom of Great Britain and Northern Ireland for Cooperation on the Uses of Atomic Energy for Mutual Defence Purposes.
- Agreement between the United States of America and the International Atomic Energy Agency for the Application of Safeguards in the United States (and the Protocol Additional Thereto).
- Agreements for Peaceful Nuclear Cooperation pursuant to Section 123 of the *Atomic Energy Act* of 1954, as amended (Numerous).
- Convention on the Physical Protection of Nuclear Material and its 2005 Amendment.
- Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency.
- Convention on Early Notification of a Nuclear Accident.
- Comprehensive Nuclear-Test-Ban Treaty. (Note: The United States has signed this treaty but has not ratified it. The treaty has not entered into force.)
- Convention on the Physical Protection of Nuclear Material and its 2005 Amendment.
- International Convention on the Suppression of Acts of Nuclear Terrorism.
- Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.
- Nuclear Security Summit 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 Limitation of Underground Nuclear Weapon Tests (also known as the TTBT).
- Treaty on the Non-Proliferation of Nuclear Weapons.
- United Nations Security Council Resolution 1540.

Appendix E: Foreign Contributions and Cost-Sharing Agreements

DOE is authorized to accept international contributions for any programs within the Office of Defense Nuclear Nonproliferation (DNN). During fiscal year (FY) 2020, DNN received a total of $13,298,143 (U.S. dollar equivalent) from four international contributors.

Foreign Government Contributions Received

FY	Program for Cooperation	Partner	Contributions (whole dollars)
2020	Global Material Security (GMS)	Canada	$7,721,370
2020	GMS	United Kingdom	$4,747,959
2020	GMS	Norway	$543,534
2020	GMS	Finland	$285,280
Total FY 2020			**$13,298,143**

Amount and Use of Foreign Contributions

International Contributor	Amount/Date Received	Use
Global Material Security		
Norway	$489,716 5/11/2020	Funds supported equipment procurement for Green Border Security Initiative work in Belarus to reduce the threat of illicit trafficking through the Chernobyl Exclusion Zone.
Finland	$285,280 5/15/2020	Funds were used to support Green Border Security Initiative in Ukraine at six checkpoints to increase security at administrative lines around temporarily uncontrolled territories.
Canada	$2,214,859 6/23/2020	Funds were used to support the provision of mobile detection systems for the Mexico National Guard to increase capability to detect and deter smuggling of nuclear and radioactive material.

Amount and Use of Foreign Contributions, Continued

International Contributor	Amount/Date Received	Use
Global Material Security		
Norway	$53,818 7/20/2020	Funds were used conduct a tabletop exercise (TTX) in support of efforts to increase the Moldovan National Police's capacity to provide adequate and timely response to security incidents at critical radiological facilities. This effort complements ongoing international efforts to enhance the security of the Moldovan National Waste Repository and to provide critical monitoring capabilities and response training to the National Police.
Canada	$3,720,640 7/27/2020	Funds were used to strengthen the capability of Georgian security agencies to detect and interdict illicitly trafficked nuclear and radioactive materials from contested areas of Georgia, which will result in a reduced threat to the population of Georgia and neighboring countries.
Canada	$892,953 7/27/2020	Funds were used to strengthen the capability of Sri Lankan security agencies to detect and interdict illicitly trafficked nuclear and radioactive materials from neighboring countries of proliferation concern, which will result in a reduced threat to the population of Sri Lanka and other populations connected through this main international airport.
Canada	$892,918 7/29/2020	Funds were used for upgrades, regulatory development, inspections, site security plans, and response training in Malaysia and Thailand.

Amount and Use of Foreign Contributions, Continued

International Contributor	Amount/Date Received	Use
Global Material Security		
United Kingdom	$4,747,959 8/3/2020	Funds were used for physical security upgrades at nuclear facilities in the Democratic Republic of Congo and Ukraine, as well as a Regional Insider Threat Mitigation workshop in Nigeria; for Belarus Green Borders Support; and for Belarus Temporary Radiological Source Storage Facility and Burma Radiological Source Security.

Amounts Retained

During FY 2020, DNN used $13,298,143 (U.S. dollar equivalent) for designated projects. None of the foreign funding contributions that were received in FY 2020 have been retained.

Appendix F: FY 2022 Program Plan

The information included in Appendix F comes directly from the Department of Energy FY 2022 Congressional Budget Request, Volume 1: National Nuclear Security Administration.

Table 1. Defense Nuclear Nonproliferation Funding by Congressional Control

(Dollars in Thousands)

	FY 2020 Enacted	FY 2021 Enacted	FY 2022 Request	FY 2022 Request vs FY 2021 Enacted ($)	FY 2022 Request vs FY 2021 Enacted (%)
Defense Nuclear Nonproliferation Appropriation					
Defense Nuclear Nonproliferation					
Material Management and Minimization					
HEU Reactor Conversion	99,000	0	0	0	0%
Conversion	0	110,000	100,660	-9,340	-8.5%
Nuclear Material Removal	32,925	40,000	42,100	+2,100	+5.3%
Material Disposition	186,608	190,711	200,186	+9,475	+5.0%
Laboratory and Partnership Support	45,000	60,000	0	-60,000	0%
Total, Material Management and Minimization	**363,533**	**400,711**	**342,946**	**-57,765**	**-14.4%**
Global Material Security [a]					
International Nuclear Security	58,000	78,939	79,939	+1,000	+1.3%
Domestic Radiological Security	147,002	185,000	158,002	-26,998	-14.6%
International Radiological Security	78,907	90,000	85,000	-5,000	-5.6%
Nuclear Smuggling Detection	159,000	175,000	175,000	0	0%
Total, Global Material Security	**442,909**	**528,939**	**497,941**	**-30,998**	**-5.9%**
Nonproliferation and Arms Control	**140,000**	**148,000**	**184,795**	**+36,795**	**+24.9%**
National Technical Nuclear Forensics R&D	**0**	**40,000**	**0**	**-40,000**	**-100.0%**
Defense Nuclear Nonproliferation R&D					
Proliferation Detection	299,046	255,000	269,407	+14,407	+5.6%
Nuclear Detonation Detection	196,617	267,000	271,000	+4,000	+1.5%
Nonproliferation Fuels Development	15,000	20,000	0	-20,000	-100.0%
National Technical Nuclear Forensics	0	0	45,000	+45,000	0%
Nonproliferation Stewardship Program	22,500	59,900	87,329	+27,429	+45.8%
Total, Defense Nuclear Nonproliferation R&D	**533,163**	**601,900**	**672,736**	**+70,836**	**+11.8%**
Nonproliferation Construction					
18-D-150, Surplus Plutonium Disposition Project	79,000	148,589	156,000	+7,411	+5.0%
99-D-143, Mixed Oxide (MOX) Fuel Fabrication Facility, SRS	220,000	0	0	0	0%
Total, Nonproliferation Construction	**299,000**	**148,589**	**156,000**	**+7,411**	**+5.0%**
Total, Defense Nuclear Nonproliferation Programs	**1,778,605**	**1,868,139**	**1,854,418**	**-13,721**	**-0.7%**

[a] The international contributions received by the GMS program shown in the FY 2020 Enacted column are a non-add. The amount received in FY 2020 totaled $13,298,143, including $543,534 from Norway, $285,280 from Finland, $7,721,370 from Canada and $4,747,959 from the United Kingdom.

Appendix G: Analysis and Explanation of FY 2020 Uncosted Balances

Background

When Congress appropriates funding for DOE programs, most funding remains available until expended. For NNSA's nuclear threat reduction programs, this can lead to funds that have not been costed by the end of one fiscal year being carried over into the subsequent fiscal year. In some cases, these carry-over balances are appropriate given the nature of the long-term aspects of the Department's nonproliferation efforts, and the balances are managed and tracked as part of the Department's financial management system.

For financial management of program execution, DOE uses best practices from the Government Accountability Office (GAO). In 1996, GAO reviewed DOE execution and raised concerns regarding the level of uncosted balances. As a result, GAO recommended, in part, "developing standard goals for all programs' carryover balances…[and] comparing the programs' goals and projected carryover balances to identify the balances that exceed requirements." Although not formalized, in response, DOE/NNSA now uses the recommendations from this report as a best practice for uncosted thresholds across multiple categories of spending (e.g., funding for major contractors, construction projects, and programs) to identify levels of carryover balances appropriate to supporting program and project goals. The thresholds provide parameters for review and an analysis framework. In particular, these thresholds are not meant as a minimum.[5] However, balances above the threshold receive more intensive review to determine their cause and to identify the expectation for full costing. GAO provided assistance in updating thresholds in 2014-2015, and as a result the thresholds were revised. On a periodic basis, DOE/NNSA assesses all uncosted carryover, particularly the balances above the recommended thresholds that are considered excess to program and project requirements. When balances are identified that are above these thresholds, the above threshold amounts can be used to address emergent issues during the year of execution consistent with reprogramming guidelines, and also for formulating future program budget requests.

As per the requirements in the *National Defense Authorization Act for Fiscal Year 2016*, Sec. 3132 (50 U.S.C. § 2575(c)(6)), DNN reports to Congress annually on any uncommitted or uncosted balances that exceed these thresholds. Uncommitted, or "unencumbered" balances include funds that have been obligated but not yet costed nor encumbered. Funds are "encumbered" through the award of direct contracts to non-management and operating (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 encumbered, rather than just the percentage of funds that have been costed, because a great deal of the program's work involves multi-year projects, or 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 not provide an accurate picture of the program's progress.

[5] GAO's recommendation specifically states, "A target threshold is defined as an analytical reference point (i.e., a specific dollar value or percentage of funds available) beyond which uncosted obligation balances should be given greater scrutiny."

Overview of DNN Balances

At the end of FY 2020, the aggregate program costs plus encumbrances for DNN were 75.8 percent of total costing authority, leaving 24.2 percent available in:

- The International Material Protection and Cooperation Program (IMPC) (a past program now reorganized into the GMS Program, which has remaining uncosted unencumbered prior year funds on account)
- The Global Material Security Program (GMS)
- Defense Nuclear Nonproliferation Research and Development (DNN R&D)
- The Material Management and Minimization Program (M3)
- The Nonproliferation and Arms Control Program (NPAC)

Details on the balances for each budget element, explanations for the balances, and a table showing FY 2020 budget execution data in detail are provided below.

International Material Protection and Cooperation: (Total Uncosted $42.8 million, [$21.11 million encumbered, $21.7 million unencumbered])

At the end of FY 2020, International Material Protection and Cooperation costs plus encumbrances totaled $51.2 million, or 70.2 percent of total FY 2020 available funds. The uncosted balance total of $42.8 million (of which $21.1 million, representing 29.8 percent of available FY 2020 funds, was encumbered) exceeded the recommended threshold by $12.0 million. The $21.7 million in FY 2020 unencumbered balances support accelerated nuclear security engagement with international partners to protect, mitigate vulnerabilities and sustain security at nuclear sites and to support multilateral activities with the IAEA to improve nuclear security globally and the funds will also be used to support radiation detection sustainability efforts, including equipment testing and maintenance, workshops, and exercises in multiple countries.

Global Material Security: (Total Uncosted $483.2 million, [$291.2 million encumbered, $192.0 million unencumbered])

At the end of FY 2020, GMS costs plus encumbrances totaled $726.2 million, or 79.1 percent of total FY 2020 available funds. The uncosted balance total of $483.2 million (of which $291.2 million, representing 20.9 percent of available FY 2020 funds, was encumbered) exceeded the recommended threshold by $60.9 million. The $192.0 million in FY 2020 unencumbered balances support three critical programs within GMS; (1) International Nuclear Security; (2) Radiological Security; and (3) Nuclear Smuggling Detection and Deterrence.

International Nuclear Security Program

The unencumbered balances for the International Nuclear Security Program ($101.6 million) support accelerated nuclear security engagement with international partners to protect, mitigate vulnerabilities and sustain security at nuclear sites and to support multilateral activities with the IAEA to improve nuclear security globally.

Radiological Security Program

The unencumbered balances for the Radiological Security Program ($53.1 million) support continued work with domestic and international partners to secure high-risk radioactive

materials. The balance includes $17.0 million of funding for a training facility at Y-12 National Security Complex and $6.0 million to cover a portion of the expected remediation costs at the University of Washington following a cesium contamination incident.

Nuclear Smuggling Detection and Deterrence Program

The unencumbered balances for the Nuclear Smuggling Detection and Deterrence Program ($37.4 million) did not exceed the recommended threshold. Balances will support high-priority activities in FY 2021, including acceptance testing, site assurance visits, workshops and exercises, and maintenance contracts.

International Contributions

The unencumbered balances for International Contributions (UK, Canada and Norway) ($5.8 million) support the removal of approximately 40 Canadian-origin high-activity radioactive sources from Mexico, conducting tabletop exercise (TTX) in support of efforts to increase the Moldovan National Police's capacity to provide timely response to security incidents and funds for Jordan and Ukraine Physical Protection Upgrades, Transportation Security in Africa and Insider Threat Mitigation.

Defense Nuclear Nonproliferation Research and Development: (Total Uncosted $260.3 million, [$89.4 million encumbered, $170.9 million unencumbered])

At the end of FY 2020, DNN R&D costs plus encumbrances totaled $636.6 million, or 78.8 percent of total FY 2020 available funds. The uncosted balance total of $260.3 million (of which $89.4 million, representing 21.2 percent of available FY 2020 funds, was encumbered) exceeded the recommended threshold by $33.9 million. The $170.9 million in FY 2020 unencumbered balances are allocated to planned and approved work scope primarily at the national laboratories. They are spent at appropriate rates for the types of work conducted, as specified in approved Life Cycle Plans for each project defining their work scope and timeline against funds. These funds will support long-lead (8–24 months) procurements, major field experiments and demonstrations, space-based nuclear detonation detection satellite payload interagency integration activities, major lab equipment purchases, and payment of laboratory salaries.

Material Management and Minimization: (Total Uncosted $331.4 million, [$144.1 million encumbered, $187.3 million unencumbered])

At the end of FY 2020, M3 costs plus encumbrances totaled $431.2 million, or 69.7 percent of total FY 2020 available funds. The uncosted balance total of $331.4 million (of which $144.1 million, representing 30.3 percent of available FY 2020 funds, was encumbered) exceeded the recommended threshold by $63.3 million. The $187.3 million in FY 2020 unencumbered balances support four critical programs within M3: (1) Conversion; (2) Nuclear Material Removal; (3) Material Disposition; and (4) Laboratory and Partnership Support.

Conversion Program

The unencumbered balances for the Reactor Conversion Program ($42.3 million) support completing post-irradiation examination activities at Idaho National Laboratory on various irradiation campaigns (MP-1, EMPIrE, and KJRR), planning and design activities for future irradiation experiments, irradiation costs for the FUTURE-HFIR experiment, fuel fabrication

optimization activities, and reactor conversion analyses and other cross-cutting activities to support the conversion of USHPRRs; and new projects, including PRO-X and a DNN-level priority effort in South Africa; and annual modeling and code maintenance and updates at ANL as well as server updates to support reactor conversion.

Nuclear Material Removal Program

The unencumbered balances for the Nuclear Material Removal Program ($25.8 million) continue to support the Mobile Melt-Consolidate System, ongoing and future nuclear material removal campaigns from Asia, the Relentless Rook and Peregrine Falcon exercises that support the Mobile Uranium Facility and Mobile Plutonium Facility readiness, and contractor labor and travel to support future nuclear material removals.

Material Disposition Program

The unencumbered balances for the Material Disposition Program ($110.4 million) support U.S. Plutonium Disposition—$95.2 million at multiple sites to continue program management and integration activities, including Strategic Laboratory Assessment (SLA)/Robotics and NEPA activities; surplus pit management activities; pit disassembly and processing activities; maintenance of the WSB facility; disposition of MOX legacy materials; dilute and waste characterization technical activities; geological repository disposal program management and operational enhancement activities; and ramping up operations in support of the dilute and dispose strategy. (Out of the $95.2 million, $50.0 million is associated with capital asset acquisition projects that are required to be funded in a single year but may be costed over multiple years.) U.S. Uranium Disposition—$14.0 million at Y-12/NPO to continue HEU activities including the DBOT contract. International Disposition—$1.2 million at multiple labs to continue International Plutonium Disposition activities.

Laboratory and Partnership Support Program

The unencumbered balances for the Laboratory and Partnership Support Program ($8.8 million) did not exceed the DOE threshold. Balances will provide laboratory technical support for the development of neutron capture, accelerator, LEU, and other Mo-99 target technologies.

Nonproliferation and Arms Control: (Total Uncosted $62.7 million, [$22.6 million encumbered, $40.1 million unencumbered])

At the end of FY 2020, NPAC costs plus encumbrances totaled $149.9 million, or 78.9 percent of total FY 2020 available funds. The uncosted balance total of $62.7 million (of which $22.6 million, representing 21.1 percent of available FY 2020 funds, was encumbered) exceeded the recommended threshold by $14.3 million. The $40.1 million in FY 2020 unencumbered balances support four critical programs within NPAC: International Nuclear Safeguards; Nuclear Export Controls; Nuclear Verification; and Nonproliferation Policy.

The unencumbered balances for International Nuclear Safeguards ($14.9 million) will be used to conduct these engagements where possible, provide for enhanced development of distance learning/engagements, and/or redirected to advance the development of a nonproliferation enrichment safeguards testing and training platform.

The unencumbered balances for Nuclear Export Controls ($12.6 million) will be used to accelerate the development of training courses in export licensing and industry outreach and to accelerate lab participation in export licensing review and adjudication.

The unencumbered balances for Nuclear Verification ($8.3 million) will be used to enhance team readiness for UVT and PVT and to support key contracts to enable warhead, fissile material, and nuclear explosion monitoring, and disablement and dismantlement verification capabilities that will be placed in early FY 2021.

The unencumbered balances for Nonproliferation Policy ($4.3 million) will be used to implement statutory requirements and Part 810 licensing reviews.

Cost + Encumbrance Status, End of Fiscal Year 2020 (whole dollars)

Expense Type	Program	A Total Funds Available to Cost	B YTD Cost	C Total Uncosted Encumbered Obligations	D B + C Current Costs + Encumbrances	E D / A Costed or Encumbered as a % of Costing Authority	F A - D Total Uncosted Unencumbered Obligations	G F / A Unencumbered as % of Costing Authority
Operating								
	DN10 Global Material Security	918,211,645	435,001,839	291,241,714	726,243,553	79.1%	191,968,092	20.9%
	DN20 DNN Research and Development	807,602,421	547,296,080	89,352,421	636,648,501	78.8%	170,953,920	21.2%
	DN30 Material Management and Minimization	618,512,622	287,058,701	144,135,141	431,193,842	69.7%	187,318,780	30.3%
	DN40 Nonproliferation and Arms Control	189,930,078	127,275,721	22,595,405	149,871,126	78.9%	40,058,952	21.1%
	DN80 Legacy Contractor Pensions - NN	13,712,315	11,870,670	1,841,645	13,712,315	100.0%	0	0.0%
	Elimination of Weapons Grade Plutonium Production	526,968	0	526,968	526,968	100.0%	0	0.0%
	Global Threat Reduction Initiative	10,639,720	6,263,979	4,258,451	10,522,430	98.9%	117,290	1.1%
	NN20 Defense Nuclear Nonproliferation Research and Development DNN R&D	1,097,768	910,793	179,856	1,090,648	99.4%	7,120	0.6%
	NN40 Nonproliferation and International Security NIS	893,170	733,444	79,099	812,543	91.0%	80,627	9.0%
	NN50 International Material Protection and Cooperation IMPC	72,893,525	30,133,038	21,058,939	51,191,976	70.2%	21,701,549	29.8%
	NN60 Fissile Materials Disposition	8,548,467	2,871,912	5,458,642	8,330,554	97.5%	217,913	2.5%
	NN91 Highly Enriched Uranium HEU Reactor Conversion	814,011	503,341	0	503,341	61.8%	310,670	38.2%
	NN92 International Nuclear and Radiological Material Removal and Protection	34,592,781	2,931,855	32,534,735	35,466,590	102.5%	-873,809	-2.5%
	NN93 Domestic Radiological Material Removal and Protection	780,134	697,939	56,634	754,573	96.7%	25,561	3.3%
	Russian Surplus Fissile Materials Disposition	139,046	0	139,046	139,046	100.0%	0	0.0%
Operating Total		2,678,894,671	1,453,549,312	613,458,695	2,067,008,008	77.2%	611,886,663	22.8%
	DN01 DNN Construction	263,325,463	176,952,149	2,271,563	179,223,712	68.1%	84,101,751	31.9%
		79,000,000	40,726,204	1,749,209	42,475,413	53.8%	36,524,587	46.2%
Construction Total		343,324,156	218,118,665	4,579,153	222,697,818	64.9%	120,626,338	35.1%
Grand Total		3,022,218,827	1,671,667,978	618,037,848	2,289,705,826	75.8%	732,513,001	24.2%

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A Report to Congress

Prevent, Counter, and Respond—NNSA's Plan to Reduce Global Nuclear Threats
FY 2022-FY 2026

December 2021

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