



# The Global Nuclear Detection Architecture: Issues for Congress

**Dana A. Shea**

Specialist in Science and Technology Policy

March 25, 2009

Congressional Research Service

7-5700

[www.crs.gov](http://www.crs.gov)

RL34574

## Summary

The U.S. government has implemented a series of programs to protect the nation against terrorist nuclear attack. Some of these programs predate September 11, 2001, while others were established since then. Most programs are within the Nuclear Regulatory Commission; the Departments of Defense, Energy, and State; and agencies that became part of the Department of Homeland Security (DHS) upon its creation, and they are focused on detecting the illicit acquisition and shipment of nuclear and radiological materials and protecting and securing nuclear weapons. These disparate programs have historically been viewed as lacking coordination and centralized oversight.

In 2005, the Domestic Nuclear Detection Office (DNDO) was established within the Department of Homeland Security to centralize coordination of the federal response to an unconventional nuclear threat. The office was codified in 2006 through the passage of the SAFE Port Act (P.L. 109-347) and given specific statutory responsibilities to protect the United States against radiological and nuclear attack, including the responsibility to develop a “global nuclear detection architecture.” Determining the range of existing federal efforts protecting against nuclear attack, coordinating the outcomes of these efforts, identifying overlaps and gaps between them, and integrating the results into a single architecture are likely to be evolving, ongoing tasks.

The global nuclear detection architecture is a multi-layered system of detection technologies, programs, and guidelines designed to enhance the nation’s ability to detect and prevent a radiological or nuclear attack. Among its components are existing programs in nuclear detection operated by other federal agencies and new programs put into place by DNDO. The global nuclear detection architecture is developed by DNDO in coordination with other federal agencies implementing nuclear detection efforts and this coordination is essential to the success of the architecture.

This architecture is a complicated system of systems. Measuring the success of the architecture relative to its individual components and the effectiveness of additional investments are challenges. The DNDO is developing risk and cost methodologies to be applied to the architecture in order to understand and prioritize the various nuclear detection programs and activities in multiple federal agencies.

Congress, in its oversight capacity, has shown interest in the development and implementation of the global nuclear detection architecture and in the decision-making process attendant to investments in it. Other issues that may be foci of congressional attention include the balance between investment in near-term and long-term solutions for architecture gaps, the degree and efficacy of federal agency coordination, the mechanism for setting agency investment priorities in the architecture, and the efforts DNDO has undertaken to retain institutional knowledge regarding this sustained architecture effort.

## **Contents**

Introduction .....	1
Federal Efforts.....	1
Domestic Nuclear Detection Office .....	2
What Is the Global Nuclear Detection Architecture? .....	3
Layered Defense.....	6
Methodology and Metrics for Evaluation .....	7
Priority Setting .....	10
Interagency Coordination.....	11
Issues for Congress.....	13
Priorities and Funding Levels Within the Global Nuclear Detection Architecture .....	13
Balance Between Incremental and Transformational Changes to the Global Nuclear Detection Architecture .....	16
Long-Term Maintenance of the Global Nuclear Detection Architecture .....	17
Research and Development Coordination.....	18

## **Figures**

Figure 1. Layers of the Global Nuclear Detection Architecture.....	5
--	---

## **Tables**

Table 1. Distribution of Global Nuclear Detection Architecture FY2007 Budget for Detecting Radiological and Nuclear Weapons or Materials.....	14
Table 2. DNDO Staff Levels .....	18

## **Contacts**

Author Contact Information .....	19
----------------------------------	----

## Introduction

Detection of and protection against illicit acquisition and use of special nuclear material (SNM) is a longstanding concern of the U.S. government.<sup>1</sup> Since the development of nuclear weapons, federal agencies have been involved in securing U.S. nuclear assets against diversion, theft, and attack. Similarly, concerns that terrorists or non-state actors might acquire a nuclear weapon or the materials necessary to construct one have led to federal efforts to track, detect, and secure such materials domestically and abroad.

Preventing a terrorist or non-state nuclear attack within the United States involves more than detection of the nuclear weapon. A larger system of deterrence, counterproliferation, and response activities are established to address the nuclear threat. Intelligence information gathering regarding the intent and capability of terrorist and non-state groups and law enforcement activities that disrupt the formation and action of these groups play key roles in preventing initial acquisition of nuclear and radiological materials. Another crucial step subsequent to the detection of illicit nuclear or radiological materials is successful interdiction of these materials. Nevertheless, this report addresses only the global nuclear detection architecture, not programs focusing on events prior or subsequent to the detection opportunity.

## Federal Efforts

The federal government has implemented a series of programs focused on detecting the illicit shipment of nuclear and radiological materials and protecting and securing nuclear weapons and material. Following the events of September 11, 2001, these programs were augmented by new programs focusing on preventing radiological and nuclear terrorism within the United States. Some of these new and existing efforts had overlapping goals, but they generally used different approaches to improve the detection and security of nuclear materials. These programs largely reside within the Departments of Defense, Energy, and State; agencies that became part of the Department of Homeland Security (DHS) upon its creation in 2002; and the Nuclear Regulatory Commission. Many of these agencies have both national and international roles in nuclear defense, protecting domestic nuclear assets while aiding in securing or detecting the transport of foreign nuclear material.

Programs established by the Departments of Defense and Energy and the Nuclear Regulatory Commission have focused on the security of nuclear and radiological materials. For example, the Department of Energy (DOE) International Nuclear Materials Protection and Cooperation program aids in securing foreign special nuclear material.<sup>2</sup> The Department of Defense (DOD), through the Defense Threat Reduction Agency (DTRA), has enhanced the security and safety of fissile material storage and transportation in the former Soviet Union while dismantling and destroying associated infrastructure.<sup>3</sup>

---

<sup>1</sup> The term “special nuclear material” was defined by the Atomic Energy Act and includes plutonium and uranium enriched in the isotope 233 or in the isotope 235. See 42 U.S.C. 2014.

<sup>2</sup> For more information about the International Nuclear Materials Protection and Cooperation program, see online at [http://nnsa.energy.gov/nuclear\\_nonproliferation/Office%20of%20Int'l%20Material%20Protection%20&%20Cooperation.htm](http://nnsa.energy.gov/nuclear_nonproliferation/Office%20of%20Int'l%20Material%20Protection%20&%20Cooperation.htm). See also CRS Report RL31957, *Nonproliferation and Threat Reduction Assistance: U.S. Programs in the Former Soviet Union*, by Amy F. Woolf.

<sup>3</sup> For more information on DTRA activities in Cooperative Threat Reduction, see online at <http://www.dtra.mil/oe/ctr/> (continued...)

Other programs have focused on detection of nuclear and radiological materials in transit, in order to detect attempts to illicitly transport a nuclear weapon or special nuclear material across borders. The DOE Second Line of Defense (SLD) program aids in establishing capabilities to detect nuclear and radiological materials in foreign countries at ports of entry, border crossings, and other designated locations.<sup>4</sup> The Department of State Export Control and Related Border Security Assistance Program undertakes similar efforts to provide radiation detection capabilities at border crossings.<sup>5</sup> Other programs are designed to detect nuclear and radiological materials in transit towards the United States, through screening either at foreign ports or at the U.S. border. For example, U.S. Customs and Border Protection uses both handheld and portal-based radiation monitoring to detect nuclear and radiological materials entering the United States.

Once created, DHS expanded the deployment of radiation detectors, both portal monitors through the Radiation Portal Monitor (RPM) program and handheld and portable detectors through the U.S. Coast Guard and Customs and Border Protection. The DHS Science and Technology (S&T) Directorate began research and development activities to develop an improved radiation detection portal and an integrated plan and structure for the use of federal radiation detection equipment. Additionally, DHS developed several overarching initiatives, such as the Container Security Initiative and the Secure Freight Initiative, to increase the likelihood that nuclear and radiological material or a nuclear weapon would be detected, identified, and interdicted during shipping. These initiatives built on other federal efforts, such as the DOE Megaports Initiative, which deploys radiation detection equipment and aims to increase detection of nuclear materials at ports of departure rather than at ports of entry.

The early post-September 11, 2001, efforts of the federal government, taking place in several agencies and departments, were criticized by experts who perceived these activities as uncoordinated and insufficient to protect the United States from nuclear terrorism.<sup>6</sup> The Defense Science Board, among others, recommended that the federal government make a greater, more organized effort to protect the United States against the nuclear terrorism threat.<sup>7</sup>

## **Domestic Nuclear Detection Office**

The Domestic Nuclear Detection Office (DNDO) was established by President Bush on April 15, 2005.<sup>8</sup> Intended to centralize coordination of the federal response to an unconventional nuclear

---

(...continued)

programs/index.cfm. See also CRS Report RL31957, *Nonproliferation and Threat Reduction Assistance: U.S. Programs in the Former Soviet Union*, by Amy F. Woolf.

<sup>4</sup> For more information on the Second Line of Defense program, see Office of the Second Line of Defense, National Nuclear Security Administration, *SLD Implementation Strategy: Revision B*, April 2006, and the Office of the Second Line of Defense, National Nuclear Security Administration, *Strategic Plan*, 2006. See also CRS Report RL31957, *Nonproliferation and Threat Reduction Assistance: U.S. Programs in the Former Soviet Union*, by Amy F. Woolf.

<sup>5</sup> For more information on the Export Control and Related Border Security Assistance Program, see online at <http://www.state.gov/t/isn/rls/other/72934.htm>. See also CRS Report RL31957, *Nonproliferation and Threat Reduction Assistance: U.S. Programs in the Former Soviet Union*, by Amy F. Woolf.

<sup>6</sup> See, for example, Government Accountability Office, *Combating Nuclear Smuggling: Efforts to Deploy Radiation Detection Equipment in the United States and in Other Countries*, GAO-05-840T, June 21, 2005.

<sup>7</sup> See Defense Science Board, *Report of the Defense Science Board Task Force on Preventing and Defending Against Clandestine Nuclear Attack*, June 2004, and Defense Science Board, *Protecting the Homeland: Report of the Defense Science Board 2000 Summer Study; Executive Summary, Volume I*, February 2001.

<sup>8</sup> Executive Office of the President, The White House, *Domestic Nuclear Detection*, Homeland Security Presidential (continued...)

threat, DNDO is located within the Department of Homeland Security. Its first budget was requested as part of the S&T Directorate, but DNDO was subsequently established as an independent office whose Director reports directly to the Secretary. The SAFE Port Act (P.L. 109-347) gave the office statutory authority and specific responsibilities to protect the United States against radiological and nuclear attack. Among these responsibilities is to

develop, with the approval of the Secretary and in coordination with the Attorney General, the Secretary of State, the Secretary of Defense, and the Secretary of Energy, an enhanced global nuclear detection architecture with implementation under which (A) the Office will be responsible for the implementation of the domestic portion of the global architecture; (B) the Secretary of Defense will retain responsibility for implementation of Department of Defense requirements within and outside the United States; and (C) the Secretary of State, the Secretary of Defense, and the Secretary of Energy will maintain their respective responsibilities for policy guidance and implementation of the portion of the global architecture outside the United States, which will be implemented consistent with applicable law and relevant international arrangements.<sup>9</sup>

The development and implementation of a global nuclear detection architecture is a challenging endeavor. Because federal efforts to protect against nuclear attack are spread among multiple agencies, determining the full range of existing efforts, coordinating the outcomes of these efforts, identifying any overlaps and gaps between them, and developing an architecture integrating current and future efforts are likely to be evolving, ongoing tasks.

## **What Is the Global Nuclear Detection Architecture?**

The SAFE Port Act requires that DNDO establish an “enhanced global nuclear detection architecture,” but it does not define this term. A variety of interpretations are possible. For example, an architecture could be a collection of federal and nonfederal programs, a grouping of sensors or other technologies designed to detect nuclear and radiological material, a mechanism for collecting and distributing information about nuclear and radiological material, a framework for investment and prioritization of detection assets, or various combinations of the above and more.

The DNDO describes the global nuclear detection architecture as comprising several key elements: “a multi-layered structure of radiological/nuclear (rad/nuc) detection systems, deployed both domestically and overseas; a well-defined and carefully coordinated network of interrelationships among them; and a set of systems engineering-based principles and guidelines governing the architecture’s design and evolution over time.”<sup>10</sup> In implementing this definition, DNDO solicited information about existing programs from agencies involved in nuclear detection. The DNDO then performed a “net assessment” of federal nuclear detection capabilities.

---

(...continued)

Directive HSPD-14/National Security Presidential Directive NSPD-43, April 15, 2005.

<sup>9</sup> 6 U.S.C. 592(a)(4).

<sup>10</sup> Domestic Nuclear Detection Office, Department of Homeland Security, *Congressional Justification FY2009*, p. DNDO RD&O-2.

This assessment determined that 72 programs contributed in whole or in part to the existing global nuclear detection architecture, with total funding of more than \$2.2 billion in FY2006.<sup>11</sup>

This existing global nuclear detection architecture includes programs at DHS,<sup>12</sup> the Department of Defense (DOD),<sup>13</sup> the Department of Energy (DOE),<sup>14</sup> the Department of State (DOS), and other agencies. According to DHS, before the formation of DNDO these programs were “a disparate patchwork of systems, distributed and implemented in recent years across multiple departments, jurisdictions and locations without any degree of coordination.”<sup>15</sup> The DNDO has organized these programs into a global nuclear detection architecture framework, a combined system of systems, which relies heavily on its technological component. The deployment of radiation detectors at points of entry, commercial ports, and other border crossings is key to its effectiveness.

Although much focus has been given to technologies to detect nuclear or radiological material that have been developed or procured by DNDO, the global nuclear detection architecture encompasses more than just these sensors. Other elements include site security of known nuclear or radiological material, use of sensor data to inform decision makers, effective reaction to a detection event, and interdiction following detection. According to the Government Accountability Office, “combating nuclear smuggling requires an integrated approach that includes equipment, proper training of border security personnel in the use of radiation detection equipment, and intelligence gathering on potential nuclear smuggling operations.”<sup>16</sup> Other experts have concluded that the deployment of radiation detectors needs to be highly integrated with other federal efforts, prioritized on identified threats, configured for flexibility and efficiency, and organized as a global approach including international institutions.<sup>17</sup>

The DNDO has attempted to align existing federal programs so that their capabilities can be compared and integrated into an organizing framework that can help identify gaps and duplication. This framework consists of three partially overlapping layers with nine sub-layers. See **Figure 1**.

---

<sup>11</sup> This estimate may understate the total investment, as programs for which nuclear detection is only a component were prorated. This prorating may have not accurately captured the true investment for the nuclear detection component of the program. (Office of Inspector General, Department of Homeland Security, *DHS’ Domestic Nuclear Detection Office: Progress in Integrating Detection Capabilities and Response Protocols*, OIG-08-19, December 2007.)

<sup>12</sup> Such as the Container Security Initiative, the Secure Freight Initiative, and the Radiation Portal Monitor program.

<sup>13</sup> Such as the DOD Cooperative Threat Reduction activities.

<sup>14</sup> Such as the DOE Second Line of Defense programs.

<sup>15</sup> Domestic Nuclear Detection Office, Department of Homeland Security, *Congressional Justification FY2008*, p. DNDO RD&O-5.

<sup>16</sup> Government Accountability Office, *Combating Nuclear Smuggling: Efforts to Deploy Radiation Detection Equipment in the United States and in Other Countries*, GAO-05-840T, June 21, 2005.

<sup>17</sup> James Goodby, Timothy Coffey, and Cheryl Loeb, Center for Technology and National Security Policy, National Defense University, *Deploying Nuclear Detection Systems: A Proposed Strategy for Combating Nuclear Terrorism*, July 2007.

**Figure 1. Layers of the Global Nuclear Detection Architecture**

Layer		Sublayer	Example
Exterior		Foreign Origin	Foreign sites with nuclear material that could be misused.
		Foreign Transit	Illicit trafficking of nuclear material within the exterior layer
		Foreign Departure	Foreign seaport with cargo containers destined for the U.S.
		Transit to U.S.	Ships transporting cargo from overseas to U.S.
Border		U.S. Border	Official U.S. ports of entry and between official land and sea ports of entry
		U.S. Origin	Hospital with nuclear medicine equipment or industrial site
		U.S. Regional	Areas surrounding origins of nuclear material in the U.S.
		Target Vicinity	Areas surrounding potential targets of nuclear attack
Interior		Target	Potential locations of nuclear attack within the U.S.

**Source:** CRS adaptation of Domestic Nuclear Detection Office, May 17, 2007, as reproduced in Department of Homeland Security, Office of Inspector General, *DHS' Domestic Nuclear Detection Office Progress in Integrating Detection Capabilities and Response Protocols*, OIG-08-19, December 2007.

The layers are distinguished geographically: interior, border, and exterior. The overlap between the exterior and border layers may make analysis of priorities between and within the layers more difficult. The sublayers correspond mainly to conceptual steps in the transportation of a threat object to a target.

The global nuclear detection architecture has a broad, international scope, so implementing it is difficult. Multiple agency initiatives and programs must be relied on to achieve the architecture's goals, and its effectiveness is dependent on many factors outside of DNDO's direct authority and control.

By categorizing existing programs in this architecture, DNDO could analyze federal nuclear detection capabilities, identifying gaps and vulnerabilities through which a potential adversary might be able to avoid detection. These gaps may be filled by redirecting existing efforts, increasing existing efforts, deploying available technology, and implementing research and development programs that develop solutions to such gaps.



## Layered Defense

A layered, defense-in-depth approach to a global nuclear detection architecture was recommended by the Defense Science Board when considering how to protect DOD assets against unconventional nuclear threats.<sup>18</sup> Successful application of a layered defense provides multiple opportunities to detect and interdict threats. According to DNDO, “It is recognized that no single layer of protection can ever be one hundred percent successful,” and a layered defense strategy acknowledges this difficulty.<sup>19</sup> If one sublayer fails to detect a threat, the next may succeed.

This increase in the likelihood of detection occurs in two different ways. In one case, a threat may avoid the detector in an outer layer, but then encounter a detector in an inner layer. In this case, having more detection opportunities makes it more likely that a detector is encountered. An example of this approach could be the use of detection technology at U.S. borders coupled with random truck screening at weigh stations on interstate highways. The DNDO has explicitly attempted to incorporate such redundancy into its global nuclear detection architecture, identifying numerous areas where detection capabilities might be integrated into existing operations:

Examples include, but are not limited to, fixed and mobile detection systems integrated into commercial vehicle inspection activities, detection enabled law enforcement, and screening conducted for special events. Capabilities that may require additional operational costs include mobile teams sweeping of areas of concern, chokepoint screening at bridges and tunnels, roadway monitoring concepts, and options for reducing the risk posed by the small maritime craft pathway.<sup>20</sup>

Alternatively, a threat may encounter a detector in an outer layer that fails to detect it, but then may encounter a different type of detector in an inner layer that is more successful. In this case, it is the use of different detection technologies or procedures that provides the increased likelihood of success. Examples might include the screening of manifest information for shipments entering the United States, followed by the use of radiation detection equipment; the use of both radiation detectors and non-intrusive imaging technologies; or the physical search of a vehicle triggered by suspicious behavior even though a radiation detector did not detect any emitted radioactivity. Prior experience has shown that nuclear smuggling detection occurs not only through the raising of alarms by radiation detection equipment at borders, but also by intelligence information and through police investigations.<sup>21</sup>

An additional advantage to a layered system is that its multiple detection and interdiction opportunities may increase the number of steps that a terrorist group must take to evade detection. Because of these additional steps, the group may be more likely to be detected by other means unrelated to the global nuclear detection architecture. For example, if it is necessary to

---

<sup>18</sup> Defense Science Board, *Report of the Defense Science Board Task Force on Preventing and Defending Against Clandestine Nuclear Attack*, June 2004, and *Protecting the Homeland: Report of the Defense Science Board 2000 Summer Study; Executive Summary, Volume I*, February 2001.

<sup>19</sup> Domestic Nuclear Detection Office, Department of Homeland Security, *Congressional Justification FY2009*, p. DNDO ACQ-8.

<sup>20</sup> Domestic Nuclear Detection Office, Department of Homeland Security, *Congressional Justification FY2008*, p. DNDO ACQ-7.

<sup>21</sup> See Government Accountability Office, *Combating Nuclear Smuggling: Efforts to Deploy Radiation Detection Equipment in the United States and in Other Countries*, GAO-05-840T, June 21, 2005.

disassemble a nuclear device to avoid detection, the reassembly of the device within the United States might be prevented by unrelated law enforcement activities. Even better, the increased complexity of evading detection might deter an attacker from even attempting a particular type of attack.

The ability to correlate information from different layers may also enhance the detection capability of the global nuclear detection architecture. Fusion of data from the different layers may reveal patterns or information not apparent in any single layer. It is the intent of the global nuclear detection architecture to integrate detection and notification systems at the federal, state, and local level,<sup>22</sup> but accomplishing that goal may take significant time and effort, as procedures, technology, and data formats may need to be harmonized to allow easy information exchange.

## **Methodology and Metrics for Evaluation**

A significant advantage to establishing a global nuclear detection architecture is that it provides a framework for analysis of the overall effectiveness of federal nuclear detection efforts. Thus the performance of programs in each layer of the architecture can be measured and judged within the context of the overall structure rather than in isolation. In this way, effectiveness and efficiency can be maximized for the architecture overall rather than for each program individually.

Decision makers attempting to analyze the architecture effectiveness and efficiency will likely require a methodology and establishing metrics, qualitative or quantitative, for each layer or sublayer. The DNDO uses the global nuclear detection architecture framework to identify gaps in existing detection capabilities.<sup>23</sup> Methodology to map existing and future capabilities onto an analytical construct that is sensitive to changes in the architecture would provide a more robust tool for prioritization and assessment. According to DNDO, application of such a risk- and cost-based assessment methodology to radiological and nuclear countermeasures would be relatively new, and DNDO planned to validate the employed methodology in 2008 on the basis of independent peer review.<sup>24</sup>

In 2004, the DHS S&T Directorate requested studies for the development of such an analytic framework and the identification of appropriate metrics.<sup>25</sup> This work was transferred to DNDO upon its creation in 2005.<sup>26</sup> Since then, additional studies of general aviation and maritime pathways have expanded the analytic basis for assessment of investments in the global nuclear detection architecture.<sup>27</sup> The degree to which existing programs can be related to these analytic

---

<sup>22</sup> Office of Inspector General, Department of Homeland Security, *DHS' Domestic Nuclear Detection Office: Progress in Integrating Detection Capabilities and Response Protocols*, OIG-08-19, December 2007.

<sup>23</sup> The DNDO states that the largest gaps in their border layer are air, maritime, and land pathways between designated ports of entry. (Domestic Nuclear Detection Office, Department of Homeland Security, *Congressional Justification FY2009*, p. DNDO RD&O-8.)

<sup>24</sup> Domestic Nuclear Detection Office, Department of Homeland Security, *Congressional Justification FY2008*, p. DNDO RD&O-7. The FY2009 congressional justification does not state that DNDO performed an independent peer review of the employed methodology.

<sup>25</sup> Homeland Security Advanced Research Projects Agency, S&T Directorate, Department of Homeland Security, "Radiological and Nuclear Countermeasure System Architectures Analysis (RNCSAA)," BAA 04-01, February 2004.

<sup>26</sup> For an overview of the goals of this study, see Department of Homeland Security, *National Capital Region Coordination: First Annual Report*, September 2005, p. F-41, online at [http://www.dhs.gov/xlibrary/assets/NCR\\_DHS\\_Congressional\\_Final\\_090105.pdf](http://www.dhs.gov/xlibrary/assets/NCR_DHS_Congressional_Final_090105.pdf).

<sup>27</sup> Office of Inspector General, *Department of Homeland Security, DHS' Domestic Nuclear Detection Office: Progress* (continued...)

frameworks likely determines their utility and applicability. A notional analytic framework—one in which some elements of the framework may not reflect the actual systems in place or some parameters are estimated or extrapolated rather than based on empirical data—may not be adequate for deciding which programs to invest in, alter, or otherwise optimize for maximum effect within the framework. On the other hand, a framework derived only from existing programs may overvalue the existing assets while undervaluing the potential contributions of new programs.

A further concern with respect to analytic methodology is its ability to reflect the effects of both large and small changes. The global nuclear detection architecture is a multi-billion dollar enterprise composed of dozens of programs. A methodology that encompasses all these programs but omits significant detail may not be sensitive enough to reflect the impact of incremental changes. For example, some experts have advocated deployment of radiation detection sensors at specific sites based on identified smuggling routes and at ports of entry where nuclear and radiological materials are not adequately secure.<sup>28</sup> Ideally, an analytic methodology would provide the means to compare that strategy to other strategies, such as a general increase in border detectors.

A methodology that addresses all programs in sufficient detail may be cumbersome to use and may not reflect the value of intangible concepts, such as deterrence or misdirection.<sup>29</sup> An approach involving analysis of selected components of the global nuclear detection architecture, rather than the architecture as a whole, may make the analytical methodology more tractable. However, this may lead to inaccuracy when considering areas that fall between the individual component analyses or when considering the overall context of the architecture. Optimizing the efficiency and effectiveness of each individual component may not optimize the overall architecture. Even if it does, such an approach may not be cost effective.

The DNDO has stated that it takes a systems engineering approach to developing and refining the global nuclear detection architecture. Such an approach attempts to optimize the overall performance of the architecture rather than optimizing any particular program within it. Treating the global nuclear detection architecture as a “system of systems” may efficiently develop an effective architecture, but such treatment requires clear metrics around which the system is to be engineered.

The DNDO may find identifying the appropriate metrics for evaluation challenging. Outcome-oriented metrics, such as the number of false positives resolved,<sup>30</sup> the number of threats found, or the number of vehicles cleared, may not be suitable for judging the effectiveness of the architecture, though these metrics may help determine the efficiency or completeness of the planned architecture. On the other hand, more desirable measures, such as the degree of risk reduction, may require a more complete understanding of global risk than is currently available.

---

(...continued)

*in Integrating Detection Capabilities and Response Protocols*, OIG-08-19, December 2007.

<sup>28</sup> James Goodby, Timothy Coffey, and Cheryl Loeb, Center for Technology and National Security Policy, National Defense University, *Deploying Nuclear Detection Systems: A Proposed Strategy for Combating Nuclear Terrorism*, July 2007.

<sup>29</sup> An example of misdirection might be the deployment of decoy radiation detectors. While decoys would have no radiation detection capability, opponents would not know this. They might choose a more risky approach because of their inaccurate understanding of actual detector deployment.

<sup>30</sup> A false positive occurs when the system indicates a threat even though no threat is present.

Metrics based on analysis of the existing global nuclear detection architecture may have similar difficulties. If the existing architecture has insufficient detection capability or coverage, incremental improvement to that architecture may lead to a new architecture that still has insufficient detection ability or coverage. Conversely, if the performance of the architecture is acceptable, incremental improvements may not yield substantial benefit when compared with the incremental cost.

Vulnerability or gap analysis could be used to prioritize and assess architecture effectiveness.<sup>31</sup> A challenge for this approach is the difficulty of determining an acceptable level of detection and geographic coverage.

The DNDO has identified gaps in the global nuclear detection architecture and is attempting to develop options and strategies for reducing these gaps.<sup>32</sup> A vulnerability- or gap-based approach relies on identifying, developing, or implementing solutions to these vulnerabilities or gaps. Determining whether a vulnerability or gap exists may require judging the sufficiency of existing detection capabilities. This judgment of the sufficient or acceptable detection capability, unlikely to be 100%, may be open to debate.<sup>33</sup>

Finally, the nature of the terrorist nuclear threat, potentially a changing threat based on an intelligent adversary, implies that any metrics and methodology developed to assess the global nuclear detection architecture's effectiveness will need to evolve as the threat does. When advances in technology, new intelligence information, and other factors are considered, the effectiveness of the global nuclear detection architecture may need to be judged on active testing or "red teaming" of the architecture.<sup>34</sup> The results of such active testing may be misleading if the testing does not conform to the threat for which the architecture is designed. For example, if the architecture is designed to detect only large amounts of a nuclear material, testing it with a small amount of nuclear material may highlight current limitations but not address the effectiveness of the architecture at the tasks for which it is designed.<sup>35</sup> Moreover, a robust architecture containing sublayers with varying detection success rates may still provide sufficient protection against a particular threat, even if a single sublayer is insufficiently protective. In order to validate the results of "red teaming" exercises, DNDO plans to "conduct and quantify assessment results in various directions, including scenario-based 'bottom-up' assessments, capabilities-based 'top-down' assessments, and complex metrics development."<sup>36</sup>

---

<sup>31</sup> For the purposes of this report, vulnerabilities refer to when current capabilities are at least partly insufficient to meet current needs. Gaps refer to when no current capability exists to meet a current need.

<sup>32</sup> The DNDO refers to both the absence of detection capability and limitations in existing detection systems as gaps. See Domestic Nuclear Detection Office, Department of Homeland Security, *Congressional Justification FY2009*, p. DNDO R&DO-8.

<sup>33</sup> The DNDO acknowledges that "no single layer of protection can ever be one hundred percent successful." (Domestic Nuclear Detection Office, Department of Homeland Security, *Congressional Justification FY2009*, p. DNDO ACQ-8.)

<sup>34</sup> The DNDO undertakes a series of net assessments, including "red teaming" to identify the effectiveness of the planned and deployed global nuclear detection architecture. (Domestic Nuclear Detection Office, Department of Homeland Security, *Congressional Justification FY2008*, p. DNDO R&DO-2.)

<sup>35</sup> For example, individuals have been able to successfully smuggle surrogate materials into the United States past radiation detection equipment deployed by DHS. Thomas B. Cochran and Matthew G. McKinzie, "Detecting Nuclear Smuggling," *Scientific American*, March 2008.

<sup>36</sup> Domestic Nuclear Detection Office, Department of Homeland Security, *Congressional Justification FY2008*, p. DNDO R&DO-24.

## Priority Setting

Gaps and vulnerabilities in the global nuclear detection architecture, depending on their nature, may be addressed now or in the future. In some cases, no solutions to these gaps and vulnerabilities are currently available, and a solution will need to be identified through research and development. The DNDO has stated that “there are still key, long-term challenges and vulnerabilities in our detection architecture that require long-range, higher risk research programs that will need to be evaluated in terms of risk reduction, direct and indirect costs, operational feasibility, and other relevant decision factors.”<sup>37</sup> In other cases, the available near-term solution is an incremental improvement over existing approaches. In these cases, policymakers must decide whether to invest in a near-term, potentially incomplete solution; accept the presence of a gap or vulnerability and invest in a long-term program to develop a more complete solution; or do both. Choosing between these options requires an understanding of the risk posed by the existing vulnerabilities, the benefits available through the near- and long-term options, and their relative costs.

Decision makers are faced with difficult choices when setting priorities for implementing the global nuclear detection architecture. In the case of existing programs, incremental increases in the performance of a system may be challenged on the basis of their perceived costs and benefits.<sup>38</sup> In the case of new programs, questions may arise about whether the effort expended on a new program would have provided more benefits if applied elsewhere. Finally, given that improvement of the global nuclear detection architecture is a multi-year project, one must determine which portion of the architecture to focus on at any given time.

A likely benefit of casting federal efforts at nuclear detection into the framework of a global architecture is the ability to prioritize, in a quantitative or qualitative fashion, across programs.<sup>39</sup> Even without a rigorous method to discriminate finely between the results of different investments, the global nuclear detection architecture may be able to provide a rank ordering of vulnerabilities and gaps, and thus a rank ordering of investment priorities.<sup>40</sup> Thus, it may provide an interagency tool to analyze current technology options and R&D investments relative to the federal government’s detection needs.

According to the DNDO, the analysis methodology underpinning the global nuclear detection architecture continues to undergo revision and refinement:

In order to maximize the effectiveness of the FY 2008 edition of the [global nuclear detection architecture], DNDO will leverage the independent observation of a full peer

---

<sup>37</sup> Domestic Nuclear Detection Office, Department of Homeland Security, *Congressional Justification FY2008*, p. DNDO R&DO-8.

<sup>38</sup> See, for example, Government Accountability Office, *Combating Nuclear Smuggling: DHS’s Cost-Benefit Analysis to Support the Purchase of New Radiation Detection Portal Monitors Was Not Based on Available Performance Data and Did Not Fully Evaluate All the Monitors’ Costs and Benefits*, GAO-07-133R, October 17, 2006.

<sup>39</sup> The DNDO states that its risk-based cost-benefit analysis methodology is used to quantify and prioritize architecture improvements. Domestic Nuclear Detection Office, Department of Homeland Security, *Congressional Justification FY2008*, p. DNDO R&DO-9.

<sup>40</sup> According to the DNDO Inspector General, DNDO has been able to develop a list of detection priorities. (Office of Inspector General, Department of Homeland Security, *DHS’ Domestic Nuclear Detection Office: Progress in Integrating Detection Capabilities and Response Protocols*, OIG-08-19, December 2007.) It is unclear how these priorities have been ordered.

review to ensure that the requirements called forth in the [global nuclear detection architecture] continue to reduce the risk from nuclear terrorism. Accordingly, risk and economic impact methodology documents (carefully prepared and reviewed to protect sensitive/classified vulnerability information) will be produced and subjected to broad peer review.<sup>41</sup>

This review and these documents have not been made public. Congress may wish to determine whether the review addresses congressional concerns and whether the underlying architecture methodology is sufficiently robust. Alternatively, Congress may wish to direct DNDO to perform a review of the analysis methodology through an open process.<sup>42</sup>

Similarly, a global nuclear detection architecture may be able to highlight regions or modalities where investment or additional focus may provide a steeper or quicker reduction of vulnerability. For example, following the development of the baseline global nuclear detection architecture, DNDO decided to focus efforts on addressing vulnerabilities associated with aviation and maritime domains.<sup>43</sup> Similarly, DNDO has issued a request for comments on options for regional detection architectures.<sup>44</sup>

The Government Accountability Office (GAO) has recommended that DNDO establish a strategic plan for the global nuclear detection office.<sup>45</sup> The GAO recommends that establishing a comprehensive strategy with clearly defined objectives, roles, responsibilities, funding, and monitoring mechanisms would strengthen the development and coordination of the global nuclear detection architecture. As of December 2008, the DNDO had reportedly not developed an overarching strategic plan.<sup>46</sup>

## **Interagency Coordination**

As well as developing the global nuclear detection architecture, DNDO is also responsible for coordinating the activities of other federal agencies whose programs make up the global nuclear detection architecture. For the architecture to be successful, substantial interagency coordination must occur on the operational and policy levels.

Congress recognized the need for DNDO to have access to specific talent resident in other agencies. The SAFE Port Act authorizes the DHS Secretary to “request that the Secretary of Defense, the Secretary of Energy, the Secretary of State, the Attorney General, the Nuclear

---

<sup>41</sup> Domestic Nuclear Detection Office, Department of Homeland Security, *Congressional Justification FY2008*, p. DNDO RD&O-9.

<sup>42</sup> For example, the methodology underpinning the DHS Bioterrorism Risk Assessment underwent review through the National Academies of Science even though the results of this risk assessment are classified. See National Research Council, *Interim Report on Methodological Improvements to the Department of Homeland Security’s Biological Agent Risk Analysis*, National Academies Press, 2007.

<sup>43</sup> Office of Inspector General, Department of Homeland Security, *DHS’ Domestic Nuclear Detection Office: Progress in Integrating Detection Capabilities and Response Protocols*, OIG-08-19, December 2007.

<sup>44</sup> “DNDO Wants Detection Architecture Options for SE Asia,” *Terror Response Technology Report*, Vol. 4, Issue 13, June 25, 2008.

<sup>45</sup> Government Accountability Office, *Preliminary Observations on the Domestic Nuclear Detection Office’s Efforts to Develop a Global Nuclear Detection Architecture*, GAO-08-999T, July 16, 2008.

<sup>46</sup> Government Accountability Office, *Nuclear Detection: Domestic Nuclear Detection Office Should Improve Planning to Better Address Gaps and Vulnerabilities*, GAO-09-257, January 2009.

Regulatory Commission, and the directors of other Federal agencies, including elements of the Intelligence Community, provide for the reimbursable detail of personnel with relevant expertise to [DNDO].<sup>47</sup> Under this authority and that of the Intergovernmental Personnel Act (IPA),<sup>48</sup> DNDO has established a significant interagency workforce, including personnel from DOD, DOE, the Federal Bureau of Investigation, the Department of State, and the Nuclear Regulatory Commission, as well as intra-agency personnel from the Science and Technology Directorate, U.S. Customs and Border Protection, the Transportation Security Administration, and the U.S. Coast Guard.<sup>49</sup>

The DNDO uses the detailees and IPAs as part of its coordinating function. By using these experts as conduits back to their agencies, DNDO is able to draw on the expertise and address the needs and concerns of these agencies. The DNDO also has established a more senior policy coordinating body, the Interagency Coordination Council, to address higher level policy issues and further coordinate activities between agencies, but the extent to which this body is able to implement and develop new policy for the participating agencies is not known. The Interagency Coordination Council was reportedly used to develop the deployment strategy for the global nuclear detection architecture and studies of maritime and aviation threats.<sup>50</sup>

The successful operation of the Interagency Coordination Council, or a similar high-level coordinating body, is critical for oversight and implementation of the global nuclear detection architecture, but procedural and organizational issues may pose barriers to its success. The Director of DNDO may not be equal in authority to the officials in other agencies with whom he is coordinating. Other officials may have more or less control of budgets, activities, and policies. Additionally, other agencies may perceive the global nuclear detection architecture as a DNDO document, rather than as a consensus coordination document. If so, other agencies may not quickly adopt the premises or analytical constructs expressed as part of the global nuclear detection architecture, preferring to continue to operate under individual agency priorities.<sup>51</sup>

The DNDO also has implemented an Advisory Council consisting of officials from other DHS components. The DNDO uses the Advisory Council to solicit the opinions of and resolve intra-agency issues within DHS.<sup>52</sup>

Beyond the interagency activities organized within DNDO, coordination of DNDO activities with other portions of the federal government occurs within the White House through the Domestic Nuclear Defense Policy Coordinating Committee. This joint policy coordination body was created jointly by the Homeland Security Council and the National Security Council and provides

---

<sup>47</sup> 6 U.S.C. 591(a).

<sup>48</sup> The Intergovernmental Personnel Act allows for the temporary transfer of personnel to a federal agency. See 5 U.S.C. 3371-76.

<sup>49</sup> Domestic Nuclear Detection Office, Department of Homeland Security, *Congressional Justification FY2009*, p. DNDO-1.

<sup>50</sup> Office of Inspector General, Department of Homeland Security, *DHS' Domestic Nuclear Detection Office: Progress in Integrating Detection Capabilities and Response Protocols*, OIG-08-19, December 2007.

<sup>51</sup> A similar situation exists with the requirement for the DHS Under Secretary for Science and Technology to coordinate homeland security research and development across the federal government. In this case, the Under Secretary for Science and Technology was able to release a coordination document without the consensus of other government agencies, but rather with other agency consultation.

<sup>52</sup> Office of Inspector General, Department of Homeland Security, *DHS' Domestic Nuclear Detection Office: Progress in Integrating Detection Capabilities and Response Protocols*, OIG-08-19, December 2007.

a high-level forum for the generation of guidance and coordination among federal agencies with responsibilities for nuclear defense, detection, and interdiction.<sup>53</sup> Other interagency planning activities, such as coordination of long-term research and development, occur through subcommittees of the National Science and Technology Council.<sup>54</sup>

Congress has identified coordination and cooperation as a key issue for DNDO, and in the Department of Homeland Security Appropriations Act, 2007, withheld \$15 million from DNDO until a memorandum of understanding had been established with each federal entity and organization participating in DNDO activities.<sup>55</sup> The DNDO entered into these agreements throughout FY2007.<sup>56</sup>

## Issues for Congress

Multiple agencies implement the global nuclear detection architecture, even though its development is located within a single agency. Congress, in its oversight role, may be able to assess agency implementation of the global nuclear detection architecture across the federal government and thus identify weaknesses or inefficiencies that may occur. Additionally, Congress may be uniquely positioned to address policy challenges. Mechanisms for policy setting, the establishment of funding levels within the global nuclear detection architecture, implementation of development plans for the architecture and the identification of solutions to gaps and vulnerabilities, and the continued maintenance of the global nuclear detection architecture all are issues that Congress may choose to address.

## Priorities and Funding Levels Within the Global Nuclear Detection Architecture

The annual federal investment in the global nuclear detection architecture is spread across multiple agencies and across the layers and sublayers of the global nuclear detection architecture. The appropriate balance of funds in each of the different layers and sublayers, as well as between the different programs and agencies, is likely an issue of policy interest. When Congress established the Cooperative Threat Reduction program in 1991, it focused on securing nuclear materials at their source and preventing these materials from being transferred into non-state hands.<sup>57</sup> These continuing programs represent significant investment in the exterior layer of the architecture. More recently, DNDO and Congress have focused on the border layer of the global nuclear detection architecture. The DNDO has invested in Advanced Spectroscopic Portal (ASP) and Cargo Advanced Automated Radiography System (CAARS) technologies to improve the

---

<sup>53</sup> Office of Inspector General, Department of Homeland Security, *DHS' Domestic Nuclear Detection Office: Progress in Integrating Detection Capabilities and Response Protocols*, OIG-08-19, December 2007.

<sup>54</sup> Testimony of DNDO Director Vayl S. Oxford, Department of Homeland Security, before the House Homeland Security Committee, Subcommittee on Emerging Threats, Cybersecurity, and Science and Technology, on October 10, 2007.

<sup>55</sup> P.L. 109-295, Title IV.

<sup>56</sup> Department of Homeland Security, *Congressional Justification FY2009*, p. DNDO M&A-4.

<sup>57</sup> For more information on the Cooperative Threat Reduction program, see CRS Report RL31957, *Nonproliferation and Threat Reduction Assistance: U.S. Programs in the Former Soviet Union*, by Amy F. Woolf.



ability to detect nuclear and radiological materials at the borders,<sup>58</sup> and Congress has mandated the improved screening of cargo containers shipped to the United States.<sup>59</sup> Investment in the interior layer of the architecture has arisen mainly through existing programs designed to protect and safeguard national nuclear facilities and laboratories.

The GAO has reported the distribution of funding in the global nuclear detection architecture using a framework slightly different than that expressed by DNDO. See **Table 1**.

**Table 1. Distribution of Global Nuclear Detection Architecture FY2007 Budget for Detecting Radiological and Nuclear Weapons or Materials**

(\$ in millions)

Geographic Focus	DHS	DOD	DOE	State	Total
Overseas	139.77	161.90	736.74	81.13	1119.54
United States	274.65	1.60	871.49	0.00	1147.74
Cross-cutting	271.18	137.07	168.86	0.00	577.12
Total	685.60	300.57	1777.09	81.13	2844.39

**Source:** Government Accountability Office, *Nuclear Detection: Domestic Nuclear Detection Office Should Improve Planning to Better Address Gaps and Vulnerabilities*, GAO-09-257, January 2009, p. 26.

**Notes:** United States includes efforts at the U.S. border as well as within the U.S. interior.

According to the GAO, the DNDO is not using existing information on funding in the various architecture levels to coordinate with other agencies on the overall strategic direction of detection efforts.<sup>60</sup>

Congress might expand or reduce agency funding levels to more closely match the levels determined by DNDO to meet the needs of the global nuclear detection architecture, increase overall funding for all aspects of the global nuclear detection architecture to increase redundancy, or decrease funding if it believes other funding priorities are more important. Shifting funding between layers of the architecture has complex ramifications: it may imperil international agreements, lead to perceptions of weakness or strength in the various programs, or cause

<sup>58</sup> The Advanced Spectroscopic Portal is a radiation detection system designed to be able to identify the source of the detected radiation. The Cargo Advanced Automated Radiography System is an imaging system designed to automatically detect special nuclear material by X-ray imaging. The Advanced Spectroscopic Portal technology has been the subject of a number of congressional hearings and Government Accountability Office audits. See, for example, House Committee on Homeland Security, Subcommittee on Emerging Threats, Cybersecurity, and Science and Technology, “Nuclear Smuggling Detection: Recent Tests of Advanced Spectroscopic Portal Monitors,” hearing held March 5, 2008; and House Committee on Energy and Commerce, Subcommittee on Oversight and Investigations, “Nuclear Terrorism Prevention: Status Report on the Federal Government’s Assessment of New Radiation Detection Monitors,” hearing held September 18, 2007. See also, Government Accountability Office, *Combating Nuclear Smuggling: Additional Actions Needed to Ensure Adequate Testing of Next Generation Radiation Detection Equipment*, GAO-07-1247T, September 18, 2007; and Government Accountability Office, *Combating Nuclear Smuggling: DHS’s Decision to Procure and Deploy the Next Generation of Radiation Detection Equipment Is Not Supported by Its Cost-Benefit Analysis*, GAO-07-581T, March 14, 2007.

<sup>59</sup> Section 1701 of the Implementing Recommendations of the 9/11 Commission Act of 2007 (P.L. 110-53) requires that, by July 1, 2012, all maritime cargo containers entering the United States be scanned by nonintrusive imaging equipment and radiation detection equipment at a foreign port before departure.

<sup>60</sup> Government Accountability Office, *Nuclear Detection: Domestic Nuclear Detection Office Should Improve Planning to Better Address Gaps and Vulnerabilities*, GAO-09-257, January 2009.

interagency disagreements. Unless the global nuclear detection architecture has a robust evaluative system with clear metrics that tie architecture performance to program funding, changes in investment in the different layers of the global nuclear detection architecture may not yield optimal risk reduction. It is difficult to assess without careful evaluation whether shifting funds from one program to another will have a positive or negative net impact; the relative size of the two programs is not necessarily the relevant criterion for assessing its impact on the global nuclear detection architecture. Moreover, DNDO is not statutorily empowered to direct changes in the funding of other agencies. Only through higher-level budgetary policy decisions can interagency funding profiles be changed. This situation may result in a mismatch between the optimal investment levels for the global nuclear detection architecture and the actual investments made. Congress might choose to provide the DNDO Director with the authority to review and assess the budgets of other departments and agencies involved in the global nuclear detection architecture and to comment or recommend alternative budget allocation to other departments and agencies or directly to the Office of Management and Budget.<sup>61</sup>

Another possible approach would be for Congress to require that agencies create a single global nuclear detection architecture budget, to provide Congress with a more transparent correlation between agency funding and the global nuclear detection architecture. For example, an annual budget supplement is issued for the National Nanotechnology Initiative, another multi-agency federal endeavor with a large budget. Such a budget supplement for nuclear detection might be coordinated by DNDO through an interagency process; the Homeland Security Council, National Security Council, or National Science and Technology Council; or through one of the agencies participating in the global nuclear detection architecture. Alternatively, Congress might vest a budgetary coordinating role within the Office of Science and Technology Policy rather than within DNDO.

Congress established an Office of the United States Coordinator for the Prevention of Weapons of Mass Destruction Proliferation and Terrorism within the White House. The head of this office is to advise the President, formulate national strategy and policy, lead interagency coordination and implementation, and oversee development of a comprehensive, coordinated budget for weapon of mass destruction proliferation and terrorism prevention.<sup>62</sup> While the scope of the Coordinator's responsibilities is broader than nuclear and radiological issues, the comprehensive, coordinated budget so developed might be one mechanism for clarification of priorities for nuclear detection investment. As of the writing of this report, the position of Coordinator has not been filled.

The affected agencies may not support a unified budget or additional review of agency budget decisions. Reportedly, agencies resisted similar options considered during the creation of DNDO, leading to "major limits on both its scope and its power."<sup>63</sup> Agencies may perceive a bottom-up process to be more effective in meeting agency and national needs than a top-down process.

Congress has mandated an annual interagency review of the global nuclear detection architecture. This review is to be overseen by the Secretaries of Homeland Security, State, Defense, and

---

<sup>61</sup> The Director of the National Security Agency has a similar type of authority for national security telecommunications and information systems security programs. Executive Office of the President, The White House, *National Policy for the Security of National Security Telecommunications and Information Systems*, National Security Directive 42 (NSD-42), July 5, 1990.

<sup>62</sup> P.L. 110-53, Title XVII, Subtitle D, Sec. 1841.

<sup>63</sup> Michael A. Levi, *On Nuclear Terrorism*, Harvard University Press, November 2007, p. 146.

Energy, the Attorney General, and the Director of National Intelligence. Its purpose is to ensure that each participating agency assesses and evaluates its participation in the global nuclear detection architecture. The review is to include evaluation of detection technologies, identification of deficiencies, and assessment of agency capacity for implementation of its responsibilities within the global nuclear detection architecture.<sup>64</sup> This interagency review process may cause the agencies involved to clarify their priorities and funding requirements and thereby cause further evolution of the global nuclear detection architecture.

The GAO has identified that this joint annual interagency review generally is not used in this fashion. The joint annual interagency review is not used as a tool to analyze nuclear detection budgets across agencies to address the highest priority gaps or to strategically align global detection efforts. Instead the review is being used to provide agencies and Congress with an overview of existing programs and responsibilities across the government. The joint annual interagency review is not used to determine whether funding levels are reasonable according to agency or government needs.<sup>65</sup>

## **Balance Between Incremental and Transformational Changes to the Global Nuclear Detection Architecture**

The DNDO aims to improve “the probability of detection by integrating and deploying current technologies, continually improving these technologies through both near-term enhancements and transformational research and development, and expanding detection capabilities at the Federal, State and local levels.”<sup>66</sup> In expanding and improving the global nuclear detection architecture, DNDO and other participating agencies are faced with a temporal choice. Vulnerabilities and gaps identified through the global nuclear detection architecture could be reduced by applying immediately available technologies that provide a partial solution or by investing in research and development to develop technologies that will provide a more complete solution in the long-term. In the first case, the abilities of the global nuclear detection architecture would be incrementally improved as technologies that marginally increase the detection capabilities of the existing architecture are adopted and then serially replaced. Such a strategy might be costly, as multiple generations of equipment, each with some advantage over the previous version, are purchased and deployed. Although each generation would be an improvement, it would not provide a fully acceptable level of detection and security. In the other case, known vulnerabilities might not immediately be addressed at all, allowing the possibility that attackers could exploit them while a research and development program attempted to develop a single system that would remove the vulnerability. Thus, an appreciable risk would remain, even though it could be partly reduced in the near term, until the results of the research and development program came to fruition.

In practice, expansion and improvement of the global nuclear detection architecture requires a balance of these two approaches, using incremental advances and transformational research in coordination to develop a robust architecture. A key concern is how this balance is achieved and identified. The DNDO is addressing this complex problem by developing time-phased plans to

---

<sup>64</sup> P.L. 110-53, Title XI, Sec. 1103.

<sup>65</sup> Government Accountability Office, *Nuclear Detection: Domestic Nuclear Detection Office Should Improve Planning to Better Address Gaps and Vulnerabilities*, GAO-09-257, January 2009.

<sup>66</sup> Domestic Nuclear Detection Office, Department of Homeland Security, *Congressional Justification FY2008*, p. DNDO RD&O-8.

address the most important gaps in the existing global nuclear detection architecture.<sup>67</sup> These plans will allow “for the integration of current and near-term technologies and approaches, as well as longer-term options that may draw upon technologies that are currently in the R&D phase and that may not be available for implementation for several years.”<sup>68</sup>

Additionally, DNDO has taken a spiral development approach that appears to lean toward deploying available technologies, even if they serve only as partial solutions, rather than leaving a gap unaddressed. In spiral development, technologies are refined as they are implemented based on information generated during their deployment. Thus, though the technology may serve only as a partial solution when first implemented, the goal is for it to become a more complete solution over time.

Finally, DNDO has adopted a multi-faceted approach to architecture development, funding multiple types of detector technology.<sup>69</sup> Successes in developing and deploying these detector types may lead to significant advances in DNDO’s ability to detect and prevent a radiological or nuclear attack. In addition to developing and procuring such technologies, DNDO also must weigh the relative advantages to integrating these new systems into the existing architecture versus replacing existing systems with these new systems.

Among key issues facing Congress are determining the optimal process for creating a robust global nuclear detection architecture, understanding the capabilities of near- and long-term technology and their potential effect on the global nuclear detection architecture, and assessing the adequacy of the metrics used to measure the risk reduction benefits. Congress bestowed upon DNDO the responsibility for developing and implementing a global nuclear detection architecture as part of efforts to safeguard the United States. The success of DNDO’s activities in establishing this architecture will likely require ongoing evaluation and oversight into the future.

## **Long-Term Maintenance of the Global Nuclear Detection Architecture**

Although the use of detailees, IPAs, and liaisons from other agencies has helped DNDO to maintain contact with other stakeholders, its reliance on these temporary personnel may make long-term efforts difficult to sustain. As temporary personnel return to their home agency, institutional memory may be lost. As of April 2007, 79% of DNDO’s employees were either detailees, liaisons, or contractors rather than permanent staff.<sup>70</sup> Efforts that rely on continued improvement and adjustment over time, as the global nuclear detection architecture does, will likely depend on DNDO’s ability to clearly enunciate and document the rationale and approaches that it developed and considered when they were established. Otherwise, these efforts may be

---

<sup>67</sup> Domestic Nuclear Detection Office, Department of Homeland Security, *Congressional Justification FY2009*, p. DNDO RD&O-7.

<sup>68</sup> Domestic Nuclear Detection Office, Department of Homeland Security, *Congressional Justification FY2009*, p. DNDO RD&O-8.

<sup>69</sup> For example, the DNDO has invested in both portal and portable radiation detector technology as well as radiography system development. It also continues to sponsor efforts to integrate detection systems. See, for example, Domestic Nuclear Detection Office, Department of Homeland Security, *Advanced Technology Demonstration for Intelligent Radiation Sensor Systems*, BAA-09-102, March 16, 2009.

<sup>70</sup> Office of Inspector General, Department of Homeland Security, *DHS’ Domestic Nuclear Detection Office: Progress in Integrating Detection Capabilities and Response Protocols*, OIG-08-19, December 2007.

delayed as new personnel have to reevaluate the ongoing process. Similarly, coordination between agencies through the Interagency Coordinating Council may suffer if consensus decisions are not well understood by the successors of the Council participants.

The DNDO may be able to offset this potential loss of institutional memory in a number of ways. One possibility is a mentoring process in which outgoing personnel actively mentor their replacements during an overlap period in order to provide continuity of information and expertise. Another would involve comprehensive documentation of decisions, both positive and negative, so that future staff have a written record to refer to when trying to understand why a particular approach was taken and why a competing approach was set aside. Finally, expanding DNDO's permanent staff might provide long-term stability and more retention of core knowledge.

The DNDO does appear to be increasing its permanent federal staff. As seen in **Table 2**, the number of detailees has decreased and the number of permanent staff has increased since the creation of the office.

**Table 2. DNDO Staff Levels**

	<b>FY2006 (estimate)</b>	<b>FY2007 (estimate)</b>	<b>FY2008 (estimate)</b>	<b>FY2009 (requested)</b>
Detailees	66	65	45	45-50 <sup>a</sup>
Total Staff	112	130	130	144

**Source:** CRS analysis of DNDO congressional justifications for FY2007, FY2008, and FY2009.

a. DNDO reported a range in the number of detailees projected for FY2009.

Some positions within DNDO may be best filled by permanent DNDO staff, while others may require the expertise possessed only by detailees. A key issue facing decision makers is balancing DNDO's need for technical or subject matter experts with building a core of permanent DNDO staff able to develop and evolve the nascent global nuclear detection architecture.

The DNDO is aware of the need to retain institutional knowledge. Succession planning is one mechanism DNDO uses to retain this knowledge. According to DNDO, before each detailee returns to their home agency, their replacement is identified and prepared to take over the departing detailee's responsibilities.<sup>71</sup> The effectiveness of this succession planning and DNDO's strategic decisions regarding the use of detailees may require oversight from Congress to ensure that congressional interests in program and agency continuity are met.

## Research and Development Coordination

Research and development investment plays a role in strategies for addressing the architecture's gaps and vulnerabilities. The aim is to develop technologies to fill the gaps in the global nuclear detection architecture. Both DHS and DOE fund research and development in the area of nuclear and radiological detection equipment.

<sup>71</sup> Oral testimony of Mark Mullen, Assistant Director for Architecture, Domestic Nuclear Detection Office, before the Senate Homeland Security and Governmental Affairs Committee on July 16, 2008.

The SAFE Port Act of 2006 gave DNDO the statutory authority to

conduct, support, coordinate, and encourage an aggressive, expedited, evolutionary, and transformational program of research and development to generate and improve technologies to detect and prevent the illicit entry, transport, assembly, or potential use within the United States of a nuclear explosive device or fissile or radiological material, and coordinate with the Under Secretary for Science and Technology on basic and advanced or transformational research and development efforts relevant to the mission of both organizations.<sup>72</sup>

The research and development activities DNDO undertakes under this authority address gaps and vulnerabilities in the global nuclear detection architecture. The DNDO has highlighted detecting threat materials from greater distances, in highly cluttered backgrounds, and in the presence of shielding and masking materials as particular challenges.<sup>73</sup>

Although Homeland Security Presidential Directive 14 required DNDO to “conduct, support, coordinate, and encourage an aggressive, expedited, evolutionary, and transformational program of research and development efforts,” it also directed the Secretary of Energy to “lead the development of nonproliferation research and development and, where appropriate, make available dual-use counter-proliferation and counter-terrorism nuclear detection research and development to DNDO and other entities and officials to support the development of the domestic nuclear and radiological detection system.”<sup>74</sup> The long-term coordination of this research appears to be occurring through the Subcommittee on Nuclear Defense Research and Development of the National Science and Technology Council Committee on Homeland Defense and National Security.<sup>75</sup> Additional coordination occurs between agencies participating in the global nuclear detection architecture as well.

The coordination of these research and development activities is likely to remain of interest in Congress, to prevent duplication of effort and ensure that agencies meet their missions and roles. Congress may use its oversight authority to assess the balance of investments between agencies, address undue duplication of research and development activities, and increase or decrease the resources available for particular technology approaches under consideration.

## **Author Contact Information**

Dana A. Shea  
Specialist in Science and Technology Policy  
dshea@crs.loc.gov, 7-6844

---

<sup>72</sup> 6 U.S.C. 592.

<sup>73</sup> Testimony of DNDO Director Vayl S. Oxford, Department of Homeland Security, before the Senate Judiciary Committee, Subcommittee on Terrorism, Technology, and Homeland Security, on July 27, 2006.

<sup>74</sup> Executive Office of the President, The White House, *Domestic Nuclear Detection*, Homeland Security Presidential Directive HSPD-14/National Security Presidential Directive NSPD-43, April 15, 2005.

<sup>75</sup> Testimony of DNDO Director Vayl S. Oxford, Department of Homeland Security, before the House Homeland Security Committee, Subcommittee on Emerging Threats, Cybersecurity, and Science and Technology, on October 10, 2007.