Chapter 8
Countering Nuclear Threats

8.1 Overview

At the end of the Cold War, there was hope that the fall of the Soviet Union would herald a new era of peace and security. To some extent, this vision has materialized insofar as the threat of global nuclear war has been greatly diminished. However, the potential for nuclear use due to threats from nuclear terrorism and nuclear proliferation over the past two and half decades has increased. The uncertainty of a world with an increasing number of nuclear players has replaced the relative stability of a bipolar balance. Now there are state and non-state actors whose risk calculus does not deter them from conducting a nuclear attack against the United States, its allies, partners, or interests regardless of the cost to themselves.

"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."

National Security Strategy
February 2015

In development of the Presidential Policy Directive final draft for *Preventing and Countering Weapons of Mass Destruction (WMD) Proliferation, Terrorism, and Use*, the National Security Council and departmental leaders reaffirmed "the proliferation and use of WMD and their delivery systems is among the most serious threats facing the United States and the international community." Terrorist groups have declared their intent to obtain fissile materials to create a nuclear threat device (NTD), which can be anything from a crude, homemade nuclear device, to an improvised nuclear device (IND), a radiological dispersal device (RDD), or a radiological exposure device (RED), to a weapon from one of the established nuclear states that has fallen out of state control.

8.2 Efforts to Counter Nuclear Threats

The primary goal of countering nuclear threats (CNT) is to prevent a nuclear attack against the United States and its interests or, in the event of an attack, to respond effectively, avoiding additional attacks and providing the President with a range of options to hold the responsible parties accountable.

More specifically, the term CNT refers to the integrated and layered activities across the full range of U.S. Government efforts to prevent and counter radiological and nuclear incidents. Failing successful prevention of a radiological or nuclear incident, CNT also includes activities to manage the consequences of these incidents and to support the attribution process. Prevention and protection activities encompass all actions and programs that take place prior to detonation, while response activities are actions and programs that prepare for post-detonation response.

The primary goal of Countering Nuclear Threats is to prevent a nuclear attack against the United States and its interests.

CNT efforts are diverse and require the involvement of many agencies within the federal government and include partnerships throughout public and private domains. Most issues are national in scope, with implications for international security. Some aspects of CNT, such as accident response, are relatively mature, as they are based on historical and current work related to the U.S. nuclear weapons program. Others, including nuclear forensics and nuclear detection capabilities, are evolving as the threats of nuclear terrorism and nuclear proliferation continue to emerge.

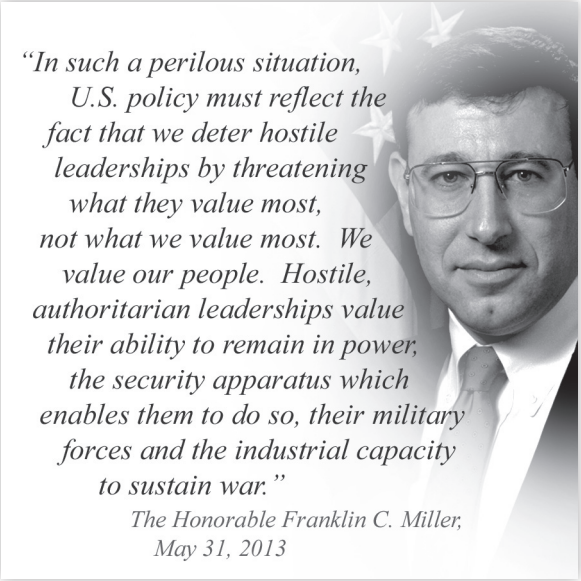
8.3 Nuclear Event Pathway

There are a number of generic steps that must be achieved for a potential adversary to be successful in carrying out an attack. These "nuclear event pathway" steps are illustrated in **Figure 8.1**. Terrorists do not share the same goals or need the same capabilities as governments. For a fabricated nuclear device, any yield production would be a success in a terrorist context. Weight and size constraints may not be important to a terrorist; unsafe designs may be acceptable, as are hazardous materials and higher dose rates. Finally, a wide variety of delivery methods could be used.

Figure 8.1 Nuclear Event Pathway

A pathway to an attack begins with motivation, planning, and intent. Next, for a credible threat, the acquisition of nuclear materials, nuclear components, or device is an essential step. This is unique for nuclear threats and is the key to a terrorist's success.

In March 2014, international partners convened a third Nuclear Security Summit in The Hague. Over 45 nations participated, representing a diverse set of regions and expertise on nuclear materials and energy. The goals of the Nuclear Security Summit were to strengthen nuclear security, reduce the continuing threat of nuclear terrorism, and assess the progress made since the Washington Summit in 2010. The summit affirmed a common goal of strengthening the international nuclear security architecture. The White House announced the fourth summit will be held in Washington, DC, in March-April 2016.



If successful in acquisition of materials, a potential adversary

must design and fabricate a NTD (or be able to use a stolen or procured device), transport and store the device, get it to its intended target, and achieve successful detonation, dispersal, or exposure. There are difficulties associated with every step along this pathway and there are specific indicators associated with each step that can facilitate the detection and interdiction of a NTD. Failing successful interdiction, rendering the device safe or unusable is necessary in responding effectively to the emergency. Finding and correctly interpreting indicators are keys to the prevention mission. In a post-detonation environment, the focus of the CNT mission shifts, in parallel with consequence management actions, to nuclear forensics and ultimately attribution to support prevention of subsequent attacks.

At each step along the pathway, a potential adversary must be successful; that is, failure at any point results in the overall failure of the objective. Therefore, efforts to counter the nuclear threat must only succeed in thwarting a potential adversary at any *one* point along the pathway to prevent a nuclear event. Additionally, even in the worst-case scenario of a nuclear detonation, there are effective steps to be taken to manage the consequences of such an event and appropriately deal with the perpetrators.

The spectrum of CNT activities is illustrated in **Figure 8.2**. The figure highlights activities beginning well before a potential nuclear event. Materials security, including the efforts embodied by the Nuclear Security Summit series, is the first step in preventing nuclear terrorism and nuclear proliferation. There is a continued need to scrutinize and modify the nuclear fuel cycle to ensure that the production of weapons-usable materials is

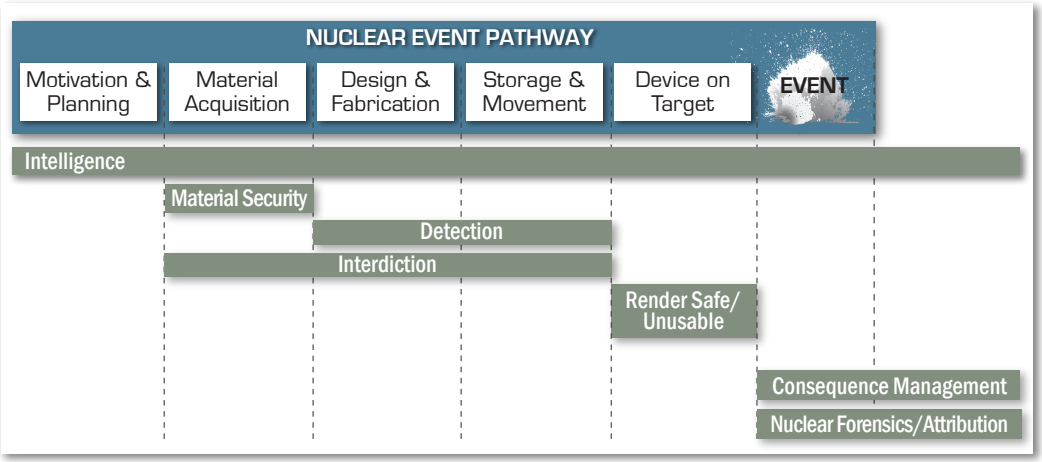


Figure 8.2 The Spectrum of CNT Activities

limited; and achieve this by instituting new processes and procedures to minimize the proliferation risks inherent in the use of nuclear power for peaceful purposes.

8.4 Understanding the Threat

The uncertainty involved with identifying specific NTDs remains a significant challenge. When dealing with a potential NTD, it is critical to identify what the device is made of, how it is configured, how it might work, and if it will produce a nuclear yield. As a result, there is no fixed set of NTD concepts or designs and our understanding of possibilities continue to evolve. NTDs can be developed from a variety of materials and may be configured with a high level of complexity. In general, less sophisticated devices require more nuclear material and produce lower yields. A crude device tends to be large and bulky, while sophisticated designs are smaller and lighter and achieve greater yields in relation to the mass of the fissile material.

The uncertainties associated with NTDs directly impact the ability to detect, interdict, and render a device safe. It is imperative that the United States continue its work to understand and characterize the full range of potential NTDs, including the characterization of nuclear and explosive materials as well as the range of potential configurations. **Figure 8.3** illustrates the intimate relationship between technical understanding of NTD designs and elements of a strong program for CNT.

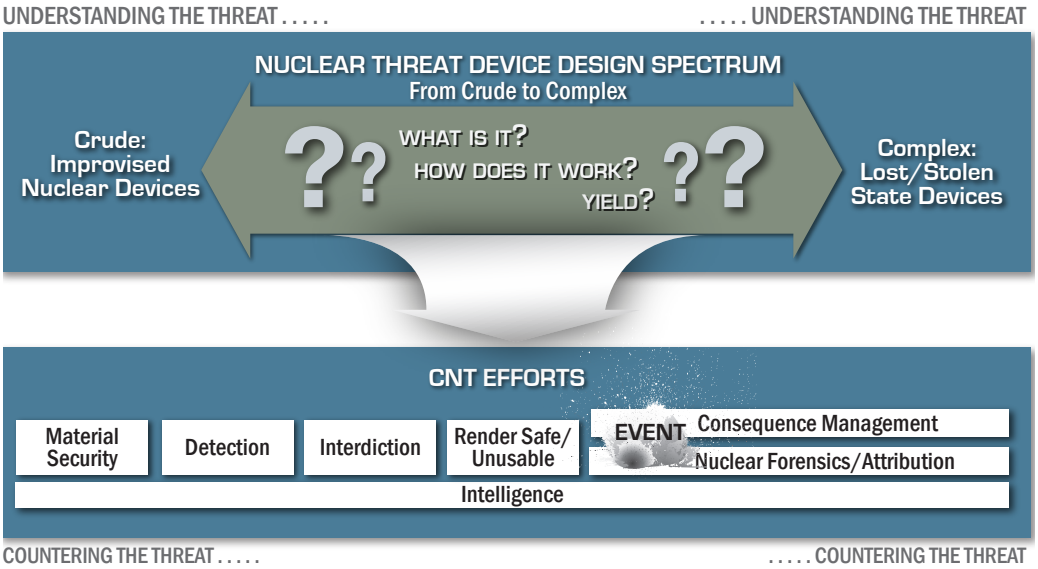


Figure 8.3 Understanding the Threat

The DOE, through the NNSA, works with domestic and international partners to perform nuclear and explosive materials characterization, device modeling, and simulation analyses to enhance the scientific and technical understanding of NTDs. Additional efforts are spent to identify and discriminate among nuclear and explosive signatures for materials security and to perform diagnostics and threat analyses. Understanding the threat also involves the development of tools, techniques, and procedures to facilitate nuclear device vulnerability exploitation and, thus, help to perform render safe functions in a timely and effective manner.

8.5 Actions to Counter the Nuclear Threat

Numerous departments and agencies within the U.S. Government and in the international arena continue their efforts to better characterize the nuclear threat. Work in these areas is divided into categories of material security, detection, interdiction, render safe, consequence management, nuclear forensics, and attribution.

8.5.1 Material Security

Weapons-usable highly enriched uranium (HEU) and separated plutonium exist in hundreds of locations around the world under varying levels of security. While the large percentage of facilities are under strong, usually military, control with continual monitoring, a significant breach at one of these locations could have an impact that would profoundly change the way the world sees and addresses nuclear terrorism today. Since the early 1990s, there are multiple instances of collaboration among countries to minimize the threat of nuclear terrorism, including collaborations between the United States and Russia.

The Material Protection, Control, and Accounting (MPC&A) program is part of the DOE/NNSA nonproliferation program and seeks to improve the security of nuclear weapons and material accounting for former nuclear sites in Russia and other countries of the former Soviet Union (FSU) that house radiological materials. The United States has funded this program and hopes it will serve as a template for future programs with other countries. The ultimate goal of the program is to improve global nuclear security and ensure that radiological sources are not accessible to illicit markets. Since the program's inception as part of the DoD Cooperative Threat Reduction (CTR) program, it has secured thousands of tons of weapons-grade nuclear material in the FSU.

Under the auspices of the 1991 Nunn-Lugar *Cooperative Threat Reduction Act*, the United States and Russia worked to build the Mayak storage facility in Russia. The

Fissile Material Storage Facility (FMSF), Mayak, Russia

facility was built to enhance security for nuclear material recovered from dismantled nuclear warheads in Russia. With space to permanently store 50,000 containers of weapons-grade plutonium from 12,500 dismantled nuclear warheads, the Mayak facility demonstrates a significant achievement in the reduction of the Russian nuclear stockpile and improved security for nuclear materials.

On July 15, 2006, President George W. Bush and Russian President Vladimir Putin launched the Global Initiative to Combat Nuclear Terrorism (GICNT). The initiative aims to broaden and enhance international partnership to strengthen global capacity to prevent, detect, and respond to nuclear terrorism. Currently, 85 countries are involved in the initiative. Members work to integrate collective capabilities and resources to strengthen the overall global architecture to combat nuclear terrorism. They bring together experience and expertise from the nonproliferation, counterproliferation, and counterterrorism disciplines; and provide the opportunity for nations to share information and expertise in a voluntary, non-binding framework.

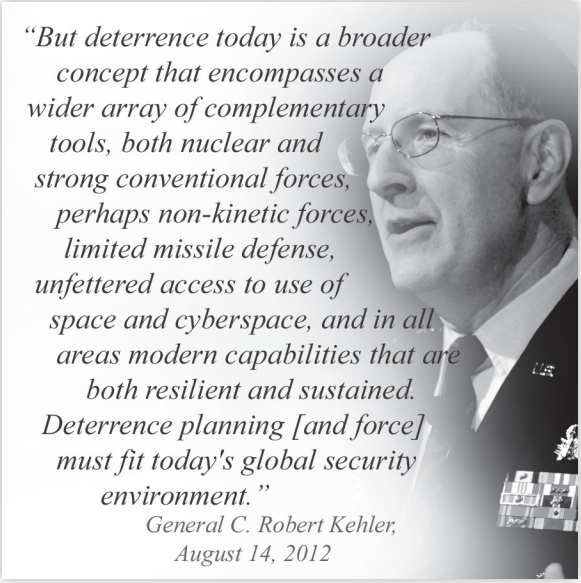
Domestically, the DoD and the DOE/NNSA are responsible for special nuclear material and nuclear weapons in their custody. Additionally, the Federal Bureau of Investigation (FBI) Nuclear Site Security Program requires each FBI field office to establish close liaison with security personnel at critical nuclear facilities, including DoD and DOE/NNSA sites as well as commercial nuclear power facilities operating under the Nuclear Regulatory Commission. This program also requires field offices to develop site-specific incident response plans and to exercise those plans with facility security personnel. Lastly, each field office has a designated, full-time special agent for all WMD-related activity, including nuclear threats.

8.5.2 Detection

The radiation detection mission is diverse and will not be solved by any single technology or configuration in the near term. The detection and identification of nuclear threats by current passive detection technologies is limited by three factors. First, the size and activity of the radiological sample is directly correlated with detectability. The quantities of interest for nuclear materials can be very small and some fissile materials have minimal radioactive emissions, limiting their detection by passive means. Second, shielding will degrade the ability to detect radiological materials. Finally, the distance between the material and the detector limits the ability to passively detect radiological materials. Nuclear radiation, like other forms of electromagnetic radiation, decreases in intensity

with the square of distance (i.e., the signal drops by a factor of four when the distance between the nuclear source and detector is doubled).

The detection mission is being addressed in interagency forums to help offset the complexity of the mission and many U.S. Government components are involved in improving radiation detection. In 2005, presidential policy established the Domestic Nuclear Detection Office (DNDO) within the Department of Homeland Security (DHS) to assist in management and improvement of U.S. capabilities to detect and report unauthorized attempts to import, possess, store, develop, or transport radiological and nuclear material. The DNDO is responsible for enhancing and coordinating efforts to detect and prevent nuclear and radiological terrorism against the United States. In this role, it is responsible for effective sharing and use of appropriate information generated by the intelligence and counterterrorism communities, law enforcement agencies, and other government agencies, as well as foreign governments. As such, DNDO conducts research, development, testing, and evaluation of detection technologies; acquires systems to implement the domestic portions of the architecture; and coordinates international detection activities. The DNDO also provides support to other U.S. Government agencies through the provision of standardized threat assessments, technical support, training, and response protocols. The DOE/NNSA Global Material Security Nuclear Smuggling Detection and Deterrence Program to prevent and detect nuclear smuggling also plays a significant role in countering possible terrorist activities involving nuclear weapons or devices.



8.5.3 Interdiction

Interdiction includes the seizure of materials or technologies that pose a threat to global security. Efforts in this area include research, development, testing, and evaluation of

detection and interdiction technologies conducted by many federal agencies. Additional activities in this area include efforts to create exclusion zones, increase surveillance, identify transit routes, monitor choke points and known smuggling routes, sustain nuclear detection programs, and support technological enablers for these efforts. The Nuclear Trafficking Response Group (NTRG) is an interagency body established by presidential directive that is responsible for coordinating the U.S. Government response to nuclear and radiological smuggling incidents overseas. The NTRG supports foreign government efforts to secure smuggled material, prosecute those responsible, and develop information on smuggling-related threats.

Presidential policy articulates roles and responsibilities for U.S. Government departments and agencies, both within the United States and overseas, and identifies the Attorney General as lead for coordination of law enforcement activities involving terrorist acts. The FBI response is fully coordinated with the Department of State (DOS), the DHS, and the DOE/NNSA while the DoD provides support to each of the civil authorities, as requested. This process ensures the response is integrated and coordinated. The DOE/NNSA acts as a cooperating federal agency, bringing assets and deployable technical teams to aid in the overall federal response and can assist, if requested, with the search of an asset or tactical operation. The DoD has responsibility for interdicting a nuclear weapon in transit outside the United States. For this reason, the DoD maintains the capabilities to interdict a weapon in the maritime, aerial, and terrestrial domains. The DoD has built upon current capabilities to ensure that, should the location of a terrorist-controlled IND, RDD, or RED be known, forces can successfully and safely recover the weapon.

In addition to being responsible for the criminal prosecution of acts of terrorism, the Attorney General is responsible for ensuring the implementation of domestic policies directed at preventing terrorist acts. The execution of this role ensures that individuals within terrorist groups can be prosecuted under U.S. law.

8.5.4 Render Safe

The ability to render a nuclear weapon safe is complex. Each device (IND, RDD, and RED) is unique and requires a distinct approach to be rendered safe. The initial phase for the render safe process is the identification of the device. In the second phase, the responders gather and analyze information as well as take appropriate render safe actions until the weapon is ready for transport. Diagnostics of a nuclear or radiological weapon will help determine render safe procedures and the weapon's final disposition.

The final phase is the disposition of the weapon, during which the radiological material and other components of the weapon are properly transported and stored. The DoD and the FBI maintain specific teams trained in rendering safe these types of ordnances.

Within the United States, the FBI holds the responsibility for render safe procedures involving terrorist activity and WMD. As the primary law enforcement agency and lead federal agency for such operations, the FBI may request cooperative assistance from the DoD or the DOE/NNSA. The DoD, the FBI, and the DOE/NNSA execute training exercises individually and jointly to streamline the render safe process and to build relationships and share technologies across the interagency.

Consequence management activities include securing the incident site, assessing the dispersal of radioactive material, enhancing first responder capabilities, ensuring availability of decontamination and site remediation resources, radiological medical triage capabilities, and increasing population resilience and recovery capabilities.

8.5.5 Consequence Management

Post-event consequence management activities are necessary in the event of a successful attack, but also necessary following a smaller scale event or even following a successful render safe mission. National-level guidance, such as the National Response Framework (NRF) and other documents, outline interagency roles and responsibilities and guide U.S. efforts in response planning, exercises, and training. Consequence management activities include securing the incident site, assessing the dispersal of radioactive material, enhancing first responder capabilities, ensuring availability of decontamination and site remediation resources, providing radiological medical triage capabilities, and increasing population resilience and recovery capabilities. In addition to managing consequences which minimize the disastrous effects desired by the adversary, demonstrated preparedness can serve as a deterrent effect.

The FBI is the lead federal agency for the crisis management response (interdiction), while the Federal Emergency Management Agency (FEMA) is the federal lead for consequence management and is an agency within the DHS. FEMA manages and coordinates any federal consequence management response in support of state and local governments in accordance with the NRF and the National Incident Management

System (NIMS). Additionally, the *Homeland Security Act of 2002* requires specialized DOE/NNSA emergency response assets fall under DHS operational control when they are deployed in response to a potential nuclear incident in the United States.

The DOE/NNSA provides scientific and technical personnel and equipment during all aspects of a nuclear or radiological terrorist incident, including consequence management. The DOE/NNSA capabilities include threat assessment, technical advice, forecasted modeling predictions, radiological medical expertise, and operational support. Deployable capabilities include radiological assessment and monitoring; identification of material; development of federal protective action recommendations; provision of information on the radiological response; hazards assessment; post-incident cleanup; radiological medical expertise; and on-site management and radiological assessment to the public, the White House, members of Congress, and coordinated through the DOS to applicable foreign governments.

8.5.6 Nuclear Forensics

Nuclear forensics provides information outside the scope of traditional forensics on interdicted materials or devices before detonation and on postdetonation debris to facilitate attribution. Attribution is an interagency effort requiring coordination of law enforcement, intelligence, and forensics information to allow the U.S. Government to determine the source of the material and device as well as its pathway to its target.

The National Technical Nuclear Forensics (NTNF) program assists in identifying material type and origin, potential pathways, and design information. Technical nuclear forensics (TNF) refers to the thorough analysis and characterization of pre- and post-detonation radiological or nuclear materials, devices, and debris, as well as prompt effects from a nuclear detonation. The attribution process merges TNF results with traditional law enforcement and intelligence information to identify those responsible for the planned or actual attack.

Nuclear forensics provides information on interdicted materials and devices before detonation and on debris post detonation to facilitate the attribution of the event.

The nuclear forensics and attribution capabilities are part of the broader CNT mission within the DoD. Knowledge of the NTNF program capabilities can discourage countries from transferring nuclear or radiological materials and devices to non-nuclear states or non-state actors and can encourage countries with nuclear facilities or materials to improve their

security. Aside from its necessity in detonation response, the capability also contributes to prevention by providing a viable deterrent.

The NTNF program is an interagency mission drawing on capabilities of the Department of Justice (DOJ), DoD, DOE/NNSA, DHS, DOS, and the Office of the Director of National Intelligence (ODNI). Additionally, nuclear forensics provides an important means for the global community to work together in the fight against nuclear terrorism. Because success in this effort is improved with nations acting collaboratively, the U.S. Government NTNF community is engaged in bilateral and multilateral activities with foreign partners.

Attribution

Attribution is a confluence of intelligence, investigative, and forensics information to arrive at the nature, source, perpetrator, and pathway of an attempted or actual attack (see **Figure 8.4**). This includes rapid and comprehensive coordination of intelligence reporting, law enforcement information, nuclear forensics information, and other relevant data to evaluate an adversary's capabilities, resources, supporters, and modus operandi. Forensics is the technical and scientific analysis that provides a basis for attribution or exclusion.

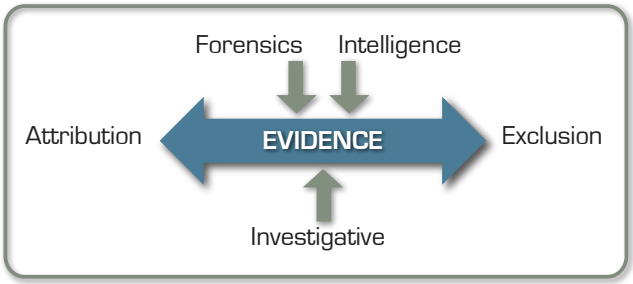


Figure 8.4 The Attribution Calculus

8.6 The Future of CNT

Nuclear threat reduction efforts and international work to counter nuclear threats is informed by a thorough scientific and technological understanding of the full range of NTD. Understanding the nuclear threat is the key to mitigation. The goal of preventing and responding to the loss of control of a nation-state nuclear weapon or to a nuclear terrorist attack is best accomplished through an integrated, whole-of-government approach and close cooperation and collaboration with international partners.

Policies and guidance for nuclear threat reduction and countering nuclear threats must be underpinned by accurate and timely technical knowledge. Sound technical knowledge is a product of research and development related to understanding NTD designs and

how these affect all aspects of countering nuclear threats, including material protection and security, detection, intelligence, interdiction, diagnostics, emergency response or disablement, nuclear forensics, and attribution.

CNT encompasses a broad spectrum of activities, performed by numerous agencies and organizations. The United States is working with other nations around the world to increase partner capacities and find solutions to technical and other challenges. International cooperation across the spectrum of CNT activities is vital to successfully addressing the nuclear threat.