U.S. DEPARTMENT OF ENERGY

National Nuclear Security Administration

Prevent, Counter, and Respond—A Strategic Plan to Reduce Global Nuclear Threats (FY 2016–FY 2020)

Report to Congress
March 2015

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

Administrator's Letter of Transmittal

The National Nuclear Security Administration (NNSA) of the Department of Energy (DOE) is pleased to submit its first strategic plan to define and describe our missions to prevent, counter, and respond to the threats of nuclear proliferation and terrorism. As President Obama recently reaffirmed in the 2015 *National Security Strategy*, "No threat poses as grave a danger to our security and well-being as the potential use of nuclear weapons and materials by irresponsible states or terrorists."

Through the capabilities resident in the DOE national laboratory system, as well as the unique suite of global security engagement programs that NNSA leads, we provide leading technical expertise to U.S. Government-wide efforts to address this enduring and evolving threat. We also are at the forefront of assessing and developing tools and approaches to address emerging vulnerabilities posed by asymmetric threats that could impact nuclear security, including the continued interest by non-state groups in acquiring nuclear materials and the security implications of the global expansion of civil nuclear power.

In an era when the threat environment is dynamic and complex, and our relationships with key nuclear powers are changing, this report charts the course for the future of these critical activities. *Prevent, Counter, and Respond—A Strategic Plan to Reduce Global Nuclear Threats (FY 2016–FY 2020)* describes how NNSA addresses these trends by effectively organizing, prioritizing, and directing its nonproliferation, counterterrorism and counterproliferation, and emergency response actions.

The plan provides insight into formulation of the five-year *Future Years Nuclear Security Program* plan from a programmatic perspective, while the information on the enduring and evolving nature of threats takes a longer-term perspective. We plan to update portions of this plan annually following release of the President's Budget Request to highlight this vital part of the NNSA's nuclear security mission.

It is important to emphasize the interrelated nature of our efforts to prevent, counter, and respond to nuclear and radiological dangers through a variety of capacity-building, analytical, and operational programs, as this collaborative interface remains foundational to effective mission delivery. This new paradigm is reflected in the President's FY 2016 Budget Request for the NNSA, which realigned these mission areas under the Defense Nuclear Nonproliferation appropriation. These activities total $1.9 billion in FY 2016, which is by far the largest program devoted to reducing global nuclear threats across the U.S. Government. NNSA's ability to achieve nonproliferation, counterterrorism and counterproliferation, and emergency response missions stems not only from the fiscal resources available, but from the DOE's historical roots in nuclear science established during the Manhattan Project and the nuclear weapons program. This unique expertise and infrastructure provide many of the base capabilities to understand how nuclear weapons and materials work, and therefore how best to prevent, counter, and respond to proliferation and security concerns associated with the use and potential spread of nuclear material, technology, and expertise.

In addition to this strategic-level, unclassified report, a classified appendix will be issued containing more details on the key nuclear and radiological risks, threats, and vulnerabilities, including the methodologies used to prioritize NNSA activities against the enduring and evolving global nuclear security environment.

This report also contains information that overlaps with three Congressionally mandated reporting requirements:

- *Receipt and Utilization of International Contributions to the Office of Defense Nuclear Nonproliferation of the National Nuclear Security Administration* (as required by Title 50, United States Code, Sec. 2569)
- *Progress in Nuclear Nonproliferation* (as required by the FY 2012 National Defense Authorization Act, Public Law 112-81, Sec. 3122)
- *Defense Nuclear Nonproliferation Programs of the National Nuclear Security Administration* (as required by the FY 2013 National Defense Authorization Act, Public Law 112-239, Sec. 3145).

The requirements for each of these reports, and the locations of the corresponding information within this report, are described in Annex A of this report. The 2015 report, *Receipt and Utilization of International Contributions to the Office of Defense Nuclear Nonproliferation of the National Nuclear Security Administration*, has been transmitted to Congress; the 2015 *Progress in Nuclear Nonproliferation* report is in the process of being transmitted. The requirement for a 2015 report on *Defense Nuclear Nonproliferation Programs of the National Nuclear Security Administration* will be satisfied by this *Prevent, Counter, and Respond—A Strategic Plan to Reduce Global Nuclear Threats (FY 2016–Main)* report.

This report is being provided to the following Members of Congress:

- **The Honorable John McCain**
  Chairman, Senate Committee on Armed Services
- **The Honorable Jack Reed**
  Ranking Member, Senate Committee on Armed Services
- **The Honorable Mac Thornberry**
  Chairman, House Committee on Armed Services
- **The Honorable Adam Smith**
  Ranking Member, House Committee on Armed Services
- **The Honorable Bob Corker**
  Chairman, Senate Committee on Foreign Relations
- **The Honorable Robert Menendez**
  Ranking Member, Senate Committee on Foreign Relations
- **The Honorable Edward R. Royce**
  Chairman, House Committee on Foreign Affairs
- **The Honorable Eliot L. Engel**
  Ranking Member, House Committee on Foreign Affairs
- **The Honorable Thad Cochran**
  Chairman, Senate Committee on Appropriations
- **The Honorable Barbara A. Mikulski**
  Vice Chairman, Senate Committee on Appropriations

- **The Honorable Lamar Alexander**
  Chairman, Subcommittee on Energy and Water Development
  Senate Committee on Appropriations

- **The Honorable Dianne Feinstein**
  Ranking Member, Subcommittee on Energy and Water Development
  Senate Committee on Appropriations

- **The Honorable Harold Rogers**
  Chairman, House Committee on Appropriations

- **The Honorable Nita M. Lowey**
  Ranking Member, House Committee on Appropriations

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

- **The Honorable Marcy Kaptur**
  Ranking Member, Subcommittee on Energy and Water Development
  House Committee on Appropriations

If you have questions about this plan, please contact me or Mr. Clarence Bishop, Associate Administration for External Affairs, at (202) 586-7332.

Sincerely,

Frank G. Klotz
Under Secretary for Nuclear Security
Administrator, NNSA

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Message from the Secretary

The last quarter century has witnessed dramatic shifts in the global nuclear security environment. The Cold War has ended, yet thousands of nuclear weapons and large stockpiles of weapons-useable material remain. Geopolitical instability and sources of potential conflict persist, especially in countries and regions with an active terrorist presence. New technology and manufacturing processes continue to emerge, sometimes without a full understanding of the potential security risks they may involve. Concerns about climate change and rising demand for clean energy have led to growing interest in civil nuclear power and fuel cycle development. Consequently, an increasing number of countries with little to no experience in nuclear technology will be faced with the tasks of safely and securely managing nuclear facilities and protecting nuclear materials, including spent nuclear fuels. In addition, the emergence of additional nuclear-capable or nuclear threshold states, such as North Korea and Iran, is challenging the fundamental principles of the global nuclear nonproliferation regime.

The Department of Energy (DOE) has long played a central role in global efforts to reduce and eliminate nuclear and radiological dangers. The trends described above have driven us to re-evaluate our nuclear nonproliferation, counterterrorism and counterproliferation, and emergency response missions to ensure that our current programs meet the needs of today and position us to deal with the challenges of tomorrow. The scientific expertise resident in DOE's network of national laboratories, production plants, and test facilities makes unique contributions to understanding the evolving threat environment; developing technical solutions to prevent, counter, and respond to nuclear proliferation and terrorism threats; and informing policy deliberations with scientific and technical analysis. Ensuring this network has the guidance, resources, and facilities necessary to carry out these vital and enduring tasks—now and in the future—is one of the highest priorities of this Department and its National Nuclear Security Administration.

As recommended by the Secretary of Energy Advisory Board's Task Force on Nuclear Nonproliferation, this new report, *Prevent, Counter, and Respond—A Strategic Plan to Reduce Global Nuclear Threats (FY 2016–FY 2020)*, articulates for the first time, in a single document, our programs to reduce the threat of nuclear proliferation and nuclear terrorism. As such, it serves as a companion piece to our annual *Stockpile Stewardship and Management Plan,* which describes in detail the programs within the NNSA's Weapons Activities appropriation account. We intend to publish both documents each year as the Department continues to assess the evolving threat environment and to adjust our programs to effectively meet emerging challenges.

We do not do this work alone. The Department participates in a whole-of-government approach to develop policies and programs that prevent, counter, and respond to nuclear threats at home and abroad. We also work cooperatively with many partner countries and international organizations—such as the International Atomic Energy Agency—to advance global nuclear security norms. In his 2009 Prague speech, President Obama announced his intent to host the first Nuclear Security Summit in 2010; that Summit led to the 2012 Summit in Seoul and 2014 Summit in The Hague, each of which served to elevate the global threat of nuclear terrorism to the highest level of national governments. The Nuclear Security Summit process has driven multinational consensus and has resulted in concrete commitments

to enhance nuclear security in individual countries and across borders. The Department is working closely with its interagency partners to ensure that the 2016 Nuclear Security Summit that President Obama will host will generate a new round of tangible commitments to strengthen national and international efforts, and reinforce the global nuclear security architecture to sustain this critical mission beyond 2016.

Sincerely,

Ernest J. Moniz

Executive Summary

Over the past 50 years, the United States has played a leading role in developing a diverse architecture and suite of capabilities to reduce the danger posed by nuclear proliferation and nuclear and radiological terrorism. Even under these international regimes, the global security environment remains extremely dynamic. There is continued interest in nuclear materials from malevolent actors, and the persistence and escalation of regional conflicts can create chaotic situations and increased lawlessness that weaken a state's ability to protect nuclear and radiological materials from theft or diversion. Increasing global trade, and the sophistication of illicit procurement networks, can enable proliferation. Rapidly changing technologies (e.g., additive manufacturing, powerful computer-aided design applications, and cyber-attack tools) and greater diffusion of dual-use knowledge may provide more ways for terrorists to threaten nuclear security systems and offer easier acquisition pathways to nuclear weapons capabilities. As additional countries consider nuclear power to meet energy needs and address global climate change, the expansion of civilian nuclear energy could potentially create additional nuclear threshold states and put additional nuclear materials at risk. Emerging civil nuclear power states will need to face the safety, security, safeguards, and emergency response challenges inherent in managing a nuclear fuel cycle system, but this can create vulnerabilities where regulations and regulatory bodies are weak. Additionally, there will be ongoing challenges related to securing and managing expanding stockpiles of nuclear and other radiological materials throughout the nuclear fuel cycle, including both fresh and spent nuclear fuel. Finally, the growth of cyber threats, and availability of cyber-attack tools, can directly affect nuclear safeguards and security systems. In light of these and other evolving threat trends, the 2015 *National Security Strategy* reminds us that "No threat poses as grave a danger to our security and well-being as the potential use of nuclear weapons and materials by irresponsible states or terrorists."

Prevent, Counter, and Respond—A Strategic Plan to Reduce Global Nuclear Threats (FY 2016–FY 2020), and its classified appendix, highlight the complexities of the global nuclear security environment, and describe the National Nuclear Security Administration's (NNSA) strategic approach to build and sustain the programs and capabilities required to prevent, counter, and respond to nuclear proliferation and nuclear/radiological terrorism. This "defense by other means" strategy is built around three pillars:

- **Prevent** non-state actors and additional countries from developing nuclear weapons or acquiring weapons-usable nuclear materials, equipment, technology, and expertise; and prevent non-state actors from acquiring radiological materials for a radiological threat device (Chapter 2).
- **Counter** the efforts of both proliferant states and non-state actors to acquire, develop, disseminate, transport, or deliver the materials, expertise, or components necessary for a nuclear or radiological threat device or the devices themselves (Chapter 3).
- **Respond** to nuclear or radiological terrorist acts, or accidental/unintentional incidents, by searching for and rendering safe, threat devices, components, and/or radiological and nuclear materials (Chapter 4).

NNSA's risk-informed approach to developing proactive global cooperative engagement activities addresses the concerns expressed in the 2015 *National Security Strategy*. NNSA participates in whole-of-government policy and program coordination processes to ensure that NNSA activities are aligned

and integrated with broad U.S. national priorities and capabilities. NNSA, working particularly with the Departments of State and Defense, has been central to U.S. efforts to develop and implement domestic and international programs and strategies to meet the enduring and evolving challenges to the global nuclear security environment.

Because nuclear security is a global issue that requires a global response, NNSA also works with key international partners and institutions, particularly the International Atomic Energy Agency. These relationships have extended the reach of NNSA programs and have played a key role in broadening and sustaining international actions against global nuclear proliferation and terrorism threats. The DOE complex of national laboratories, production facilities, and sites also provides vital and necessary tools, knowledge, and infrastructure to implement the NNSA global nuclear security engagement strategy and programs.

The programs covered by this report have been consolidated in the President's FY 2016 Budget Request under the Defense Nuclear Nonproliferation appropriation. This realignment will further the synergy between the programs and will support NNSA continuing to play a leading role in U.S. interagency nuclear threat reduction policy development and program coordination.

Over the next five years, NNSA will adapt the prevent-counter-respond mission objectives to address emerging global nuclear trends and evolving threats. Based on the current understanding of the threat environment, each program section of this report includes Future Plans and Key Program Milestones for the FY 2016 to FY 2020 period. As NNSA assesses the evolution of nuclear threat trends over this timeframe, it will continue to apply its all-source "over-the-horizon" strategic studies to validate that its efforts remain focused on both addressing current nuclear threats and anticipating emerging and evolving threat trends as far in advance as possible. Armed with these studies, and with the insights from external sources such as the Intelligence Community, foreign partners, and the international nuclear security community, NNSA will work with the DOE national laboratories, production facilities, and sites in conducting both cross-program and program-specific risk assessment and prioritization assessments. This will allow NNSA to make corporate decisions across the prevent-counter-respond mission space, which will align future program and budget priorities to address the greatest dangers to global nuclear security. To reflect such program progression, the *Prevent, Counter, and Respond* report will be updated regularly to reflect program plans, progress, and challenges across these mission areas.

PREVENT, COUNTER, AND RESPOND—A STRATEGIC PLAN FOR REDUCING GLOBAL NUCLEAR THREATS (FY 2016–FY 2020)

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List of Acronyms

AAEA	Arab Atomic Energy Agency
AAFS	American Assured Fuel Supply
ABACC	Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials
ANL	Argonne National Laboratory
APSN	Asia-Pacific Safeguards Network
ARIES	Advanced Recovery and Integrated Extraction System
ATO	Advanced Technical Operations
BNL	Brookhaven National Laboratory
BSAP	Bulk Special Nuclear Material Analysis Program
CBRN	Chemical, Biological, Radiological, and Nuclear
CFR	Code of Federal Regulations
CIRG	Critical Incident Response Group (an FBI entity)
COE	Center of Excellence
COG	Continuity of Government
COOP	Continuity of Operations Program
CT TTX	Counterterrorism Tabletop Exercise
CTBT	Comprehensive Nuclear-Test-Ban Treaty
CTBTO	Comprehensive Nuclear-Test-Ban Treaty Organization
CTCP	Counterterrorism and Counter Proliferation Program
CTIRCB	Counterterrorism and Incident Response Capacity Building
CTPC	Office of Counterterrorism Policy
CTR	Cooperative Threat Reduction
CTSD	Counterterrorism Security Dialogue
DFEAT	Disposition and Forensic Evidence Analysis Team
DFO	DOE Forensics Operations
DHS	Department of Homeland Security
DNDO	Domestic Nuclear Detection Office
DNN	Office of Defense Nuclear Nonproliferation
DNN R&D	Defense Nuclear Nonproliferation Research & Development Program
DOD	Department of Defense
DOE	Department of Energy
DOS	Department of State
DP	Office of Defense Programs
DTRA	Defense Threat Reduction Agency
E2C2	Export Enforcement Coordination Center
ECRC	Export Control Review and Compliance
EPA	Environmental Protection Agency
ESA	Essential Supporting Activities
ESWAT	Enhanced Special Weapons and Tactics
EUCOM	U.S. European Command
EURATOM	European Atomic Energy Community
EWGPP	Elimination of Weapons Grade Plutonium Production
FBI	Federal Bureau of Investigation
FCS	Federal Customs Service of Russia
FEMA	Federal Emergency Management Agency

FFRDC	Federally Funded Research and Development Center
FIOP	Federal Interagency Operations Plan
FMD	Fissile Material Disposition
FY	Fiscal Year
FYNSP	Future Years Nuclear Security Program
G7	Group of 7 (Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States
GBD	Global Burst Detector
GCC	Geographic Combatant Command or Commander
GCEP	Gas Centrifuge Enrichment Plant
GICNT	Global Initiative to Combat Nuclear Terrorism
GMS	Global Material Security Program
GNDA	Global Nuclear Detection Architecture
GP	Global Partnership Against the Spread of Weapons and Materials of Mass Destruction
GPS	Global Positioning Satellite
GTRI	Global Threat Reduction Initiative
HEU	Highly Enriched Uranium (uranium that is enriched to a 20 percent or higher concentration of the isotope U-235)
HP	Health Physics
HRT	Hostage Rescue Team (an entity of the FBI)
HSPD	Homeland Security Policy Directive
I-MED	International Medical Radiological Response Countermeasures
I-RAPTER	International Radiological Assistance Program Training for Emergency Response
IAEA	International Atomic Energy Agency
IEC	IAEA Incident and Emergency Center
IEMC	International Emergency Management and Cooperation
IMPC	International Material Protection and Cooperation Program
IMS	International Monitoring System (of the CTBTO)
IND	Improvised Nuclear Device
INECP	International Nuclear Export Control Program
INFCIRC	IAEA Information Circular
INL	Idaho National Laboratory
INS	International Nuclear Security program
INTERPOL	International Criminal Police Organization
IPC	Interagency Policy Committee
IPPAS	International Physical Protection Advisory Service
ISN	Bureau of International Security and Nonproliferation (DOS)
ITAG	Interdiction Technical Analysis Group
ITWG	International Technical Working Group
JRC-ITU	Joint Research Centre – Institute for Transuranium Elements
JTOT/ARG	Joint Technical Operation Team/Accident Response Group
LANL	Los Alamos National Laboratory
LEU	Low-Enriched Uranium (uranium whose content has less than 20 percent of the isotope U-235)
LLNL	Lawrence Livermore National Laboratory
LTBT	Limited Test Ban Treaty
M^3	Material Management and Minimization Program

MDA	Mutual Defense Agreement
MDS	Mobile Radiation Detection System
MEF	Mission Essential Function
MFFF	MOX Fuel Fabrication Facility
MNEPR	Multilateral Nuclear Environmental Programme in the Russian Federation
MNSR	Miniature Neutron Source Reactor
Mo-99	Molybdenum-99 (radio-isotope widely used in medical applications)
MOX	Mixed Oxide Fuel
MPC&A	Material Protection, Control, and Accounting
MT	Metric Tons (equals 1,000 kilograms)
MTR	Materials Test Reactor
NARAC	National Atmospheric Release Advisory Center
NATO	North Atlantic Treaty Organization
NCT	Nuclear Counterterrorism
NCTIR	Nuclear Counterterrorism and Incident Response Program
NDAA	National Defense Authorization Act
NELA	Nuclear Explosive Like-Assembly
NEST	Nuclear Emergency Support Team
NGSI	Next Generation Safeguards Initiative
NIS	Nonproliferation and International Security Program
NMF	National Mission Force
NNSA	National Nuclear Security Administration
NNSS	Nevada Nuclear Security Site
NPAC	Nonproliferation Policy and Arms Control Program
NPT	Treaty on the Non-proliferation of Nuclear Weapons
NRAT	Nuclear/Radiological Advisory Team
NRC	Nuclear Regulatory Commission
NSC	National Security Campus (Kansas City)
NSDD	Nuclear Smuggling Detection and Deterrence Subprogram
NSG	Nuclear Suppliers Group
NSPD	National Security Policy Directive
NTR	Nuclear Threat Reduction
OCONUS	Outside the Continental United States
ORNL	Oak Ridge National Laboratory
OSRP	Off-Site Source Recovery Project
P3	The group of France, United Kingdom, United States
P5	The declared nuclear weapons states under the NPT (China, France, Russia, United Kingdom, and United States)
P5+1	The group negotiating with Iran over the Iranian nuclear program (the P5 members plus Germany)
PMDA	U.S.-Russian Plutonium Management and Disposition Agreement
PNNL	Pacific Northwest National Laboratory
PPD	Presidential Policy Directive
PPRA	U.S.-Russian Federation Plutonium Production Reactor Agreement
PSSO	Program and Staff/Support Office
RAMP	Rapid Asset Mobilization Protocol
RANET	Response and Assistance Network

RAP	Radiological Assistance Program
RDD	Radiological Dispersal Device
RED	Radiological Exposure Device
RNSO	Radiological/Nuclear Search Operations
RTG	Radioisotope Thermoelectric Generators
SABRS	Space and Atmospheric Burst Reporting System
SAT	Systematic Approach to Training
SBIR	Small Business Innovative Research
SLD	Second Line of Defense program
SMU	Special Mission Unit
SNM	Special Nuclear Material (defined as plutonium, uranium-233, and uranium enriched in the isotopes uranium-233 or uranium-235; in the *Atomic Energy Act of 1954*)
SNL	Sandia National Laboratories
SPARCS	Spectral Advanced Radiological Computer System
SPE	Source Physics Experiment
SRNL	Savannah River National Laboratory
SRS	Savannah River Site
START	Strategic Arms Reduction Treaty
STC	Strategic Trade Control
STTR	Small Business Technology Transfer
THADIAS	Theft And Diversion Incident Analysis System
TRIGA	a type of U.S. nuclear reactor (stands for *Test, Research, Isotopes, General Atomics*)
TRL	Technology Readiness Level
TTMA-V	Tier Threat Modeling Archive-Validation project
TTX	Tabletop Exercise
U	Uranium
UK	United Kingdom
ULTB	Uranium Lease and Take-Back
UN	United Nations
UNE	Underground Nuclear Events
UNESE	Underground Nuclear Event Signatures Experiment
U.S.	United States
USAEDS	U.S. Atomic Energy Detection System
USAFE	U.S. Air Forces in Europe
USCENTCOM	U.S. Central Command
USD	U.S. Dollars
US NCD	U.S. National Data Center
USNDS	U.S. Nuclear Detonation Detection System
USSOCOM	U.S. Special Operations Command
U.S.S.R.	Union of Soviet Socialist Republics
VOA	Voluntary Offer Agreement
WCO	World Customs Organization
WHO	World Health Organization
WIPP	Waste Isolation Pilot Plant
WMC	Warhead Measurement Campaign
WMD	Weapons of Mass Destruction
WMO	World Meteorological Organization

WSB	Waste Solidification Building
WUNM	Weapons-Usable Nuclear Material (such as separated plutonium and highly enriched uranium)
Y-12	Y-12 National Security Complex

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

1.1 Enduring Mission, Evolving Threats

Over the past five decades, the United States has faced the risk of nuclear weapons, materials, technology, and expertise proliferating to hostile states or falling into the hands of terrorists. Consequently, a diverse nonproliferation and counterterrorism architecture has been erected, comprised of arms control treaties, international safeguards, nuclear supplier regimes, and cooperative agreements. This architecture has allowed the global nuclear energy sector to grow without a corresponding increase in nuclear-armed states. Perhaps most importantly, a set of global norms has emerged in which any non-nuclear weapons state, or any non-state actor that attempts to acquire its own nuclear weapons capability, is met with broad international disapproval.

Significant achievements have been made under this global nuclear security architecture. The United States and Russia have drastically reduced the size of their nuclear arsenals; the number of states that have developed or attempted to develop a nuclear weapons capability has been far fewer than many experts predicted; and thus far, no terrorist group has demonstrated significant progress toward acquiring a nuclear weapon. States have made substantial progress in securing weapons-usable nuclear material (WUNM) and in increasing the protective barriers against others getting the ingredients for a weapon or a terrorist device. Significant amounts of vulnerable nuclear and radiological material—enough cumulative material to build tens of thousands of nuclear weapons—have been converted to less dangerous forms. The nuclear-weapons-capable infrastructure of several states has

The Department of Energy (DOE) non-weapons nuclear security mission builds on decades of cooperative initiatives and engagement with both U.S. and foreign partners. This includes the early 1990s "lab-to-lab" cooperation in nuclear material protection, accounting, and control; the 1988 U.S.-U.S.S.R Joint Verification Experiment (where U.S. and Soviet nuclear scientists cooperated in verification experiments of on-site nuclear explosive yield measurements); and 20 years of helping Russia and other former Soviet countries (often in partnership with Russia) to reduce and better secure their inherited nuclear materials and infrastructure. These cooperative engagements steadily gave DOE and its national laboratories a unique foundation for using nuclear scientific and technical expertise, policy and program experience, and world-class infrastructure to respond to contemporary, global nuclear threat reduction challenges, including the verification of the disablement (at that time) of North Korean nuclear infrastructure during the 1990s, and the 2004 denuclearization of Libya. The DOE ability to respond quickly in assisting Japan in the March 2011 Fukushima disaster also demonstrated the readiness and effectiveness of the DOE emergency response capabilities that are the result of this same foundation of nuclear security expertise and cooperative engagement experience.

been dismantled (e.g., countries that inherited former Soviet Union nuclear weapons and infrastructure, Iraq, Libya, etc.), and the United States has led the international response to violations of the Treaty on the Non-proliferation of Nuclear Weapons (NPT). Additionally, starting in 2010 the series of Nuclear Security Summits have built international political momentum to strengthen security of nuclear facilities and materials around the world and have elevated the priority placed on creating cooperative solutions to the threat of nuclear terrorism.

In spite of these achievements, states other than the declared nuclear weapons states under the NPT (the so-called "P5": China, France, Russia, the United Kingdom, and the United States) and non-state actors continue to pursue or pose a risk of acquiring nuclear weapons or weapons capabilities, so the nuclear nonproliferation and counterterrorism missions endure. The existing nonproliferation and arms control architectures, which have been so effective over the past decades, are being challenged by the evolving nature of nuclear security threats and threat trends. Key judgments on the nuclear threat environment are included in the classified appendix to this report, but several important trends, consistent with those key judgments, have been identified through the National Nuclear Security Administration (NNSA) "over-the-horizon" strategic studies:

- **Securing and managing nuclear and radiological materials will be challenged by the significant amounts of these materials (and possibly increased amounts of WUNM), including in regions of concern, as well as by the erosion of control within weak or failing states.** The breakup of the Soviet Union highlighted the vulnerability of nuclear weapons and material stockpiles to national, regional, and global political evolutions (or revolutions). And with expanding civil nuclear power and increasing access to nuclear technology, global political dynamics can again cause situations of uncertain authority and control (even civil chaos and lawlessness) around these materials, thus increasing nuclear proliferation and security risks. Countries with nuclear power are producing spent nuclear fuel with few disposition options, and countries with reprocessing capabilities continue to produce plutonium beyond their ability to use it (and other countries may consider acquiring reprocessing capabilities as part of their long-term energy strategy). In addition, developing countries that are benefiting from the peaceful use of nuclear and radiological sources may face severe internal strife and political instability that lead to weak or failing state governance, which in turn could contribute to weakened or loss of state control over these materials. This situation is further complicated by the existence of illicit trafficking networks, which can exploit weak governance, corruption, and the blurring of borders to smuggle stolen nuclear or radiological materials and technology, requiring an agile security posture to thwart them.
- **Possessing nuclear weapons capabilities still could be seen as salient and desirable for some state and non-state actors hostile to U.S. and allied interests, putting strains on monitoring, verifying, and maintaining arms control and nonproliferation regimes**. Unresolved regional tensions and conflicts and imbalances in conventional military forces could tempt states to pursue nuclear weapons or a weapons capability. Several states have demonstrated maturing nuclear weapons capabilities and continue to produce highly enriched uranium (HEU) and plutonium that are either intended for nuclear weapons production or could be retained as latent reserves for future weapons. The possibility of regional use of nuclear weapons is just one of the more dramatic of the risks arising from this trend. Other risks may include the disruption of U.S. security relationships and of U.S.-led security policies (especially in the nuclear realm) and the encouragement of further proliferation. Technological advances that can be applicable to nuclear weapon design analysis, modeling, and manufacturing could undermine the ability to detect covert nuclear weapons development programs and provide confidence in

monitoring and verification regimes. While no evidence exists today that terrorists possess nuclear material or weapons, the expanding availability of dual-use equipment, technology, and information increases the concern that terrorists could produce an improvised nuclear device if they were to also acquire sufficient WUNM.

- **The global expansion of civil nuclear power and the wide use of radiological sources may accelerate the spread of dual-use technology and knowledge and increase demands on safety, security, safeguards, and emergency response systems.** Growing interest in mitigating the impacts of climate change by reducing carbon footprints, as well as energy insecurity driven by rising economies and population growth, may fuel the resurgence in civil nuclear power in many nations. The possible spread of nuclear fuel cycle technologies will increase the potential for additional nuclear-threshold states to appear; their commitment to nuclear nonproliferation may be uncertain. Countries developing domestic nuclear fuel cycles must establish defenses against sabotage and cyber-attacks on those fuel cycle elements (including attacks on the protective systems of fresh and spent nuclear fuel), as well as address the proliferation risks intrinsic to fuel cycle operations. Some states seeking nuclear power have inadequate experience in safeguards and physical protection, regulatory infrastructures, and emergency management, which will place new burdens on the International Atomic Energy Agency (IAEA) to supply assistance in these areas. New technologies and fuel cycles (e.g., the thorium fuel cycle) also may require new approaches in safety, security, safeguards, counterterrorism, and emergency management. Competition from France, Russia, South Korea, and perhaps China to service the growing global nuclear sector may stress export control regimes and escalate the diffusion of dual-use technology and information. Also, medical, agricultural, and other industrial advances may result in an expansion in the use and application of high-activity radioactive sources, especially in developing countries. Adequate control and security of these sources will become all the more important, including the need to keep pace with security standards, regulatory systems, and effective emergency management systems.
- **Expanding global trade volumes and sophistication of illicit procurement networks will increase the opportunities for state and non-state actors to acquire dual-use nuclear equipment and technology.** Expanding trade volumes will increase the export control, border monitoring, and law enforcement burdens on individual states and international/regional organizations, which continue to be under-resourced, to effectively combat the growing nonproliferation, counterterrorism, and emergency management challenges. A broad array of procurement networks will continue to seek increasingly sophisticated means to evade export controls and thereby increase proliferation, terrorism, and public safety risks. Weak governance, corruption, the blurring of borders within regions, the nexus of criminal and terrorist networks, and use of common network facilitators (e.g., financing and transportation) will be key enablers.
- **Rapidly changing technologies and greater diffusion of dual-use knowledge are expected to provide more ways for terrorists to threaten nuclear security systems and easier acquisition pathways to nuclear weapons capabilities.** Scientific advances and manufacturing improvements (such as additive manufacturing and ever-more powerful computer-aided design applications) may create new and worrisome pathways to nuclear weapons. The wider availability and increased capabilities of cyber-attack tools in the hands of malevolent insiders, states, or non-state actors will make the security and safeguarding of nuclear and radiological facilities, and their associated networks, more vulnerable to attack (e.g., disabling security systems, falsifying material accounting balances, and unauthorized access to sensitive

information). Further, the diffuse and decentralized nature of science and technology development, coupled with greater information connectivity, will increase the availability of sensitive information. Each of these changes may compromise traditional approaches to nonproliferation, presenting additional security imperatives for the United States, not least of these being the need to anticipate technology surprise and to rapidly develop new policies to respond to the impacts of these disruptive technologies.

1.2 National Policy Goals and Mission

In responding to this global nuclear threat environment, President Barack Obama—stating in 2009 that the danger of a terrorist acquiring a nuclear weapon is "the most immediate and extreme threat to global security"—placed preventing nuclear proliferation and nuclear terrorism among the key U.S. national security strategic objectives. The 2015 *National Security Strategy*, the 2010 *Nuclear Posture Review*, and the 2011 *National Strategy for Counterterrorism* all make prevention of nuclear proliferation and terrorism a top priority in the U.S. nuclear agenda and a key component for achieving the vision of a world free of nuclear weapons. These national policy documents also call for the United States to "lead with capable [foreign] partners **…** [because] American leadership remains essential for mobilizing collective action to address global risks and seize strategic opportunities." (*National Security Strategy, February 2015*). To this end, the United States has emphasized raising the public visibility and political priority of nuclear security worldwide, such as through the multilateral Nuclear Security Summit Communiqués and joint commitments, as well as the recent consensus Nuclear Security Resolution from the September 2014 IAEA General Conference.

> *"No threat poses as grave a danger to our security and well-being as the potential use of nuclear weapons and materials by irresponsible states or terrorists. … Vigilance is required to stop countries and non-state actors from developing or acquiring nuclear, chemical, or biological weapons, or the materials to build them." (National Security Strategy, February 2015)*

Presidential policy guidance further defines the U.S. nuclear threat reduction policy goals, many of which have been successfully incorporated into broader multilateral statements on global nuclear security priorities (including Nuclear Security Summit Communiqués). Among these policy goals are:

- Seeking permanent threat reduction, whenever and wherever possible, by reducing the civilian use of WUNM and by eliminating or disposing of excess and surplus WUNM and high-activity radiological materials worldwide.
- Strengthening and enhancing the effective, global implementation of physical protection, control, and accounting systems over all nuclear and high priority radiological materials.
- Combating the illicit trafficking of nuclear and radiological materials by preventing, deterring, detecting, interdicting, and recovering all such materials that are outside of regulatory control.
- Preventing the theft, diversion, or spread of sensitive nuclear materials, technology, information, and expertise.
- Developing advanced unilateral and multilateral capabilities to monitor existing or future arms control treaties/agreements and foreign nuclear weapons program activities.
- Monitoring and promoting international acceptance and implementation of the terms and attributes of all nonproliferation and arms control treaties, conventions, and norms.

- Cooperating to ensure comprehensive response to acts of nuclear terrorism or to nuclear/radiological emergencies.
- Developing a safe, secure, and safeguarded nuclear energy infrastructure in those countries that seek to peacefully use nuclear energy for their energy security needs and climate goals.

Because of its world leadership in scientific and technical expertise and programmatic capabilities in the nuclear security arena, DOE, mostly through the NNSA, plays the central U.S. Government role in pursuing U.S. nuclear security goals. The *DOE Strategic Plan, 2014–2018* supports the President's nuclear security agenda by establishing "Nuclear Security" as one of the Department's strategic goals and by incorporating "Reduce global nuclear security threats" as a specific strategic objective. Further, the NNSA mission to enhance global security includes nonproliferation and counterterrorism among its activities. NNSA makes full use of all the resources at its disposal to fulfill its nonproliferation and counterterrorism missions by:

> ***DOE Goal 2: Nuclear Security***
>
> *"Enhance national security by maintaining and modernizing the nuclear stockpile and nuclear security infrastructure, reducing global nuclear threats, providing for nuclear propulsion, improving physical and cybersecurity, and strengthening key science, technology, and engineering capabilities." (DOE Strategic Plan, 2014–2018, March 2014)*

- Developing and implementing policy and technical solutions to eliminate proliferation-sensitive materials and limit or prevent the spread of materials, technology, and expertise related to nuclear and radiological weapons and programs around the world.
- Providing expertise, practical tools, and technically informed policy recommendations required to advance U.S. nuclear counterterrorism and counterproliferation objectives.
- Maintaining essential components of the U.S. capability to respond to nuclear or radiological crises and manage the consequences (domestically or internationally) of civilian radiation exposure resulting from a nuclear or radiological incident, especially those involving terrorism.

1.3 Overall Program Strategy, Objectives, and Prioritization

To pursue these U.S. nuclear security goals within this enduring and evolving nuclear threat environment, the NNSA program strategy is to organize its nuclear nonproliferation and counterterrorism actions into three primary areas that cover the entire nuclear threat spectrum:

1. **Prevent** non-state actors and additional countries from developing nuclear weapons or acquiring weapons-usable nuclear materials, equipment, technology, and expertise; and prevent non-state actors from acquiring radiological materials for a radiological threat device.
2. **Counter** the efforts of both proliferant states and non-state actors to steal, acquire, develop, disseminate, transport, or deliver the materials, expertise, or components necessary for a nuclear or radiological threat device or the devices themselves.
3. **Respond** to nuclear or radiological terrorist acts, or accidental/unintentional incidents, by searching for and rendering safe threat devices, components, and/or radiological and nuclear materials, and by conducting consequence management actions following an event to save lives, protect property and the environment, and enable the provision of emergency services.

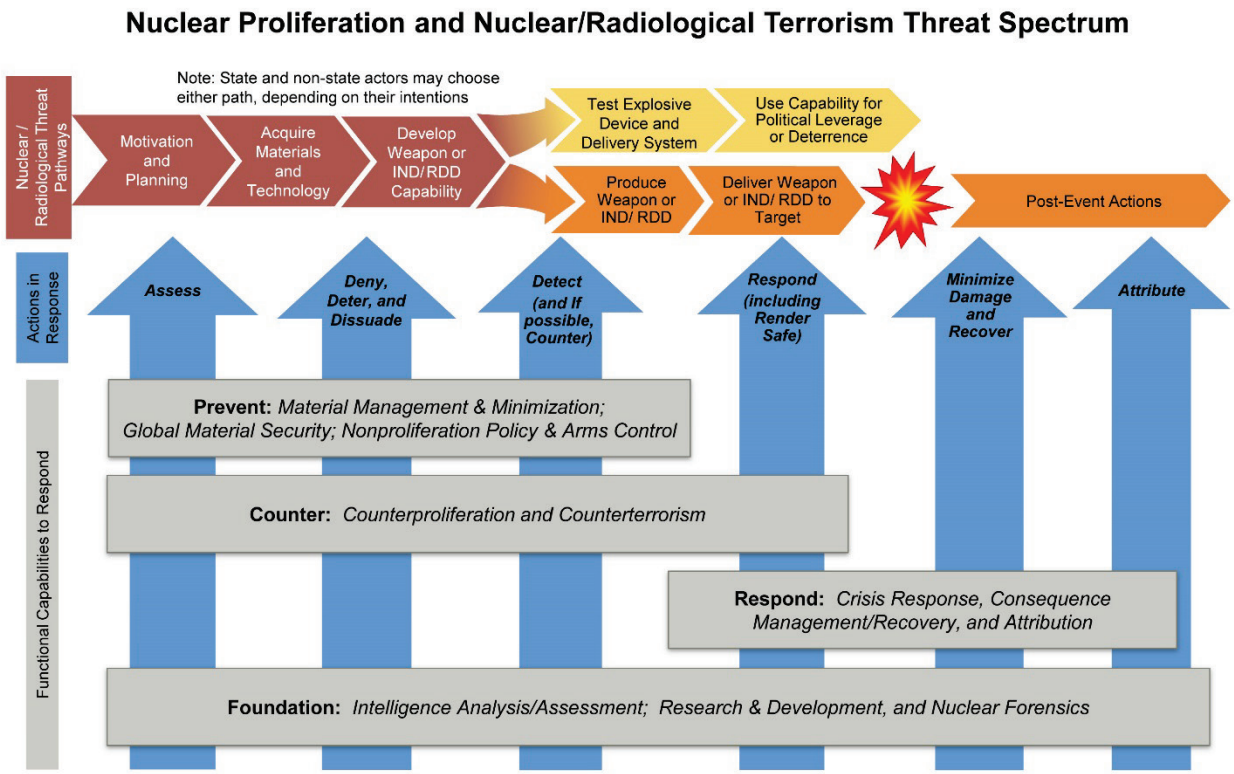

Figure 1. NNSA Strategic Approach to Countering Nuclear Proliferation and Terrorism

In carrying out these missions, NNSA works collaboratively with members of the Intelligence Community—including DOE's own Office of Intelligence and Counterintelligence—and other U.S. Government interagency partners, such as the Department of State (DOS), Department of Defense (DOD), and Department of Homeland Security (DHS), and the Federal Bureau of Investigation (FBI).

Through its prevent-counter-respond strategic approach, NNSA pursues the following objectives:

- Minimize and, when possible, eliminate excess WUNM, ensure sound management principles for remaining nuclear materials, and make available nuclear materials to encourage and support peaceful uses initiatives.
- Achieve security, protection, control, and accounting for all nuclear and radiological materials worldwide (in accordance with internationally accepted recommendations), and prevent the illicit movement of nuclear weapons, proliferation-sensitive materials, and radiological sources.
- Prevent the proliferation of weapons of mass destruction (WMD)—including dual-use materials, equipment, technology, and expertise—by state and non-state actors through nuclear safeguards and export controls and by strengthening nonproliferation and arms control regimes.
- Develop effective technologies to detect foreign nuclear weapons proliferation and nuclear detonations and support monitoring and verification of foreign commitments to treaties and other international agreements and regimes.
- Strengthen nuclear counterterrorism and counterproliferation capabilities by pursuing scientific and technical activities to understand nuclear threat devices, designs, and concepts (including

improvised nuclear devices) and to address risks arising from lost or stolen foreign nuclear weapons and their constituents (namely, nuclear and energetic materials).

- Reduce the terrorist value of nuclear or radiological weapons/devices by maintaining a nuclear and radiological emergency response capability to respond to, manage, avert, and contain the consequences of nuclear/radiological incidents in the United States or elsewhere in the world.
- Respond to nuclear or radiological terrorist acts by searching for and/or rendering safe threat devices, components, and/or radiological and nuclear materials and by conducting consequence management actions following an event to save lives, protect property and the environment, and meet basic human needs.

1.4 Program Realignments under the NNSA Defense Nuclear Nonproliferation Appropriation

The nuclear threat prevent-counter-respond activities of the NNSA nuclear nonproliferation and counterterrorism mission are supported by funding from the Defense Nuclear Nonproliferation appropriation. In the FY 2016 President's Budget Request, NNSA proposes to fund two mission areas under the Defense Nuclear Nonproliferation appropriation: 1) the Defense Nuclear Nonproliferation Program and 2) the Nuclear Counterterrorism and Incident Response (NCTIR) Program. NCTIR and the Counterterrorism and Counterproliferation (CTCP) Programs were previously funded under the Weapons Activities appropriation. This move aligns all NNSA funding for preventing, countering, and responding to global nuclear dangers in one appropriation; strengthens existing collaborations and shared tasks between the two mission areas; and clarifies total funding and work scope dedicated to counterterrorism.

Additionally, the FY 2016 proposal reflects the realignment of budgets managed by the Office of Defense Nuclear Nonproliferation (DNN) into the following programs: Material Management and Minimization (M^3), Global Material Security (GMS), Nonproliferation and Arms Control (NPAC), Nonproliferation Construction, and Defense Nuclear Nonproliferation Research & Development (DNN R&D). Detailed crosswalks between the old structure and new structure can be found in the Fiscal Year 2016 Department of Energy Congressional Budget Justification, Volume 1 (National Nuclear Security Administration).

The FY 2016 request proposes to combine the NCTIR and CTCP programs to eliminate confusion about NNSA nuclear

NNSA Role and Contribution to Nuclear Forensics Development

Nuclear forensics is the technical evaluation of nuclear materials and related items recovered out of regulatory control with the goal of determining the history and provenance of the material or items. Should a radiological/nuclear attack be attempted or actually occur, the United States maintains an effective and robust forensics and attribution capability to determine in a timely fashion who was responsible and to take appropriate actions. A range of NNSA programs, spanning much of the prevent-counter-respond spectrum, leads and supports interagency nuclear forensics efforts.

The NNSA nuclear forensics mission portfolio includes efforts in both nuclear and non-nuclear materials characterization; nuclear material pre- and post-detonation collection and analysis; pre- and post-detonation nuclear device modeling; advanced research and development to improve current capabilities within these areas, including the identification and exploitation of new signatures; and international capacity-building to strengthen and accelerate global efforts to prevent nuclear terrorism.

counterterrorism programs and activities. The change of the NCTIR name from its previous name, "Nuclear Counterterrorism Incident Response Program" to "Nuclear Counterterrorism ***and*** Incident Response Program" is meant to reflect this new proposed program structure. The program strategically manages and deploys expert scientific teams and equipment to provide a technically trained, rapid response to nuclear or radiological incidents and accidents worldwide. NCTIR evaluates and assesses nuclear or radiological threats and leverages that knowledge to provide interagency policy and contingency planning, training, and support to national and international counterterrorism, counterproliferation, and incident response capabilities. Finally, NCTIR also executes the DOE's Emergency Management and Operations Support Program that manages the Emergency Operations Centers, Emergency Communications Network, and Continuity of Operations Program activities.

1.5 Risk Assessment and Prioritization Approach

Previously, each program office under DNN appropriation has applied rigorous internal risk assessment and prioritization approaches (including Intelligence Community assessments) to inform, develop, and provide the foundation for its fiscal year funding request. Although significant program-level coordination continues, the realignment of the NCTIR Program under the DNN appropriation, the reorganization of the Office of Defense Nuclear Nonproliferation, and the standup of NNSA's new Cost Estimating and Program Evaluation Office will now provide NNSA with a more integrated structure for program planning, budgeting, and evaluation as well as cross-program prioritization.

At the individual program level, the risk-informed prioritization process is directly influenced by U.S. policy imperatives, program management judgment, and a variety of other external factors. NNSA programs generally use classical risk assessment calculations (i.e., assessed threats, level of vulnerability, degree of consequences), which are tailored to their program-level missions and capabilities and influenced by external considerations (e.g., emergence or evolution of threat trends, time-urgency of a specific threat, windows of opportunity to act, level of long-term political support and cooperation from partners, adequacy of technical capabilities, and availability of resources). Chapters 2 through 4 of this report describe the risk assessment and prioritization methodologies used by each NNSA program. Additional details on the nuclear and radiological threat environment and on NNSA programs' use of these methodologies can be found in the classified appendix to this report.

1.6 The Vital Role of the DOE National Laboratories

The DOE complex of national laboratories, plants, and sites are central to NNSA's ability to prevent proliferation and nuclear terrorism. The DOE complex provides the science, technology, engineering, and manufacturing capabilities that are the tools by which NNSA solves the technical challenges of combating nuclear terrorism and proliferation, verifying treaty compliance, and guarding against threats posed by nuclear technological surprise. All parts of the DOE scientific enterprise contribute to the NNSA nonproliferation and counterterrorism mission. For example, the unique and extensive science, technology, engineering, and manufacturing capabilities developed over decades of nuclear weapons research, development, and stockpile management enables the DOE complex to play a critical role in the nation's ability to understand nuclear proliferation and terrorism threats worldwide.

The national laboratories, sites, and plants of the NNSA nuclear security enterprise are U.S. national assets, contributing directly to the missions of DOD, DOS, DHS, the U.S. Intelligence Community, and other agencies and government entities. They also support broader international efforts through Mutual Defense Agreements (MDAs) and agreements with other countries as part of the collective goal to ensure nuclear deterrence and reduce the threat of nuclear terrorism. The DOE scientific complex and NNSA nuclear security enterprise will only become more important in the future as NNSA faces the evolving technical challenges of verifying treaty compliance under more complex treaty obligations, assessing foreign nuclear weapons activities that are more easily hidden and enabled in today's information environment, combating ever-adapting tactics and pathways to nuclear terrorism and proliferation, and guarding against technological surprise.

Figure 2. DOE National Laboratories, Plants, and Sites Contributing to the Prevent-Counter-Respond Mission

1.7 Coordination within U.S. Interagency

As the U.S. leader in nuclear security, DOE is a primary U.S. Governmental department for implementing the U.S. nuclear nonproliferation agenda and works in partnership with other U.S. Governmental agencies involved in nuclear nonproliferation and nuclear counterterrorism activities, most notably DOS, DOD, DHS, the U.S. Intelligence Community, and the U.S. Nuclear Regulatory Commission (NRC).

NNSA actively participates in White House-led Interagency Policy Committee (IPC) and Sub-IPC meetings on nuclear nonproliferation, counterterrorism, and emergency response, which are routinely held to develop consistent interagency policy positions and implementation strategies. Moreover, Presidential initiatives, such as the sustained effort to secure or eliminate vulnerable nuclear weapon materials, may involve additional coordination mechanisms, such as program-level interagency working groups.

Within the U.S. interagency, NNSA coordinates its nonproliferation and counterterrorism programs most closely with the DOD Cooperative Threat Reduction (CTR) Program, the DOS Bureau of International Security and Nonproliferation (ISN), and the NRC. Through a "Bridge Meeting" process, NNSA and the Office of the Secretary of Defense hold Assistant Secretary-level coordination meetings on their cooperative nuclear nonproliferation program activities, and discuss areas of common interest where NNSA and DOD program strengths and unique capabilities may complement each other. A similar focused coordination forum was created among the DOS, DOD, and DOE to "map" their nuclear nonproliferation program plans in specific foreign countries, to better leverage the three departments' nuclear security cooperative assistance activities. In addition, NNSA's emergency management priorities (including its response to nuclear/radiological proliferation and terrorist threats) are informed by, and aligned with, national security priorities as defined by counterterrorism and incident management lead-agencies. These national security priorities include interagency strategic and operational plans developed by the FBI, DHS's Federal Emergency Management Agency (FEMA), as well as DOS and DOD.

1.8 Foreign Partnerships and Contributions

The U.S. national security strategy makes international cooperative partnerships a critical and necessary element in achieving U.S. nuclear/radiological security objectives. NNSA is the U.S. lead or co-lead in many key international engagements to cooperatively strengthen the global nuclear security regime. These partnerships extend the reach of NNSA programs and play a key role in demonstrating international support for action against the global nuclear proliferation and terrorism threat. Further, this broader and ongoing engagement helps establish a level of confidence and trust that bolsters NNSA's ability to quickly engage the support of regional partners whenever a transformative event suddenly occurs.

Further, U.S. foreign partners recognize NNSA and other parts of DOE as possessing world-leading expertise and infrastructure for strengthening nuclear security around the globe, and thus share the cost of program actions in pursuit of common nuclear security objectives and priorities with NNSA. Since 2005, NNSA has had Congressional authorization to receive direct financial contributions from foreign partners. Nuclear nonproliferation programs have received nearly $95 million (in U.S. dollars) for designated projects from eight foreign countries, enabling NNSA programs to implement cooperative nuclear security work that advances the mutual nonproliferation objectives of both the foreign partner and the United States.

Internationally, DOE has a strong and long-established partnership with the IAEA, and conducts multilateral consultations through forums such as the Nuclear Security Summits, the Global Initiative to Combat Nuclear Terrorism (GICNT), the G7 Global Partnership Against the Spread of Weapons and Materials of Mass Destruction (GP), and the United Nations (UN) Committee implementing UN Security Council Resolution 1540. In addition, NNSA acts as the U.S. lead or co-lead in a number of bilateral cooperation coordination bodies, including (but not limited to) the U.S.-China Peaceful Uses of Nuclear Technology Joint Coordination Committee; the U.S.-European Atomic Energy Community (EURATOM) Joint Coordination Committee; the U.S.-Japan Nuclear Security and Emergency Management Working Groups; the U.S.-India Joint Working Group on nuclear security cooperation through India's Global Center for Nuclear Partnership; and the U.S.-Russia Bilateral Presidential Commission's Nuclear Energy/Nuclear Security Working Group.

Under its counterterrorism/counterproliferation mission, NNSA sustains international technical and policy engagements with key allies and foreign partners, conducts bilateral counterterrorism security dialogues with other countries that maintain peaceful nuclear power programs, and coordinates

outreach to strengthen WMD counterterrorism capabilities, domestically and abroad. For example, in support of the U.S.-UK-France Joint Statement on Nuclear Terrorism issued at the 2012 Nuclear Security Summit in Seoul, and working closely with UK and French partners, NNSA continues its international engagements supporting approaches to reduce the attractiveness of nuclear materials to terrorists, and continues sharing specialized knowledge to diagnose, render safe, characterize, and dispose of nuclear threat devices.

NNSA also works with foreign partners to improve their emergency response and management capabilities in the face of a nuclear or radiological incident. The International Emergency Management and Cooperation (IEMC) program works under assistance and cooperation agreements with more than 80 countries and 10 international organizations to provide consistent emergency plans and procedures, effective early warning and notification of nuclear/radiological incidents or accidents, and delivery of assistance to an affected nation should it ask for assistance in response to an incident/accident.

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Chapter 2: Prevent
Preventing Nuclear/Radiological Proliferation & Terrorism

<u>Prevent</u> non-state actors and additional countries from developing nuclear weapons or acquiring weapons-usable nuclear materials, equipment, technology, and expertise; and prevent non-state actors from acquiring radiological materials for a radiological threat device.

2.1 Material Management and Minimization

2.1.1 Program Objectives, Priorities, and Performance Metrics

The M^3 Program seeks to minimize/ eliminate excess weapons-useable nuclear materials and provide nuclear materials for peaceful uses.

While upgrading the security of vulnerable nuclear materials at their sources is a key step to reducing the risk of theft, the only way to eliminate the risk of the material being stolen is to eliminate the material entirely. The Material Management and Minimization (M^3) Program, therefore, uses an integrated approach to achieve permanent threat reduction by minimizing and, when possible, eliminating WUNM from civilian use around the world.

A key starting point for materials minimization is reducing (and to the extent possible, eliminating) the civilian use of, and demands for, WUNM. The M^3 Program works around the world to convert or verify shutdown of civilian research and test reactors that use or produce WUNM. In support of this goal, the M^3 Program works to develop and qualify new fuels and technologies to support reactor conversions. Additionally, the M^3 Program works with international isotope producers to convert them from HEU to low-enriched uranium (LEU) targets and accelerate the establishment of reliable supplies of the medical isotope molybdenum-99 (Mo-99) produced without HEU in the United States. These efforts result in permanent threat reduction by minimizing, avoiding, and to the extent possible, eliminating the use of HEU in civilian applications.

Once WUNM is no longer required, the M^3 Program works with facilities to remove and dispose of the excess HEU and plutonium, including repatriating U.S.-origin HEU and LEU fuel (mostly from material test reactors [MTR] and Test, Research, Isotopes, General Atomics- [TRIGA-] type reactors), repatriating Russian-origin HEU to Russia, and removing and disposing of so-called “gap material,” which is HEU and separated plutonium that fall outside of the U.S.- and Russian-origin material categories. The M^3 Program also maintains the capability to rapidly respond (when tasked) to support the denuclearization of any countries of concern, building on the experiences gained and infrastructure developed in past denuclearization initiatives (e.g., the 2004 effort in Libya).

Material returning to the United States will be incorporated into material disposition and management plans. One of the disposition paths for HEU is down-blending into 19.75 percent LEU as feed stock for LEU research reactors and isotope production targets. The M^3 Program manages U.S. enriched uranium supply and demand needs, providing material to support peaceful uses such as research reactor fuel,

isotope production targets, and the American Assured Fuel Supply (AAFS). By making LEU available for partners looking to convert reactors and targets from HEU to LEU, the M^3 Program closes the materials management loop that began with HEU-to-LEU reactor conversions.

The M^3 Program prioritizes its work based on the following factors:

- **Material Attractiveness:** M^3 focuses its efforts on nuclear materials that could be used by state and non-state sponsors of terrorism to fabricate a nuclear weapon known as an improvised nuclear device (IND)—HEU and plutonium. M^3uses the DOE Categorization Chart (DOE M 474.1-1B, 6-13-03) as a reference for categorizing nuclear material attractiveness. However, the chart does not take into consideration all of the factors that M^3must consider.
- **Internal Site Vulnerability:** M^3also considers site security conditions. This information could come from a number of sources, including formal assessments from NNSA's Office of Global Material Security (GMS), the Office of Nonproliferation and Arms Control (NPAC), and the DOE Office of Intelligence and Counterintelligence. Information also could come from informal M^3 assessments of security obtained from site visits to implement its programs.
- **Country and Regional-Level Threat Environment:** M^3 also assesses the threat level in partner countries and regions. Data for country and regional threat environments are derived from an assessment of terrorist presence, terrorist attacks, nuclear/radiological smuggling, nuclear/radiological thefts, and any other relevant information.
- **Technical Feasibility:** The technical feasibility of safely completing the conversion, removal, and/or disposition activity is also a contributing factor. Although a facility may be a high priority based on the first three factors, M^3 also will take into account the technical feasibility of an activity when allocating resources to that effort. In accordance with the first three factors above, M^3 will make it a priority to do the technical work necessary to complete these activities as soon as it is feasible to do so.
- **Political Willingness:** The willingness of the partner country to cooperate in conversion, removal, and/or disposition activities also must be considered. While these issues remain largely outside the control of the M^3 Office, M^3 works closely with its interagency partners to obtain agreement to work at priority facilities as soon as possible.

The M^3 Program regularly measures its performance in (a) cumulative number of HEU reactors and isotope production facilities converted to LEU use or verified as shutdown prior to conversion; (b) cumulative number of kilograms of vulnerable nuclear material (HEU and plutonium) removed or disposed; (c) cumulative amount of surplus U.S. HEU down-blended or shipped for down-blending; and (d) cumulative kilograms of plutonium metal converted to oxide at the Los Alamos National Laboratory (LANL) and at the Savannah River H-Canyon site.

2.1.2 Program Activity, Accomplishments, and Challenges

The M^3 Program supports activities in three areas: Conversion, Nuclear Material Removal, and Material Disposition.

Conversion

In the area of Conversion, the M^3 Program supports two programmatic areas: the Conversion Program and the Mo-99 subprogram. The **Conversion Program** will continue pursuing reactor conversions and verifying shutdowns around the world. The focus of the Conversion Program will be on continuing efforts to convert the remaining U.S. HEU-fueled research reactors and the remaining HEU research

reactors in Europe, Asia, Africa, and North America. A key part of this effort will be the successful qualification and commercial-scale fabrication of new high-density LEU fuels to convert high-powered research reactors—primarily in the United States, Europe, and Russia—that cannot be converted with existing LEU fuels. Conversion work in Russia will focus on bilateral technical exchanges on converting the six reactors originally agreed to in 2010.

The **Mo-99 subprogram** works to accelerate the establishment of reliable supplies of the medical isotope Mo-99 that are produced without the use of HEU. Under its long-standing HEU minimization mission, and in pursuit of commitments made in Nuclear Security Summit Communiqués, the Mo-99 subprogram provides assistance to global medical isotope producers to eliminate the use of HEU at their production facilities located in Belgium, Canada, the Netherlands, and South Africa. The Mo-99 subprogram also works with U.S. commercial entities (via cooperative agreements funded on a 50-50 cost-share basis) to accelerate the establishment of new Mo-99 production in the United States without using HEU.

Developing New Nuclear Fuel for Reactor Conversions

One challenge to converting HEU-fueled research reactors is to find an LEU fuel that still retains as much of the original reactor performance as possible. To this end, NNSA is sponsoring development of very high-density LEU fuels for research and test reactors. The Fuel Development Project at ***Idaho National Laboratory (INL)*** *is focused on two major goals:*

1) *Develop uranium-molybdenum monolithic fuels with the highest possible uranium density (~16g U/cm^3) suitable for use in high performance U.S. research reactors (e.g., the University of Missouri Research Reactor, Massachusetts Institute of Technology Reactor, National Bureau of Standards Reactor, Advanced Test Reactor, etc.).*
2) *Develop high-density dispersion fuels with uranium densities in the range of 8–10 g U/cm^3 primarily for use in Europe.*

This project will lead to a Base Fuel Qualification Report to the NRC for generic approval of the LEU fuel, projected to take place by 2023.

In 2014, the project achieved a major milestone with the completion of the irradiation fuel test, RERTR-12. RERTR-12 is an experiment incorporating a matrix of specimens that includes low, intermediate, and high fission rates; low, intermediate, and high burnup; and thin and thick fuel plates. The results from RERTR-12 contributed data that are critical to the understanding of the fuel's mechanical integrity during normal and off-normal operating conditions, stable and predictable behavior, the sensitivity of fuel and blister performance to fuel design features, and fission product release.

As required by the American Medical Isotopes Production Act of 2012, the Department is currently on track to establish a Uranium Lease and Take-Back (ULTB) program by January 2016. Under this program, DOE will make LEU available through lease contracts for the production of Mo-99 for medical uses. The lease contracts allow the producers of the Mo-99 to take title to, and be responsible for, the Mo-99 created. After the irradiation, processing, or purification of the leased uranium, DOE is then required to take title and be responsible for the final disposition of (1) radioactive waste for which DOE determines the Mo-99 producers do not have access to a disposal path, and (2) spent nuclear fuel. The M^3 Program will work with the DOE Office of Environmental Management to implement the ULTB program.

FY 2015 Planned Accomplishments

- Convert or verify the shutdown of an additional two reactors in FY 2015 for a total of 94 reactors and isotope production facilities worldwide, including the first Chinese-origin Miniature Neutron Source Reactor (MNSR) from HEU to LEU fuel (allowing for future conversions in five other foreign countries).
- Provide technical and financial support to the U.S. private sector to accelerate the establishment of a reliable domestic production capability for Mo-99 without the use of HEU, and to existing global Mo-99 producers to convert from the use of HEU targets to LEU targets.
- Continue ongoing work on the ULTB program.

Program Challenges

- Political issues may affect implementation of key programs, particularly with Russia where the majority of remaining civilian HEU research reactors are operating.
- Developing and qualifying new high-density LEU fuels needed to convert high performance research reactors poses significant technical challenges.
- Economic conditions in the current Mo-99 market continue to make it difficult for private investors to commit funding to domestic Mo-99 production.

Nuclear Material Removal

Activities of the **Nuclear Material Removal Program** support the removal and disposal of U.S.-origin HEU and LEU, Russian-origin HEU, and other high-risk nuclear materials. The Nuclear Material Removal Program will continue to support the removal of U.S.-origin HEU and LEU from eligible research reactors to the United States until 2019 as part of an incentive for previous HEU-to-LEU reactor conversions. It will continue to work closely with the Russian Federation to remove Russian-origin HEU from third countries. The Nuclear Material Removal Program also will support the removal and disposal of vulnerable, high-risk nuclear materials that are not covered by the Russian-origin and U.S.-origin Nuclear Material Removal Program activities. This includes U.S.-origin HEU that is not eligible under the U.S.-origin Nuclear Material Removal Program, HEU of non-U.S. and non-Russian-origin, and separated plutonium. The Nuclear Material Removal Program also will work to consolidate nuclear material within other countries into fewer, more secure locations if they cannot be removed or dispositioned. This approach decreases the number of proliferation-attractive targets, as well as the long-term equipment and personnel costs associated with securing special nuclear material (SNM).

Figure 3. Glove Box for Plutonium Packaging

In addition, as part of its mission to address emerging threats, the Nuclear Material Removal Program will continue to develop the capability to rapidly respond when there is a need to remove nuclear material from countries of concern (such as Libya in 2004) or where material is vulnerable. This includes

Recovering Vulnerable Nuclear Materials Around the World

Nuclear Material Removal from Vietnam

Under President Obama's Four-Year Effort to secure and eliminate vulnerable nuclear materials, NNSA worked with the IAEA, Russia, and other partners to remove both U.S. and Russian-origin HEU and separated plutonium from locations around the world. From April 2009 to December 2013, NNSA removed or confirmed the disposition of over 3,000 kg of HEU—enough material for 100 nuclear weapons. The Four-Year Effort resulted in the removal of all HEU from 11 countries (Austria, Chile, Czech Republic, Hungary, Libya, Mexico, Romania, Serbia, Turkey, Ukraine, and Vietnam) plus Taiwan.

Over the lifetime of this initiative, NNSA has removed or confirmed the disposition of over 5,000 kg of HEU and separated plutonium from 37 countries plus Taiwan, with all HEU removed from 26 of those countries and Taiwan. Within this amount, nearly 1,300 kg of Russian-origin HEU was securely repatriated to Russian territory, with IAEA providing verification services for all shipments. Several DOE national laboratories and sites contributed important technical expertise and infrastructure to support these removal projects: ***Argonne National Laboratory*** *on Russian-origin nuclear material removals,* ***Idaho National Laboratory*** *on Russian-origin and U.S.-origin nuclear material removals,* ***Oak Ridge National Laboratory*** *on Russian-origin nuclear material removals,* ***Savannah River National Laboratory*** *and* ***Savannah River Site*** *on Russian-origin, U.S.-origin, and gap nuclear material removals, and* ***Y-12 National Security Complex*** *on U.S.–origin and gap nuclear material removals.*

developing systems that can be deployed outside the United States to enable trained personnel to safely handle, stabilize, and package nuclear materials (focusing on HEU and plutonium) for removal.

FY 2015 Planned Accomplishments

- Remove and/or confirm the disposition of an additional 125 kg of HEU and plutonium from countries such as Canada, Jamaica, Kazakhstan, and Uzbekistan, for a cumulative total of 5,332 kg.

Program Challenges

- Political engagement on material removal plans with some countries has been challenging, and may continue to be so in the future.

Material Disposition

The **Material Disposition Program** is responsible for disposing of surplus HEU and weapons-grade plutonium in the United States, working with Russia to dispose of Russian surplus weapons-grade plutonium under the U.S.-Russia Plutonium Management and Disposition Agreement (PMDA), directing the international plutonium management initiative, and managing material for peaceful uses.

Over the past decade, the Material Disposition Program has eliminated more than 145 metric tons (MT) of weapons-usable HEU by down-blending it to LEU for use in power and research reactors as well as isotope production targets for use domestically and abroad. The Program has substantially reduced holdings of fissile materials throughout the DOE complex, rid the world of more than 5,800 weapons-worth of unneeded material, helped reduce civil use of HEU worldwide, and made a significant contribution to electricity supplies. The program also has been able to offset appropriations by using bartering to pay for commercial down-blending services, and funds received from the sale of LEU are returned to the U.S. Treasury. The Program will continue down-blending U.S. HEU to meet nonproliferation objectives, and in developing future projects from unallocated HEU inventories. Additionally, material returning to the United States from the Nuclear Material Removal Program is incorporated into those disposition and management plans.

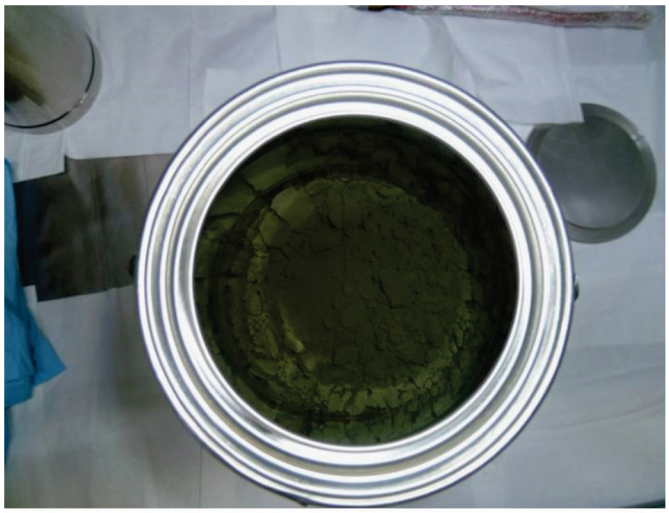


Figure 4. Sample of Plutonium Oxide

The Materials Disposition Program also will be responsible for managing enriched uranium supply and demand needs and commitments, in support of DNN statutory obligations and mission goals to support the provision of material for peaceful uses. This will include oversight of contractor management of the LEU for the AAFS, research reactor conversion supplies, and supplies to support medical isotope production. These activities support U.S. Government nonproliferation and nuclear security objectives to discourage development of indigenous enrichment and reprocessing capabilities by other countries and minimize the use of HEU in civilian nuclear applications.

To dispose of U.S. plutonium, the Materials Disposition Program has been constructing the Mixed Oxide (MOX) Fuel Fabrication Facility (MFFF) at the DOE Savannah River Site (SRS), which would enable the Department to dispose of weapons-grade plutonium by fabricating it into MOX fuel and irradiating it in commercial nuclear reactors. The program also has been constructing the Waste Solidification Building (WSB) to handle the waste streams from the MOX facility. (See related information in Section 2.5.)

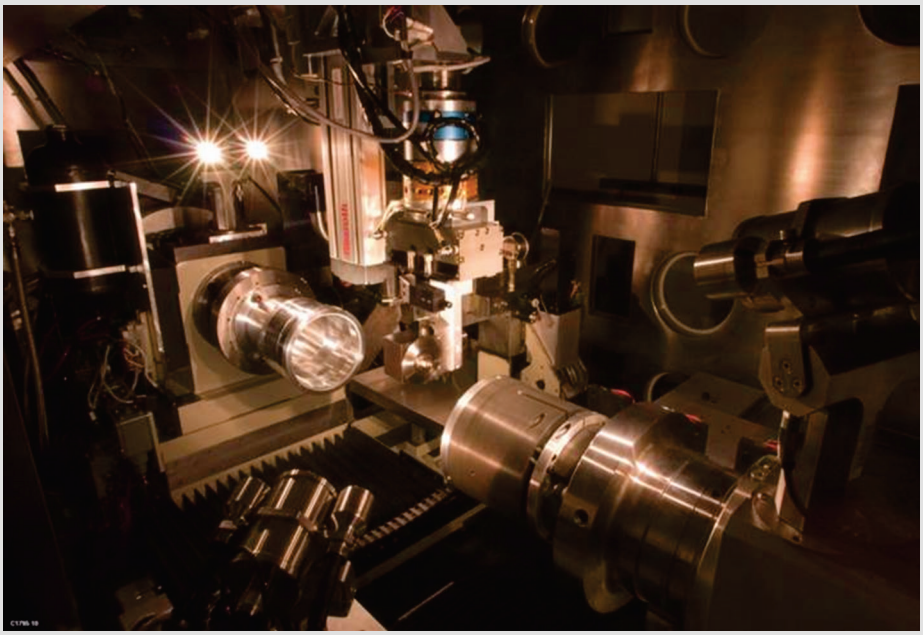
During FY 2013, DOE decided to initiate an analysis of options for completing the plutonium disposition mission more efficiently. On April 29, 2014, the Department's Plutonium Disposition Working Group released its preliminary study of potential disposition options, which will serve as a basis for evaluating the best path forward for plutonium disposition. These options included the MOX fuel approach, irradiation of plutonium fuel in fast reactors, and non-reactor options such as immobilization with high-level waste, down-blending and disposal, and deep borehole disposal. Based upon the analysis, the Department determined that the MOX fuel approach is more expensive than anticipated, with a life

cycle cost estimate in excess of $30 billion, even with consideration of potential contract restructuring and other improvements that have been made to the MOX project. The FY 2015 National Defense Authorization Act and the FY 2015 Consolidated and Further Continuing Appropriations Act each directed the Department to conduct additional analyses of the MFFF project, including independent cost and schedule estimates, as well as an analysis of alternative approaches for disposition of the 34 MT of weapons-grade plutonium and their relationship to the PMDA. The Department has requested Aerospace Corporation, a Federally Funded Research and Development Center (FFRDC), to perform these analyses. These analyses will be completed during FY 2015 and will inform the path forward on plutonium disposition.

The Materials Disposition Program continues to convert existing surplus U.S. plutonium material into plutonium oxide, a necessary first-step in disposing of this material. Approximately 3.7 MT of cumulative plutonium at the SRS (H-Canyon) eventually will be converted to plutonium oxide, as will approximately 2 MT of plutonium at LANL.

Dismantling Plutonium Pits through ARIES

As part of the U.S. plutonium disposition campaign, one step in the process is to convert excess plutonium material into plutonium oxide (PuO_2). At the ***Los Alamos National Laboratory (LANL)****, plutonium "pits" from disassembled U.S. nuclear warheads are converted to PuO_2 material by the Advanced Recovery and Integrated Extraction System (ARIES). The ARIES prepares, packages, and certifies the PuO_2 product, which eventually will be eliminated under one of the plutonium disposition options (once an option is chosen). The ARIES production program has made significant progress in maintaining and improving production capability, particularly in the areas of criticality safety, by addressing potential single point failures in the production line, improving operations, and certifying additional PuO_2 material. ARIES also supports the* ***NNSA Office of Defense Programs*** *by exercising and maintaining plutonium-related skill sets and infrastructure capabilities that are used in U.S. nuclear weapons stockpile management.*



Robotic Pit Disassembly Lathe at LANL

In addition, the Materials Disposition Program will (with appropriate authorization, as needed) support Russian efforts to dispose of at least 34 MT of Russian surplus weapons-grade plutonium withdrawn from its nuclear weapons program, as required under the amended U.S.-Russia PMDA. The program also will serve as a focal point within DNN for the development of international plutonium management strategies with countries other than Russia, by developing bilateral and multilateral working arrangements in which countries engage at a technical level to support efforts to manage plutonium inventories in ways that minimizes the stockpiles of excess plutonium.

FY 2015 Planned Accomplishments

- Continue to disassemble nuclear weapon pits and convert resulting plutonium metal into oxide at LANL (using the LANL ARIES process), as part of the 2 MT campaign; and continue processing of existing plutonium metals and oxides in the H-Canyon and HB Line at SRS as part of the 3.7 MT campaign.
- Continue to down-blend HEU for research reactor needs in support of reactor conversion efforts.
- Complete 5 MT of the MOX Backup LEU Inventory Project.
- Begin processing of a new 3 MT extension of the MOX Backup LEU Inventory Project.
- Complete construction of the WSB and place it in lay-up.

Program Challenges

- The limitation of disposition pathways (both in the United States and abroad) hinders program ability to eliminate vulnerable HEU and plutonium in foreign countries.
- Need to establish a path forward on plutonium disposition in the United States.
- Prolonged operational delays at the LANL plutonium processing facility, PF-4, which is converting laboratory-held plutonium into plutonium oxide.

2.1.3 Future Program Plans

The M^3 Program is working in over 25 countries around the world to implement nuclear material minimization strategies. By the end of 2020, the M^3 Program will have converted or verified the shutdown of 118 HEU research reactors and isotope production facilities around the world, removed approximately 6,800 kg of excess WUNM, dispositioned 165 MT of surplus U.S. HEU, and worked toward dispositioning plutonium in accordance with the amended U.S.-Russia PMDA.

Main Areas of Activity for FY 2016 – FY 2020

- Convert research reactors and isotope production facilities to the use of non-weapons usable nuclear materials, or verify their shutdown, while limiting scope with Russia to technical engagement on additional reactor conversions beyond the current pilot program of six facilities to be converted (with appropriate authorization, as needed).
- Establish domestic Mo-99 production without HEU and assist global Mo-99 production facilities to eliminate the use of HEU targets.
- Establish the ULTB program by January 2016, in accordance with the American Medical Isotopes Production Act of 2012 to provide LEU for non-HEU based domestic Mo-99 production.

- Eliminate excess HEU and plutonium around the world, to include the following countries: Argentina, Canada, France, Germany, Indonesia, Japan, Switzerland, Poland, Kazakhstan, and potentially Ghana.

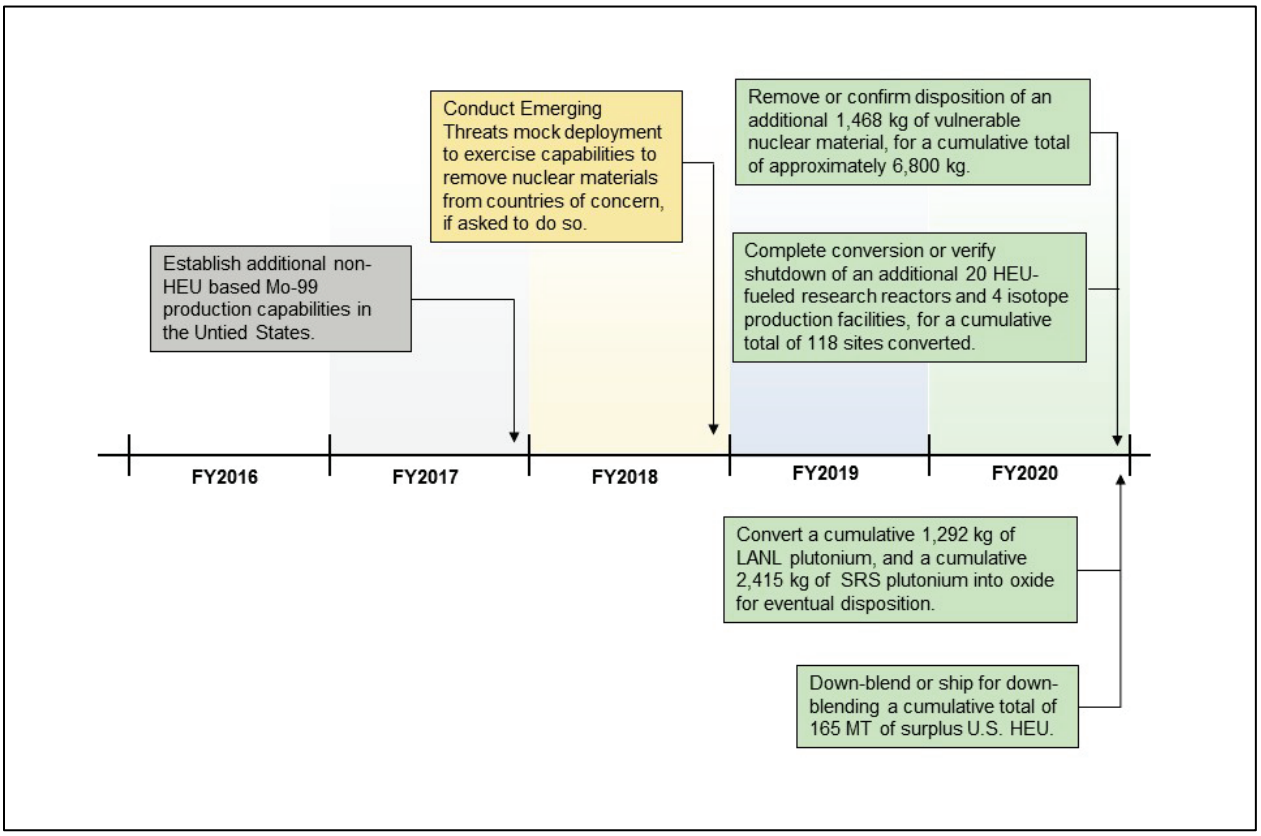


Figure 5. M^3 Key Program Milestones

2.2 Global Material Security

2.2.1 Program Objectives, Priorities, and Performance Metrics

The Global Material Security (GMS) Program implements a multifaceted approach to strengthen partner capacity and commitment to secure nuclear and radiological materials at their sources, reduce the risk of their illicit theft or acquisition by terrorists and/or proliferant states, and improve capacity to detect these materials when outside regulatory control. The first line of defense provides nuclear and radiological material protection, control, and accounting (MPC&A) upgrades and related training, and strengthens MPC&A regulations, inspections, and security culture. It provides significant support to the IAEA to further that Agency's nuclear security guidance documents and training, contributes to global nuclear security architecture objectives of the Nuclear Security Summit process, and supports a growing network of nuclear and radiological security practitioners through best-practice technical exchanges, as well as through development of Nuclear Security Centers of Excellence (COEs). To complement efforts to secure materials at their source, the GMS Program also supports the recovery of orphaned or disused radiological sources, both domestically and abroad, and their transportation to secure storage locations. GMS also promotes the use of non-isotopic, alternative technologies to reduce the number of attractive radiological targets in the civilian sector as a long-term threat reduction strategy.

The GMS Program seeks to secure, account for, and interdict the illicit movement of nuclear weapons, proliferation-sensitive materials and radiological sources.

To address the contingency that nuclear or radiological materials might pass through this first line of defense, NNSA has established and works to strengthen a second line of defense that endeavors to prevent the illicit transfer of nuclear/radiological material across national borders. The GMS Nuclear Smuggling Detection and Deterrence (NSDD) subprogram strengthens the capacity and commitment of foreign governments to deter, detect, and interdict illicit trafficking in nuclear and radiological materials across international borders, both maritime and continental. NSDD provides fixed and mobile radiation detection systems, training, and maintenance and sustainability support to partner countries. NSDD deploys its systems at carefully selected locations as part of the United States' global defense-in-depth approach to countering nuclear trafficking. The detection systems deployed by NSDD are the single largest U.S. Government-provided technology component to the exterior layer of the Global Nuclear Detection Architecture (GNDA), which is a framework for detecting (through technical and non-technical means), analyzing, and reporting on nuclear and other radioactive materials that are out of regulatory control.

Figure 6. Example of a Nuclear Protective Force Training Facility

In the long term, each partner country must be able to sustain its ability to secure, control, and interdict nuclear materials. The sustainability component of the GMS Program focuses on improving indigenous security infrastructure at the site and national levels, and it helps improve regulatory systems,

transportation security, training, maintenance, performance testing, life cycle planning, and nuclear security culture.

The GMS Program uses the following principles to guide its prioritization of activities:

- **Response to Imminent Threats**: The variety of active external and insider threats, plus the numerous illicit trafficking networks, require focused, timely, and adaptable programs that can disrupt current and emerging security risks.
- **Defense-in-Depth Compensates for Inherent Weaknesses:** No facility or border security system is foolproof. All systems are inherently limited by their technical capabilities, human error, corruption, deterioration, and other factors. These weaknesses can be mitigated by establishing multiple layers of security and detection.
- **Target–Out Approach:** Nuclear material security measures and nuclear trafficking detection efforts are most effective close to "target" nuclear material inventories. Probability of interruption and neutralization of an attempted theft, as well as the probability of detecting an attempt to smuggle material, is highest when closest to the source of the materials.
- **Commitment to Sustainability:** In order for security improvements to be sustained, partner countries must commit resources to national regulations, oversight, system operation, and security culture.
- **Permanent Threat Reduction:** GMS encourages nuclear material consolidation where possible in order to reduce vulnerability, and it also works with NNSA's research and development branch, national laboratories, and relevant U.S. Government agencies to identify and advance non-isotopic, alternative technology as replacements for high-activity radiological sources.

The GMS Program uses multi-factor risk assessment methodologies to determine which specific programmatic elements, and activities within elements, should receive higher priority. In light of the FY 2016 realignment of DNN programs, GMS is in the process of integrating the strategic and prioritization approaches of its individual programs into a broader GMS-wide approach.

Figure 7. Secure Transport of Russian Nuclear Material

For example, the nuclear and radiological security programs identify the potential consequences posed by theft or loss of a given material (i.e., a graded assessment of the destructive potential of the material and the ease with which it could be converted into a weapon) and evaluate the effectiveness of the physical protection and material control and accounting systems of the facility against the likely threats posed to the facility.

NSDD uses several factors in assessing and prioritizing where it will install or enhance radiation portal monitoring systems and operational practices. These factors include attractiveness to nuclear smugglers of seaports that ship containerized cargo (with emphasis on high-volume scanning of containers at strategic ports); the importance of interdicting trafficked material closest to the source, incorporating failure and corruption mitigation measures (including some redundancy along the highest threat routes); consideration of multiple types of smugglers and their routes; societal factors, such as political stability and the presence of groups interested in acquiring nuclear/radiological materials; terrorist

activity; prior incidents of trafficking in nuclear or radioactive materials; and the country's ability to successfully support a sustained capacity for detecting and interdicting illicitly trafficked materials.

After countries have been selected for partnership, NSDD customizes its detection equipment deployments and associated training and support to counter the smuggling scenario that is most likely to occur in a given location. For example, in locations where border checkpoints could be evaded by an adversary, NSDD may provide mobile detection equipment and associated training for partner country officials, and work with them to facilitate the integration of relevant information from police and intelligence services into their counter nuclear smuggling efforts. In other areas where natural obstacles such a mountains or rivers serve to channel adversaries into official border checkpoints, NSDD provides fixed radiation detection equipment.

NSDD's risk assessments for specific deployment contexts (international crossing points, large maritime container ports, and partner country interiors) are regularly updated to ensure that NSDD's equipment deployments are consistent with the current threat environment and that programmatic resources are optimized across pathways and detection platforms. In addition to the continuous updating of risk assessments for each of the deployment contexts, NSDD also periodically conducts program-wide strategic reviews to address changes in the program's operating environment that may affect the program's overall approach to its mission. For example, NSDD has recently had to assess its approach due to the impact of Customs' Unions, the changing relationship with Russia, and the rise of the Islamic State of Iraq and the Levant in the Middle East.

To determine progress towards its program objectives, the GMS Program regularly measures its performance in (a) the cumulative number of buildings containing nuclear and radiological material that have been protected (i.e., received security enhancements); (b) the annual total of MPC&A upgrade and sustainability initiatives completed and transitioned to the host country; (c) the cumulative number of sites installing NSDD nuclear detection equipment and the cumulative number of mobile detection systems deployed; and (d) the cumulative number of NSDD fixed sites and mobile detection system deployments that are being indigenously sustained. NSDD also tracks performance and effectiveness through a number of internal metrics based on data received from partner countries.

2.2.2 Program Activity, Accomplishments, and Challenges

The GMS Program supports activities in three areas: International Nuclear Security, Radiological Security, and Nuclear Smuggling Detection and Deterrence.

International Nuclear Security

Within the GMS Program, **International Nuclear Security (INS)** supports MPC&A enhancement activities, including MPC&A regulations and inspections support, implementation of nuclear security training, and the exchange of MPC&A best practices.

INS cooperates with former Soviet Union partner countries to upgrade and sustain nuclear material security at sites that store both WUNM and other proliferation-attractive nuclear material. INS teams work with partner countries to plan and implement, on a cost-shared basis, security upgrades for highly attractive nuclear material at each site. Rapid MPC&A upgrades are installed to mitigate the immediate risk of theft and diversion until long-term, more comprehensive MPC&A upgrades are designed, installed, and placed into operation. After the design and implementation phases, INS teams maintain cooperation with sites in order to promote sustainability. Sustainability practices aim to improve systems and train individuals on how to identify and resolve gaps in the protection strategy. INS also

works with sites and national-level stakeholders to conduct technical exchanges that support the improvement and sustainability of existing MPC&A systems.

INS' approach to site security is based on experience derived from NNSA's decades of cooperation with Russia on nuclear security MPC&A activities at both the site and national levels. Russia phased out cooperation at its nuclear weapon sites in 2013, and at its nuclear weapons complex sites and many civilian sites in late 2014. With appropriate authorization as needed, INS plans to seek opportunities to continue limited MPC&A-related work with select sites and organizations in Russia, and to cooperate with Russia in the form of nuclear security best practices workshops and technical exchanges.

Figure 8. Transport of Spent HEU Fuel to Secure Storage in Kazakhstan

INS assists foreign partner countries in developing and maintaining a national-level nuclear security infrastructure that improves security practices and supports the sustainability of U.S.-funded security upgrades. Projects include support in developing and strengthening MPC&A regulations, implementing training and educational programs, developing sustainability planning, enhancing secure transportation, improving protective force capability, developing and maintaining material control and accounting measurement capabilities, and enhancing nuclear security culture activities internationally.

INS supports MPC&A projects, best practices workshops, and technical exchanges in Belarus, China, India, Israel, Japan, Kazakhstan, South Korea, and South Africa. INS supports nuclear security training programs in Belarus and Kazakhstan as a follow-up to significant past MPC&A upgrade cooperation. In Kazakhstan, INS works closely with local officials on the development of Kazakhstan's Nuclear Security Training Center, a commitment that Kazakhstan reaffirmed at the 2014 Nuclear Security Summit.

NNSA currently cooperates with the Chinese Atomic Energy Agency on the construction of China's first Nuclear Security COE. The COE will address China's domestic nuclear security training requirements, provide a forum for bilateral and regional best practice exchanges, and serve as a venue for demonstrating advanced technologies related to nuclear security.

In the international community, INS works closely with the IAEA to encourage countries to meet internationally recommended levels of nuclear and radiological material security. Improving countries' capacities to uphold international nuclear security recommendations is a key goal for the United States, and INS collaborates with the IAEA's Division of Nuclear Security in pursuit of this goal. INS and IAEA cooperate to establish regulatory frameworks and documents that codify these standards, such as the IAEA's Information Circular 225, Revision 5 (INFCIRC 225/Revision 5) and the IAEA's Nuclear Security Series documents. INS provides technical and policy support for the development of IAEA nuclear security guidance documents and associated curricula, and provides subject matter experts for IAEA training workshops, International Physical Protection Advisory Service (IPPAS) missions, technical and consultancy meetings, and senior advisory committees. INS works bilaterally to train foreign partners

Strengthening Global Implementation of Nuclear Cyber Security

*In the 2012, the **NNSA Office of Defense Nuclear Nonproliferation** conducted an "over-the-horizon" study of the potential threats and trends that NNSA nuclear nonproliferation programs might face in the time period beyond the NNSA's five-year fiscal budget planning horizon. One trend identified in this study was the growth of cyber threats to nuclear safeguards and security equipment, systems, and associated facilities. While many parts of DOE and NNSA are already engaged in various aspects of cyber security, NNSA organized a joint Headquarters-National Laboratory "Cyber Environment Task Force" to evaluate the current and potential future cyber challenges to global nuclear and radiological security regimes and identify the appropriate scope and possible options for addressing these challenges through NNSA nonproliferation programs.*

*The **Idaho National Laboratory (INL)** serves as the Lab co-chair of this Task Force. INL uses its unique technical leadership in nuclear cyber security training content and cyber publications to help ensure the protection of nuclear facility digital data and defense of systems and networks against malicious cyber-attack. INL provides enhanced cyber security expertise to the IAEA for nuclear facilities and owners/transporters of radioactive material worldwide. This knowledge is shared with IAEA Member States through the development of Nuclear Security Series Fundamental and Recommendation Publications, where states learn to specify objectives and set measures for an effective national nuclear security regime. Additionally, INL develops Implementing Guides and training courses to provide specific technical assistance on protecting sensitive information and maintaining effective nuclear security systems and measures. INL works with the IAEA to consider how existing and future challenges can best be met to ensure effective and sustainable nuclear security worldwide.*

on physical protection and nuclear security recommendations in IAEA INFCIRC 225/Revision 5 and security best practices.

FY 2015 Planned Accomplishments

- Continue engagement with India on the nuclear security components of its COE, including one nuclear material security best practice exchange.
- Provide sustainability support, including support for training, procedures, maintenance, equipment repair, critical spare parts, performance testing, and other activities.
- Provide support for IAEA development of nuclear security guidance document development, training, IPPAS missions, and other consultancies.
- Work bilaterally with partner countries to provide training on IAEA INFCIRC 225/Revision 5 and knowledge security best practices.
- Support enhanced nuclear security culture, promoting the importance of personal responsibility for MPC&A with bilateral partner countries and in cooperation with the IAEA.
- Significantly increase support for MPC&A in key, non-former Soviet Union partner countries.
- Continue to engage with China on modern nuclear material security methodologies and best practices in support of the COE initiating operations.
- Conduct training, technical exchanges, and consultations to improve security at nuclear material locations and during transit.

- Sustain and replace infrastructure equipment and update curriculum at training centers.

Program Challenges

- Worsening bilateral relations have affected the ability for INS to continue major cooperative projects in Russia. Given the size of Russia's stockpile of WUNM (and the security risks inherent in such a large material inventory), INS will continue (with appropriate authorization as needed) to look for partnership opportunities with Russia to address common nuclear security challenges.
- It is challenging to establish foreign partner ownership of the INS mission and objectives, particularly when those partner countries suffer from a lack of personnel and resources.

Radiological Security

The **Radiological Security Program** works both domestically and internationally to secure, remove, and reduce the threat posed by vulnerable high priority radiological materials. The Program has developed a radiological material down-selection process and source prioritization methodology to assist focusing resources on high priority targets aimed at preventing access to materials that could be used in radiological dispersal devices (RDD) or radiological exposure devices (RED).

The Program works with domestic and international partners to implement security at high priority radiological materials targets worldwide. The goal is to enhance the protection of high-activity radiological materials typically located at soft target sites (e.g., hospitals and universities) that could be stolen for use in an RDD and RED. The Domestic Material Protection activity works in cooperation with federal, state, and local agencies, and private industry to install security enhancements for high priority radiological materials located at civilian sites in the United States. Protection efforts are a critical interim step while permanent threat reduction solutions are developed (e.g., further development and application of nascent technologies that do not rely on radioactive sources). The International Material Protection activity works in cooperation with international partners worldwide to install physical security enhancements at civilian sites that store or use high priority radiological materials.

The Radiological Security Program also supports domestic and international radiological consolidation and removal efforts. Domestically, the Off-Site Source Recovery Project (OSRP) recovers the known backlog of excess, abandoned, orphan, and unwanted radioactive sealed sources from licensees across the United States. This material includes priority sources from the commercial sector and sources from state agencies that are holding at-risk sources for temporary safe keeping. This work is conducted in close cooperation with federal, state, and local agencies, as well as private industry in the United States. The International Radiological Material Removal activity supports the removal and disposition of excess or abandoned radioactive sources in other countries, as well as provides search and secure training and equipment to enable each country to locate and recover sealed radioactive sources that have fallen out of regulatory control. The removal work includes Russian radioisotope thermoelectric generators (RTGs), U.S.-origin sealed sources in other countries, and other disused or orphaned radiological materials.

Recovering and Securing Vulnerable Radiological Sources

*Over the last decade, **Lawrence Livermore National Laboratory (LLNL**) has had a leading role in NNSA cooperation with Russia to recover Russian radioisotope thermoelectric generators (RTGs). A total of 482 RTGs have been recovered, securing more than 20 million curies of vulnerable radioactive material. In 2013, NNSA announced the successful removal of the remaining 14 Russian RTGs within the Arctic Circle. Under currently existing agreements, LLNL will remove four RTGs in Antarctica and one RTG in Russian Far East during FY 2015.*

The RTG recovery effort involves multiple Russian government and commercial entities for the removal, disassembly, and final disposition of strontium-90 sources. RTGs are surveyed, certified, prepared, and then transported by helicopter, train, ship, and/or vehicle to secure interim storage sites or sent directly to disassembly facilities. Radioactive heat sources are extracted and then shipped in special transportation containers for final disposition. Alternative power sources were installed at most sites that had RTGs removed; these power sources are based on solar technologies with components designed to withstand the harsh climate and conditions.

In addition to the protect and reduce mandates, the Radiological Security Program also is investing in longer-term permanent threat reduction measures to reduce the risk of vulnerable materials used in a spectrum of civilian activities. Considering the volume of high priority sites globally, the most sustainable and resource-efficient means of addressing material vulnerabilities is to encourage reliable and efficient non-isotopic alternatives for the highest activity sources, and develop incentives for users (licensees) to replace high-activity devices with safe alternatives. The strategy also encompasses working with industry on security by design and in-device delay measures that make devices utilizing sources inherently more secure both in static storage and when field-deployed.

FY 2015 Planned Accomplishments

- Recover and dispose of disused or orphaned radioactive sources in other countries and remove an additional 2,000 excess and unwanted sealed sources from locations in the United States, resulting in a cumulative total of more than 37,000 sources removed.
- Complete security enhancements at an additional 105 buildings that use or store radiological materials, resulting in a cumulative total of 1,921 buildings secured—both domestically and abroad.
- Continue efforts to work with U.S. states and the NRC to transfer long-term recovery and disposal costs from U.S. taxpayers to licensees.

- Expand efforts to find better long-term threat reduction solutions; including further development and promotion of public- and private-sector transition to technologies that do not rely on radioactive sources.

Program Challenges

- Creating an effective and sustainable physical security system at soft target locations where radiological materials are used and stored requires balancing the need for regular access to use these materials for legitimate commercial purposes with the need for appropriate security.
- Sites both internationally and domestically may fail to understand the security implications of high-activity sources and thus fail to "volunteer" for security assistance. The program may be unable to engage high priority sites in difficult to reach areas of concern.
- It is challenging for international partners to sustain effective radiological security regimes, particularly when those partner countries suffer from a lack of personnel and resources.
- The availability of disposal pathways for disused radioactive sources and access to facilities that are managed by other DOE offices (e.g., the Waste Isolation Pilot Plant [WIPP]) for certain categories of disused sources have been restricted. Without certain disposal pathways, GMS cannot find sites willing to store disused sources, and therefore cannot recover certain high priority subsets of them.

Radioactive Material Tracking and Monitoring

Argonne National Laboratory, *in collaboration with* ***Idaho National Laboratory****, supports the Radioligical Security Program through three, closely interlinked activities:*

- *Facility Scoping involves identifying and locating commercial facilities (domestic and international) that contain risk-significant quantities of radioactive material and are candidates for security upgrades or material removal activities. Facility Scoping databases also provide insights that help NNSA counterterrorism and emergency response activities, as well as DHS and FBI preparedness cooperation with U.S. state and local governments.*
- *RadTrax monitors open source and official information sources for evidence of threats or vulnerabilities associated with risk-significant, commercial radioactive material. RadTrax information has supported NNSA reporting to other U.S. Government agencies during significant foreign events involving the loss of radioactive material (e.g., the December 2013 theft of a cobalt-60 teletherapy device during transport in Mexico).*
- *The Theft And Diversion Incident Analysis System (THADIAS) tracks incidents involving the theft, loss, or recovery of radioactive material worldwide. THADIAS-based analyses provide deeper insights into the prevalence and nature of radioactive material loss and trafficking. THADIAS served as the foundation for the radioactive materials portion of INTERPOL's WMD efforts and has informed radiological forensics work at the DHS/Domestic Nuclear Detection Office (DNDO) and the FBI.*

Nuclear Smuggling Detection and Deterrence

The **NSDD subprogram** (formerly called the Second Line of Defense program, or SLD) strengthens the capacity and commitment of foreign governments to deter, detect, and interdict illicit trafficking in nuclear and other radioactive materials across and within international borders, and through the global shipping system. NSDD's strategy is to improve partner countries' capacity by providing fixed and mobile radiation detection systems (MDS) and associated training, maintenance, and sustainability support. NSDD deploys its systems at carefully selected locations as part of the broader U.S. Government-led, global defense-in-depth approach to countering nuclear trafficking. NSDD also coordinates with the IAEA, the European Union, INTERPOL, and other organizations to facilitate coordination and consistency in efforts to counter nuclear smuggling worldwide.

Figure 9. Radiation Monitors along a Rail Line

NSDD's priorities include addressing remaining gaps in fixed detection capabilities in the GNDA, expansion of mobile detection capabilities to complement fixed deployments and create more defense-in-depth, and continued emphasis on sustainability. NSDD optimizes the placement of radiation detection monitors based on an analysis of threat, terrain, and other factors. NSDD also maintains close working relationships with partner countries to continually assess deployed detector performance and effectiveness based on extensive performance data. Sponsoring workshops and exercises to develop cross-border and regional collaboration also remains a priority.

Providing Worldwide Technical Support and Reachback for Deployed Radiation Detection Systems

*The **Pacific Northwest National Laboratory (PNNL)** has been designated as the lead national laboratory to provide key NSDD project/program management assistance, training, acquisition planning/execution, and sustainability support. This role applies to the installation and sustainability of both fixed and mobile radiation detection systems at strategic international seaports, land border crossings, and airports around the globe. PNNL serves in a similar role for DHS, as DHS fulfills its responsibility for equipping all U.S. ports of entry with radiation detection systems.*

PNNL also operates the NSDD Help Desk to aid partner countries in ensuring that deployed NSDD radiation detection systems are functioning at an optimum level and are repaired as quickly and efficiently as possible when issues do occur. Maintaining the operational effectiveness of installed radiation detection systems is a critical aspect of achieving persistent risk reduction. Since its inception in 2009, the NSDD Help Desk has resolved over 4,000 service requests, with 1,000 being received in FY 2014.

Assisting Partner Countries with Radiation Alarm Adjudication

The NNSA NSDD subprogram coordinates closely with the ***NNSA Office of Emergency Operations*** *to provide expert advice, training, and technical support to NSDD international partners that lack a well-developed, indigenous reachback organization to help adjudicate radiation alarms of concern. Over the past five years, Emergency Operations' DOE Triage Program has helped to analyze and resolve multiple alarms from NSDD partners in Jamaica, Kenya, Djibouti, and Malta. NSDD and Emergency Operations have worked closely to improve the DOE Triage submission process for international partners to help ensure that DOE receives all of the information it needs to resolve alarms in a timely manner. Emergency Operations has provided source recovery training and assistance in extracting radiation sources from containers in Jamaica and Djibouti and a source recovery and training mission in Bangladesh. In addition, Emergency Operations invites NSDD to send participants to its annual International Radiological Assistance Program Training for Emergency Response (I-RAPTER) training course in the United States, and NSDD has sponsored multiple participants for the last two years.*

Installations of fixed sites will increase in the near term, due in part to the threat constituted by adversary groups now operating in the Middle East and Africa and also to address remaining gaps in the GNDA (mainly, but not exclusively, in countries neighboring Russia). As NSDD completes identified international nuclear detection fixed deployments, it will expand mobile detection initiatives consistent with the strategies reflected in the International Implementation Plan for the GNDA. In FY 2016, NSDD will transition an additional 68 sites to indigenous sustainability, bringing the total number of sites handed over to host country responsibility to over 550. NSDD also will continue efforts to attract host-country and industry funding of radiation detection systems through donations, cost-sharing arrangements, and technical exchanges.

The **International Nuclear Forensics Cooperation subprogram** will continue efforts to strengthen foreign partner nuclear forensics analytical and investigatory capabilities, which are integral to a robust nuclear security program to deter and counter illicit trafficking and strengthen the security of nuclear and radioactive material. The subprogram will engage bilaterally in direct capacity-building efforts with up to 13 priority partner countries (as determined by their nuclear material holdings, historical trafficking issues, and other considerations), and also with regional organizations to strengthen nuclear forensics capabilities. The subprogram also will work multilaterally to build nuclear forensics awareness

in cooperation with the IAEA, GICNT, and with the Nuclear Forensics International Technical Working Group (ITWG) on the development of international guidance documents and best practices. The International Nuclear Forensics Cooperation subprogram also will continue peer-to-peer collaborations with foreign partners to strengthen the understanding of nuclear forensics and signatures that hold attribution value.

FY 2015 Planned Accomplishments

- Deploy a total of 24 fixed radiation detection systems and 20 MDS for a cumulative total of more than 580 sites/ports and more than 100 deployed MDS.
- Transition more than 20 sites/ports and MDS to partner country responsibility.
- Conduct more than 100 specialized radiation detection operator and maintenance trainings, more than 20 workshops, and three tabletop/field training exercises.
- Maintain collaborative relationships with partner countries to verify continued NSDD-deployed system performance and operation, help desk support, and assurances visits.
- Maintain global awareness of smuggling trends and issues through technical exchange data anaylsis, and support for the Rapid Asset Mobilization Protocol (RAMP) to increase a partner country's readiness to respond quickly to a radiation alarm information alert.
- Maintain strong partnerships with the IAEA, GICNT, GP, INTERPOL, the World Customs Organization (WCO), international forensics working groups, and other key international organizations.
- Continue to provide instructors and subject matter experts to assist with multilateral awareness-raising activities on nuclear forensics fundamentals and best practices.
- Co-sponsor the third IAEA Nuclear Forensics Methodologies Workshop; conduct a thorough quality assurance review of the curriculum to standardize the content for future use.
- Strengthen existing direct bilateral capacity-building efforts to advance partner countries' nuclear forensics capabilities.
- Where possible, identify cross-cutting initiatives among NNSA mission areas to provide a comprehensive approach to nuclear detection, emergency response, nuclear forensics, and safeguards/environmental monitoring.

Program Challenges

- Evolving smuggling threats, including the emergence of adversary groups (such as the Islamic State of Iraq and the Levant) and evolving geopolitical realities (such as the evolving U.S. relationship with Russia and the advent of Customs' Unions in areas where NSDD has completed deployments), require continuous assessment and international focus, as well as development of new counter-smuggling responses, in order to be effectively countered.
- International partners face challenges in sustaining counter-nuclear-smuggling efforts, particularly when those partner countries suffer from a lack of personnel and resources.
- There are currently not enough technical experts available to support capacity-building efforts in nuclear forensics.

2.2.3 Future Program Plans

From FY 2016 to FY 2020, GMS will continue to work with international partners to enhance nuclear security both bilaterally and through appropriate multilateral forums, such as the GP and the growing network of Nuclear Security COEs. GMS will support the expansion of nuclear security best practices training and technical capabilities in several partner countries.

When and where possible, GMS will seek to continue cooperative engagement with Russia (with appropriate authorization as needed). In spite of the current geopolitical situation with Russia, given the size of Russia's remaining material stockpiles, GMS programs will continue to stay alert for opportunities to solidify nuclear security successes in Russia through improvements in regulatory development, inspections, and enforcement capabilities; sustainability; secure transportation of nuclear materials; MPC&A training; protective force effectiveness; and nuclear security culture enhancement.

GMS also will work in countries around the world to implement radiological threat reduction. By the end of 2020, GMS will have protected 2,649 of the estimated 6,500 buildings with high priority nuclear and radiological materials, both domestically and abroad, and also will strive to encourage replacement of high-activity radiological devices with non-isotopic technologies, thus creating permanent threat reduction and eliminating the need to sustain high-level security upgrades.

The NSDD component of GMS will complete identified international nuclear detection fixed deployments and expand mobile detection initiatives consistent with the strategies reflected in the International Implementation Plan for the GNDA, maintain and extend sustainability programs, and support the expansion of nuclear forensics capabilities. The International Nuclear Forensics Cooperation subprogram will collaborate with the NSDD subprogram to bring together detection and forensics activities to promote a more coordinated approach to border monitoring capacity-building efforts (e.g., highlighting the linkage of field officers' response to nuclear or radioactive material outside of regulatory control with nuclear forensics investigations). NSDD will equip 632 sites with detection equipment and provide 148 mobile detection systems by the end of FY 2020. The program has undertaken a strategic review to validate its scope and priorities through FY 2020.

Main Areas of Activity for FY 2016 – FY 2020

- Support joint development and conduct of nuclear security best practices training courses at the China Nuclear Security COE, India's Global Center for Nuclear Energy Partnership, and the Nuclear Security Training Center in Kazakhstan, and with partners in Belarus and Israel.
- Continue capacity-building cooperation on the new physical protection security recommendations in INFCIRC 225/Rev 5.
- Provide policy and technical expertise to the IAEA to further develop international nuclear security initiatives and Nuclear Security Series documents.
- Develop and implement knowledge security training to strengthen the implementation of nuclear and knowledge security norms and best practices at the facility level.
- Develop and implement training courses and engage international partners on cyber security best practices for nuclear facilities, and improve on these best practices through development of new cyber security techniques, procedures, and technologies.
- Complete upgrades at 759 buildings with high priority radioactive sources in the United States and internationally.

- Recover an additional 10,755 disused and unwanted radioactive sealed sources located in the United States.
- Promote long-term risk reduction through replacing radiological source-based devices in the United States with non-isotopic technologies and find better long-term threat reduction solutions, including deploying source tracking tools and further development and application of now nascent technologies that do not rely on radioactive sources.
- Provide additional mobile and man-portable radiation detection systems, along with training in partnership with the FBI, for use by law enforcement in countries of strategic interest.
- Provide additional fixed radiation detection systems, focusing on key gaps in the global nuclear detection architecture and major hubs in the global maritime shipping network; continue to connect sites to national communication systems.
- Continue to transition full responsibility for the long-term operation (sustainability) of sites/ports where the systems have been installed but are not yet indigenously sustained.
- Sponsor workshops and exercises to strengthen country and regional detection networks, and continue technical collaborations with government and industry.
- Work with multilateral partners, such as the IAEA, GICNT, INTERPOL, and WCO on the development of international guidance documents and best practices in the areas of forensics and countering nuclear smuggling.

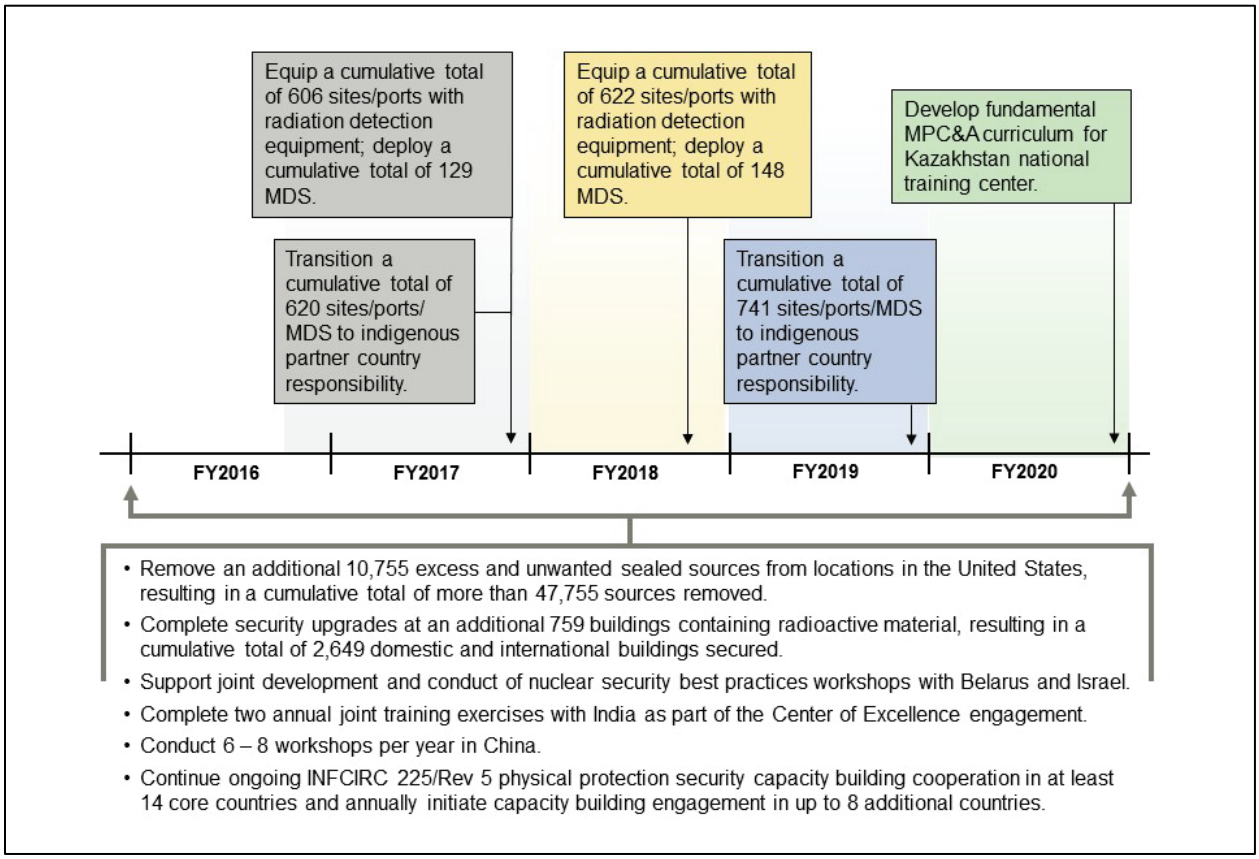


Figure 10. GMS Key Program Milestones

2.3 Nonproliferation and Arms Control

2.3.1 Program Objectives, Priorities, and Performance Metrics

The NPAC Program seeks to prevent proliferation of sensitive dual-use technology, equipment, and information; ensure peaceful nuclear uses; and enable verifiable nuclear arms reduction.

The Nonproliferation and Arms Control (NPAC) Program strengthens the nonproliferation and arms control regimes by working to: (1) detect undeclared nuclear materials and activities and diversion of declared material; (2) detect and deter illicit transfers of WMD-related dual-use materials, equipment, and technology; (3) reduce the number of nuclear weapons and their associated delivery systems; and (4) address evolving threats, challenges, and compliance concerns associated with the nonproliferation and arms control regimes. NPAC implements a comprehensive and integrated set of initiatives and activities to achieve these four key objectives that are designed to: (1) build capacity of the IAEA and Member States to implement and meet safeguards obligations; (2) build domestic and international capacity to implement export controls; (3) develop and implement verification regimes to reduce the number of nuclear weapons and detect and dismantle undeclared nuclear programs; and (4) develop programs and strategies to address emerging nonproliferation and arms control challenges and opportunities. NPAC advances the long-term sustainability of its programs through train-the-trainer capacity-building approaches, partnerships with international organizations to incorporate nonproliferation best practices among member states, and applied technology development tailored to address an identified nuclear safeguards or verification deficiency, ensuring that best practices continue to be implemented once U.S. assistance ends. Accordingly, NPAC metrics are designed to gauge progress toward self-sustaining and measurable outcomes.

The NPAC Program prioritizes its work according to the following categories:

- **Statutory Mandates/Authorities:** Activities that the Department is legally required or authorized to implement (e.g., implementation of U.S. safeguards obligations under the Voluntary Offer Agreement/Additional Protocol, technical reviews of domestic export licenses and Code of Federal Regulations [CFR] Title 10 Part 810 applications for nuclear technology exports, and technical support for the negotiation of peaceful nuclear cooperation [Atomic Energy Act Section 123 Agreements]).
- **Treaties and Other International Agreements:** Activities that implement legally-binding treaty and other international agreement obligations (e.g., support for implementation of the New Strategic Arms Reduction Treaty [START], U.S.-Russian Federation Plutonium Production Reactor Agreement [PPRA], Biological Weapons and Toxins Convention, and Chemical Weapons Convention).
- **Presidential Priorities:** Activities to accomplish Administration priorities/objectives articulated in the 2015 *National Security Strategy*, 2010 *Nuclear Posture Review*, and the Nuclear Security Summits (e.g., Next Generation Safeguards Initiative [NGSI], maintaining readiness for denuclearization activities, and select export control foreign capacity building).
- **Non-binding Engagements with International Partners:** Activities that implement international engagements in the form of memoranda of understanding and cooperation/statements of intent (e.g., select export control foreign capacity building and Track 1.5 engagements).

Building on these overall categories, NPAC subprograms also use risk prioritization methodologies to determine specific outreach priorities and annual resource allocations. These methodologies include quantitative rankings of objective risk criteria that are then weighted to reflect their relative importance to the respective program missions. For example, the NPAC Safeguards Engagement subprogram assesses nuclear material diversion risks within specific regions, nuclear safeguards capacities, quantities and types of nuclear materials and facilities of potential partners, and other similar factors to determine which states may be most vulnerable and where capacity-building partnerships may be of highest priority. As part of this process, NPAC subprograms also overlay U.S. Government policies and priorities and account for related activities in other NNSA programs and U.S. Government agencies to ensure appropriate coordination and leveraging of resources.

To assess progress toward its program objectives, the NPAC Program regularly evaluates its performance by measuring: (a) the cumulative number of countries where NPAC is engaged that have export control systems that meet critical requirements; (b) the annual number of safeguards tools deployed and used in international regimes and other countries that address an identified safeguards deficiency; and (c) the physical security of U.S.-obligated nuclear material located at foreign facilities, determined by conducting bilateral physical security assessment reviews designed to evaluate the adequacy of existing security measures and provide recommendations for enhancing security, if necessary.[1]

2.3.2 Program Activity, Accomplishments, and Challenges

The NPAC Program supports activities in four areas: Nuclear Safeguards, Nuclear Controls, Nuclear Verification, and Nonproliferation Policy.

Nuclear Safeguards

Nuclear Safeguards strengthens the international safeguards regime and the IAEA's ability to detect non-compliance through the implementation of NGSI. NPAC launched NGSI in 2008 to develop the policies, concepts and approaches, human capital, technology, and infrastructure required to strengthen the international safeguards system and provide the IAEA with all necessary resources to meets its evolving mission. NGSI has the following three areas of concentration: Safeguards Policy, Safeguards Engagement, and Safeguards Technology Development.

Figure 11. Nuclear Safeguards Inspection

The **Safeguards Policy subprogram** incorporates three areas: Policy, Concepts and Approaches, and Human Capital Development. The Safeguards Policy team works with other U.S. agencies and the IAEA to conduct activities designed to: (1) strengthen and

[1] Under the DNN organizational re-alignment, NPAC retained the bilateral physical protection visit portfolio, as it is a regulatory function that stems from the U.S. bilateral agreements for nuclear cooperation (123 Agreements), which are negotiated by the NPAC policy group in technical support of the State Department. In addition, sites assessed often include facilities where the GMS Program has previously installed security enhancements or where the M^3 Program is planning to export LEU for reactor conversions.

encourage full use of existing IAEA authorities and consider seeking possible new authorities; (2) develop policies and strategies that will help the IAEA plan, evaluate, and report on the implementation of safeguards agreements in a manner that is effective, efficient, objective, transparent, and non-discriminatory; and (3) increase public awareness and understanding of the role of international safeguards in international efforts to prevent the spread of nuclear weapons. The team develops advanced safeguards concepts and approaches to enhance the effectiveness, efficiency, and credibility of international safeguards focusing on: (1) identifying and analyzing best practices, gaps in current capabilities, and new requirements; and (2) demonstrating and evaluating advanced methods to safeguard nuclear material and facilities. These efforts help inform investment decisions about future safeguards technology research and development to support enhanced safeguards concepts and approaches. NGSI promotes the concept of Safeguards by Design, in which international safeguards are fully integrated into the design process of a new nuclear facility from the initial planning through design, construction, operation, and decommissioning. Additionally, the team is charged with developing sustainable academic and technical programs that support the recruitment, education, training, and retention of the next generation of young and mid-career international safeguards professionals.

The **Safeguards Engagement subprogram** cooperates with international partners to: (1) support the development of the fundamental and sustainable nuclear safeguards infrastructure necessary to support the safe, secure, and peaceful uses of nuclear energy; (2) enhance IAEA safeguards by improving the correctness and completeness of Member States' declarations of nuclear material and facilities, thereby reducing the likelihood of theft or diversion of nuclear material for non-peaceful purposes; and (3) test and implement new safeguards technologies to meet identified future and current safeguards challenges.

Enhancing the Effectiveness of Nonproliferation Training

Brookhaven National Laboratory (BNL) *is playing a key role in helping the Safeguards Engagement subprogram enhance the effectiveness of its training activities by applying the Systematic Approach to Training (SAT), which is recognized worldwide as the international best practice for attaining and maintaining the qualification and competence of nuclear power plant personnel. SAT is an approach that provides a logical progression from the identification of the competencies required to perform a job to the development and implementation of training to achieve the competencies, and subsequent evaluation of this training. SAT consists of five interrelated phases: analysis, design, development, implementation, and evaluation. SAT-based curricula offer consistency, efficiency, and management control, and are not dependent on the knowledge and experience of specific instructors. Experts from BNL are helping the program work with the IAEA to apply the SAT methodology to safeguards-related training wherever feasible.*

The **Safeguards Technology Development subprogram** directs the DOE national laboratories in the development and testing of tools, technologies, and methods that are intended to optimize the effectiveness and efficiency of safeguards implementation at both the facility and state levels and enhance the IAEA's ability to detect non-compliance. In particular, this subprogram focuses on transitioning advanced and maturing technologies with near-term safeguards applications from the laboratory into the field. Focus areas include advanced nuclear measurement technologies; field-portable, near-real-time analysis tools; and improved detector materials; as well as strengthened technology development infrastructure at the national laboratories.

DOE National Laboratories Develop New Safeguards Technologies

DOE National Laboratories have an important role in the NGSI to prepare deployable technologies that can address safeguards challenges.

Los Alamos National Laboratory (LANL) *is working to develop the next generation of neutron detectors using new front-end electronics. Neutron detectors are used for nonproliferation and treaty verification applications to determine the presence or absence of SNM. For more than three decades, helium-3 proportional counters have been the workhorse of neutron detectors. However, the limitations of these conventional detector systems are being reached. Improvements are necessary to obtain accurate, cost-effective measurements for mixed oxide or advanced fast reactor fuels. LANL is helping to develop near-term solutions to address this technology gap.*

Another important requirement for the international safeguards community is the ability to determine the enrichment level and mass of uranium in gas centrifuge enrichment plants and nuclear fuel fabrication facilities. ***LANL, Pacific Northwest National Laboratory,*** *and* ***Oak Ridge National Laboratory*** *have been working on an integrated system that could automate these measurements using an unattended cylinder verification station.*

FY 2015 Planned Accomplishments

- Provide safeguards expert support to the U.S. Government and the IAEA for the implementation of IAEA's State Level Concept approach, with a focus on developing acquisition pathway analyses for proliferation and evaluation performance metrics for effective safeguards implementation.
- Field test and finalize advanced safeguards concepts for gas centrifuge enrichment plants (GCEP) for transfer to the IAEA, and pursue promising cost-effective safeguards approaches for facilities.
- Maintain qualified and knowledgeable safeguards staff at the national laboratories and IAEA in support of the international safeguards regime, through sustainable academic and technical programs; internships, post-graduate and graduate fellowships; and short courses on safeguards.
- Implement U.S.-IAEA safeguards obligations at DOE facilities (including annual reporting requirements).

- Provide customized training to more than 25 countries to develop effective State Systems of Accounting and Control and strengthen implementation of Comprehensive Safeguards Agreements and Additional Protocols, thereby enhancing IAEA means to detect non-compliance.
- Partner with the IAEA and advanced nuclear partners to conduct joint nuclear safeguards outreach to existing partner countries and additional "nuclear newcomer" states.
- Develop an integrated safeguards concept for electrochemical processing based on research and development conducted with international partners.
- Transfer spent fuel non-destructive assay technologies to foreign partners and deploy new technologies designed to enhance in-field detection of undeclared activities.
- Demonstrate and transfer new technologies designed to enhance inspector capabilities in high priority areas such as in-field detection and GCEP monitoring.

Program Challenges

- Potential resource demands that could be imposed by sudden, transformative events. The most significant "unknown" is the additional safeguards demands that may result from a positive outcome of the P5+1 (China, France, Russia, United Kingdom, United States, plus Germany) negotiations with Iran on its nuclear program.
- The fundamental difficulty in detecting undeclared (covert) nuclear facilities and activities at an early stage.
- Growing number of nuclear facilities and increasing amount of nuclear materials under IAEA safeguards outpacing the IAEA's resources in an era of a flat (or zero-growth) budget.
- Inherent difficulty and expense of safeguarding enrichment plants and reprocessing facilities (the two main pathways to acquiring fissile material to produce nuclear weapons).
- Demographics resulting in the accelerated retirement of nonproliferation/safeguards experts.

Nuclear Controls

Nuclear Controls facilitates nuclear cooperation by building global capacity to prevent the spread of nuclear and WMD-related dual-use materials, equipment, and technology. Nuclear Controls accomplishes its objectives by implementing programs that: (1) conduct technical reviews of domestic export licenses for dual-use commodities (thousands each year) and provide guidance to help strengthen export control compliance across the DOE complex; (2) provide technical support to enhance U.S. Government capacity to detect and interdict illicit WMD-related commodity technology transfers to foreign programs of concern, and conduct all-source, technical assessments to address the gaps in export control regulations; (3) strengthen foreign partner national systems of WMD export control, in coordination and consistent with U.S. policy and the multilateral supplier regimes; and (4) provide training and technical support for U.S. enforcement agencies. Nuclear Controls is organized into the following three subprogram areas: Export Control Review, Compliance Guidance, and Enforcement Support; U.S. WMD Interdiction efforts; and the International Nonproliferation and Export Control Program (INECP).

The **Export Control Review and Compliance (ECRC) subprogram** implements the Export Administration Act of 1979, as continued by the President under the International Emergency Economic Powers Act pursuant to Executive Order 13222 as amended by Executive Order 13637, as well as Executive Order 12981 (The Administration of Export Controls), which authorize DOE to support the Department of

Commerce in the review of dual-use exports and technical negotiations with multilateral control regimes. Among other core functions, the ECRC program provides compliance guidance on export control laws and regulations for DOE and its contractors and reviews export license applications submitted by U.S. industry to ensure that export-controlled hardware, software, materials, and technologies are not transferred to entities and programs of concern.

The **WMD Interdiction subprogram** provides technical reviews and all-source information and analysis to support U.S. interagency interdiction efforts and U.S. Government bilateral and multilateral export sanctions. Pursuant to National Presidential Security Directives (NSPD) 17 and 20; Executive Order 13382; and the Iran, North Korea, and Syria Nonproliferation Act of 2000, the WMD Interdiction subprogram: (1) provides WMD subject matter expert technical support to U.S. interagency interdiction activities through the Interdiction Technical Analysis Group (ITAG), which is composed of ECRC and national laboratory subject matter experts; and (2) uses information systems, such as the Nonproliferation Policy Analysis and Interdiction Resource, to conduct interdiction case reviews to support interdiction and sanction decisions.

WCO Strategic Trade Control Enforcement Initiative

Argonne National Laboratory *led development of the WCO's Strategic Trade Control (STC) Enforcement Curriculum with NNSA support. WCO asked for Argonne support to develop a curriculum to promote strategic trade controls to its 179 member states as a key customs function. The curriculum provides technical guidance to the member states on implementing the controls.*

The program is focused on three key WCO efforts, including production of a comprehensive curriculum, organization of seminars to raise awareness in each of WCO's six regions, and organization of a global STC law enforcement operation.

The WCO law enforcement operation—codenamed Operation Cosmo—was initiated with participation from Argonne experts and brought together customs administrations from 90 WCO members. The operation started with intelligence-gathering and target-building, and then moved into interdiction in October. Follow up, investigation, and reporting are ongoing.

INECP engages foreign partners to build their export control implementation capacity. Specifically, the team builds export control capacity in dozens of supplier and transit countries on the basis of overall proliferation risk and nuclear commercial ties with the United States to ensure partners are able to regulate and control exports and re-transfers appropriately. To this end, INECP: (1) engages international partners in establishing and strengthening their licensing procedures by training license reviewers on WMD control lists and how to successfully apply proliferation risk analysis to the review process; (2) assists partner governments in establishing sustainable compliance outreach programs for manufacturers of WMD-related materials, equipment, and technology; and (3) trains domestic and international partners' enforcement personnel to recognize WMD and nuclear-related dual-use items, thereby strengthening domestic and international enforcement capacity. INECP emphasizes train-the-trainer approaches to ensure that export control norms and best practices are fully sustained in the partner country.

FY 2015 Planned Accomplishments

- Prevent illegal transfer of dual-use commodities and technology to programs and activities of concern by conducting approximately 5,600 technical reviews of export licenses for dual-use commodities per year (on average, NPAC recommends nearly 200 denials per year).
- Provide state-of-the-art technology assessments to the multilateral control regimes.
- Provide training courses for DOE and U.S. Government officials regarding changing export-controlled technologies and proliferation concerns.
- Provide approximately 2,800 comprehensive and real-time, technical interdiction analyses to support the U.S. Government interdiction community—the equivalent of six to seven interdiction analyses per day (though the actual daily caseload varies and is contingent on respective level of effort required).
- Provide unique analytical products regarding proliferation trends and commodity gaps through the ITAG.
- Engage over 35 foreign partners to strengthen national systems of export control and prevent illicit trafficking in WMD commodities through export licensing, enterprise outreach, and enforcement capacity building programs.
- Train U.S. export enforcement targeteers, inspectors, and investigators on nuclear and WMD-related dual-use commodities, in partnership with the Export Enforcement Coordination Center (E2C2) established under the Export Control Reform Initiative.

Program Challenges

- Augmenting the ability or willingness of some international partners to absorb bilateral and multilateral export control engagement, while enhancing their ability to sustain effective implementation of export controls and related export enforcement norms independently.
- Managing external challenges to the nonproliferation regime (e.g., technological advancement, political unpredictability, countries of concern actively pursuing WMD).
- Emergence of suppliers outside the multilateral export control regimes (e.g., North Korea).
- Expansion from state-based, sanctioned, or complicit transfers to “privatized” suppliers, brokers, front companies, and franchises in states with weak controls.

Nuclear Verification

Nuclear Verification reduces and eliminates proliferation concerns through the promotion of transparent arms reductions by supporting the development, negotiation, and implementation of U.S. nonproliferation and arms control treaties and other international agreements. Nuclear Verification also conducts applied technology development, testing, evaluation, and deployment of proven technical concepts to ensure the availability and application of required verification capabilities and to lay the foundation for future nonproliferation and arms control initiatives. Nuclear Verification is organized into the following subprograms: Warhead Dismantlement and Fissile Material Transparency, Nuclear Noncompliance Verification, and the soon-to-be-completed HEU Transparency Implementation subprogram.

The **Warhead Dismantlement and Fissile Material Transparency subprogram** develops policy, technology, and approaches for transparent reductions and monitoring of nuclear warheads, fissile

material, and related facilities through the following activities: Current and future arms control and nonproliferation initiatives, including implementation of the U.S.-Russia New START Treaty and policy development for any future follow-on treaty and its technology requirements; Nuclear Testing Limitations, including Comprehensive Nuclear-Test-Ban Treaty (CTBT) activities; the Seismic Cooperation Program; U.S.-UK Cooperation on Nonproliferation and Arms Control Technology; the PPRA; and the Chemical Weapons Convention.

The **Nuclear Noncompliance Verification subprogram** provides advanced technology applications to detect undeclared nuclear materials and activities and support the verifiable dismantlement of nuclear programs in countries of concern to the United States through the following activities: (1) maintaining readiness and capability to deploy for verification missions in countries of proliferation concern; (2) applied verification technology developments for fuel-cycle facilities not currently covered by the IAEA inspection regime; and (3) Emerging Threats Program. In certain emerging threat situations, this activity also will partner with the denuclearization capability under the M^3 Program's Nuclear Material Removal Program (see Section 2.1.2).

Turning Megatons into Megawatts

Final HEU Purchase Agreement Shipment Arrives in United States, December 2013

*NPAC's **HEU Transparency Implementation subprogram** negotiated and implemented transparency measures to monitor the annual conversion of 30 MT of Russian weapons-origin HEU into LEU under the 1993 U. S.-Russia HEU Purchase Agreement. A cumulative total of 500 MT of Russian-weapons origin HEU—the equivalent of 20,000 nuclear warheads—was down-blended to LEU and then delivered to the United States for use in commercial nuclear power plants. This LEU fuel, once used for nuclear weapons, instead produced 10 percent of all U.S. electricity during the past 15 years.*

The HEU Transparency Implementation subprogram combined data from monitoring visits during the Russian HEU down-blending process, coupled with Russian accountability and process documents and with independent measurements from U.S. monitoring equipment, to build confidence that all LEU purchased under the Agreement was produced from Russian weapons-origin HEU. In FY 2014, the subprogram completed all monitoring in Russian facilities, and will conduct close-out activities in FY 2015.

FY 2015 Planned Accomplishments

- Develop advanced technologies and concepts for future warhead and fissile material transparency and verification regimes, while continuing to support the implementation of New START.
- Collaborate with the United Kingdom under the 1958 MDA and other partner countries to develop potential common approaches to warhead dismantlement verification and other challenging verification issues and problems.
- Conduct monitoring visits in Russia under the terms of the PPRA to ensure that Russian plutonium production reactors remain in a non-operational status and monitored fissile material remains in storage until it is transitioned to a disposition regime.
- Continue activities to prepare for CTBT ratification and implementation.
- Provide capacity-building training in seismology to foreign partner institutions to enhance their abilities to detect and analyze possible nuclear explosions, as well as to mitigate geophysical hazards.

Program Challenges

- Uncertainties about the future of arms control cooperation with Russia.

Figure 12. U.S.-UK Discussions on Nuclear Disarmament Verification Challenges

Nonproliferation Policy

Nonproliferation Policy develops and executes cross-cutting programs and strategies to implement U.S. Government nonproliferation policy objectives. Specifically, Nonproliferation Policy supports the negotiation and implementation of bilateral and multilateral nonproliferation agreements, meeting the requirements set forth in the Atomic Energy Act of 1954, as well as stemming from national nonproliferation initiatives, treaties, and other international agreements. Additionally, Nonproliferation Policy provides policy guidance to DOE on nuclear technology transfer and nuclear fuel cycle issues and undertakes activities to improve and update multilateral nuclear supplier arrangements and to identify supplier vulnerabilities and potential gaps in supplier arrangements. Finally, Nonproliferation Policy supports a Regional Analysis and Engagement subprogram. Nonproliferation Policy is organized into the following three areas: Global Regimes, Multilateral Supplier Policy, and Regional Analysis and Engagement.

The **Global Regimes subprogram** provides statutorily required technical assistance to the State Department with respect to the negotiation of Agreements for Peaceful Nuclear Cooperation (Section 123 Agreements) and their administrative arrangements, as well as implements the regulations governing the transfer of unclassified nuclear technology found at 10 CFR Part 810—Assistance to Foreign Atomic Energy Activities. Global Regimes also supports the development of a new international framework for civil nuclear cooperation for implementation within the U.S. Government and in cooperation with industry. Finally, the Global Regimes subprogram assesses emerging trends and nuclear technologies to raise awareness of decision makers in the U.S. Government and international community to prevent and counter efforts of known and would-be proliferators.

The Multilateral Supplier Policy subprogram helps to strengthen and update the Nuclear Suppliers Group (NSG) Guidelines, control lists, and operations, and serves as the DOE lead for the U.S. interagency providing technical and policy expertise to help negotiate and advance U.S. interests and positions. The mandate of the NSG is to set global standards to ensure that nuclear technologies are exported for peaceful purposes, in line with NPT Article III.2, which requires members and adherents to apply safeguards and other nonproliferation conditions on exports of nuclear material and specialized nuclear equipment and related technology to all states. The NSG comprises nuclear supplier states that have developed guidelines for nuclear exports and nuclear-related (dual-use) exports. The Multilateral Supplier Policy subprogram's NSG support focuses on facilitating nuclear trade within the international safeguards regime by reducing the risk of diversions of material, equipment, and technology to nuclear weapons programs.

The **Regional Analysis and Engagement subprogram** conducts nonproliferation and nuclear stability-focused Track 1.5 engagements with stakeholders in India, Pakistan, China, and Burma with the objective of leveraging these engagements for greater regional government-to-government cooperation on arms control, nonproliferation, and disarmament issues. Additionally, through social media programming, the subprogram conducts outreach initiatives throughout South Asia to advocate for nuclear confidence building and stability measures.

Publishing of the New Part 810 Rule

On February 23, 2015, culminating a multi-year notice and comment rulemaking process led by NPAC, DOE issued its revised Part 810 final rule (76 FR 55278). The Part 810 regulations implement section 57 b.(2) of the Atomic Energy Act of 1954, which authorizes persons to engage or participate, directly or indirectly, in the development or production of any SNM outside the United States upon authorization by the Secretary of Energy "after a determination that such activity will not be inimical to the interests of the United States." This revised rule is the first comprehensive update to Part 810 since 1986. It was necessary in order to make the regulations consistent with current global civil nuclear trade practices and nonproliferation norms and to update the activities and technologies subject to the rule. Furthermore, the rule is in line with and supports the President's export control reform initiative. The final rule updates a list of destinations for which most assistance to foreign atomic energy activities is generally authorized, provides expanded authorization provisions for operational safety assistances and "deemed exports" at U.S. nuclear plants, and clarifies the scope of technology transfers subject to the regulation. DOE first issued the Notice of Proposed Rulemaking to update Part 810 on September 7, 2011, and a Supplemental Notice of Proposed Rulemaking on August 2, 2013. The Department has since been working closely with industry, senior public officials, and academia to fine tune the proposed rule revision to effectively meet U.S. nonproliferation and national security requirements while balancing that goal with addressing what U.S. industry needs to compete effectively in global nuclear commerce.

FY 2015 Planned Accomplishments

- Continue to provide technical and policy solutions to support the negotiations on Iran's nuclear program.
- Provide technical assistance to the negotiation of three anticipated Section 123 Agreements for Cooperation and their administrative arrangements.
- Work with the 48 governments of the NSG to strengthen controls on nuclear technology transfers, including amending the NSG Guidelines and ensuring the NSG control lists remain up to date with advancing technologies.
- Implement an electronic Part 810 authorization system to modernize the specific authorization application process and allow for electronic general authorization reporting.
- Provide regional outreach regarding implementation of the revised Part 810 rule and new process improvements, including the electronic authorization system and web-based guidance documents, when the Final Rule takes effect.
- Implement DOE obligations under the NPT and conduct analyses of the impact of NPT-related developments on NNSA weapons and nonproliferation work.
- Conduct analyses of the impact of a potential fissile material cut-off regime on the DOE complex.
- Conduct Track 1.5 engagements in India, Pakistan, China, and Burma.

Program Challenges

- Balancing the nonproliferation objectives of the Part 810 regulations governing unclassified nuclear exports with the benefits of U.S. commercial participation in foreign civil nuclear power programs.
- Managing external challenges to the nonproliferation regime (e.g., global change, technological advancement, political unpredictability, countries of concern actively pursuing WMD).

2.3.3 Future Program Plans

In its future years' program plan, NPAC will place increasing emphasis on strengthening the IAEA safeguards regime by revitalizing the U.S. technical and human capital base that supports safeguards and ensuring the application of safeguards norms and best practices internationally. The NPAC Program also will provide for export control-related activities that address proliferation by Iran, North Korea, Syria, and proliferation networks; strengthen international nonproliferation agreements and standards; and encourage global adherence to and implementation of international nonproliferation requirements. Finally, in collaboration with the DNN Research & Development (DNN R&D) Program, the NPAC Program will support the development and evaluation of negotiating positions and verification technologies for future nuclear weapons reduction treaties and technologies to support U.S. arms control and nonproliferation initiatives. This includes applied development, testing and evaluation, and deployment of advanced radiation measurement technologies for application under New START, as well as other concept-proven technologies for future treaty verification, transparency, and safeguards purposes. Also, NPAC will continue to place emphasis on integrating and collaborating with the DNN R&D Program to ensure the effective implementation of innovative, concept-proven safeguards and verification technologies.

Main Areas of Activity for FY 2016 – FY 2020

- Meet standing NNSA statutory and treaty/agreement obligations, including: (a) bilateral physical security assessment visits for U.S.-obligated materials at foreign facilities; (b) implementation of U.S. safeguards obligations under the U.S. Voluntary Offer Agreement/Additional Protocol at DOE sites; (c) U.S. nonproliferation and export control activities (license reviews, 123 Agreements, 10 CFR Part 810 applications); (d) provision of safeguards training; and (e) implementation of DOE obligations under New START, PPRA, Chemical Weapons Convention, and Biological and Toxin Weapons Convention.
- Engage 25–35 foreign partners annually to strengthen national systems of export control and prevent illicit trafficking in WMD commodities through export licensing and enforcement training programs.
- Field test and finalize advanced safeguards concepts for GCEP and other fuel cycle facilities for transfer to the IAEA.
- Strengthen the U.S. safeguards technology and human capital base to meet projected U.S. and IAEA resource requirements.
- Work with other DOE and interagency partners to facilitate the expansion of civil nuclear power while minimizing proliferation risks through global outreach and capability building in nuclear safeguards and export controls. Also, provide nonproliferation assessments of emerging nuclear technologies.

- Maintain technical and manpower readiness for future monitored dismantlement of nuclear programs of concern.

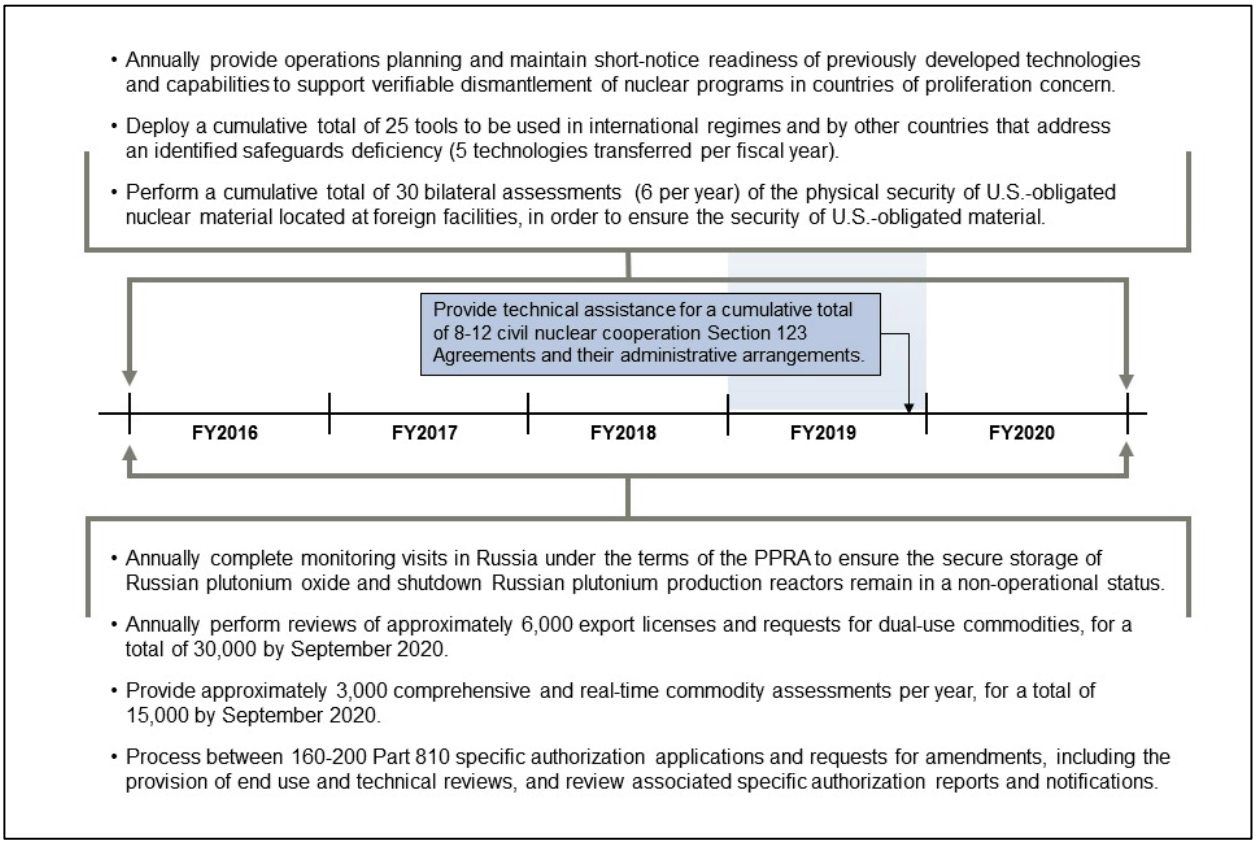


Figure 13. NPAC Key Program Milestones

2.4 Defense Nuclear Nonproliferation Research & Development

2.4.1 Program Objectives, Priorities, and Performance Metrics

The DNN R&D Program drives innovation of unilateral and multilateral technical capabilities to detect, identify, and characterize foreign nuclear weapons programs, illicit diversion of SNM, and global nuclear detonations. Specifically, DNN R&D funds nuclear security-specific innovation and focused investment in technologies to improve U.S. and international detection and characterization of foreign nuclear weapons programs. This work includes development of capabilities to meet U.S. nuclear treaty verification and detonation detection requirements, as well as broader U.S. Government nuclear security requirements. For example, DNN R&D supports a complex, multi-discipline, and multi-

The DNN R&D Program seeks to develop and produce advanced technologies for detection of foreign weapons development, nuclear detonations, and movement/ diversion of special nuclear materials.

organization warhead measurement campaign with NNSA's Office of Defense Programs that, upon completion, will provide a robust future basis for assessing weapons and material accountability capabilities and defining technical limits and opportunities for end-to-end arms control transparency.

To meet these and other mission requirements, the DNN R&D Program leverages the unique facilities and scientific skills of the NNSA nuclear security enterprise, other DOE national laboratories, academia, and industry to perform research, conduct technology demonstrations, develop prototypes for operational scenarios, and build sensors for space-based operational deployment. This includes a DNN R&D-sponsored University Consortia program, composed of three consortia that link universities and DOE national laboratories to address basic research gaps in nuclear nonproliferation and security and treaty-compliance monitoring. Such activity also encourages the development of the next generation of nuclear engineers and scientists for meeting future nuclear security challenges and broader nonproliferation activities across the nuclear security enterprise.

DNN R&D establishes its program priorities based on U.S. strategic goals, policy guidance, legal and treaty obligations, and other commitments (e.g., those to the U.S. Nuclear Detonation Detection System [USNDS]). Technology maturation often must occur in advance of formal requirements, so DNN R&D engages mission stakeholders in developing long-term, comprehensive research prioritization and investment strategies. In addition, DNN R&D takes into account external views as reflected in the Executive Office of the President's *Nuclear Defense Research and Development Roadmap* and the 2014 *Defense Science Board Task Force Report on Nuclear Treaty Monitoring and Verification Technologies*, as well as broad interagency perspectives to form, prioritize, and implement research investment strategies across the interagency.

Program-level performance is measured against progress defined in technology roadmaps corresponding to DNN R&D mission areas in: Nuclear Weapons Development and Material Production Detection, Nuclear Weapons and Material Security, and Nuclear Detonation Detection. These multi-year roadmaps (typically five years in length) were written by teams of subject matter experts, aligned with DOE and NNSA strategic goals and milestones, and vetted with the interagency community. Subject matter expert opinion was used to establish anticipated annual progress in each mission area. DNN R&D has a documented general framework for understanding research and development deliverables relative to technology maturation, and outlines an approach to technology readiness based on DOE and DOD terminology and definitions of technology readiness levels (TRLs). TRLs support the DNN R&D office in managing the process of developing technology solutions through maturation phases of:

- Proof of concept
- Technology development and demonstration
- Integration assessment and validation
- Limited production and fielding
- Full implementation and operations

Each funded project begins with a current TRL (state of the art) and an anticipated end-state TRL when the project is complete. Annual assessment of each project in the DNN R&D portfolio for TRL allows the tracking of progress in the overall mission areas as a percentage of effort along the full roadmap.

2.4.2 Program Activity, Accomplishments, and Challenges

The DNN R&D Program supports activities in two areas: Nuclear Proliferation Detection and Nuclear Detonation Detection.

Nuclear Proliferation Detection

The **Proliferation Detection subprogram** sponsors the development of advanced sensing capabilities to detect foreign nuclear material production and nuclear weapons development programs; advances the technical base for future nuclear arms control treaty verification and monitoring goals; and supports a broad set of national nuclear security technical needs, including nuclear counterproliferation, nuclear counterterrorism, and emergency operations. Essential elements of the research straddle the cooperative and non-cooperative realms of international policy, and therefore include both enhancement of capabilities to detect SNM production, movement, and weaponization, as well as improvement of current technologies and approaches for transparent nuclear reductions and monitoring.

Nuclear Weapons Development and Material Production Detection. These efforts improve national capabilities to detect, locate, and characterize foreign SNM production and nuclear weaponization activities by developing advanced *in-situ*, near-field, and remote sensing technologies. This research and development focuses on the nuclear fuel and weapons cycle and on addressing challenges posed by non-cooperative foreign environments. Research on enriched uranium production detection and weapons-grade plutonium production detection provides improvements to national technical means to detect and characterize foreign nuclear weapons activities.

Nuclear Weapons and Material Security. These efforts improve national capabilities to detect, locate, and identify SNM for nuclear security and nuclear arms control treaty monitoring applications. These

Recovering Rare Isotope for Improved Detection and Attribution Analysis

Oak Ridge National Laboratory (ORNL) *is recovering approximately 1 kg of the purest U-233 in the world, which will replenish the dwindling U.S. inventory of this ultrapure material for safeguards and forensics applications. Ultrapure U-233 is a necessary reference material for isotopic analysis and for improving current isotopic detection levels.*

Mass spectrometry aided by the use of ultrapure U-233 reference materials are used to characterize the tiniest samples with regard to "conformance with declarations and expectations" (safeguards) and a wide variety of forensics applications. The application of ultrapure U-233 to isotopic analysis extends beyond uranium enrichment to plutonium production, as the isotopes of uranium present in plutonium due to radioactive decay act as a "clock" to provide the age of the material since production—and thus is important for attribution of interdicted materials and explosive debris.

This U-233 material also is being used to produce sealed sources for DHS/DNDO and has application to the ***NNSA Nuclear Counterterrorism and Incident Response*** *mission. U-233 daughter products are being recovered for the* ***DOE Office of Science*** *mission to support cancer-treatment clinical trials.*

efforts include developing advanced and more cost-effective materials for radiation detection and tools for safeguards, treaty monitoring and verification, operational interdiction, radiological source replacement, interdiction, and nuclear material security. These advanced capabilities provide the U.S. Government and foreign partners with increasing confidence in maintaining the material protection, accountancy, and control of radiological and nuclear materials; confirming nuclear warheads; verifying warhead dismantlement; and maintaining continuity-of-knowledge and nuclear safeguards relating to treaties such as New START and the NPT. NNSA's approach is to develop and assess capabilities that balance potential transparency and verification requirements with operational and security considerations, while engaging other partners to gain from their experience and perspectives.

Developing Secure Transparency Measures on Nuclear Warheads

Neutron Image Measurements Associated with the Warhead Measurement Campaign.

The Warhead Measurement Campaign (WMC) is a joint effort between the ***NNSA Office of Defense Programs (DP)*** *and* ***Office of Defense Nuclear Nonproliferation (DNN)*** *to develop reference data for assessing weapons and material accountability and for defining technical limits and opportunities for end-to-end arms control transparency while protecting sensitive warhead information. In this effort, DP is providing access to nuclear weapons and components for DNN scientists to measure radiation signatures. In addition, a modeling effort is using the experimental data to validate and improve computer codes for both forward and inverse modeling. Planning for the campaign began in FY 2011 and the first object measured was a Nuclear Explosive Like-Assembly (NELA), constructed from the B-53 nuclear weapon at the* ***Pantex Plant****. (The B-53 is representative of an early thermonuclear device and, because of its size and construction, provided a challenge to the measurement team.) Since then, the WMC has done measurements of seven warhead pits from the enduring U.S. nuclear weapon stockpile at Pantex and measurements of seven "secondary stages" at the* ***Y-12 National Security Complex.*** *Current WMC plans include a Nuclear Explosive Safety study in preparation for measuring four warheads and bombs representative of the enduring stockpile in FY 2016. At the end of the WMC, all data will be archived and preserved for the use of both the arms control policy community and the emergency response community.*

In addition, DNN R&D contributes to the following other nonproliferation and emergency response areas:

- Safeguards research to develop and demonstrate new technologies and capabilities, including for national technical means, which will provide for comprehensive monitoring, detection, and analysis of civilian nuclear fuel cycle programs and activities to provide confidence that they are not diverting nuclear material or being misused for weapons programs.
- Arms control and treaty verification activities that develop and demonstrate new technologies and capabilities for an expanded set of attributes for verifying nuclear weapons and nuclear materials. This includes technology for warhead confirmation, continuity of knowledge of nuclear weapons, and transparent and verifiable dismantlement of nuclear weapons and disassembly of warhead components for nuclear material disposition.
- Nuclear emergency response and interdiction activities that develop and demonstrate advanced detectors, active interrogation sources, and algorithms for enhanced search, detection, and identification in signal-starved environments.
- Radiological source replacement activities to develop alternative technologies for medical, industrial, and research applications using high-activity sealed radioactive sources. Radiological source replacement projects will be supplemented by Small Business Innovative Research (SBIR) projects in order to more quickly transfer the technologies to industry.

FY 2015 Planned Accomplishments

- DNN R&D plans to advance toward meeting its Office of Management and Budget metrics for demonstrating the next generation of technologies and methods to detect U-235 production, weapons-grade plutonium production and weapons and material production detection:
  - Complete a High Explosive Test series for weaponization detection.
  - Establish a signatures test bed for detecting covert reprocessing activities.
  - Develop remote sensing technologies to detect solid compounds of interest.
  - Execute two test campaigns of a joint, NNSA- and Defense Threat Reduction Agency- (DTRA-) developed nonproliferation test bed, along with 10 interagency participants for developing innovative material production monitoring capabilities.
- DNN R&D has expanded work to develop transparency measures and detect clandestine foreign nuclear material movement to achieve the following outcomes:
  - Demonstrate new advanced materials for radiation detection.
  - Complete radiation signature measurements of canned sub-assemblies for the warhead measurement campaign.

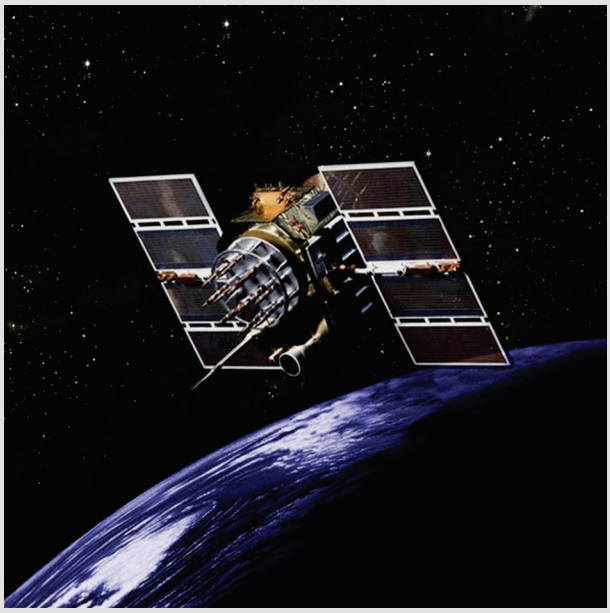
Nuclear Detonation Detection

The **Nuclear Detonation Detection subprogram** advances the underlying technical capability for detecting foreign nuclear weapon detonations, including for test ban treaty monitoring and verification needs and military requirements. In this area, DNN R&D Program plans are driven by requirements set in U.S. law for designing and building space-based sensors for the nation's operational nuclear test treaty monitoring systems and Integrated Threat Warning/Attack Assessment capabilities. Additional needs-based research advances the nation's nuclear detonation detection capabilities through improvements in technical forensics, as well as seismic and radionuclide sensing, collection, and

analysis. Particular focus includes providing the U.S. Government with increasing confidence in detecting, discriminating, and determining increasingly lower nuclear event yields.

Space-based Nuclear Detonation Detection. The Nuclear Detonation Detection subprogram develops and builds space-based sensors for the nation's operational nuclear test treaty monitoring and Integrated Threat Warning/Attack Assessment requirements. This is largely a requirements-driven production activity, focusing on developing, building, and testing the nation's operational sensors to monitor the entire planet from space to detect, locate, and report surface, atmospheric, or space nuclear detonations. These sensors rapidly identify and characterize nuclear detonations in the atmosphere or in space by detecting signals from neutrons or from radiation in several spectral regions (e.g., radiofrequency, optical, X-ray, and gamma ray). NNSA delivers these payloads to other government agencies for incorporation into the current generation of the USNDS, and each satellite payload must meet interagency performance and schedule commitments. This activity also includes level-of-effort research supporting the underlying science and technology capability for space-based detection of foreign nuclear weapon detonations.

Providing for the Nation's Ability to Detect Nuclear Detonations



The U.S. Nuclear Detonation Detection System (USNDS) monitors compliance with the international Limited Test Ban Treaty (LTBT), in which 108 signatory countries have committed to the prohibition of nuclear testing in the atmosphere, outer space, and underwater. ***Sandia National Laboratories (SNL)*** *and* ***Los Alamos National Laboratory (LANL)*** *have been key technical partners in the 50-year partnership between the U.S. Air Force and NNSA on the USNDS. In 2014, four GPS IIF Global Positioning Satellites—each carrying a Global Burst Detector (GBD) nuclear sensing payload designed and built by LANL and SNL in the preceding decade—were successfully launched into orbit by the U.S. Air Force.*

SNL is currently the nation's prime integrator for the nuclear detection payloads that reside on the U.S. GPS, including the newly upgraded enhanced optical detector. Both LANL and SNL are responsible for advancing technologies for nuclear detonation detection instruments that will improve system performance while reducing overall cost. Future systems will collect more data, process information faster, and improve discrimination.

Seismic, Infrasonic, and Radionuclide Nuclear Detonation Detection. DNN R&D also improves technical capabilities to detect and analyze signals from underground nuclear detonations. One major focus is to improve detection of seismic, infrasound, and hydroacoustic waves (e.g., evaluating source physics, modeling signal propagation, improving sensors, and developing software tools for signal analysis). A second major focus is to improve ways to detect surface or airborne radionuclides that come from a nuclear explosion (e.g., improving collection efficiency as well as separating signals indicative of nuclear explosions from competing signals such as medical isotope emissions through signal processing methods). Primary stakeholders include DOS and DOD, including the Air Force Technical Applications Center. In addition, the technical advances are incorporated into the U.S. Atomic Energy Detection System (USAEDS) and the U.S. National Data Center (US NDC), and as appropriate, the International Monitoring System (IMS) associated with the CTBT.

Campaign of Verification Experiments to Detect Low-Yield Underground Nuclear Explosions

Source Physics Experiment Preparations

Nevada National Security Site (NNSS) *is hosting a series of multi-laboratory field experiments for the* ***NNSA Office of Defense Nuclear Nonproliferation*** *that drive toward increasing confidence in effectively monitoring nuclear weapons development activities-of-interest, and verifying compliance with arms control treaties. The Source Physics Experiments (SPE), which are a series of chemical explosions to develop and validate new physics-based models, are improving nuclear test monitoring capabilities by advancing an understanding of underground nuclear events (UNEs) for developing sophisticated models and simulations that can be adapted to foreign testing scenarios. The Underground Nuclear Event Signatures Experiment (UNESE) focuses on the production of key post-detonation signatures and observables, and will advance the United States' ability to detect clandestine UNEs. Because UNEs can generate signals and signatures that are prompt (e.g., the seismic and infrasound signatures from SPE) and delayed (e.g., gas emissions and post-detonation changes to the containment regime as part of UNESE), these experiments can improve our understanding of the time-dependent detectability of UNEs. This will help to improve predictive models and tools to more effectively support national security goals. Data and results from these experiments are shared with the U.S. and international stakeholder community, including the DOS, DOD, academia, and other non-profit seismic research institutes worldwide, and the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO).*

Nuclear Forensics. DNN R&D advances analytic forensic capabilities for characterization, analysis, and evaluation of bulk nuclear materials, devices, and detonations in order to identify their distinguishing characteristics and provenance. Nuclear forensics research is focused on technical areas in which limitations or uncertainties in current techniques exist, as well as areas in which emerging technologies may revolutionize nuclear forensics methods. Technical topics include prompt signal collection and analysis, nuclear debris collections, laboratory analysis of nuclear debris samples, and data evaluation (including debris diagnostics and device reconstruction and modeling).

In these areas, the DNN R&D nuclear forensics program seeks to improve the nation's technical nuclear forensics capability by sponsoring research designed to provide more accurate, discriminating, and timely responses about the characteristics or provenance of interdicted items or the distinguishing features of a detonated nuclear device.

FY 2015 Planned Accomplishments

- Deliver the second Space and Atmospheric Burst Reporting System (SABRS-2) payload for integration on a classified host satellite.
- Support the Air Force with the launch and on-orbit testing of two Global Burst Detector (GBD) payloads on two separate GPS IIF satellites.
- Deliver the first GBD nuclear detonation detection payloads for GPS Block III satellites in accordance with the negotiated schedule with U.S. Air Force.
- Develop the UNESE test bed to support test monitoring and verification objectives and test site transparency, including capabilities to detect radionuclide gases, topographical changes, and other potential signatures that may appear as a result of an underground nuclear event.
- Develop Source Physics Experiments (SPE) test bed to advance the United States' ability to detect and discriminate "low-yield" nuclear explosions amid the clutter of conventional explosions and small earthquake signals.
- Address January 2014 Defense Science Board recommendations for treaty verification and monitoring technologies.
- Advance on-site inspection capabilities to improve confidence in detecting and identifying treaty-relevant radionuclides and other signatures and observables.
- Advance technical tools used to detect and analyze prompt weapon outputs and weapon effects.
- Advance tools and techniques for nuclear fallout debris collection and analysis.
- Develop time-sensitive tools for operational radiochemistry.
- Develop operationally relevant nuclear cross section data.

Program Challenges

- Sustaining a nuclear detonation detection sensor production rate and capability that aligns with DOD's changing satellite launch schedule and long-term procurement plans and requirements.
- Identifying a long-term satellite host platform that addresses the requirement to maintain current nuclear detonation detection capabilities at geosynchronous altitude.

2.4.3 Future Program Plans

DNN R&D will continue advancing the detection capabilities that address current and projected threats to national security posed by the proliferation of nuclear weapons and diversion of SNM. DNN R&D also will contribute substantially to the success of international nuclear treaties and other international agreements, which depend, in part, upon having the technical means and policy context to support negotiations and detect non-compliance with existing treaties. Finally, DNN R&D will continue to produce sensors to support the nation's operational nuclear detonation detection and reporting infrastructure through joint programs with the DOD.

Main Areas of Activity for FY 2016 – FY 2020

- Advance the detection capabilities of nuclear weapons proliferation and of the diversion of special nuclear material, to include expanding work on verification technologies and detecting clandestine foreign nuclear material movement and weapons production facilities and processes, such as (a) demonstrating technologies for detecting foreign uranium enrichment, (b) developing warhead monitoring and chain-of-custody capabilities for end-to-end field demonstrations in advance of new arms control commitments, and (c) demonstrating remote monitoring capabilities for reactor operations.
- Meet applicable January 2014 Defense Science Board recommendations for treaty verification and monitoring technologies, and identify and characterize what could be early trends and indicators in potential proliferant behavior.
- Maintain the nation's space-based global nuclear detonation detection capability by delivering scheduled sensor payloads (including integration and testing), such as GBD nuclear detonation detection payloads for GPS Block III satellites in accordance with the negotiated schedule with U.S. Air Force.
- Continue baseline schedule for advancing research, technology development, and related science to improve pre- and post-detonation technical nuclear forensic capabilities.

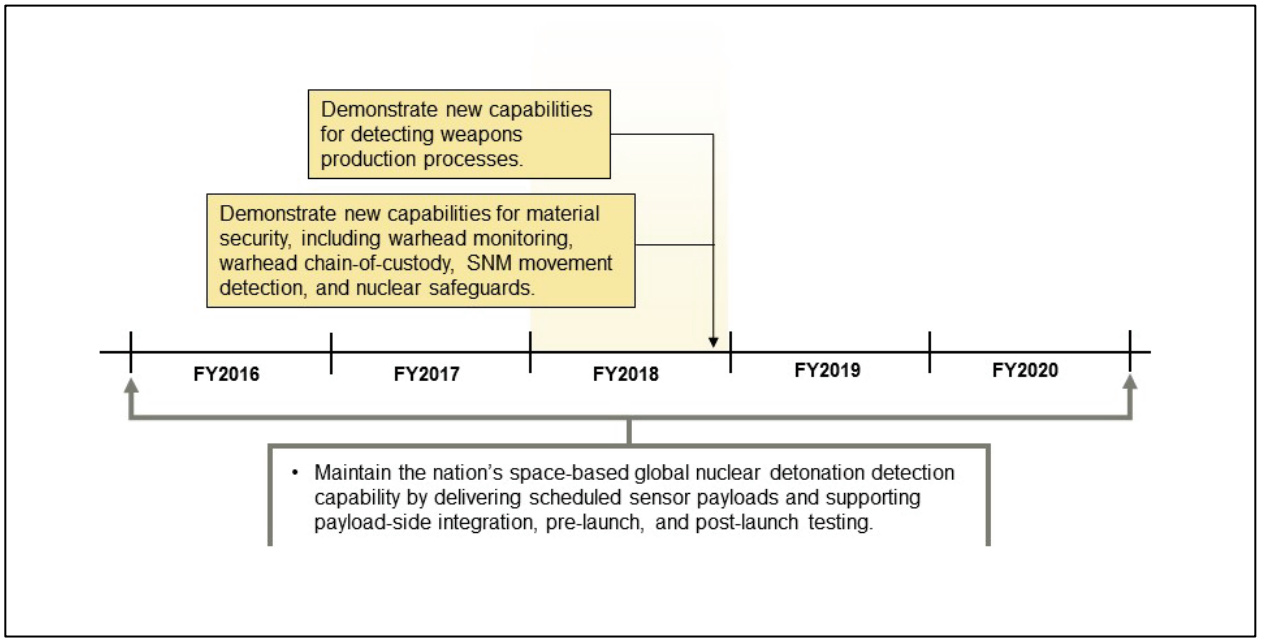


Figure 14. DNN R&D Key Program Milestones

2.5 Nonproliferation Construction Program

2.5.1 Program Objectives, Priorities, and Performance Metrics

The Nonproliferation Construction Program consolidates the construction costs for NNSA nuclear nonproliferation programs, which primarily are the construction projects connected to U.S. plutonium disposition (under the M^3 Material Disposition Program). The Nonproliferation Construction Program is building the infrastructure necessary to dispose of surplus U.S. weapons-grade plutonium via the MOX fuel option. The program has been constructing the MFFF, which would enable the Department to dispose of weapons-grade plutonium by fabricating it into MOX fuel and using it as fuel in commercial nuclear reactors. The program also has been constructing the WSB to handle the waste streams from the MOX facility.

2.5.2 Program Status, Accomplishments, and Challenges

As noted in the M^3 Program's description (Section 2.1.2), activities associated with the current plutonium disposition strategy were slowed while the Department conducted an analysis of options to complete the mission more efficiently. In the course of this analysis, it was determined that the MOX fuel approach is significantly more expensive than anticipated, even with consideration of potential contract restructuring and other improvements that have been made to the MOX project.

The Department has requested Aerospace Corporation, an FFRDC, to perform analyses of disposition options. These analyses will be completed during FY 2015 and will inform the path forward on plutonium disposition. The Department will work with Congress in 2015 to determine whether the MOX approach is the path forward for plutonium disposition.

The WSB project currently is scheduled to be completed in August 2015 and will be placed in a lay-up configuration, to preserve it for possible future use as the Department completes the independent validation of plutonium disposition options, and until it is required for MOX cold start-up activities. An independent validation of the preliminary analysis of plutonium disposition options is expected to be completed at the end of FY 2015. The FY 2016 Budget Request supports a current services projection for plutonium disposition pending a decision on the way forward.

2.5.3 Future Program Plans

Future years' planning for the Nonproliferation Construction Program will depend on the outcomes of the Departmental review and decisions on the plutonium disposition options being analyzed.

Future Key Milestones

- Scope and costs will be updated in the outyears to reflect the decision resulting from the analysis of the plutonium disposition options to complete the mission more efficiently.

Chapter 3: Counter
Countering Nuclear/Radiological Proliferation & Terrorism

***Counter* the efforts of both proliferant states and non-state actors to steal, acquire, develop, disseminate, transport, or deliver the materials, expertise, or components necessary for a nuclear or radiological threat device or the devices themselves.**

The NNSA Nuclear Counterterrorism (NCT) Assessment mission is to advance U.S. counterterrorism and counterproliferation objectives through innovative science, technology, and policy-driven solutions. Nuclear counterterrorism activities (a) reduce the risk of terrorist acquisition or use of nuclear devices and materials, as well as (b) develop the technical understanding required to characterize, detect, and defeat the range of nuclear devices potentially available to a non-state actor. Nuclear counterproliferation consists of strategies employed after state actors have (or are presumed to have) obtained nuclear materials, technologies, or devices. NCT leads these missions across NNSA and influences a wide range of policies both domestically and internationally.

Specifically, NCT uses its specialized knowledge of nuclear threat devices—which include INDs, proliferant devices, and state weapons outside of state control—to inform U.S. policy relating to the nation's nuclear counterterrorism and counterproliferation priorities. These policies cover a broad spectrum, ranging from the storage and transport of nuclear materials to the detection, characterization, and disablement of nuclear threat devices. In this sense, NCT's influence spans the full continuum of nuclear security policies from the protection of materials to counterterrorism operations. NCT also informs intelligence collection and analytical practices, as well as safeguards-sensitive, IND-related design information. Additionally, NCT conducts research and experimentation to assess future nuclear threats, ensuring that the United States is not susceptible to technological surprise by its enemies. Finally, using this unique technical perspective and threat understanding, NNSA partners with key U.S. Government and international partners to strengthen nuclear and WMD counterterrorism capabilities and inform nuclear counterterrorism and security policy.

3.1 Developing Technical Understanding of Threat Devices

Nuclear Threat Device Assessment

NCT is responsible for identifying the theoretical design space for INDs, as well as understanding other nuclear threat devices, such as nuclear devices of proliferation concern and nuclear weapons outside of state control. This vital program relies on specialized device modeling and simulation capabilities, as well as the vast science and technology experience base of the U.S. nuclear weapons complex, to advance the nation's technical knowledge of these devices, including crude, simple, or innovative IND designs, concepts, and related manufacturing or processing pathways.

This generated knowledge actively informs a range of U.S. Government nuclear threat reduction (NTR) policies, including detection and interdiction practices and emergency response operations. The latter activity, in particular, is strongly influenced by NCT's understanding of IND design configurations. This

Figure 15. Render Safe Tool in Use by DOD and Department of Justice Responders During IND Defeat Training

knowledge dictates the optimal means of rendering safe a nuclear device, as well as predicting the potential consequences of such operations. Additionally, NCT supports the development of purpose-built tools to neutralize these devices, distributing them to various U.S. Government operators and training them in their use. As a result, emergency response planning at every level of the government is directly influenced by NCT's technical knowledge.

Standoff Disablement

At the request of the DOD, and in support of U.S. national policy objectives, NCT will gather existing experimental and other data, identify information and modeling gaps, and develop the ability to predict the behavior of non-stockpile nuclear materials or components in response to innovative approaches for standoff disablement. This activity includes experimental and computational investigations that improve our confidence in modeling capabilities.

Materials Characterization

NCT performs a national security mission that is unique to NNSA: the study of the basic physical properties of materials to determine their utility in nuclear threat devices. This activity uses nuclear warhead stockpile tools that the NNSA nuclear weapons laboratories developed over several decades to build and service the U.S. nuclear arsenal. NCT analyzes nuclear materials through an extensive research and experimentation campaign to enable effective U.S. Government responses to their potential use in a nuclear device. Beginning in FY 2016, this work will be performed by DNN R&D on behalf of NCT.

Moving Next Generation Neutron Detector from Prototype to Production

*The Global Security Team of the **Nuclear Security Campus - Kansas City (NSC)** collaborated with teams from the DOE National Laboratories to move hardware designed to support NNSA missions from the development and prototype stage into production. The Next Generation Neutron Multiplicity Detector (MC-15) is being prepared for production. It is supported by both NCT and the **NNSA Office of Emergency Response** as an improvement over current capabilities to assay a neutron source and provide more versatility in measuring a wider range of source configurations.*

Neutron multiplicity counting is an established technique for identifying SNM and can be used as a tool to estimate SNM mass, design, and presence of neutron moderators. The Next Generation Neutron Multiplicity Detector will assay a neutron source (already located), assist in threat analysis of an unknown container, and assist in the quantitative analysis of multiplication and mass. In FY 2015, the NSC will use its engineering and industrial production expertise to review the manufacturability of the current design, provide feedback to the design team on proposed improvements, and work with the design team in transitioning the detector to production by building four pre-production units and preparing the production package.

*These efforts will allow the design to move from prototype stage to product and manufacturing process qualification, so the detector can go into production in FY 2016 for shipment to the field in support of emergency responders. The NSC Global Security Team also worked proactively with the **Office of Emergency Operations** to identify and then procure more than $4 million of equipment and components that will support the critical missions of the emergency responders.*

The technical understanding generated by this material characterization activity provides crucial insights that inform a large number of policies relating to nuclear security. One notable application of this knowledge is NCT's technical guidance concerning efforts to reduce the "attractiveness" of nuclear materials, where attractiveness is defined as material characteristics (e.g., physical form or weight) that make them desirable to illicit actors.

NCT guidance is used to determine physical protection standards for nuclear materials to ensure that they are kept beyond the reach of adversaries. Combining materials characterization and other skill sets, NCT also will continue to improve key nuclear forensics modeling efforts at the DOE national laboratories in support of threat device attribution.

Policy Engagement

Policy engagement with both the U.S. interagency and international partners is a cornerstone of NCT's mission. Indeed, the fundamental purpose of the office's development of technical knowledge is to facilitate technically informed policymaking to counter the threat of nuclear terrorism and nuclear proliferation. Domestically, its policy engagement spans the U.S. interagency, providing technical insights to DOD, DHS, NRC, and the Intelligence Community. In this role, NCT serves as the central clearinghouse for technical knowledge relating to nuclear threat devices within the U.S. Government.

NCT's international engagement takes three principal forms. First, the office conducts classified information exchanges with the United Kingdom and France under MDAs with both countries; second, NCT manages the P3 (France, United States, and United Kingdom) NTR Terms of Reference agreement by which technical knowledge relating to nuclear terrorism is shared trilaterally among the United States, United Kingdom, and France; third, NCT conducts select bilateral engagements with additional

U.S. partners, sharing its technical knowledge to reduce the risk of nuclear terrorism and nuclear proliferation.

U.S. Interagency Engagement. The knowledge that NCT possesses has been shared throughout the U.S. Government, in many cases leading to significant changes in important assumptions about the ability of terrorists to build a nuclear device. This enhanced understanding of what terrorists may be technically capable of achieving has driven a diverse set of U.S. policies and practices, including domestic nuclear materials protection, intelligence collection requirements, radiation detection specifications, and emergency response doctrine. More broadly, this enhanced appreciation of the realm of the possible with respect to nuclear threat devices has influenced high-level U.S. national security priorities, adding renewed urgency to the effort to secure WUNM worldwide.

Bilateral Exchanges. The United States and the United Kingdom share a long history of scientific and technical cooperation to reduce the threat of nuclear terrorism and proliferation. This bilateral exchange has been successfully managed by NNSA and DOD and by the Ministry of Defence for the United Kingdom. Likewise, NNSA conducts exchanges with France's *Commissariat à l'énergie atomique et aux énergies alternatives*, sharing scientific insights and collaborating to address global nuclear threats.

P3 Exchanges. In addition to bilateral NTR relationships, the United States, United Kingdom, and France have formalized a program of enhanced technical collaborations on a wide range of NTR subjects. The three nations have established a framework for cooperation on incident response and crisis management, nuclear energy and materials security, sharing of threat-related information, and IND design disclosure in the public domain. These exchanges have had far-reaching effects not only on the policies of the three countries but also on international nuclear security policy.

Additionally, at the 2012 Nuclear Security Summit in Seoul, the United States joined with the United Kingdom and France in issuing a Joint Statement on Nuclear Terrorism, which pledged to conduct international outreach in two key areas: reducing the attractiveness of nuclear materials using a graded approach to security and strengthening emergency response capabilities. In fulfillment of this pledge, NNSA continues to support international engagements regarding materials attractiveness, further strengthening worldwide preparedness to contend with the threat of nuclear terrorism.

Other International Outreach. NCT's technical knowledge is shared internationally in support of a variety of missions, including influencing the protection standards surrounding global stocks of nuclear material. A key purpose of NCT's international exchanges is to apprise foreign governments and commercial entities of the risk of nuclear terrorism and the policies they can implement to lessen this risk. These activities must be closely informed by highly sensitive science and technology knowledge.

One such international collaboration is an NCT effort under the Nuclear Security Working Group with Japan, which addresses the nuclear terrorism threat to Japan's civil nuclear sector. As part of this effort, the office coordinated a joint technical study with Japan to identify potential approaches to reduce the attractiveness of various civil nuclear materials that could be used for malevolent purposes. Following this effort, the two countries will soon conduct a joint technical impact study to evaluate the cost and engineering challenges associated with the options identified.

3.2 Strengthening WMD Counterterrorism Capabilities and Building Partnerships

Another NCT mission is to strengthen WMD counterterrorism capabilities domestically and overseas. NCT executes this mission by developing and conducting custom-designed counterterrorism tabletop exercises (TTXs); leading standing, senior-level bilateral and multilateral Counterterrorism Security Dialogues (CTSDs) with advanced civil nuclear partners; and providing technical and policy support to U.S. Government and multilateral counterterrorism efforts. Activities use NCT's unique understanding of the nuclear terrorism threat environment and the capabilities required to address this threat. Informed by the U.S. National Strategy on Counterterrorism, Presidential Policy Directive (PPD) on National Preparedness, and other U.S. strategy and policy documents, activities focus on core WMD counterterrorism capabilities related to threat awareness, security, preparedness, and resilience requirements.

To assess and prioritize capacity-building outreach opportunities, NCT annually assesses potential outreach partners to determine relative NCT priorities. Using a proprietary, unclassified methodology, NCT incorporates a variety of authoritative, third-party terrorism-related factors. Domestically (at the city and state levels), U.S. states and metropolitan areas are assessed on a relative basis by considering a number of factors associated with possible human, economic, and other impacts of a WMD terrorism incident. Internationally (at the national level), countries are assessed on a relative basis using a number of factors associated with terrorism incidence, governance, and security. As a next step, NCT considers applicable policy and practical considerations to prioritize and guide the program's capacity-building outreach.

The program's formal metrics assess the breadth of NCT outreach programs, using annual targets for numbers of federal, state, and local officials trained via the WMD Counterterrorism Tabletop Exercise (CT TTX) Program. By the end of FY 2015, the goal is to have trained a cumulative 11,000 officials; the FY 2018 training target is a cumulative 14,200 officials.

WMD Counterterrorism Tabletop Exercises

The WMD CT TTX Program designs, produces, and conducts tailor-made TTXs in order to increase WMD counterterrorism awareness and capabilities, both domestically and internationally. Since its start in 1999, the WMD CT TTX Program has trained 10,362 federal, state, local, and foreign officials via 120 different WMD counterterrorism, prevention, and response exercises across the United States and in key international partner nations. All exercises are open-source, without evaluation or attribution, to maximize full participation and practical value to participants.

Domestically, as part of a highly successful, cost-share collaboration between NNSA's GMS Program and the FBI's WMD Directorate, the NCT Program designs, produces, and conducts *Silent Thunder* site-specific TTXs at U.S. private- and public-sector locations with civil nuclear or radiological sources. *Silent Thunder* exercises bring together federal, state, and local agencies and on-site officials charged with security, emergency preparedness, and emergency response functions to practice their response to a hypothetical, custom-designed attack scenario. The WMD CT TTX Program's *Eminent Discovery* and other international TTXs similarly focus on strengthening WMD counterterrorism capabilities through familiarization with, and exercise of, international recommendations and best practices as well as relevant national legal frameworks and standard operating procedures. Conducted in partnership with the Chemical, Biological, Radiological, and Nuclear (CBRN) Commodity Identification Training activity managed by NNSA's INECP, the *Eminent Discovery* exercise series sensitizes participants to the WMD

terrorism threat while strengthening officials' coordination and communication skills needed to interdict WMD-related commodities being trafficked for terror purposes.

Counterterrorism Security Dialogues

Beyond capacity-building, CTSDs use bilateral classified and/or sensitive-information sharing agreements to conduct standing, senior-level interagency discussions with advanced civil nuclear partners on non-state actor threats to nuclear facilities and materials. These unique information-sharing agreements allow for an open and robust exchange in counterterrorism security cooperation. CTSDs cover such topics as nuclear terrorism threat assessments, best practices, technical approaches and tools to reduce terrorist risks to nuclear facilities and material transports, relevant counterterrorism policy and standard operating procedures, and reciprocal observations and peer assessments of national-level nuclear

Reducing WMD Terrorism Threats on Kenya's Borders

Historically, nuclear security efforts have focused first on states with vast materials holdings, with great strides made consolidating and securing materials at nuclear and radiological facilities. However, in today's increasingly technological globalized economy, civil nuclear and radiological materials transit the globe in greater numbers every day. This fact, combined with concerns over possible terrorist acquisition of WMD-related materials via illicit means, calls for involving a broader range of security officials in nonproliferation and counterterrorism capacity-building efforts. With nearly 3,500 kilometers of green borders (many of which span National Park territory) and the proximity of terror groups such as Al Shabaab, Kenya has become an integral—but non-traditional—ally in the modern fight against WMD-related illicit trafficking. In 2013, ***NNSA's Offices of Nonproliferation and Arms Control (NPAC)*** *and* ***Counterterrorism Policy and Cooperation (CTPC)*** *partnered with Kenya's Wildlife Service to host an East African regional training workshop and subsequent exercise (named "Harambee Discovery") to strengthen the skills of frontline border security officials in identifying and interdicting CBRN or explosives-related materials being trafficked for terrorism purposes.*

This low-cost workshop aligned NNSA's complementary WMD export control and WMD counterterrorism skill sets to deliver a uniquely practical, team-building training experience. Both NPAC's Commodity Identification Training and CTPC's WMD CT TTX Programs began more than 10 years ago as domestic capacity-building programs for U.S. law enforcement and homeland security officials, leveraging NNSA's unparalleled nuclear technical expertise. This successful joint NNSA activity now has been conducted with U.S. partners in the Middle East and Southeast Asia.

exercises and training. These mutually beneficial bilateral (and sometimes trilateral) CTSDs foster regular discussions between senior interagency teams responsible for various aspects of nuclear security and WMD counterterrorism. Efforts also focus on exchanging, as appropriate, advanced technical capabilities and expertise resident within DOE and the national laboratories to address the shared nuclear terrorism threat.

NCT manages the Department's liaison officers to key U.S. Government partners. These liaison officers serve as senior, expert Departmental representatives to their host organizations to ensure that the Department's technical expertise is fully applied to address the most urgent national security and nuclear security priorities. Senior NNSA representatives are detailed to U.S. Special Operations Command (USSOCOM), U.S. Central Command (USCENTCOM), and DTRA.

FY 2015 Planned Accomplishments

- Sustain threat device modeling and experiments, as well as development and testing of render safe tools.
- Continue standoff disablement exploration and computational activities.
- Support international collaboration activities through the NTR channels to conduct evaluations of nuclear terrorism risks and scenarios, as well as materials attractiveness studies under the U.S./Japan Nuclear Security Working Group.
- Maintain post-detonation device modeling capabilities.
- Continue to manage the monitoring, assessment, and response of open-source nuclear threat device information.
- Strengthen WMD counterterrorism capabilities by conducting CTSDs with key advanced civil nuclear countries and designing, developing, and conducting nuclear/radiological counterterrorism TTXs domestically and internationally.
- Design, develop, and conduct *Silent Thunder* domestic nuclear/radiological counterterrorism TTXs and international counterterrorism security exercises with key foreign partners.

Program Challenges

- In order to meet current or emerging demands imposed on the U.S. Intelligence Community, the DOD combatant commands, and the DOD and FBI National Mission Force (NMF), effective coordination and execution is needed with both interagency and key international partners. Continued effort is also needed to synchronize and execute internal agency activities.
- Continued support by U.S. Government and international partners to maintain the program results.
- Key nuclear security enterprise experimental facilities must be available for the duration of current nuclear and energetic materials roadmap needs. Funding priorities would need to be adjusted should key facilities be identified for closure before experimental activities are completed.

3.3 Future Program Plans

NCT will sustain nuclear threat device assessment capabilities and expertise, including unique modeling efforts. Additionally, NCT is focusing on the evaluation of response options when appropriate, will

sustain the measures to protect IND design information, and manage the assessment of open-source information. NCT also will sustain international technical and policy engagements through the NTR channels. In addition, the program will support bilateral counterterrorism security dialogues with advanced civil nuclear partner countries and conduct outreach to strengthen WMD counterterrorism capabilities domestically and abroad.

The NCT long-term priorities are to improve and sustain the ability to understand nuclear threats by improving NCT capabilities and applying NCT knowledge to enhance the operational capabilities of key partners. NCT goals are centered on improving the ability to assess nuclear threat devices and inform national and international policy decision-making processes to minimize the possibility of a nuclear detonation or nuclear terrorist event.

NCT goals also include innovative approaches for standoff disablement through experiments and computational modeling, thus meeting key DOD needs in support of national policy objectives. Additional NCT goals include strengthening nuclear counterterrorism capabilities and awareness, through WMD counterterrorism outreach focused on the expertise, coordination, and communication required to address nuclear or radiological terror threats associated with nuclear or radiological facilities or materials. NCT also will continue to assess open-source publications to protect nuclear threat device design information. Additionally, NCT will maintain post-detonation nuclear device modeling and data evaluation capabilities.

Main Areas of Activity for FY 2016 – FY 2020

- Increased activities for threat device modeling and experiments, as well as development and testing of render safe tools.
- Selected experiments also are planned, meeting key DOD operational needs.
- Restart execution of the Tier Threat Modeling Archive-Validation (TTMA-V) project.
- Execute a full range of standoff disablement experiments and modeling activities. This project includes a wide array of new experimental and complex modeling efforts designed to inform U.S. Government policies through NCT technical insights on a range of contingency options.
- Support international collaboration activities through the NTR channels to conduct evaluations of nuclear terrorism risks and scenarios, as well as materials attractiveness studies under the U.S./Japan Nuclear Security Working Group.
- Sustain the ability to respond to post-detonation events with device modeling capabilities.
- Manage the monitoring and assessment of open source nuclear threat device information and maintain the ability to respond to new open source disclosures and discoveries.
- Expand conduct of domestic Silent Thunder nuclear/radiological tabletop exercises and international WMD counterterrorism tabletop exercises to additional, priority partners.
- Strengthen counterterrorism capabilities and reduce non-state actor threats to nuclear facilities and materials by conducting CTSDs with key advanced civil nuclear countries.

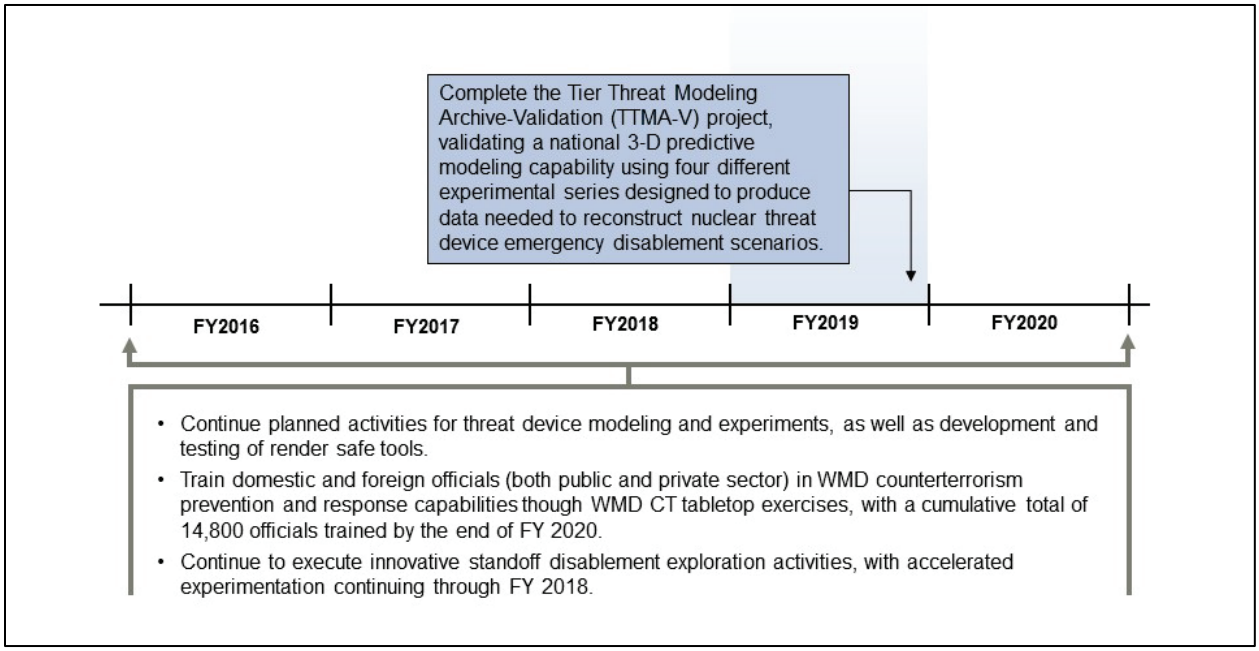


Figure 16. NCT Key Program Milestones[2]

[2] Beginning in FY 2016, the NCT Assessment Program and the Counterterrorism and Incident Response Capacity Building (CTIRCB) Program (and their Key Milestones depicted here), will, in part, become subprograms of the Nuclear Counterterrorism and Incident Response (NCTIR) Program. See Department of Energy's FY 2016 Congressional Budget Justification, Vol. 1 (National Nuclear Security Administration), Defense Nuclear Nonproliferation for more detail.

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

<u>Respond</u> to nuclear or radiological terrorist acts, or accidental/unintentional incidents, by searching for and rendering safe threat devices, components, and/or radiological and nuclear materials, and by conducting consequence management actions following an event to save lives, protect property and the environment, and enable the provision of emergency services.

In support of U.S. Government efforts to conduct nuclear/radiological emergency response and threat-related operations, NNSA engages its crisis operations, consequence management, and emergency management core missions and associated capabilities. Crisis operations refer to the set of NNSA programs and missions focused on preventing and protecting the United States and its allies from threats and adversaries associated with nuclear/radiological materials and devices. Working together with other departments and agencies, such as FBI, DHS, DOD, and others, the crisis operations program and its missions encompass searching for, locating, assessing, and making safe radiological and nuclear materials and devices. Consequence management refers to the set of NNSA missions focused on responding to both accidental and intentional releases of radioactive materials that can harm people and the environment. Like crisis operations, the consequence management program and its missions work with, and often times support, DOE laboratories and sites, the departments and agencies listed above, as well as the Environmental Protection Agency (EPA), the NRC, and state and local governments. These consequence management missions encompass a wide range of modeling, technical assessment, and operational support disciplines. The products are used to support incident commanders responding to both DOE on-site and nationwide events, with a focus on saving and sustaining lives and minimizing the effects of contamination on both infrastructure and the environment following a nuclear/radiological incident.

NNSA's Office of Emergency Operations is the U.S. Government's primary resource for radiological/nuclear crisis and consequence management leadership and provides security to the nation from the threat of nuclear terrorism. It provides the U.S. Government with quickly deployable, dedicated resources capable of responding rapidly to nuclear or radiological incidents worldwide.

The emergency management program and its missions ensure that nuclear/radiological emergency management and response capabilities are in place and effectively integrated to respond to any DOE and NNSA facility emergency events. The program and its missions also are responsible for developing and promulgating emergency management, continuity of operations (COOP), and continuity of government (COG) policy and guidance across NNSA. Together these missions and capabilities provide a range of critical emergency response expertise to the United States across the informed emergency preparedness spectrum defined in PPD-8 to include prevention, protection, mitigation, response, and recovery (see Annex A for further detail on PPD-8).

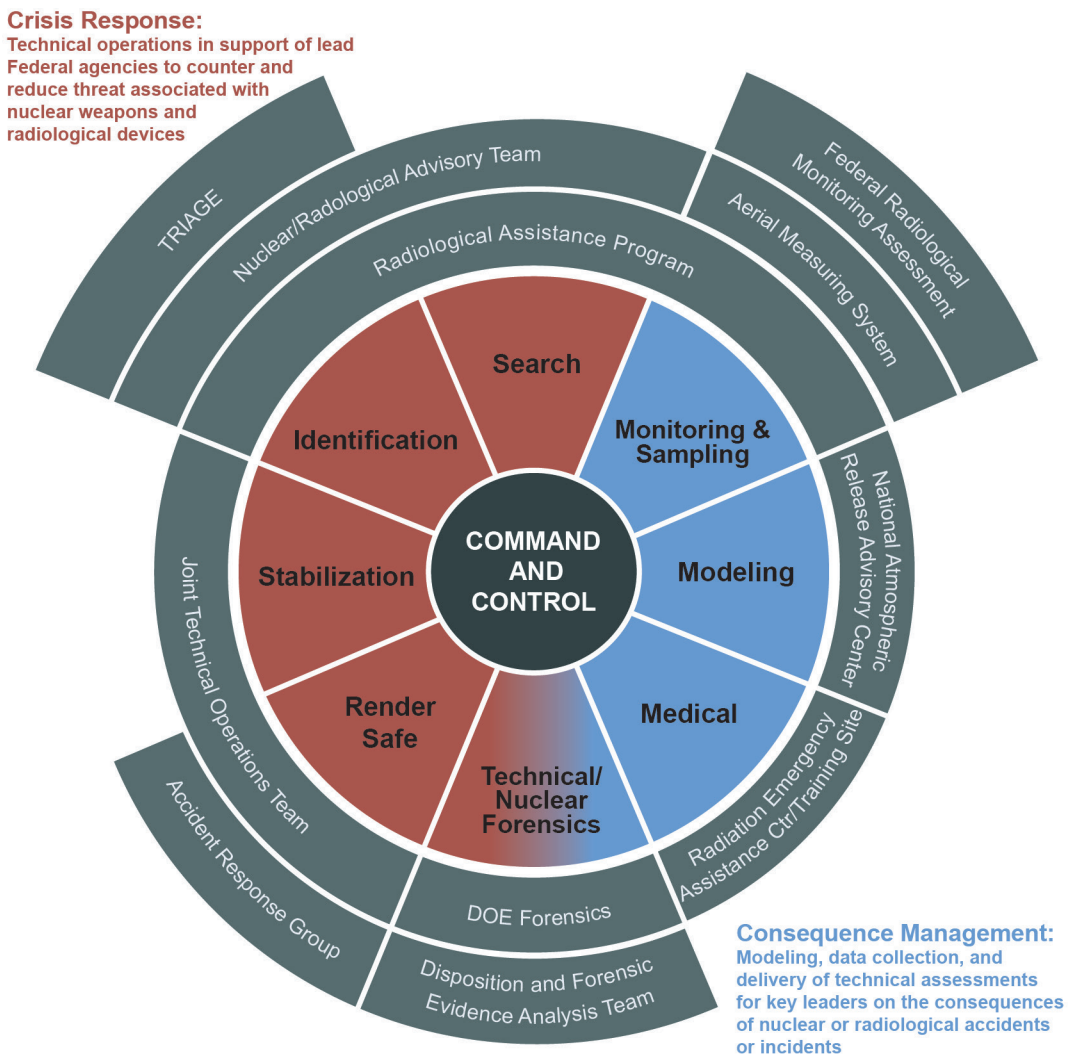


Figure 17. Office of Emergency Operations Assets

4.1 Crisis Operations

4.1.1 Program Objectives, Priorities, and Performance Metrics

The Crisis Operations mission is to organize and maintain an agile, scalable, and rapidly employable response capability in support of nuclear or radiological crisis prevention, protection, and associated mitigation functions. Program objectives include providing preeminent, national-level, nuclear, and radiological science and technology expertise during the deployment and conduct of detection and search operations, device stabilization, and render safe operations. NNSA teams provide their crisis response technical expertise to assist U.S. federal, state, tribal, and local law enforcement agencies. NNSA deployable personnel also serve as the information conduit to NNSA command, control, and coordination elements during crisis operations.

Additionally, NNSA's IEMC program provides specialized crisis operations support to foreign nations and international organizations in the areas of nuclear/radiological search, emergency response management, and reachback support to triage and medical assistance, through the conduct of formalized training courses and long-term detection equipment loan programs.

4.1.2 Program Activity, Accomplishments, and Challenges

NNSA provides technical support to DHS, FBI, and DOD to respond to incidents, including terrorist threats involving nuclear materials. The primary missions of the technical teams are to search for, identify, characterize, render safe, and dispose of any nuclear or radiological device. Two of these NNSA technical assets support FBI search missions: the Nuclear/Radiological Advisory Team (NRAT) and the Radiological Assistance Program (RAP) teams. NRAT is the primary technical support to the FBI's National Search Mission Force. NRAT provides continuous, on-call nuclear and radiological expert advice and operational support from two locations: Washington, D.C., and Las Vegas, Nevada. The RAP is the primary technical support to the FBI's Regional Search Mission Force Enhanced Special Weapons and Tactics (ESWAT) and provides radiological emergency first-response capabilities to federal, state, and local governments. The RAP provides continuous on-call technical response and advice, exploiting the expertise and knowledge from the DOE complex.

NNSA's emergency response teams are deployed more than 100 times a year, mainly within the United States, and most are radiological search deployments. The deployments are intelligence-driven in support of law enforcement and for planned events, such as the Super Bowl, Presidential inaugurations, or political conventions.

Detection and Search

NNSA subject matter experts provide technical assistance to FBI's National and Regional Search Mission Forces and to other federal, state, tribal, and local law enforcement agencies in the detection, identification, analysis, and response to events involving the potential loss and/or theft of nuclear/radiological materials and devices. U.S. policy guidance (PPD-25, see Annex A) designates NNSA as the Technical Lead for Interagency Radiological/Nuclear Search Operations (RNSO). NNSA employs the unique expertise of the U.S. nuclear security complex during nuclear/radiological search operations by assessing the technical characteristics of the threat; by recommending tactics, equipment configurations, resource tracking, and allocation during the planning and operational phases; and by status tracking, anomaly adjudication, and technical briefings during execution. NNSA activities are fully integrated with U.S. law enforcement and provide for responder health and safety, protection of classified materials and data, and the seamless transition to Render Safe or Consequence Management operations.

NNSA's RAP—which has locations near nine DOE national laboratories—provides continuous technical response, support, and advice to the FBI's Regional Search Mission. NNSA supports search field elements with a dedicated search home team node that provides technical assistance in support of the larger Crisis Response Home Team.

NNSA supports the FBI-led process to evaluate CBRN threats in the event of a radiological or nuclear threat. Upon determination that the threat is credible, a course of action will be determined by assessing the potential impact of the threat. NNSA is integrated into the FBI-led planning efforts and leads technical/scientific evaluations and consequence management.

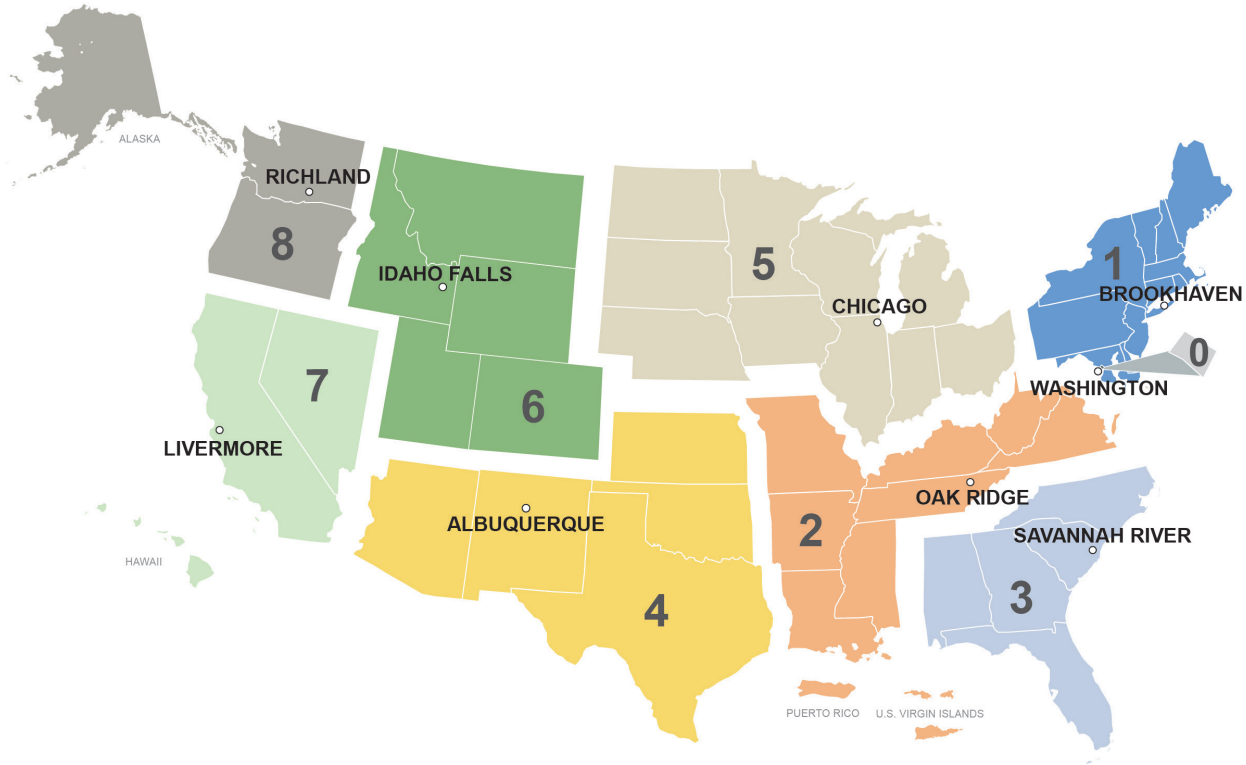


Figure 18. NNSA Emergency Response RAP Regions

The identification and resolution of radiation alarms is a major pillar of NNSA support. Radiation anomalies discovered in the environment are usually benign, but in the event of a threat, each must be assessed carefully. Accurate identification requires expert analysis. NNSA Triage is the world's preeminent program to analyze field-collected radiation data. Triage is staffed by NNSA national laboratory scientists and engineers with specialized skills to analyze data and perform radioisotope identification.

NNSA also provides technical radiological search support to national- and regional-level special security events, including political gatherings, such as the UN General Assembly, U.S. State of the Union Address, and large public events, such as the Olympics, the Super Bowl, and major-city New Year's Eve celebrations. NNSA supports search field elements with a dedicated search home team node that provides technical assistance in support of the larger Crisis Response Home Team.

The IEMC program has established a relationship with partner countries and the IAEA Incident and Emergency Center (IEC). IEMC has forged effective mechanisms for mitigating the effects of a nuclear incident anywhere in the world to strengthen the emergency management system with international reachback capabilities that include both the International Exchange Program for plume modeling and effects and radiological triage for technical analysis. Radiation detection equipment is provided to foreign partners through the IEMC program to improve and enhance radiation detection and to ensure necessary capabilities are in place to effectively respond to any nuclear/radiological event. Equipment provided on long-term loan includes the Spectral Advanced Radiological Computer System (SPARCS) for aerial and ground operations, radiation pagers, backpacks, identi-FINDERS (hand-held instruments that quickly detect, locate, and identify radiation sources), and health physics (HP) kits.

Render Safe

The NNSA Render Safe Program and missions provide technical assistance, training, and operational support to the FBI and DOD to prevent nuclear terrorism, using technology and the application of special methods and tools to interrupt the functions of radiological and nuclear devices. NNSA's render safe technical advisory teams have the specialized personnel and equipment necessary to assess, analyze, and provide technical advice to the U.S. Government's National WMD Render Safe capability, in support of rendering the weapon or device safe and making it ready for packaging and movement to a secure location. The FBI's Critical Incident Response Group (CIRG) has primary responsibility to respond to terrorism involving an IND, RDD, or other WMD within the continental United States, via FBI Field Offices. DOD has primary responsibility to respond to terrorism involving an IND, RDD, or other WMD outside the continental United States (OCONUS), via Special Mission Units (SMU) and the Geographic Combatant Command (GCC). NNSA's Render Safe Program provides technical assistance, training, and operational support to the FBI (and DOD) through technology and the application of special methods and tools to interrupt the functions of IND and RDD threat devices.

The NNSA Render Safe Program supports the following activities:

- *Device Stabilization* - The Stabilization Operations Program is a joint effort of the FBI and NNSA.
- *Device Characterization* - NNSA deploys specialized teams to determine the nature of a known radiological/nuclear threat using advanced diagnostic techniques.
- *Render Safe Technical Assistance* - The Joint Technical Operation Team/Accident Response Group (JTOT/ARG) provides technical expertise from the NNSA nuclear weapons design and engineering laboratories. They advise on the use of physics defeat, high explosives defeat, component defeat, and advanced manual techniques.
- *Device Secure Packaging & Transportation* - The NNSA Office of Secure Transport handles the secure packaging and transportation of a nuclear weapon.

Nuclear Forensics

Under the NCTIR Program, NNSA's Office of National Technical Nuclear Forensics is the U.S. lead for developing and sustaining pre-detonation nuclear device forensics concept of operations and associated capabilities and provides technical and operational support to material and post- detonation technical nuclear forensics. The NNSA's technical nuclear forensics teams and operations have specialized personnel, equipment, and capabilities to support the technical nuclear forensics mission. When those NNSA-developed capabilities are needed, the FBI (as the U.S. federal agency responsible for the investigation of crimes involving WMD within the United States and its territories) has designated the FBI Laboratory as their lead for coordinating technical nuclear forensics for the United States in incidents involving an IND, RDD, or interdicted radiological or nuclear material.

Within the Pre-Detonation Device Mission, following Render Safe, NNSA supports the disassembly and technical assessments of the IND or RDD and supports the FBI in collection of traditional forensic evidence. To provide this support, NNSA forms the Disposition and Forensic Evidence Analysis Team (DFEAT), a deployable team with specialized equipment and expertise in weapons engineering, explosives handling, arming and firing, detonators, explosives, device design, and other specialties.

Within the Post-Detonation Debris Mission, the DOE Forensics Operation (DFO) team is part of an interagency Ground Collection Task Force with the FBI and DOD. The DFO is a deployable, specialized response team composed of subject matter experts from across the DOE national laboratory complex. This team provides a reliable capability to support ground sample collection, perform in-field sample

processing, and deliver high quality samples to the FBI for shipment to designated laboratories for analysis. NNSA also supports evaluation of analytical results and supports proficiency and readiness for device reconstruction, the interpretation of data following collections, and analysis of debris.

NNSA also coordinates the interagency Bulk Special Nuclear Material Analysis Program (BSAP), capable of delivering high accuracy measurements of nuclear materials. Measurement capability is sustained through proficiency testing on nuclear materials and benchmarking of analytical methods, integrating with signature development for assessing the production history and origin of materials.

Nuclear Forensics Priorities

- Establish a program for nuclear forensics on SNM and pits at LANL.
- Improve the ability to generate quick, technical device assessments and integrate into the larger U.S. attribution effort.
- Document, exercise, and improve technical capabilities for pre- and post-detonation nuclear forensics.
- Conduct infrastructure improvements at the National Nuclear Security Site (NNSS) to ensure a safe, effective, sustainable facility for disposition operations.
- Improve technical capabilities to collect and screen debris in the field.
- Validate and benchmark radio chronometry, trace element, and morphology methods.

Nuclear Forensics Performance Metrics

- Maintain the capability to respond to pre-detonation INDs.
- Maintain the capability to respond to post-detonation INDs.
- Maintain laboratory staff expertise, capability, and readiness to respond and analyze pre-detonation nuclear material.

Disposition and Device Assessment - The technical and operational proficiency of the DFEAT to respond, disassemble INDs, and perform device assessment has improved greatly in the last five years. The DFEAT composition, depth, and training have been tuned to ensure effectiveness and responsiveness. Facility and communication improvements at NNSS have improved the ability to respond. Interagency teamwork and integration and DOE technical proficiency at the nuclear weapons laboratories, NNSS, and Pantex sites have greatly improved the ability to perform device assessment and support FBI traditional forensics.

Ground Collections - The DFO team has improved technical and operational capabilities to respond, plan collection missions, and screen nuclear debris following a detonation as part of the interagency Ground Collections Task Force. DFO teams stand continuously ready to deploy and can deploy within eight hours of a notification. DFO continues to improve staff proficiency and develop cutting-edge methods to collect and screen nuclear debris in the field to ensure sample quality.

Bulk Special Nuclear Material Analysis - A bulk SNM analysis capability for nuclear forensics was conceived in 2011 and reached operational status in FY 2013 through interagency teamwork and integration of DOE technical proficiencies at the nuclear weapons laboratories. Operational procedures are complete and the program continues to validate a number of methods specific for attribution. Capability is maintained through proficiency testing on nuclear materials and benchmarking of analytical methods.

FY 2015 Planned Accomplishments

- Conduct two *Marble Challenge* events (FBI-led domestic render safe exercises that approximate the complexity of conducting operations on a nuclear/radiological device in the United States).
- Conduct two OCONUS major events with Combatant Command participation: *Fused Response* and *Vital Archer* (both are DOD-led OCONUS render safe exercises that approximate the complexity of conducting operations on a nuclear/radiological device overseas).
- Conduct two OCONUS events with international partners: *Espial* (a render safe event during which NNSA works with select countries to radiograph, diagnose, and assess a training aid in a secure environment), and *Diamond Dragon* (an OCONUS accident response exercise where NNSA will assess, with DOD U.S. Air Force in Europe [USAFE]/U.S. European Command [EUCOM] units and a select country's incident response structure, response plans to a U.S. nuclear weapon accident).
- Conduct four Navy Explosive Ordinance Disablement Basic Courses.
- Conduct Block I through VIII training courses (64 one-week courses in total) for DOD SMU and FBI NMF Team.
- Conduct 15 Advanced Technical Operations (ATO) I and II courses for a DOD mission support partner.
- Improve technical capabilities to collect and screen post-detonation debris in the field.
- Establish nuclear forensics capability to handle SNM and pits at LANL.

Exercising Domestic Consequence Management to a Nuclear Terrorist Attack

*Consequence Management teams from the **NNSA Office of Emergency Response** participated in the VIBRANT RESPONSE 14 exercise at Camp Atterbury in Muscatatuck, Indiana, and surrounding areas. VIBRANT RESPONSE 14 is a U.S. domestic response exercise to a simulated terrorist attack with a nuclear weapon. Taking advantage of this U.S. Army North-led exercise, NNSA, alongside FEMA; the Indiana Department of Homeland Security; and numerous local, state, and federal agency civilian personnel from across the country, participated in this exercise. NNSA deployed personnel to federal and state operating facilities to coordinate the response to the radiological aspects of this scenario. Additionally, a Consequence Management Home Team provided support from Las Vegas, Nevada; Livermore, California; and Albuquerque, New Mexico. This team provided models of fallout deposition and analysis of environmental monitoring data. This was the most extensive exercise of this type to date, involving more than 5,000 deployed DOD military personnel in the field, and a multitude of support and coordination facilities across the country.*

- Conduct sustainment training for Stabilization Teams in eight cities, and complete the stand-up of a fully operational Stabilization Team in a ninth city.
- Complete the development, testing, and fielding of the next generation stabilization tools.

Program Challenges

- Infrastructure improvements are needed at NNSS to ensure a safe, effective, sustainable facility for disposition operations.
- Need to maintain laboratory staff expertise, capability, and readiness and support measurement proficiency testing.
- Infrastructure replacements are needed at the Nuclear Response Group Readiness Operations Complex to ensure a safe, effective, sustainable facility for deployment, equipment maintenance, and storage. Support to training and deployment operations.
- Communications Networks and capabilities are fragmented, outdated, and cumbersome in the ability to move data and keep multiple organizations informed of activities from field-level to executive-level. Differing levels of classification along with organizational rules on use of communications systems make it difficult to move data from one system to another.
- Difficult to develop, train, and maintain a cadre of individuals with expertise in the areas necessary to support emergency response operations. Limited funding levels prohibit having excess personnel to immediately fill vacant positions resulting from retirements, burnout, and promotions. This situation does not allow for the individual to devote the time to emergency response.

4.2 Consequence Management

4.2.1 Program Objectives, Priorities, and Performance Metrics

The Consequence Management Program provides preeminent, national-level technical expertise during the initial hours and days following a nuclear or radiological event through the evaluation of the radiological consequences of a nuclear or radiological incident. The program organizes the delivery of this essential response capability for mission integration with other federal, tribal, state, local, and international radiological consequence assessment capabilities and for full integration within the incident management structure and organization. Program objectives include the following:

Figure 19. Aerial Measurement System Training for the Ohio National Guard

- Develop and maintain a cadre of individuals with expertise in the areas of radiological data collection, assessment, and interpretation.
- Establish and maintain equipment, tools, facilities, and methodologies to support the mission.

Figure 20. Emergency Response Technical Team Departs for Japan, March 2011

- Organize and integrate the radiological hazard consequence assessment capabilities to effectively support key leaders and incident management.
- Continue to work with international partners to strengthen the global nuclear emergency management system.

4.2.2 Program Activity, Accomplishments, and Challenges

Emergency Response

In the event of a nuclear or radiological emergency, NNSA engages an emergency response management system to assist first responders and consequence management systems to plan and manage nuclear/radiological incident responses and mitigation efforts. This NNSA-supported response architecture includes management of the multiagency Federal Radiological Monitoring Assessment Center, which coordinates on-scene monitoring and assessments during a radiological emergency; a Radiation Emergency Assistance Center, providing 24-hour consultation services on radiation-affected health problems; an Aerial Measurement System, in which NNSA aviation-based equipment conducts wide-area radiological searches and surveys for emergency planning and response management; and the National Atmospheric Release Advisory Center (NARAC), which provides real-time predictions of atmospheric transport of radioactivity from a nuclear/radiological incident.

FY 2015 Planned Accomplishments

- Serve as the lead U.S. federal agency for a National Level Exercise.
- Coordinate with EPA, NRC, other elements within DOE, and provide support to the Nuclear Emergency Support Team (NEST) programs to safeguard the public and environment to ensure the successful resolution of an accident or incident.

- Facilitate radiological response and recovery efforts in the event of the intentional or accidental release of radiological or nuclear material.
- Inform public health officials on evacuation guidance and health effects from the accidental or intentional release of radiological materials.

International Emergency Management and Cooperation

Building on the NNSA emergency response capabilities for U.S. domestic incidents, IEMC collaborates with foreign governments and international organizations to reduce the risk of international nuclear and radiological events by strengthening emergency preparedness and response capabilities worldwide. IEMC develops program plans and infrastructure; provides technical assistance; and designs, organizes, and conducts training to strengthen and harmonize emergency management systems worldwide.

IEMC currently cooperates with more than 80 countries and 10 international organizations. IEMC has hosted International Search and Consequence Management workshops; International Aerial Measuring System trainings for Mexico, Chile, Brazil, Taiwan, Iceland, Denmark, Norway, Sweden, France, Canada, and the IAEA; and sponsored specific consequence management training for Argentina, Brazil, Iceland, Mexico, Morocco, Russia, and Vietnam. IEMC liaises with, and participates in, projects sponsored by international organizations, including the IAEA, Nuclear Energy Agency, the European Union, the North Atlantic Treaty Organization (NATO), the G7 countries, World Health Organization (WHO), World Meteorological Organization (WMO), and the Arctic Council. The IAEA's IEC maintains the Response and Assistance Network (RANET), which is one mechanism for coordinating international assistance.

Figure 21. Helo-Borne Aerial Messurement System

The IEMC program assists partners by providing capabilities for atmospheric modeling, environmental data collection and mapping, and data analysis for environmental radioactivity monitoring and assessment against IAEA and the International Basic Safety Standards for public protective action guidelines. These capabilities include:

- Modeling to provide an estimate of dispersion of radioactive material for the purposes of taking protective actions to protect the public, siting of response capabilities, and informing the planning of monitoring activities. Modeling may include projections of future possible release scenarios.
- Airborne and ground-based monitoring and sampling to provide radiation data and samples (soil, water, air, and vegetation) to define the amount and extent of contamination and evaluate the hazards to the responders, environment, and public.

- Laboratory analysis to evaluate the amount and type of radioactive materials in collected samples to provide data for the assessment process.
- Assessment to interpret radiological conditions and provide guidance to responsible government authorities. All radiological predictions and measurements are evaluated in terms of protective action guidelines, which are the criteria for making decisions such as evacuation, sheltering, relocation, and food embargo. These decisions control health risks by placing restrictions on the radiological dose received via the principal pathways.
- Medical response to provide technical assistance on the treatment of radiological injuries and contaminated patients and training for a cadre of medical personnel to respond to radiological injuries and contaminated patients.

Figure 22. I-RAPTER Training in Jordan

The IEMC program leverages knowledge, skills, and capabilities in medical response that reside within the NNSA nuclear security complex to assist foreign partners. IEMC conducts the International Medical Radiological Response Countermeasures (I-MED) training course for hospital management, doctors, nurses, and other medical professionals to stress the integration of professional medical care and radiation protection/health physics principles. IEMC also conducts the I-RAPTER program to provide specialized nuclear/radiological emergency preparedness and response training, based on training developed for U.S. responders. Additionally, the IEMC program conducts five specialized training courses per year with the IAEA and three per year with NATO, enabling the program to reach a broader international audience.

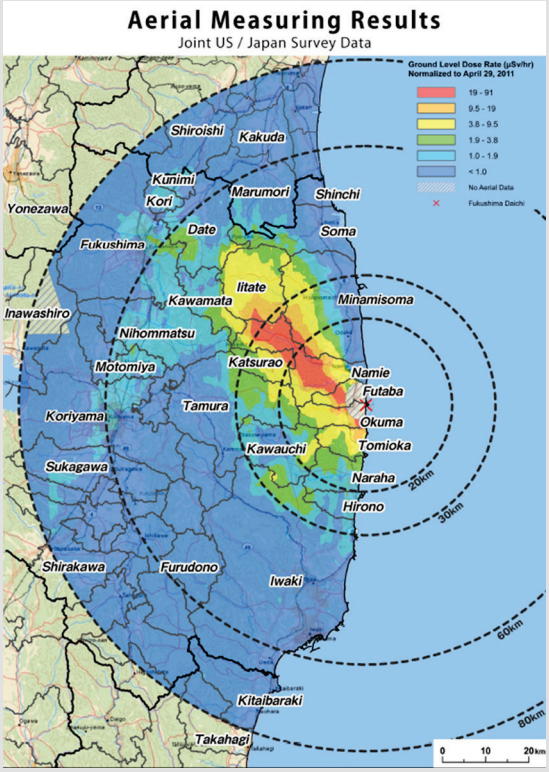
FY 2015 Planned Accomplishments

- Provide NARAC atmospheric plume modeling capabilities to 46 partner nations and three international organizations.
- Provide graphic information mapping assistance through the International Radiation Mapping Application to 22 partner nations and the IAEA.
- Assist Cambodia, Chile, China, Djibouti, Iraq, Jordan, Kazakhstan, Philippines, Romania, and Vietnam in developing a consequence management capability.
- Organize and conduct specialized emergency management training courses and programs to meet the specific emergency management needs of partner nations.

Program Challenges

- To ensure effective and efficient nuclear/radiological emergency programs at the national, regional, and international levels, the IEMC program would need to initiate activities with seven to ten countries per year, while maintaining sustainability of the program capabilities and continuing necessary interactions with international organizations to ensure compatible and harmonized systems worldwide. At current resource levels, the IEMC program only can initiate activities with two to three countries per year.

Aerial Radiation Survey of Fukushima Disaster Area



For ten weeks following the March 2011 earthquake and subsequent tsunami that devastated the area around Fukushima, Japan, NNSA scientists flew aboard U.S. Air Force aircraft operated out of Yokota Air Base to conduct more than 500 flight-hours of aerial surveys, measuring radiation levels associated with radioactive material deposited on the ground surrounding the Fukushima Daiichi nuclear power station. After deploying its Consequence Management Response Team and Aerial Measuring System, DOE, and NNSA provided ongoing assistance to the Government of Japan to support dose assessment through collaboration on data analysis and quality control. NNSA also loaned the Government of Japan an Aerial Measuring System and other equipment to augment Japan's own capability.

4.3 Emergency Management and Site-Level Preparedness

4.3.1 Program Objectives, Priorities, and Performance Metrics

The Emergency Management and Site-Level Preparedness Programs develop and implement specific programs, plans, and systems to minimize the impacts of emergencies on worker and public health and safety, the environment, and national security. This work is accomplished by promulgating appropriate Departmental policies and implementing requirements and guidance; developing and conducting training and other emergency preparedness activities; supporting NNSA readiness assurance activities and participating in interagency emergency planning and coordination activities. The objective is to continue to have a fully implemented and fully integrated, comprehensive emergency management system throughout the NNSA enterprise. The Emergency Management Program serves as the single point of contact for implementing and coordinating emergency management policy, preparedness, and response activities within NNSA, including supporting and coordinating NNSA field and contractor implementation of emergency management policy.

NNSA's Office of Emergency Operations maintains situational awareness of the nation's nuclear weapons complex and facilitates management of national emergency events via a secure nationwide communications network. The Operations Center provides an integrated, scalable, mobile, and/or virtual response capability to enable NNSA to successfully conduct routine and emergency operations.

DOE established a comprehensive Emergency Management System to provide an integrated and consistent approach to emergency planning, preparedness, readiness assurance, response, and recovery throughout NNSA. The system is based upon a "commensurate with hazards" approach with sufficient flexibility to tailor or grade programs to meet the needs of the specific site or activity. The DOE "comprehensive" emergency management system provides a framework to address all hazards, from natural phenomena to terrorist attacks, and all of the components of an effective emergency management program.

The NNSA Emergency Management System core objectives are to:

- Ensure that the DOE Emergency Management System is ready to respond promptly, efficiently, and effectively to any emergency involving or affecting NNSA sites, facilities, or operations by applying the necessary resources to mitigate the consequences and protect workers, the public, the environment, and national security.
- Effectively integrate planning, preparedness, response, and recovery activities for a comprehensive, all-emergency management concept.
- Effectively integrate applicable policies and requirements, including those promulgated by other federal agencies and interagency emergency plans into the Department's emergency Management System.
- Effectively implement NNSA COOP requirements and execution of mission essential functions (MEFs).

The NNSA Emergency Management Program is responsible for developing and promulgating Emergency Management, COOP, and COG policy and guidance for NNSA and assists in Headquarters, field, and contractors' implementation through the conduct of training, program validation, and interagency emergency management activities. The Program also establishes requirements for the implementation

of a comprehensive planning, preparedness, readiness assurance, response, and recovery activities of NNSA emergency management programs at all levels of the Emergency Response organization. In addition, the Program seeks to:

- Promote more efficient use of Departmental resources through greater flexibility (i.e., the graded approach) in addressing emergency management needs consistent with the changing missions of the Department and its facilities.
- Integrate public information and emergency planning to provide accurate, candid, and timely information to site workers and the public during all emergencies.
- Support planning and execution of exercises involving challenging and realistic scenarios based on hazard and risk assessments and credible threats.
- Support planning and execution of DOE's Continuity Program.
- Provide policy, guidance, and planning assistance to international organizations, such as the IAEA, European Union, NATO, and the Nuclear Energy Agency, to improve and harmonize nuclear and radiological emergency programs.

The NNSA Emergency Management Program evaluates its progress against these metrics: (a) develop, interpret, and resolve Emergency Management policy; (b) emergency planning and Continuity Program activities at NNSA sites/facilities are developed and implemented; (c) emergency preparedness activities at NNSA sites/facilities are developed and implemented. Additional metrics include:

- Readiness assurance activities at NNSA sites/facilities are developed and implemented.
- Participate in the planning of field annual exercises and support a minimum of two exercises per month of key NNSA facilities.
- Develop and distribute the DOE Annual Report for the Fiscal Year on the Status of the Department's Emergency Management System.

4.3.2 Program Activity, Accomplishments, and Challenges

Operations Centers Management

The Headquarters Operations Center serves as the Headquarters point of contact for receipt of all emergency notifications and reports. Accordingly, the Headquarters Operations Center receives, coordinates, and disseminates emergency information to Headquarters elements and program office emergency points of contact, the White House Situation Room, and other federal agencies. Operations Center Management identifies and tracks the Critical Information Requirements identified by senior leadership to provide a common operating picture for the Departmental steady-state and enhanced levels of response.

Emergency Communications Networks Management

The Emergency Communications Networks is a system established and maintained for 24-hour initial receipt and further dissemination of emergency notifications. A current listing of personnel designated to perform the function is maintained and routinely provided to the Headquarters Operations Center. This system provides for unclassified and classified voice, video, and data communications between Headquarters and NNSA facilities. These communications are accomplished through a mixture of terrestrial- and satellite-based methods, providing redundancy in the event of the loss of a critical communications node. In the coming years, a review of customer requirements and system capabilities,

coupled with wide refurbishment and critical review of essential services, will present both challenges and opportunities for enhanced operations.

Emergency Notification and Situational Awareness Coordination

This activity ensures that effective communication systems and protocols are coordinated and maintained between the Headquarters Operations Center, the Program Secretarial Officer, and the Cognizant Field Element during emergencies. In close coordination with the DOE and NNSA Office of the Chief Information Officer, Common Operating Picture tools such as WebEOC will be refined and deployed on enterprise-supported servers, making them available to the emergency management personnel at all NNSA sites and facilities.

NNSA Site-Level Emergency Preparedness Evaluations

Readiness assurance must include assessments and documentation to ensure that stated emergency capabilities are sufficient to implement emergency plans. In coordination with the Program Secretarial Officers and the Cognizant Field Element managers, these evaluations support a readiness assurance program consisting of evaluations, improvements, and emergency response assistance plans. Each NNSA site/facility must establish a readiness assurance program to ensure that stated emergency capabilities are sufficient to implement emergency plans. NNSA prepares an Annual Report on the status of the Emergency Management System, containing summaries of DOE and NNSA readiness assurance activities.

NNSA Site-Level Training and Exercises

NNSA maintains a trained cadre of experts capable of supporting a Headquarters response to an Operational Emergency and/or an emergency requiring emergency assistance resources and capabilities (e.g., radiological response assets).

FY 2015 Planned Accomplishments

The NNSA Emergency Management Program activities include:

- Coordinate and implement NNSA-specific emergency management planning, preparedness, readiness assurance, and response activities at NNSA Headquarters.
- Develop and promulgate policy, requirements, and guidance.
- Provide technical support and assistance to Headquarters and field elements.
- Plan, participate, and support exercises and drills.
- Interface with other federal agencies involved in the development and implementation of National Plans and Response Operations.
- Support the conduct of effective training and other emergency preparedness and readiness assurance activities in support of Headquarters and field elements (e.g. Emergency Management Team/Nuclear Incident Team-supported exercises).
- Support annual planning and coordination of COOP exercises to test execution of DOE's MEFs and alternate facilities/systems.
- Provide assistance to partner nations in developing the core elements of an emergency response program.

NNSA Continuity of Operations Program and Plans

Each NNSA Headquarters Program and Staff/Support Office (PSSO) is required to develop and implement an office-specific COOP Implementation Plan, which works in coordination with the NNSA Continuity Plan. The PSSO and Field Continuity Implementation Plans are subordinate to the NNSA Continuity Plan. The NNSA Continuity Plan addresses elements of the Continuity Program for all of NNSA, such as the identification of Departmental MEFs and Essential Supporting Activities (ESAs).

Program objectives, scope of activities, and priorities of the Departmental Continuity of Operations and Government Program established a comprehensive continuity program to provide an integrated and consistent approach to planning and preparing for, responding to, and recovering from a natural or manmade disaster, with the primary focus on the performance of essential functions. This program and its requirements are outlined in DOE Order 150.1A, *Continuity Programs*.

In accordance with the Homeland Security Presidential Directive (HSPD)-20/NSPD-51, *National Continuity Policy*, the Continuity Office is responsible for ensuring DOE is prepared for, and ready to respond to, a wide range of events that may disrupt normal operations. The national program contains two primary programs: COG and COOP.

- *COG* - A coordinated effort within each branch of the U.S. Government (e.g., the executive branch) to ensure that MEFs continue to be performed during a catastrophic emergency.
- *COOP* - An effort within individual organizations (e.g., federal executive branch departments and agencies) to ensure that essential functions continue to be performed during a wide range of emergencies, including localized acts of nature, accidents, technological, or attack-related emergencies.

The NNSA Continuity Program Office activities include:

- Develop and promulgate continuity of operation and continuity of government policy, requirements, and guidance for the entire department.
- Provide technical support and assistance to Headquarters and field elements.
- Plan, participate in, and support yearly National Level Exercises and drills.
- Interface with the National Security Staff, the White House Military office, and other federal agencies.
- Support the conduct of effective training and other preparedness and readiness assurance activities in support of Headquarters and field elements.
- Establish a close partnership between Headquarters, field elements, and other agencies to ensure seamless implementation and integration of continuity protocols.
- Support annual planning and coordination of COOP exercises to test execution of DOE's MEFs and alternate facilities/systems.

Program Challenges

- Emergency response infrastructure at all sites needs to be assessed to ensure that emergency operations centers are survivable, habitable, and able to function across all hazards during severe events.

- Exercises across the complex need to be designed and assessed to ensure that sites are prepared to effectively respond to all-hazards scenarios that challenge existing emergency management capabilities, particularly during severe events.

4.4 Future Program Plans

During this period, NNSA will continue to partner with the FBI to roll out radiological/nuclear device stabilization capabilities to selected cities and provide yearly recurring sustainment training and equipment maintenance.

Main Areas of Activity for FY 2016 – FY 2020

- Provide technical assistance to federal, state, tribal, local, and foreign government agencies to deal with nuclear/radiological incidents, including terrorist threats that involve potential use of nuclear materials.
- Provide technical assistance to a lead federal agency to search for or detect illicit radiological or nuclear material.
- Inform public health officials on evacuation guidance and health effects from the accidental or intentional release of radiological materials.
- Expand (and sustain) Render Safe Stabilization capability from the current seven cities to a total of nine cities, including training and equipment maintenance.
- Provide technical and operational capabilities in support of the U.S. Government interagency technical nuclear forensics program, and maintain readiness to respond to pre- and post-detonation nuclear events.
- Maintain readiness to respond to pre- and post-detonation events.
- Participate in two Ground Collection Task Force field exercises each year.
- Conduct two DFEAT exercises, including one “end-to-end” exercise with Device Assessment, each year.
- Conduct a total of four to five no-notice exercises each year at NNSA sites to gauge emergency preparedness.
- Conduct activities to promote consistency of emergency management practices at NNSA sites and in implementing emergency planning for severe events.
- Continue to implement emergency management policy for NNSA sites and continue to update and implement departmental policy and procedures.
- Provide program support to develop, design, organize, and conduct specialized emergency management training courses and programs to meet the specific emergency management needs of partner nations.
- Continue to provide enhanced communication and radiation monitoring equipment, technical assistance, and training for IAEA and foreign government emergency programs to address nuclear/radiological incidents and accidents including lost radiological sources.

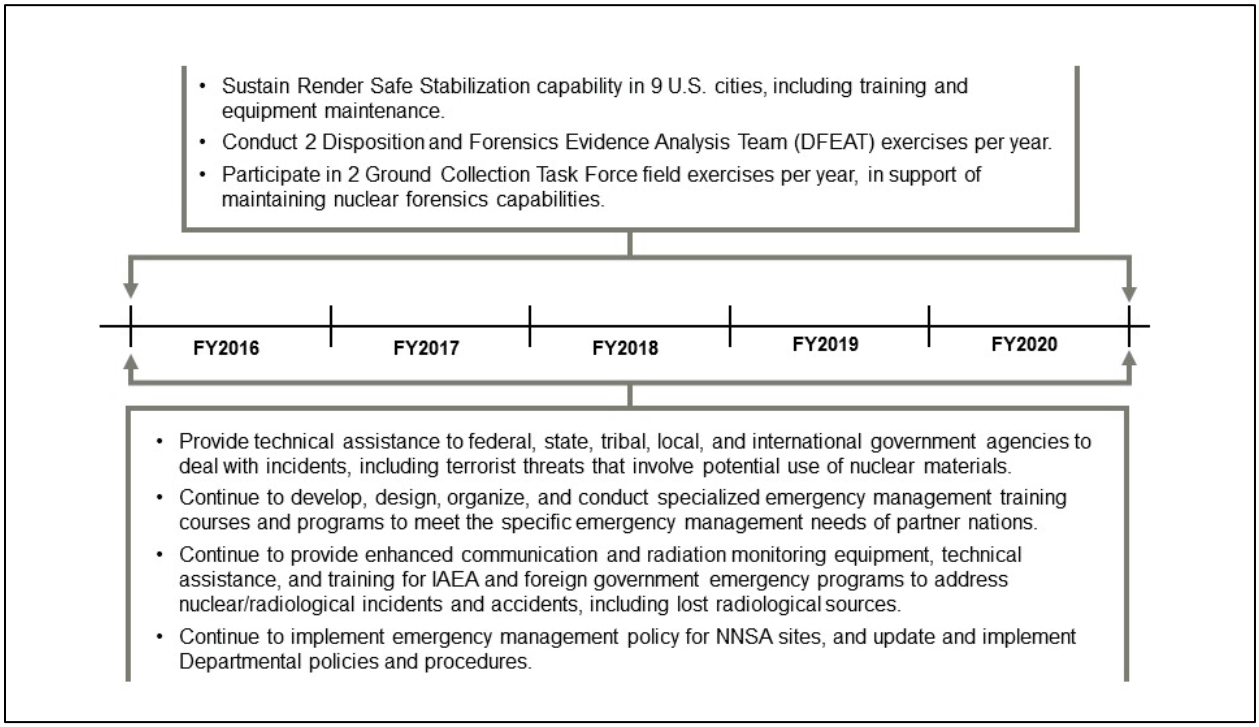


Figure 23. NCTIR Key Program Milestones[3]

[3] NCTIR Key Milestones depicted here are those other than those of the NCT Assessment Program and the Counterterrorism and Incident Response Capacity Building Program (CTIRCB), which are summarized in Chapter 3 and in Figure 16. Beginning in FY 2016, the NCT and CTIRCB Programs (and their Key Milestones) will, in part, become subprograms of NCTIR. See Department of Energy's FY 2016 Congressional Budget Justification, Vol. 1 (National Nuclear Security Administration), Defense Nuclear Nonproliferation for more detail.

Chapter 5: Conclusion

In response to suggestions from a variety of DOE stakeholders and advisors, in particular the Secretary of Energy's Advisory Board and Congressional authorizing and appropriation committees, NNSA has developed this report to better describe its strategic approach and program planning in preventing nuclear proliferation and terrorism. NNSA approaches the DOE "Nuclear Security" strategic goal by organizing programmatic actions along three pathways: **prevent** state and non-state actors (particularly, terrorists) from acquiring the materials, technology, and expertise for a nuclear or radiological threat device; **counter** efforts of proliferants and terrorists to obtain or develop the designs, constituent parts, and operational capability to build, deploy, and detonate a nuclear or radiological threat device; and **respond** to a nuclear or radiological crisis or post-incident emergency situation to minimize the damage of a nuclear or radiological incident to the public.

NNSA organizes its program management and resources to execute its global nuclear security engagement plans along the prevent-counter-respond approaches. To implement its program plans, NNSA makes full use of the DOE national laboratories, plants, and sites, which are recognized as the world leaders in scientific, technical, and engineering expertise and infrastructure in the nuclear security area. Building on this foundation of more than 50 years of experience in nuclear weapons design, production, and security, the DOE national laboratories, plants, and sites provide the vital and necessary tools, knowledge, and infrastructure to implement the NNSA global nuclear security engagement strategy and program plans.

NNSA programs play a central role in U.S. interagency policy coordination, program coordination, and leveraging other expertise and capabilities within the U.S. national security interagency. DOE and NNSA also are the U.S. leads or co-leads on a wide set of bilateral, multilateral, and international nuclear security groups and forums, demonstrating DOE's leadership in global nuclear security and the global fight against nuclear proliferation and terrorism.

As NNSA assesses the evolution of nuclear threat trends over the FY 2016–FY 2020 timeframe, it will continue to apply its all-source "over-the-horizon" strategic studies to validate that its efforts remain focused on both addressing current nuclear threats and anticipating emerging and evolving threat trends as far in advance as possible. Armed with these studies, and with the insights from external sources such as the Intelligence Community, foreign partners, and the international nuclear security community, NNSA will work with the DOE national laboratories, production facilities, and sites in conducting both cross-program and program-specific risk assessment and prioritization assessments. This will allow NNSA to make corporate decisions across the prevent-counter-respond mission space, which will align future program and budget priorities to address the greatest dangers to global nuclear security. To reflect such program progression, the *Prevent, Counter, and Respond* report will be updated regularly to reflect program plans, progress, and challenges across these mission areas.

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Annex A: Legislative Requirements Mapping Matrix

This *Prevent, Counter, and Respond* report contains information that duplicates information in three Congressionally mandated reports:

- *Receipt and Utilization of International Contributions to the Office of Defense Nuclear Nonproliferation of the National Nuclear Security Administration* (as required by Title 50, United States Code, Sec. 2569)
- *Progress in Nuclear Nonproliferation* (as required by the FY 2012 National Defense Authorization Act, Public Law 112-81, Sec. 3122).
- *Defense Nuclear Nonproliferation Programs of the National Nuclear Security Administration* (as required by the FY 2013 National Defense Authorization Act, Public Law 112-239, Sec. 3145).

The March 2015 editions of the first two reports (*Receipt and Utilization of International Contributions to the Office of Defense Nuclear Nonproliferation of the National Nuclear Security Administration* and *Progress in Nuclear Nonproliferation*) have been transmitted to Congress. The March 2015 edition of the report on *Defense Nuclear Nonproliferation Programs of the National Nuclear Security Administration* is satisfied by this *Prevent, Counter, and Respond* report.

The reader can locate the information duplicated in each of these Reports to Congress in the following matrix:

FY 2007 National Defense Authorization Act (P.L. 109-364), as amended, Sec 3113 and 3114)	***NNSA Response***
…authorizes the Department of Energy to accept international contributions for any programs within the Office of Defense Nuclear Nonproliferation of the National Nuclear Security Administration. This statute directs the Secretary of Energy to submit an annual report to the Congressional defense committees on the receipt and use of international contributions during the preceding fiscal year.	Annex B
FY 2012 National Defense Authorization Act (P.L. 112-81), Sec 3122	
…directs the Secretary of Energy to submit an annual report on the strategic plans of the Department of Energy and the National Nuclear Security Administration to prevent the proliferation of materials, technology, equipment, and expertise related to nuclear and radiological weapons in order to minimize the risk of nuclear terrorism and the proliferation of such weapons.	
(i) Preventing nuclear terrorism by securing and removing highly-enriched uranium and plutonium worldwide;	Sections 2.1.2 and 2.1.3
(ii) Converting reactors from highly-enriched uranium to low-enriched uranium in the Russian Federation and other countries;	Sections 2.1.2 and 2.1.3
(iii) Providing radiation detection capability at ports and borders;	Section 2.2.2 and 2.2.3
(iv) Securing and removing radiological materials worldwide;	Section 2.2.2 and 2.2.3

(v) Developing and improving technology to detect the proliferation and detonation of nuclear weapons; verify foreign commitments to treaties and agreements with respect to nuclear weapons; and detect the diversion of nuclear materials, including safeguard technology;	Section 2.4.2 and 2.4.3
(vi) Preventing and countering the proliferation and use of nuclear weapons (including materials, technology, and expertise related to such weapons), including through safeguards, export controls, international regimes, treaties, and agreements;	Section 2.3.2 and 2.3.3
(vii) Disposing of surplus material of both the United States and Russia;	Sections 2.1.2, 2.1.3, 2.5.2, and 2.5.3
(viii) Preventing the proliferation of nuclear weapons expertise.	Section 2.3.2 and 2.3.3
The report is to include "[a]n estimate of the budget requirements of the National Nuclear Security Administration, including the costs associated with the implementation of the strategic plans… over the 5-year period following the date of the report."	Annex C
The report is to include "[a] discussion of the coordination of the programs of the National Nuclear Security Administration with other offices of the Department of Energy and with other agencies and offices of the Federal Government with respect to implementing the strategic plans …."	Section 1.7; Sections 2.1.2, 2.2.2, 2.3.2, and 2.4.2; and Annex C
FY 2013 National Defense Authorization Act (P.L. 112-239), Sec 3145	
…Not later than March 1 of each year from 2013 through 2015, the Administrator for Nuclear Security shall submit to the appropriate congressional committees a report on the budget, objectives, and metrics of the defense nuclear nonproliferation programs of the National Nuclear Security Administration… Each report shall include the following:	
(A) An identification and explanation of uncommitted balances that are more than the acceptable carryover thresholds, as determined by the Secretary of Energy, on a program-by-program basis.	Annex D
(B) An identification of foreign countries that are sharing the cost of implementing defense nuclear nonproliferation programs, including an explanation of such cost sharing.	Annex B
(C) A description of objectives and measurements for each defense nuclear nonproliferation program.	Sections 2.1.1, 2.2.1, 2.3.1, and 2.4.1
(D) A description of the proliferation of nuclear weapons threat and how each defense nuclear nonproliferation program activity counters the threat.	Section 1.1 and Sections 2.1.2. 2.2.2, 2.3.2, and 2.4.2
(E) A description and assessment of nonproliferation activities coordinated with the Department of Defense to maximize efficiency and avoid redundancies.	Section 1.7 and Sections 2.1.2. 2.2.2, 2.3.2, and 2.4.2
(F) A description of how the defense nuclear nonproliferation programs are prioritized to meet the most urgent nonproliferation requirements.	Section 1.3 and Sections 2.1.1, 2.2.1, 2.3.1, and 2.4.1

Policy/Departmental Requirements for Emergency Response and Operations

The following policy and Departmental documents are cited in Chapter 4, as guiding documents for some of the NNSA Office of Emergency Operations programs:

- PPD-8, entitled "National Preparedness" was issued by the President in March 2011. It is focused on strengthening the security and resilience of the United States, through the systematic preparation for the threats that pose the greatest risk to the security of the nation. PPD-8 defines five mission areas: Prevention, Protection, Mitigation, Response, and Recovery, and directed the development of a series of policy and planning documents to enhance national

preparedness. During 2014, a set of Federal Interagency Operations Plans (FIOPs), one for each of the five mission areas, was finalized. These FIOPs, which build upon the National Planning Framework, specify the critical tasks and identify resourcing and sourcing requirements for delivering specified core capabilities.

- PPD-25 (classified directive) outlines the U.S. Government's response to terrorist threats within the United States and overseas, including weapons of mass destruction.
- NSPD 51/HSPD 20 prescribes the national continuity policy and emphasizes the incorporation of redundancy and resiliency as a continuity planning requirement.
- DOE Order 150.1A provides the operational framework to implement continuity policies, and requirements, which requires that all elements of a viable continuity capability be addressed at the Department level and at the level of the individual elements, both at Headquarters and in the field. All DOE and prime contractor facilities and sites are subject to the Order. The DOE continuity program provides a framework to allow all PSSO, staff offices, and field elements to address the continuity of operations and government against all hazards, from natural phenomena to terrorist attacks.

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Annex B: Foreign Contributions and Cost-Sharing Arrangements

The information in this annex duplicates information in two annual Reports to Congress that are focused on the programs of NNSA's Office of Defense Nuclear Nonproliferation (DNN): *Receipt and Utilization of International Contributions to the Office of Defense Nuclear Nonproliferation of the National Nuclear Security Administration* and *Defense Nuclear Nonproliferation Programs of the National Nuclear Security Administration*.

Section 2569(f) of Title 50, United States Code, authorizes the Secretary of Energy to maintain and use funds contributed any person (including a foreign government, international organization, or multinational entity), for the purposes of programs within DNN. In general, NNSA nuclear nonproliferation programs have benefited from partnerships and collaborations with foreign countries, including direct international financial contributions to designated projects and cost-sharing arrangements for those projects. These partnerships have extended the reach of NNSA programs and have played a key role in demonstrating international support for action against the global nuclear proliferation threat. Further, multilateral forums such as the G7 Global Partnership Against the Spread of Weapons and Materials of Mass Destruction and the Nuclear Security Summit process help encourage foreign partner interest in project matchmaking, coordination, and leveraging of effort with DNN programs.

Since 2005, DNN programs have received nearly $95 million U.S. Dollars (USD)[4] in direct financial contributions from eight countries. During FY 2014, DNN programs received the following contributions (note that Table 1 reflects the DNN programs as they were named and organized during FY 2014: the Global Threat Reduction Initiative Program [GTRI]; the International Material Protection and Cooperation Program [IMPC]; the Nonproliferation and International Security Program [NIS]; the Defense Nuclear Nonproliferation Research & Development Program [DNN R&D]; and the Fissile Material Disposition Program [FMD]). As of January 1, 2015, DNN has a new organizational structure and has replaced the previous DNN program office titles with new functional program office titles. See the Department of Energy FY 2016 Budget Request, Volume 1 – National Nuclear Security Administration for more details).

[4] Of this total, the now-completed Elimination of Weapons Grade Plutonium Production (EWGPP) program—which assisted in the shutdown of three Russian plutonium production reactors—received a total of $31,152,517 USD in contributions from Canada ($7,319,453), Finland ($628,900), the Republic of Korea ($750,000), the Netherlands ($1,190,200), New Zealand ($308,000), and the United Kingdom ($20,955,964).

Table 1. Summary of FY 2014 International Contributions to DNN Programs

DNN Program (as of FY 2014)	*Partner*	*FY 2014 Contribution*	*Use of FY 2014 Contribution*	*Cumulative Contribution Total (since 2005)*
GTRI	Canada			$ 17,360,691
	Czech Rep			$ 26,400
	Netherlands	$499,970	Contribution will fund radiological material security projects in Kazakhstan including source categorization, secure storage and transportation, and upgrades at Baikal-1 and Aktau facilities.	$ 1,649,940
	New Zealand			$ 406,050
	Republic of Korea	$200,000	Contribution will fund radiological material security projects in Ukraine.	$ 450,000
	United Kingdom	$2,461,110	Contribution will fund radiological material security projects in Tajikistan, Kazakhstan, India, Kyrgyzstan, the Philippines, and Afghanistan, and will support a pilot project to secure cesium irradiators in the United Kingdom.	$ 17,197,290
Total Contributions to GTRI		***$ 3,161,080***		***$ 37,090,371***
IMPC (MPC&A)	Canada			$ 5,169,026
	United Kingdom			$ 2,957,000
Total Contributions to IMPC (MPC&A)				***$ 8,126,026***
IMPC (SLD)	Canada			$ 8,485,885
	Finland	$458,975	Contribution will fund the installation of fixed radiation detection systems at three of Ukraine's high priority border crossings with Moldova.	$ 1,668,265
	New Zealand	$255,810	Contribution will fund radiation detection systems and workshops and exercises that build capacity for operating, maintaining, and managing radiation detection systems in Latin American and African nations.	$ 2,129,318
	Norway			$ 1,349,676

DNN Program (as of FY 2014)	*Partner*	*FY 2014 Contribution*	*Use of FY 2014 Contribution*	*Cumulative Contribution Total (since 2005)*
	Republic of Korea			$ 1,750,000
	United Kingdom	$997,800	Contribution will fund the deployment of mobile radiation detection systems to Iraq and other SLD partners.	$ 3,097,800
Total Contributions to IMPC (SLD)		**$ 1,712,585**		**$ 18,480,944**
Grand Total (as of End of FY 2014)		**$ 4,873,665**		**$ 63,697,341** **(plus $31,152,517 for the completed EWGPP program)**[1]

In addition, many DNN programs are developed on a targeted cost-sharing partnership basis with foreign partners, who bring financial, personnel, and technical resources to projects. This approach also helps strengthen the investment of the partner in the long-term sustainability of the program accomplishments.

GTRI: To the greatest extent possible, GTRI shares the cost of its threat reduction activities with the host country and/or other partner countries that make contributions directly to GTRI, to the host country, or to the IAEA. In many cases, GTRI will pay for the equipment and U.S. expert labor/travel, while the host site/country will pay for local labor. Bilateral arrangements with partner countries usually include a provision that the foreign counterparts are responsible for all labor and travel for government participants. These arrangements also include cost-avoidance measures such as no payment of foreign government taxes.

For nuclear material removal in high-income economy countries, DOE has contracts with its foreign partners that stipulate the responsibilities (both financial and otherwise) for each shipment. Typically, the partner country pays all costs associated with packaging, loading, and transport of the material, as well as the fee charged by DOE's Office of Environmental Management to accept the material. For example, in FY 2014, Italy and Belgium sent HEU and plutonium to the United States under these conditions, at a total cost to them of approximately $35 million. For Russian-origin material removals, costs for disposition are covered by that country's agreement with Russia (either via a fee charged by Russia or by agreement to accept the return of the waste resulting from reprocessing).

For conversions of research reactors and isotope production facilities, GTRI policy is that high-income economy countries pay a greater share of the costs associated with the actual conversion from HEU fuel and targets to LEU fuel and targets. GTRI contributes to the research and development of non-proprietary LEU-based technologies to enable the high-income economy country to complete the conversion effort. GTRI pays for all costs, or a greater share of the costs, associated with the conversion of reactors and isotope production facilities in other-than-high-income economy countries.

NIS: In FY 2014, NIS had cost-sharing arrangements with a total of 43 countries and territories, including Algeria, Argentina, Armenia, Australia, Bulgaria, Burma, Canada, China, Croatia, European Union, France, Georgia, Germany, Hungary, Indonesia, Iraq, Israel, Japan, Kazakhstan, Kenya, Kuwait, Kyrgyzstan, Malaysia, Malta, Mexico, Morocco, Netherlands, Oman, Philippines, Portugal, Romania, Russia, Saudi

Arabia, Serbia, South Africa, South Korea, Sweden, Thailand, Ukraine, United Arab Emirates, United Kingdom, and Vietnam, as well as the governing authorities on Taiwan. NIS also had cost-sharing arrangements with several regional and international organizations, including the Arab Atomic Energy Agency (AAEA), EURATOM, European Commission's Joint Research Centre – Institute for Transuranium Elements (JRC-ITU), the Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials (ABACC), the Asia-Pacific Safeguards Network (APSN), the WCO, and the IAEA.

In most cases, NIS subprograms provide funds for the travel and time associated with U.S. subject matter experts. Occasionally, NIS subprograms will fund the fabrication costs of technology prototypes or the participation by collaborators from developing states to attend regional or international meetings. Other costs associated with joint activities—fees for local infrastructure, venues and services, equipment, overnight accommodations, among other things—are the responsibility of the country and/or organization that incurs them, subject to the availability of appropriated funds by the appropriate governmental authority and compliance with the laws and regulations applicable to the parties.

IMPC: IMPC has cost-sharing arrangements that vary depending on the partners involved and the types of project work. Cost-sharing has grown in the MPC&A cooperation with all partner countries, including Russia. In some cases, MPC&A project costs are shared evenly (i.e., 50–50 split); in some cases the country or that country's ministry/agency pays a larger share of the project costs (and in other cases, the MPC&A pays a larger share). For some multi-year projects, there is a cost schedule whereby the recipient assumes more of the cost share over time, until it eventually assumes all of the costs.

There are some projects where other U.S. programs join IMPC program work, along with the recipient country. For the new Nuclear Security COE in China, IMPC and DOD contribute technical support and training equipment, and the Chinese government supports all aspects of designing, constructing, and operating the COE. China will contribute about $80–$120 million, and the U.S. contribution is about $45 million, shared between IMPC ($35 million) and DOD ($5–10 million).

The SLD program has worked with Federal Customs Service of Russia (FCS) since 1998 to jointly equip all international crossing-points in Russia. As of the end of FY 2014, SLD had equipped 124 sites, FCS had equipped 123, and FCS and SLD have jointly equipped 136 sites. Of the more than 2,000 radiation portal monitors installed under this SLD/FCS cooperation, SLD funded the installation of 1,012 while Russia funded the remainder. While it is difficult to know the total amount that Russia has spent on these projects, it is estimated that Russia has spent more than $71 million on the purchase and installation of radiation detection equipment. As of the end of FY 2014, SLD was still working with FCS to integrate sites into regional and national communications centers, and Russia also was contributing approximately half of the funding for this work. SLD has also employed a more limited cost-sharing approach with many of its partners at large container seaports (Megaports); the share of partner country expenditures to date is estimated to be approximately 5 percent of total expenditures. Also, SLD is working to increase cost-sharing of detection equipment installments with industry, particularly large terminal operators at seaports who have expressed an interest in collaborating with SLD. The SLD program continues to solicit G7 Global Partnership contributions, as well as to engage in collaborative efforts with the European Union and IAEA on installation, training, and maintenance of radiation detection systems.

Annex C: FY 2016 Future Years Nuclear Security Program Plan

The following section comes directly from the Department of Energy FY 2016 Congressional Budget Request, Volume 1: National Nuclear Security Administration. This information also duplicates information in the annual Report to Congress, *Progress in Nuclear Nonproliferation*.

In its FY 2016 Budget Request, NNSA proposes to fund two mission areas under the Defense Nuclear Nonproliferation appropriation: 1) the Defense Nuclear Nonproliferation (DNN) Program and 2) the Nuclear Counterterrorism and Incident Response (NCTIR) Program. The NCTIR Program was previously funded under the Weapons Activities appropriation. This move aligns all NNSA funding for preventing, countering, and responding to global nuclear dangers in one appropriation; strengthens existing collaborations and shared missions between the two mission areas; and clarifies total funding and work scope dedicated to counterterrorism.

Additionally, the FY 2016 proposal reflects the realignment of budgets managed by the Office of Defense Nuclear Nonproliferation into the following programs: Material Management and Minimization, Global Material Security, Nonproliferation and Arms Control, Nonproliferation Construction, and Defense Nuclear Nonproliferation R&D. This proposed realignment presents with greater clarity the total funding and level of activity undertaken by NNSA in this increasingly important area. Similarly, this realignment focuses the Weapons Activities appropriation on maintenance, modernization, and security of the U.S. nuclear stockpile and related activities.

Table 2. NNSA FY 2016 Budget Request –Defense Nuclear Nonproliferation

(Dollars in Thousands)

	FY 2014 Enacted	FY 2014 Current	FY 2015 Enacted	FY 2016 Request	FY 2016 vs FY 2015
Defense Nuclear Nonproliferation Appropriation					
Defense Nuclear Nonproliferation					
Global Material Security	0	0	0	426,751	+426,751
Material Management and Minimization	0	0	0	311,584	+311,584
Nonproliferation and Arms Control	0	0	0	126,703	+126,703
Defense Nuclear Nonproliferation R&D	0	0	393,401	419,333	+25,932
Nonproliferation and Verification R&D	398,838	461,125	0	0	+0
Nonproliferation Construction					
99-D-143 Mixed Oxide (MOX) Fuel Fabrication Facility, SRS	0	0	0	345,000	+345,000
Total, Nonproliferation Construction	0	0	0	345,000	+345,000
Global Threat Reduction Initiative					
Highly Enriched Uranium (HEU) Reactor Conversion	162,000	161,648	119,383	0	-119,383
International Nuclear and Radiological Material Removal and Protection	200,102	199,960	117,737	0	-117,737
Domestic Radiological Material Removal and Protection	80,000	79,829	88,632	0	-88,632
International Contributions	0	3,161	0	0	0
Total, Global Threat Reduction Initiative	442,102	444,598	325,752	0	-325,752
Nonproliferation and International Security	128,675	135,481	141,359	0	-141,359
International Material Protection and Cooperation	419,625	415,091	270,911	0	-270,911
Fissile Materials Disposition (FMD)					
U.S. Surplus FMD (Operations and Maintenance)					
U.S. Plutonium Disposition	157,557	155,057	60,000	0	-60,000
U.S. Uranium Disposition	25,000	27,500	25,000	0	-25,000
Subtotal, U.S. Surplus FMD Operations and Maintenance	182,557	182,557	85,000	0	-85,000
Construction	343,500	402,743	345,000	0	-345,000
Total, U.S. Surplus Fissile Materials Disposition	526,057	585,300	430,000	0	-430,000

	(Dollars in Thousands)				
	FY 2014 Enacted	FY 2014 Current	FY 2015 Enacted	FY 2016 Request	FY 2016 vs FY 2015
Russian Surplus Fissile Materials Disposition	**0**	**0**	**0**	**0**	**0**
Total, Fissile Materials Disposition	**526,057**	**585,300**	**430,000**	**0**	**-430,000**
Total, Defense Nuclear Nonproliferation	**1,915,297**	**2,041,595**	**1,561,423**	**1,629,371**	**+67,948**
Nuclear Counterterrorism and Incident Response Program	**0**	**0**	**0**	**234,390**	**+234,390**
Legacy Contractor Pensions	**93,703**	**116,556**	**102,909**	**94,617**	**-8,292**
Subtotal, Defense Nuclear Nonproliferation Programs	**2,009,000**	**2,158,151**	**1,664,332**	**1,958,378**	**294,046**
Use of Prior Year Balances	**-55,000**	**-216,168**	**-22,963**	**-18,076**	**4,887**
Recission of Prior Year Balances	**0**	**0**	**-26,121**	**0**	**26,121**
Total, Defense Nuclear Nonproliferation Appropriation	**1,954,000**	**1,941,983**	**1,615,248**	**1,940,302**	**325,054**

SBIR/STTR:

- FY 2014 Transferred: SBIR: $6,975; STTR: $997
- FY 2015 Projected: SBIR: $6,223; STTR: $860
- FY 2016 Projected: SBIR: $6,784 ; STTR: $1,018

Table 3. FY 2016 Outyears for Defense Nuclear Nonproliferation

	(Dollars in Thousands)			
	FY 2017 Request	FY 2018 Request	FY 2019 Request	FY 2020 Request
Defense Nuclear Nonproliferation Appropriation				
Defense Nuclear Nonproliferation				
Global Material Security	**534,263**	**543,665**	**552,122**	**580,363**
Material Management and Minimization	**315,463**	**337,593**	**348,494**	**344,490**
Nonproliferation and Arms Control	**131,305**	**140,726**	**144,033**	**146,909**
Defense Nuclear Nonproliferation R&D	**430,202**	**440,174**	**448,047**	**456,583**
Nonproliferation Construction				
99-D-143 Mixed Oxide (MOX) Fuel Fabrication Facility, SRS	**221,000**	**221,000**	**221,000**	**221,000**
Total, Nonproliferation Construction	**221,000**	**221,000**	**221,000**	**221,000**
Total, Defense Nuclear Nonproliferation	**1,632,233**	**1,683,158**	**1,713,696**	**1,749,345**
Nuclear Counterterrorism and Incident Response Program	**241,754**	**239,518**	**239,613**	**243,060**
Legacy Contractor Pensions	**69,208**	**52,640**	**29,296**	**29,296**
Subtotal, Defense Nuclear Nonproliferation Programs	**1,943,195**	**1,975,316**	**1,982,605**	**2,021,701**
Use of Prior Year Balances	**0**	**0**	**0**	**0**
Recission of Prior Year Balances	**0**	**0**	**0**	**0**
Total, Defense Nuclear Nonproliferation Appropriation	**1,943,195**	**1,975,316**	**1,982,605**	**2,021,701**

SBIR/Small Business Technology Transfer (STTR):

- FY 2017 Request: SBIR: $7,434; STTR: $1,045
- FY 2018 Request: SBIR: $7,610; STTR: $1,070
- FY 2019 Request: SBIR: $7,733; STTR: $1,087
- FY 2020 Request: SBIR: $7,902; STTR: $1,111

Annex D: FY 2014 Program Implementation

The information in this annex also is called for in the report to Congress, *Defense Nuclear Nonproliferation Programs of the National Nuclear Security Administration*, which responds to Section 3145 of the National Defense Authorization Act for FY 2013 (P.L. 112-239) (FY 2013 NDAA). The FY 2013 NDAA directs the Administrator for Nuclear Security to submit an annual report (until FY 2015) on the budget, objectives, and metrics of the Defense Nuclear Nonproliferation programs of the National Nuclear Security Administration. This report is to include an identification and explanation of uncommitted balances that are more than the acceptable carryover thresholds, as determined by the Secretary of Energy, on a program-by-program basis. Because this current reporting requirement covers the FY 2014 period, the information presented is formatted according to the Office of Defense Nuclear Nonproliferation (DNN) organization and budget account lines of FY 2014.

The following table shows the costed (i.e., expended), encumbered (i.e., committed), and unencumbered (i.e., uncommitted) financial amounts for all of the DNN programs. At the end of FY 2014, the aggregate program costs plus encumbrances for DNN were 82.9 percent of total costing authority, leaving 17.1 percent unencumbered with two Global Threat Reduction Initiative (GTRI) subprograms, the Defense Nuclear Nonproliferation Research & Development (DNN R&D), Nonproliferation and International Security (NIS), International Material Protection and Cooperation (IMPC) programs and two Fissile Material Disposition (FMD) subprograms above the DOE threshold for uncosted balances.

GTRI

As of the end of FY 2014, GTRI has costs plus encumbrances totaling $730.1 million, or 88.7 percent of its total FY 2014 available funds; the remaining $93.2 million in uncosted unencumbered balances (11.3 percent of the available FY 2014 funds) does not exceed the DOE threshold. However, two of the three GTRI Congressional controls in FY 2014 ($22.6 million for HEU Reactor Conversion and $33.5 million for International Nuclear and Radiological Material Removal and Protection) were above the threshold. For HEU Reactor Conversion, this was mostly due to delays in placing Cooperative Agreements under the Mo-99 subprogram due to delays in one partner's proposal submittal and a second partner's securing of the required cost-sharing funds. For International Nuclear and Radiological Material Removal and Protection, several associated project efforts that encountered obstacles in FY 2014 resulted in higher ending encumbrances. Additionally, a pending correction in the DOE accounting system of a total of $18.1 million in encumbrances (which should have been recorded in this Congressional control rather than the Global Threat Reduction Congressional control) would place the amount over-threshold by $8.0 million as opposed to $33.5 million.

DNN R&D

At of the end of FY 2014, DNN R&D had costs plus encumbrances totaling $488.2 million, or about 81.0 percent of its total FY 2014 available funds; the remaining $114.7 million in uncosted, unencumbered balances (19.0 percent of the available FY 2014 funds) exceeded the DOE threshold by $25.0 million. The $25.0 million in FY 2014 uncosted, unencumbered balances were driven by continued support of

long-lead procurements (8 to 24 months), primarily in the space and field testing programs and major laboratory equipment purchases. Long-lead procurements in field testing program account for $13.0 million and major laboratory equipment purchases account for $12.0 million. Balances reflect the requirement that funds be fully on hand at the laboratories prior to their execution of long-lead (8 to 24 months) procurements. The trend in the balances shows that awards and contracts are being executed expeditiously.

NIS

At the end of FY 2014, NIS had costs plus encumbrances totaling $150.2 million, or 83.6 percent of its total FY 2014 available funds; the remaining $29.4 million in uncosted, unencumbered balances (16.4 percent, of the available FY 2014 funds) exceeded the DOE threshold by approximately $6.3 million. The $29.4 million in uncosted, unencumbered balances are due primarily to unavoidable delays in several projects with Jordan, Sub-Saharan Africa, Russia, Ukraine, and Southeast Asia. There were delays in hosting a safeguards training course which is now scheduled for January. Also, carryover was required to fund the Chemical Weapons Convention laboratory proficiency test in October, Plutonium Production Reactor Agreement monitoring visit costs carrying over from September, and activities early in the fiscal year leading up to the November–December CTBT Integrated Field Exercise 2014. In addition, there was uncertainty and delay in nuclear forensics projects planned for Russia and Ukraine, as well as delays in NSG technical assessments and updates to the NSG Handbook.

IMPC

As of the end of FY 2014, IMPC had costs plus encumbrances totaling $769.0 million, or 77.9 percent of its total FY 2014 available funds; the remaining $218.7 million in uncosted, unencumbered balances (22.1 percent of available FY 2014 funds) exceeded the DOE threshold by $79.7 million. The $218.7 million in uncosted, unencumbered balances are primarily due to delays in program work in Russia while both countries continued negotiations on implementing agreements subordinate to the Multilateral Nuclear Environmental Programme in the Russian Federation (MNEPR) Framework Agreement (e.g., site access agreements). In addition, work with Russia was further delayed when Russia slowed the pace of cooperation to conduct a review of all ongoing nuclear security cooperation. Other IMPC uncosted, unencumbered balances are related to delays in the construction and development of the Nuclear Security Center of Excellence in China. The remaining uncosted, unencumbered balances will be obligated to national laboratories to ensure that critical global nuclear material security projects are appropriately supported in FY 2015.

FMD

U.S. Surplus Fissile Materials Disposition

As of the end of FY 2014, U.S. Surplus Fissile Materials Disposition had costs plus encumbrances totaling $226.9 million, or 67.4 percent of its total FY 2014 available funds; the remaining $109.5 million in uncosted, unencumbered balances (32.6 percent of available FY 2014 funds) exceeded the DOE threshold by $60.1 million. The $109.5 million in uncosted, unencumbered balances will support the other project costs associated with the MOX Fuel Fabrication Facility and Waste Solidification Building projects such as construction oversight, licensing activities, pre-operations and start-up planning, development of procedures, and construction support. In addition, these funds will continue to support the 2 MT oxide production campaign at LANL; the 3.7 MT oxide campaign at SRS; procurements of shipping containers for plutonium oxide shipments; and integration of program elements such as integrated program execution plan and schedule, program risk management plan, and interface control

documents. Other FMD uncosted, unencumbered balances are related to the HEU Disposition program. The unencumbered balance is projected to be costed by the second quarter of FY 2015. These balances will be used to continue the level of effort needed to down-blend surplus HEU to low-enriched uranium.

Russian Surplus Fissile Materials Disposition

As of the end of FY 2014, Russian Surplus Fissile Materials Disposition had costs plus encumbrances totaling $4.3 million, or 15.8 percent of its total FY 2014 available funds; the remaining $23.0 million in uncosted, unencumbered balances (84.2 percent of available FY 2014 funds) exceeded the DOE threshold by $19.6 million. The majority of these balances are being redeployed to other DNN programs in FY 2015 consistent with direction contained in the explanatory statement accompanying the Consolidated and Further Continuing Appropriations Act, 2015 (P.L. 113-235).

Table 4. Cost + Encumbrance Status, End of Fiscal Year 2014

		A	B	C	D	E	F	G
					B+C	D/A	A-D	F/A
Expense Type	Program	Costing Authority (Obligated Funds)	Year to Date Cost	Total Uncosted Encumbered Obligations	Current Costs + Encumbrances	Costed or Encumbered as a % of Costing Authority	Total Uncosted Unencumbered Obligations	Unencumbered as % of Costing Authority
Operating								
	Nonproliferation and Verification Research and Development	602,873,175	362,076,586	126,141,293	488,217,879	81.0%	114,655,296	19.0%
	Nonproliferation and International Security	78,969	78,900	69	78,969	100.0%	0	0.0%
	U.S. Surplus Fissile Materials Disposition	336,347,920	158,346,186	68,505,501	226,851,688	67.4%	109,496,232	32.6%
	Russian Surplus Fissile Materials Disposition	27,284,818	3,113,675	1,207,741	4,321,415	15.8%	22,963,403	84.2%
	Global Threat Reduction Initiative	383,160,875	241,134,105	160,135,972	401,270,077	104.7%	-18,109,202	-4.7%
	NN81 Legacy Contractor Pensions-DNN	116,556,818	116,556,818	0	116,556,818	100.0%	0	0.0%
	NN50 International Material Protection and Cooperation (IMPC)	987,619,006	316,742,220	452,214,962	768,957,182	77.9%	218,661,824	22.1%
	NN40 Nonproliferation and International Security (NIS)	179,574,039	131,788,806	18,415,645	150,204,451	83.6%	29,369,588	16.4%
	NN91 Highly Enriched Uranium (HEU) Reactor Conversion	161,648,357	59,609,241	57,467,433	117,076,675	72.4%	44,571,682	27.6%
	NN92 International Nuclear and Radiological Material Removal and Protection	198,658,211	61,255,742	77,710,128	138,965,871	70.0%	59,692,340	30.0%
	NN93 Domestic Radiological Material Removal and Protection	79,828,693	37,065,715	35,681,195	72,746,910	91.1%	7,081,783	8.9%
Operating Total		3,073,630,881	1,487,767,994	997,479,940	2,485,247,934	80.9%	588,382,947	19.1%
Construction								
	U.S. Surplus Fissile Materials Disposition	48,394,707	17,278,546	640,834	17,919,379	37.0%	30,475,327	63.0%
	Waste Solidification Building, Savannah River, SC							
	Pit Disassembly And Conversion Facility, Savannah River, SC	303,678	0	0	0	0.0%	303,678	100.0%
	Mixed Oxide Fuel Fabrication Facility, Savannah River, SC	518,663,477	321,565,756	194,205,015	515,770,771	99.4%	2,892,706	0.6%
Construction Total		567,361,861	338,844,302	194,845,849	533,690,150	94.1%	33,671,711	5.9%
Grand Total		3,640,992,742	1,826,612,295	1,192,325,789	3,018,938,084	82.9%	622,054,658	17.1%

A Report to Congress

Prevent, Counter, and Respond—A Strategic Plan to Reduce Global Nuclear Threats (FY 2016-FY 2020)

March 2015

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