INSTITUTE FOR DEFENSE ANALYSES

Force Enhancement Packages for Countering Nuclear Threats in the 2022–2027 Time Frame: Final Report

Dr. Robert L. Bovey, Project Leader
Dr. M. Anthony Fainberg, Deputy Project Leader
Mr. Vernon D. Bashaw
Ambassador Linton F. Brooks
Mr. Frederick S. Celec
Dr. Daniel L. Cuda
Ms. Rachel D. Dubin
Dr. John R. Harvey
Brig Gen S. Curtis Heady, U.S. Air National Guard (Ret.)
Dr. Richard L. Wagner

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4850 Mark Center Drive
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- Dr. John R. Harvey, former Principal Deputy Assistant Secretary of Defense for Nuclear, Chemical and Biological Defense and former Director of the Policy Planning Staff of the National Nuclear Security Administration.
- Dr. Richard L. Wagner, former Assistant to the Secretary of Defense for Atomic Energy and chair of Defense Science Board task groups charged with studying countering weapons of mass destruction since 2000.

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Executive Summary

In February 2015, the Director, Office of Countering Nuclear Threats, in the Office of the Deputy Assistant Secretary of Defense for Nuclear Matters in the Office of the Assistant Secretary of Defense for Nuclear, Chemical and Biological Defense, asked the Institute for Defense Analyses (IDA) to develop a vision of a force enhancement package (FEP) that would serve the Department of Defense (DOD) in its Countering (Clandestine) Nuclear Threats (CNT) mission in the 2022–2027 time frame and to lay out approaches to achieve it. This document summarizes the results of the IDA project, as of August 2015.

Based on a review of available information, the IDA research team concludes that clandestine nuclear threats involving a single nuclear device, in the time frame of 10 to 15 years out, are likely to be quite similar to those of 2015 with three notable exceptions. First, trans-national terrorist interest in large attacks on the United States could increase from its 2015 level. Second, foreign nuclear stockpile security systems could be under higher threat of disabling cyberattacks relative to 2015 and hence less reliable. Finally, the security of Russia's nuclear stockpile could be more worrisome, assuming that Russia continues in its unwillingness to cooperate and provide transparency.

While recognizing the importance of continuing ongoing programs that focus on strong steady-state defenses against clandestine nuclear threats, the IDA team concludes that, in addition, there is a special opportunity for DOD to contribute to the whole-of-government effort ten years out by developing and exercising abilities to:

(1) augment quickly existing border security,

(2) establish new defense perimeters, and

(3) search within perimeters to locate a "loose nuke" in allied partner nations through whose territories such contraband may be transported.

This is based on the IDA team conclusion that DOD has superior technology, knows the tactics, techniques, and procedures (TTP) to augment or establish perimeters quickly, and can teach these to partner militaries. The IDA team also accepts that specialized DOD units can search successfully within a small area (for example, something less than a square kilometer). However, the team was unable to identify combinations of DOD technology and TTP superior to those used by domestic law enforcement agencies to search wide areas tens to thousands of square kilometers or more. Therefore, the IDA team could not recommend immediately including wide-area search among the operations to be taught to partner militaries. Rather, the IDA team recommends an initial focus on experiments to seek better methods, holding active teaching until later. The team expects that better methods would involve collection using multiple intelligence, surveillance, and reconnaissance (ISR) sensors and on-the-ground investigators, with only limited use of radiation detectors. This collection likely would be supported by improved search and decision-planning aids and brought together by advanced fusion and analysis.

To address this opportunity, the IDA team developed four mutually supporting components. Each component is scalable in level of effort and cost; and varying levels of the components produce different FEPs. In common with other situations of seeking to find a lost thing or person, the effectiveness of containments and the searches associated with them will decay as the delay grows before they are executed. The most challenging case for quickly deploying the defenders' capabilities is when warning is received, say, within hours of a loss or sighting of a nuclear weapon or equivalent material: the speed of deployment can make a large difference in the likelihood of success in finding the material and interdicting its transport. To maintain their potential effectiveness, the capabilities must be deployed and activated very quickly (again within hours) because that potential is decaying as every hour passes.

Test bed. The first component proposed is an experimental program in an organizational structure called a test bed, which is assembled to learn how to search wide areas better so that, among other things, improved technologies and TTP can be taught to partner militaries.

Partner militaries and partner nations. The second component is a program to do joint planning, training, exercising, and operating with partner militaries to address augmentation in crises of border security (conducted in steady state by customs and border patrol organizations) and the establishment of other perimeters within a nation. Parenthetically, when the test bed produces improvements in wide-area search capabilities, the cooperation can be extended to this activity as well. The IDA team proposes specifically that DOD may accomplish this by building on long-standing relations between the National Guards (NGs) of individual U.S. states and the militaries of partner nations under the State Partnership Program. In particular, because of a concern to compensate for declining confidence in Russia's nuclear security, the IDA team proposes that DOD focus first on countries near European Russia, with expansions to other countries as likely follow-ons.

Caching (nuclear gear reserves). A third component is the pre-positioning of one or more caches of specialized equipment that can be rapidly deployed to provide the technology useful to carry out border security and perimeter control operations. These caches also can contain equipment useful to searching, but initially this will not be a priority.

Coordinating headquarters (HQ). A final component is the establishment of an HQ function in an existing organization to manage the three components just described and to coordinate them with other complementary initiatives. These additional initiatives are intended, among other things, to assure the ability to refocus and redeploy quickly national, theater, and tactical ISR assets; and to assure the ability to deploy quickly operational command and control (C2) with adequate communications, and the cache equipment and personnel, to where they are needed in a crisis.

To judge the feasibility and general cost of these components, the IDA team used professional judgment to construct notional instantiations. These are described in the document's appendixes and involve judgments as to how they could be created and operated, and as to particular numbers of people and equipment that would be reasonable in applications to countries that neighbor Russia from the Baltics to the Caspian Sea and possibly into Central Asia. The costs of alternative notional components were then estimated using DOD planning factors for personnel and group activities, catalog prices or prices recently paid for equipment, and sometimes commercial costs of travel. The IDA team judged that no new facilities would be required for the components examined.

After examining several alternatives, the IDA team recommends an FEP consisting of the following:

(1) the experimental test bed;

(2) twelve state NG Counter Nuclear Threats force enhancement teams (FETs) partnered with seven countries that border European Russia and five that border those seven; the seven constitute a first tier of partner nations and the five constitute a second tier;

(3) two caches of equipment to improve the capabilities of those partnerships to establish and maintain perimeters; and

(4) a small coordinating HQ element in an established DOD organization.

The IDA team judges that funding this FEP will require about $25 million in fiscal year (FY) 2018, rising to about $40 million a year in FY22 and beyond. These values are computed in FY15 constant dollars.

As important as obtaining funding will be gaining the support of the relevant combatant commands and defense agencies, the National Guard Bureau, the Joint Staff, the Office of the Secretary of Defense, and the Departments of State, Justice, Energy, and Homeland Security. Because the FEP would be oriented to dealing with declining stockpile security in Russia, it would be useful in building support to perform a formal survey of experienced Russian "hands" in both the Intelligence and Cooperative Threat Reduction communities to verify and characterize the concerns expressed in this report.

Because the recommended FEP is small relative to what is normally handled by the DOD requirements, the Planning, Programming, Budgeting, and Execution system, and acquisition systems, it might be possible to proceed with less than full formality: adequate "blessings" in each area might be achieved via informal processes to produce adequate documentation. One aspect of the proposed FEP that could assist these informal processes is that the initiative contributes to the North Atlantic Treaty Organization's overall response to deteriorating Russian attitudes without being menacing to Russia.

The IDA team considered adding a third group of National Guard FETs and a third and fourth cache. The team decided to recommend only two sets of FETs (for the two tiers of nations) and two caches because their added value was clear in the IDA team's view even though not quantifiable with currently available information. The addition of a third tier in Eastern Europe or a group of countries in Central Asia or Southeast Asia was not of such clear value to make the team want to support such action until more detailed examination occurred. This can be done as the recommended FEP is being deployed without disrupting a smooth overall deployment, should an expansion be selected before FY22.

Contents

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1. Introduction

The objective of the project, "DOD Future CNT [Counter Nuclear Threats] Future Capabilities," is to assist in developing one or more future Department of Defense (DOD) enhancements that would help counter attempts at a clandestine nuclear attack on the United States or its allies and friends. These attacks could be carried out by either state or by non-state actors. The time frame would be roughly ten years in the future, from 2022 to 2027. For the purpose of this document, threats are understood to be those that may exist by then. The capabilities considered to counter (clandestine) nuclear threats are limited to those that can be developed by that time.

Early in the project, in light of threat assessments[1] and of a review of previous studies in the CNT mission area (in almost all of which one or more members of the Institute for Defense Analyses (IDA) team had participated),[2] the IDA team (with sponsor agreement) decided to focus on the more specific problem of how to contain and locate a nuclear weapon or weapon-usable nuclear material that had gone missing, a loose-nuke. Previous studies pointed this out as a problem deserving additional attention.

This document is intended to assist the staff of the Office of the Deputy Assistant Secretary of Defense for Nuclear Matters (ODASD(NCB/NM)) in providing support to the Assistant Secretary of Defense for Nuclear, Chemical, and Biological (ASD(NCB) Defense Programs. It furnishes a concrete, coherent vision of those components that collectively would constitute future DOD CNT capabilities beyond those available in 2015. The components, taken as a whole, are referred to in this document as a future force enhancement package (FEP). An FEP would address a range of loose-nuke situations that might plausibly arise in the 2022–2027 time frame. The FEPs also would account for costs; technological practicalities; and programming, budgeting, and acquisition processes from 2015 through

[1] United States Government, National Intelligence Council, *Global Trends 2030: Alternative Worlds* (Washington, DC: Office of the Director of National Intelligence, December 2012), 59; and United States Department of Energy, National Nuclear Security Administration (NNSA), *Report to Congress: Prevent, Counter, and Respond—A Strategic Plan to Reduce Global Nuclear Threats (FY 2016–FY 2020)* (Washington, DC: Department of Energy, March 2015), 2-15.

[2] D. Sean Barnett et al., (U) *Countering Nuclear Threats: Portfolio Management and Strategic and Capability Frameworks*, IDA Document D-4766 (Alexandria, VA: Institute for Defense Analyses, March 2013); and U.S. Strategic Command, Center for Combating WMD (SCC-WMD/J8), *Initial Capabilities Document for Countering Nuclear Threats, Analysis Summary Book* (Washington, DC: Defense Threat Reduction Agency, December 2010), (SECRET/NOFORN).

2022, which may constrain what is achievable. To do this, the IDA team would first use professional judgment to construct notional instantiations[3] of the components; the team then would estimate FEP costs using DOD planning factors for personnel and group activities, catalog prices, or prices recently paid for equipment, and sometimes commercial costs of travel. Moreover, this document also would assist the OASD(NCB/NM) by laying out approaches to augment current DOD capabilities in CNT with the envisioned future FEPs.

Two experienced students of CNT led the team, which included four senior practitioners with significant experience at the Deputy Assistant Secretary to Under Secretary levels in DOD and other sectors of the U.S. Government. These experts were intimately involved in creating the components of the FEPs and the approaches for moving them forward through DOD management processes.

[3] *Notional instantiations* are understood as detailed examples of the recommended components, used for the purpose of costing and to allow an analysis of their effectiveness.

2. Threats, a Notional Scenario, and a Vision of a System

A. Threats

The threat of nuclear terrorism in the near future (2022–2027), particularly from non-state actors, continues to be a serious concern among experts who are charged with estimating challenges that the United States may face over the next decade or two. Two relevant, recent unclassified analyses from U.S. Government agencies have commented on nuclear terrorism. The first is a report, *Global Trends 2030: Alternative Worlds*, issued by the National Intelligence Council (NIC) in December 2012. *Global Trends 2030*, identifies the potential for increased conflict in the world as a major game changer that may appear before 2030. Among the factors making increased conflict more likely, the NIC identified the period near 2030 where:

> Unlike previous periods, large-scale violence is increasingly no longer the monopoly of the state. Individuals and small groups will have access to Weapons of Mass Destruction (WMD) and cyber instruments capable of causing massive harm and widespread disruption.[4]

In addition, the executive summary of the same report calls out "Nuclear War or WMD/Cyber Attack" as among the "potential black swans that would cause the greatest disruptive impact" on the global future. The possibility was further explained:

> Nuclear powers such as Russia and Pakistan and potential aspirants such as Iran and North Korea see nuclear weapons as compensation for other political and security weaknesses, heightening the risk of their use. The chance of non-state actors conducting a cyber attack — or using WMD —also is increasing.[5]

In March 2015, the National Nuclear Security Administration (NNSA) delivered a report to Congress, *Prevent, Counter, and Respond—A Strategic Plan to Reduce Global Nuclear Threats (FY 2016–FY 2020)*, which states:

> Worsening bilateral relations have affected the ability for [NNSA] to continue major cooperative projects in Russia. Given the size of Russia's stockpile of [weapon-usable nuclear material] (and the security risks inherent in such a large material inventory), [NNSA] will continue (with appropriate authorization as

[4] United States Government, National Intelligence Council, *Global Trends 2030*, 59.

[5] Ibid., p. xi.

needed) to look for partnership opportunities with Russia to address common nuclear security challenges.[6]

The IDA team interprets this to imply that there is a possibility that the security of weapons-usable nuclear materials[7] in the Russian Federation will decline over the next several years. Whether it actually declines or not, the United States will be less likely to know the state of nuclear security at Russian storage sites, which, until recently, had been verified by U.S. experts in the course of providing security assistance. The implication of these conclusions may be reflected in further mention in the NNSA report to Congress to the effect that radiation detection assistance in the form of fixed sites provided to partner nations across the world "to address remaining gaps in the Global Nuclear Detection Architecture" will be focused "…mainly, but not exclusively, in countries neighboring Russia."[8]

To understand further the future state of security of Russian nuclear weapons and materials stockpiles, the IDA team suggests that it would be useful, as an ancillary effort, to survey a group of experts with on-the-ground experience in post-Soviet Russia, and members of the Intelligence Community. This survey would evaluate (1) trends in Russian nuclear security over the next 15 years and (2) the quality of future U.S. knowledge about such trends.

B. IDA's Notional Scenario

The thinking of the IDA team was facilitated by adopting a simple notional scenario: a nuclear weapon is stolen from a northwestern Russian facility and is feared to be moving into or across Eastern Europe.

- The scenario pictures how defenses would be deployed across the globe as the time from the initial warning grows longer.
- It then narrows its focus on the Baltic Sea, postulating how the countries around it might react in terms of maritime patrols, airport, port and border security, and sharing information.
- Next, the scenario zooms in on the Baltic republics of Estonia, Latvia, and Lithuania, postulating that each of these countries would strengthen border security to block the entry of the stolen weapon, establish barriers to keep it out of their capital and other large cities, and search for the weapon in its territory.

6 U.S. Department of Energy, NNSA, 2-15.

7 These include in decreasing order of concern (1) weapon-grade material held by various organizations throughout Russia, (2) warheads awaiting dismantling, (3) warheads in custody of what would be called in U.S. general purpose forces, and, of least concern, (4) warheads that are part of weapons in the strategic missile forces and naval fleet ballistic missile submarines.

8 Ibid., 2-19.

- The scenario further addresses how specialized capabilities would be deployed very quickly into the three Baltic republics to augment their own capabilities.
- Finally, the scenario focuses on how, as an example, Estonia, aided by U.S. capabilities, might react to suspicious activity in one of its towns.

On the one hand, this scenario is broadly representative of the class of loose-nuke scenarios, in which the emphasis is on land operations, with maritime operations secondary. Further, the emphasis in the scenario is on containing the threat by strengthening existing barriers and establishing new ones, and searching within the resulting containments with two objectives: (1) to find the threat and (2) to increase confidence that the missing nuclear weapon is not in areas behind the barriers so that normal activities can be resumed in those locations.

This scenario is broadly similar to most scenarios involving a single nuclear device or weapons-usable quantity of nuclear material being moved by criminals or terrorists in Europe, Central Asia, and North America. Details will vary of course. For example, strengthening the border security of the Baltic republics vis-à-vis Russia involves great stretches of boreal forest; doing the same in the Caucasus involves expanses of mountains; and in Central Asia, securing the borders involves mountains and desert. Another and important variable in the scenario is the ability and willingness of local governments to cooperate in preparations for and execution of the mission.

On the other hand, there are classes of loose-nuke scenarios that are not represented by this notional scenario. For example, it is not representative of an attempt by North Korea to sell a nuclear device to a nation or transnational group. Neither is it representative of a scenario involving the loss of control of a nation's entire nuclear stockpile.

C. Vision of a Wide-Area Search System

Within the applicable class of scenarios, the emphasis on containing threats and searching within containments influenced the selection of candidate FEPs. The team concluded that it understood how to operate *containments* (also referred to herein as perimeters and barriers) and therefore could make specific recommendations. The team also concluded that it is not certain that it knows, better than law enforcement agencies, how to conduct a search of thousands, hundreds, or even tens of thousands of square kilometers well enough to make a recommendation as to how to do it. It therefore recommends instead an effort to understand better how to conduct such wide-area searches.

Considerable effort is being devoted to the CONSTELLATION project in the Defense Threat Reduction Agency (DTRA) to improve warning of a stolen nuclear device or weapon-usable quantity of material.[9] This is one of several such efforts directed toward improving warning

[9] CONSTELLATION is a project under operational prototype development at DTRA in collaboration with the U.S. Strategic Command (USSTRATCOM) and the Defense Intelligence Agency. It provides situational awareness

systems. In this document, the IDA team assumes that these efforts will have borne sufficient fruit over the next decade that it is quite possible that the United States will receive timely warning, that is, warning within a few hours of the event or even warning that a plot is being hatched. In the case of timely warning of a recent theft, success in containing and finding the material is within reach if and only if the response to warning is very quick—again, within hours, not days. The appropriate containment actions would include strengthening border security in the direction from which the threat is expected and establishing internal defense layers, such as perimeters, around large cities, airports, and ports.

In the case of warning of a plot being hatched, the first action would be to notify and offer assistance to the country that owns the material. If that produces success, all's well and good. It also would be appropriate to strengthen the border security of at least its neighbors. Here, however, because the weapon-usable material has not yet been diverted, the urgency of doing so would be less, so carrying out that strengthening over a few days might well be adequate.

Strengthening border security can be somewhat slower as the warning grows stale. The notional scenario postulated that if the loose nuke was not located within, at most, a few days the continental United States (CONUS) defenses would surge, and, as occurred after 9/11, military, especially National Guard, forces would be called to strengthen border, port, and airport security. That allows for some post-warning planning and preparation, unlike the situation in the front line Baltic republics, where the planning and preparation will need to be done in advance to be useful.

As the time lapse between the loss of control and the receipt of warning increases beyond a few days, the urgency and utility of surges to strengthen existing barriers and set up new ones decrease, as does the value of wide-area searches. In the limit, when there is no specific warning, the appropriate posture has to be one that can be maintained indefinitely. This is what is sought by the Departments of Homeland Security (DHS), Energy (DOE), State (DOS), Justice (DOJ), and, within DOD, DTRA. The strengthening of border security and establishing new perimeters described earlier in this section is envisioned as something that can be maintained for at most a few weeks.

and knowledge management capabilities for countering WMDs (CWMD). When completed, CONSTELLATION will fuse information from a variety of databases and other sources to enable the CWMD mission. Some versions will be accessible as open sources. In addition, for authorized users, access to classified data sources will be available in parallel. Information sharing among users is also a major capability of this project.

1. Assumptions

Force Enhancement Packages

Assumptions underlying the IDA team's search for possible FEPs include the following:

1. Preventing illegal nuclear material or weapons from entering and transiting a country is primarily the responsibility of civil law enforcement authorities of that country, which include border control and interior ministry units that may be organized similarly to military units; it may also include conventional local police.
2. These countries are amenable to U.S. assistance in a loss-of-control event.
3. An acceptable balance (satisfactory to the government of each country) is struck between *effectiveness* and *cost* of their day-to-day activities of border surveillance and control. Over the past 20 years, the U.S. Government has helped many countries improve the effectiveness of their civil law enforcement to perform these roles. The DOE's NNSA, however, judges that cost constraints for these purposes are tight,[10] suggesting to the team that the balances may be shifting toward less effective defenses.
4. Existing programs are generally manned and equipped to carry out day-to-day operations, including responding to small-scale challenges, using the normally available personnel. These programs lack the numbers of trained people and the equipment to deal with a demand for stronger border security and establishing additional containment perimeters within their countries, a demand that would arise from a credible threat that a diverted nuclear weapon is heading for their border or is in their country.
5. The militaries of these countries contain sufficient numbers of trainable people and normal military equipment (for example, vehicles, fixed and rotary wing aircraft, boats, and field kitchens). With specialized equipment and training (and if such deployment did not interfere with their ability to meet direct military threats), they could deploy forces temporarily to significantly increase the effectiveness of border control and to establish domestic perimeters. This could include establishing roadblocks, screening traffic (which would be more effective than normal screening, and with relatively little interference to legitimate traffic flow), and employing the intelligence, surveillance, and reconnaissance (ISR) assets that they have in support of searches. Such deployed forces could free up law enforcement personnel to conduct wide-area searches inside the country.[11]

[10] United States Department of Energy, NNSA, C-2.

[11] In some countries under certain circumstances, military forces also could participate in searches directly. However, this IDA document suggests that DOD's limited ability to achieve near-term improvements to its wide-area search capabilities argues for delays of a few years before teaching these techniques to foreign militaries.

6. Governments will believe that maintaining stockpiles of specialized equipment in each country would either (1) unduly dilute resources needed to maintain steady-state border controls at best, or (2), at worst, could be prohibitively expensive.
7. DTRA's CONSTELLATION program and similar efforts in the next decade will be capable of receiving a timely warning within hours of the diversion of a nuclear weapon or a weapon-usable quantity of nuclear material. Time will be of the essence—the defenders' first responses will need to unfold in hours, not days, because the area of uncertainty of the location of the loose-nuke is expanding rapidly. The IDA team treated situations in which slower responses would be adequate as cases that would be lesser-included cases: that is, more easily handled than the notional scenario, and therefore not needing more resources than envisioned for that baseline.
8. Once a nuclear device or material is located in a relatively small area (e.g., a city block), local and U.S. Special Forces units and their supporting radiation detection specialists, would seize it and render it safe. (The IDA document does not address this situation.)
9. The actions of the military in strengthening border security and establishing interior perimeters, and those of law enforcement in conducting wide-area searches, will necessarily become public knowledge. The IDA team suggests that the process of making the public aware of these actions be carried out in an orderly fashion to reduce anxiety and create opportunities for the public to help in the search. (The IDA team did not examine the specifics of how to do this.)

Additional Assumptions

An additional set of assumptions addresses the willingness of the U.S. Government, DOD, and certain partner nations, at least in principle, to carry out certain activities. The development of the FEPs assumes the following, subject to further assessment:

1. DOD will maintain caches (nuclear gear reserves) of specialized equipment and cadres of qualified operators ready to deploy rapidly to countries facing an imminent threat of having a nuclear weapon or nuclear material enter and traverse the country or remain in their territory.
2. DOD will train the militaries in selected countries so that they can, for the purposes of dealing with a loose-nuke scenario, augment local law enforcement to enhance border security and establish defense layers and perimeters inside the countries.
3. DOD will engage with other government departments and agencies and with international organizations, under the State Department lead, to ensure coordinated and effective responses in assisting nations to counter nuclear terrorism threats.
4. DOD will participate in planning and exercises with the selected countries. This planning will include producing lists of cache equipment that will be deployed to various countries under various scenarios from the caches described in item 1 above.

5. In performing items 2 and 4, DOD will build on the successes of the NG State Partnership Program (SPP) to create long-term NG-partner nation CNT relationships. Where NG SPPs do not exist, tailored substitute programs will be established by the geographic combatant command (GCC).
6. Upon receiving a warning, DOD, other U.S. Government agencies, and allies will deploy equipment and people from a cache. U.S. and allied ISR and appropriate C2 elements will move to predetermined locations to support barrier building and area searching according to a time-phased plan.
    a. Cache equipment and personnel will deploy to arrive in country within several hours.
    b. NG country-specific teams will deploy within several hours but will arrive later than the cache capabilities (nuclear gear reserves). These teams, which will have language competency and subject matter knowledge, will be assigned to advise host nation units, embassy staffs, and U.S. HQs.
    c. National, theater, and tactical ISR will be deployed or focused from afar to the countries in need starting immediately and will begin providing information as quickly as possible, in periods ranging from a few hours to a few days. For example, situational awareness information generated by the DTRA CONSTELLATION will be provided by DOD to host militaries.
    d. Other specialized units will deploy within a few days and arrive at nearby North Atlantic Treaty Organization (NATO) bases as soon as possible, probably within several days. These would include specialist units for tactical radiological or nuclear search, a render safe team, forensics capability, and additional intelligence fusion and analysis assets.
    e. A small force able to step in to provide security, medical, and explosive ordnance demolition (EOD) will deploy within a day from the vicinity of the combatant command (COCOM) HQ to a nearby NATO base, but will remain in the background until called upon.
7. Host nations will provide food, lodging, medical, security services, and local transportation for the first few days of a crisis. If planning calls for it, these are augmented by U.S. resources thereafter.
8. The augmentations of DOD, other U.S. Government agencies, and allies will last a few weeks. At the end of the period, U.S. units will collect their gear and redeploy.
9. DOD, other U.S. Government agencies, and allies will continue to carry out cycles of deployment, action, and redeployment in other countries, expanding out from the suspected origin of the diversion. After (at most) a few days, these cycles will include strengthening the borders of the United States. The cache equipment, specialists, and

other ISR assets will be increasingly stretched by the multiplying demands. This IDA document does not address how to allocate scarce assets beyond the first hours and days. It does, however, include the constraint that only a fraction of each cache will be deployed initially, saving capability for later calls.

10. Rather than seeking to teach wide-area search immediately, DOD will undertake a program of experimentation in an organizational structure called a test bed to learn how to conduct more effective wide-area searches than those commonly employed by civil law enforcement agencies. The IDA team suggests that better methods likely will involve collection by multiple ISR sensors and on-the-ground investigators, with only limited use of radiation detectors. The collection likely will be supported by improved search- and decision-planning aids and brought together by advanced fusion and analysis capabilities.

3. The Proposed Components of FEPs: National Guard, Caches, Test Bed and HQ Staff

The IDA team identified four components to be included in candidate FEPs:

- an augmented SPP, a military partnership between many U.S. NG units and friendly foreign nations;
- strategically pre-positioned caches, providing responders with the equipment they need when dealing with a loose-nuke;
- an experimental test bed, manned by a White Team, which would design and conduct experiments and exchange lessons learned with field practitioners; and
- a coordinating HQ element, lodged within an existing DOD organization, charged with coordinating CNT activities and components.

A set of complementary initiatives would support each FEP. They include the following:

- Rapidly moving cache assets and personnel using existing air transport (military or commercial).
- ISR supports ground personnel, who are securing perimeters and narrowing down possible locations of the loose-nuke.
  - Theater and tactical ISR assets are re-deployed and national intelligence collectors are re-focused.
  - Intelligence fusion and analysis centers are established in the field and reach-backs to DTRA's CONSTELLATION, the National Counter-Proliferation Center, and other theater, national, and international analysis assets are put in place.
- Operational C2 is established in the field.
- The coordinating HQ must work with the appropriate agencies and GCCs to ensure that priorities are set and templates for orders are prepared and ready for details.
- Augment U.S. embassy staff in affected nations with officers from NG teams and cache specialists.

The components and initiatives are discussed in the following sections.

A. Expanded NG State Partnership Programs

The first component proposed for the candidate FEPs is an extension of an already existing program involving individual state units of the U.S. National Guard. For some years, there has been a working military partnership between many state NG units and friendly foreign nations under the SPP. A nation has been matched by the National Guard Bureau with a state unit to provide additional training of the host nation's forces, using expertise present in the Guard. Personal relationships between the two parties are established, allowing the development of mutual trust and providing for smoother cooperation and greater success in transferring expertise. The list of currently matched NG units and foreign partner nations is given in Appendix A.

The NG component proposed in this document takes advantage of this collaboration by adding to its responsibilities the specific training and mentoring needed to help strengthen border security and establish internal perimeters to interrupt the movement of nuclear material found to be out of regulatory control in or near each partner nation. Selected personnel[12] are organized into a force enhancement team (FET) dedicated to CNT in that state NG's partner nation. FET members are thoroughly trained in CNT matters and in language and cultural awareness.[13]

Further, each partner nation forms a similarly structured Force Development Team (FDT). FDT members would be trained in CNT perimeter operations by U.S. experts with their NG FET-mates acting as mentors. Later the two teams (aided by a specialist from a cache) would train partner nation troops to conduct perimeter operations. Also under the supervision of GCC officers, the two teams would develop plans for various scenarios that would be taught to partner nation commanders. The two teams would lead exercises to test plans and develop proficiency.

The states that are currently participating in the SPP are divided into two tiers, for the purposes of the analysis in this IDA document; one or both may be used in some alternative options. For reasons discussed in section A of Chapter 2, the IDA team proposal focuses on material smuggled out of Russia, the tiers are defined by their proximity to Russian borders.

- Tier 1 generally includes states in Europe that border on Russia.
- Tier 2 consists of those nations that border on Tier 1 states.

[12] For purposes of discussion and costing, the IDA team judged that about 14 commissioned and noncommissioned officers, led by an O-6, would be reasonable to carry out the specific tasks described in Appendix A.

[13] See Appendix A, section C, paragraph 4.b., which discusses the need for the significant amount of training required.

- The addition of a third group of countries is a possibility.

Based on risk analyses and resource availability, a Tier 3 (within a Russia-Europe scenario) could consist of states that border on Tier 2 nations. Other possibilities for a third group could include a set of states in Central Asia or a set in Southeast Asia. A notional set of six partner nations was included in some alternative FEPs but not in the one eventually recommended.[14]

B. Caches

Pre-positioned storage caches will be strategically located to provide responders quickly with various kinds of equipment needed to deal with the scenario they face at the time. These caches constitute the second initiative proposed by this document. Each cache will have a cadre of perhaps 50 personnel[15] to maintain equipment but mostly to help train foreign operators and support operations in the field. The equipment will be used for training and, when acting in a crisis, to set up barriers, detect radioactive materials, and communicate securely with other defenders.

The proposed equipment in the caches includes examples selected, based on the professional judgment of the IDA team members that they would be helpful. These examples include *radiation detectors* for use in maintaining perimeters through which passing objects would be screened for radioactive material content. They also include *intrusion detection devices*: in this case, the IDA team's selections were based on microwave or seismic sensors employed by U.S. forces. Secure communications equipment will also be included. Samples of the equipment will be used in training foreign military personnel to deal with a loose-nuke crisis. This training will be conducted by NG FETs, cache experts, and partner nation FDTs, as described in Appendix A.

In the event of a confirmed loose-nuke warning, the first step in response would be to monitor the international borders across which the material might be expected to pass and to establish keep-out perimeters around important regions such as capital cities, ports, and airports. Later, if or when the material is localized to some degree to an area within a partner nation, through intelligence or law enforcement work, a containment perimeter would be created around that area of interest. Objects moving across the boundary would be screened for radioactive contraband. The final step, when localization has succeeded to the degree that the loose-nuke is strongly believed to be within a small area (e.g., less than one square kilometer), would be an intensive search to find the nuclear contraband within this reduced area, preferably in a joint effort by both local authorities and U.S. experts. The cached

[14] See Appendix A, section C, paragraph 2, for three possible sets of Tier 3 nations, either bordering on Tier 2 nations, in Central Asia or in Southeast Asia. Tier 3 nations would constitute the third of the three NG Partner Tiers/Groups of Alternatives A and B, found later in Chapter 4, Table 2.

[15] A reasonable number in light of their activities and used for costing this component.

equipment, when used by host nation military personnel who have been trained in its use, will be used for establishing perimeters. The caches will be sized to contain enough equipment to assist in establishing a few perimeters in partner nations. Precisely how much is enough will have to await detailed country-by-country assessments; the sizes presented in Appendix B judged to be a reasonable starting point by the IDA team.

C. Experimental Test Bed

The third component proposed in this document is an experimental test bed. This is similar to a concept that was proposed by the Defense Science Board in 2014.[16] It is intended as another component to be used in an FEP to counter future nuclear terrorism. The test bed will be used initially to develop and obtain validation of modeling and simulation efforts in support of improving wide-area search techniques, primarily for nuclear contraband. In its second stage, table-top exercises that model wide-area searches will be developed and run. And in the final stage, actual field exercises, mimicking an actual wide-area search, will be conducted. These will apply and test the search methodology developed using the software of the first stage and the exercises in the second. Initiating the field testing would not mean that modeling and simulation or table-top exercises would cease; both will continue to support the development, planning, and execution of field exercises.

The test bed would be manned by a White Team that would design and conduct experiments and exchange lessons learned with field practitioners. It would be assisted by a standing Red Team that would be devising realistic tactics for a group diverting a nuclear weapon or material and then act them out in experiments. The defenders would be simulated by Blue Teams that would be drawn from U.S. general purpose forces as needed. To test and cost this concept, the IDA team considered that the White Team would start as about 6 military and government employees and eventually be augmented by contractors to grow to about 30. The Red Team would start a few years later as two contractors, growing eventually to about nine, which would be augmented by other affiliated contractors to prepare for, conduct, and debrief experiments. If and when success is achieved in early stages, it may well be appropriate to increase the numbers in these groups; until then the combined professional judgments of IDA team members was that these numbers are appropriate.

Appendixes A, B, and C describe the above FEP components in detail.

[16] Office of the Under Secretary of Defense for Acquisition, Technology and Logistics (OUSD(AT&L)), Defense Science Board, *Task Force Report: Assessment of Nuclear Monitoring and Verification Technologies* (Unclassified), (Washington, DC: January 2014).

D. Coordinating Headquarters

In addition, it is proposed to establish an HQ to coordinate CNT activities and components. The location would be in CONUS. This entity would be permanent, staffed, for example, by ten full-time personnel and supplemented by approximately 90 assigned part-time personnel,[17] who would assist the full-time staff in day-to-day operations and participate in exercises, and would be "chopped" to the HQ in a crisis—after an alarm reporting nuclear material that may be out of regulatory control. This staff would, in normal, "steady-state" times, manage the activities of the NG FETs, caches and test bed. It also would participate in periodic exercises to train and to maintain necessary capabilities for a crisis response. In the crisis, the headquarters would support the joint task force headquarters that will be established in the field by the cognizant geographic combatant commander upon recognition of a crisis.

To be more concrete, the IDA team suggests thinking in terms of the HQ being commanded by a general officer, who is "dual-hatted" with a position in the parent organization. The ten full-time personnel, assisted by part-time helpers, would fill, for example, the following functional billets:

1. Chief of Staff (COS) to oversee all aspects of the organization
2. Legal Officer to coordinate with the Federal Bureau of Investigation (FBI), DOS, DHS
3. Military Information Support Operations (MISO) Officer to work with the MISO Command and interagency strategic messaging
4. Operations Officer to coordinate airlift and logistics support
5. Human Resources Officer to coordinate staff and support the other three components
6. Policy Officer to ensure coordination with the policy community
7. Liaison Officer to the Joint Staff, National Guard Bureau, and COCOMs
8. Intelligence Officer to ensure the proper use of national, theater, and tactical ISR
9. Communications Officer to work with relevant organizations to ensure that communications are ready to support exercises and crisis actions
10. Budget and acquisition officer to deal with the Planning, Programming, Budgeting and Execution (PPBE) system and to acquire equipment.

[17] These 90 part-time personnel would continue to perform their current jobs but they would be available for training, exercises, and actual operations.

E. Complementary Initiatives

For the NG FETs and caches to be fully effective, several complementary initiatives are needed. All require careful prior planning and detailed arrangements, which the headquarters staff will ensure are accomplished. The IDA team suggests that the proposed HQ staff can do this without requiring significant additional funding in the proposed FEP.

Rapid movement of cache assets and personnel to an area of need hinges on the availability of air transport, which can be military or commercial. The HQ staff must work with the appropriate GCC, U.S. Transportation Command, and the Joint Staff to ensure that priorities are established in advance, detailed information on numbers of people and volume and weight of equipment to be transported is exchanged, overflight permission processes are pre-planned, and rehearsals are conducted to test for problems.

ISR is likely to play a critical role, interacting with personnel on the ground, who are securing perimeters and narrowing down possible locations of a loose-nuke; therefore there is a need to rapidly

- re-deploy theater and tactical ISR assets;
- refocus national intelligence collectors; and
- establish intelligence fusion and analysis center(s) in the field, and support their reach-back to CONSTELLATION, the National Counter-Proliferation Center, and other theater, national, and international analysis capabilities.

The HQ staff must work with the appropriate agencies and GCCs to ensure that priorities are set and templates for orders are prepared and ready for the details to be entered. This sets the stage for tasking orders that will in fact produce the desired actions. Finally, the HQ staff will ensure exercises are used to rehearse these actions.

Operational C2 must be established in the field to support partner nations. The responsible geographic combatant commander will establish a joint task force HQ in the field and a supporting headquarters function in the combatant commander's headquarters. There also will be a need to augment U.S. embassy staff in each of the nations involved. Therefore, arrangements are expected to include detailing one NG FET officer to each place, and one cache specialist to each embassy until relieved by a NG FET officer. In addition, part-time members of CNT HQ staff will augment the field HQ and the team at the GCC HQ. The HQ proposed here must facilitate these arrangements and verify that they are made and maintained current. These complementary initiatives are discussed in Appendix D.

4. Proposed Configuration of the FEP Components

As the recommended base FEP, this document proposes the following grouping of components described in the previous chapter:

- Two tiers of expanded National Guard SPPs with 12 nations in Europe. The first tier would include the seven countries that border on Russia and the second tier would be comprised of the five nations bordering on those countries. These expanded programs would include training in perimeter establishment, checkpoint operations, and searches of people, vehicles, and vessels to enable location and recovery of loose nuclear weapons or weapon-usable material.
- Two pre-positioned equipment caches for establishing perimeters, which in turn support search and recovery operations for nuclear material out of regulatory control: one in USEUCOM's area of responsibility (AOR) and one in U.S. Northern Command (USNORTHCOM).
- An experimental test bed organization that will research and develop methods of improving wide-area search capability. This will be achieved first through modeling and simulation, second, through table-top exercises, and finally through field exercises.

An estimate of the yearly cost for this base alternative, assuming a moderately aggressive rate of deployment for the several components, is given in Table 1. The costs are planning estimates only. They are not meant to suggest quality estimates appropriate for budgeting. "Common" refers to the costs associated with establishment of the coordination HQ and to the start-up costs for the other components; for example:

- The Initial Operational Capability (IOC) for the HQ would be in FY17;
  - the IOC for the Test Bed in FY16;
  - the IOC for the first cache would be in FY21;
  - IOC for the first expanded NG SPP would be in FY21.
- Full Operational Capability for the HQ would be in FY19,
  - the Test Bed in FY21,
  - for the caches in FY24, and
  - for the NG SPP in FY24.

Table 1. Approximate Costs (in FY15 $M) and Rough Timelines for Base FEP (Alternative C)

Year	15	16	17	18	19	20	21	22	23	24	25	26	27
NG Prtnr	0	0	0	11.6	6.9	6.9	15.8	11.7	11.7	13.1	11.7	11.7	13.1
Caches	0	0	0	6.8	8.7	10.5	14.2	16.0	17.9	14.7	14.7	14.7	14.7
Test Bed	0.2	1.0	3.4	5.0	9.5	11.1	11.6	11.6	11.6	11.6	11.6	11.6	11.6
Common	0.2	0.4	0.4	1.1	1.1	1.0	1.1	1.1	1.0	1.1	1.1	1.0	1.1
Total	0.4	1.5	3.8	24.5	26.1	29.5	42.7	40.4	45.2	40.5	39.1	39.0	40.4

This plan would start building the test bed capability immediately; later, in the third fiscal year, it would begin to phase in together the caches and the National Guard partnerships. The first cache and the first tier of partner nations would be deployed and activated over three years, beginning in FY18. The second tier of partner nations and the second cache would be deployed over three more years, starting in FY21. The test bed would start by ramping up modeling and simulation capabilities and then move to table-top exercises in FY17 and FY18. The field exercises would phase in during FY19 and FY20, reaching full capability in FY21.

There may be opportunities for cost savings in the caches and, possibly, in the test bed. For one thing, there is a significant amount of relevant equipment deployed around the globe in various Army storage sites. It is possible that some of this could be applied to what is needed for the caches envisioned in this document. Second, there are steps now underway to deploy military equipment at several locations in Eastern Europe. Cost reductions for the FEP could be achieved, were it possible to take advantage of this pre-positioning infrastructure that will already be present and reduce the number of maintenance people assigned to the cache. The document assumed that already existing physical facilities could be used to support deployment of these CNT caches.

Regarding the test bed, the IDA team suggests the use of sites at certain military ranges in CONUS. These sites would be evaluated for suitability and eventual costs after preliminary efforts defined more exactly the physical requirements of the test bed experiments.

Several variations on the base case are offered as alternate possibilities. They vary the number of NG CNT tiers, caches, and experiment and test bed programs. HQ elements vary somewhat to fit with the variations of the other components. The alternatives are displayed in Appendix E. Their components are summarized in Table 2.

Table 2. Alternative Force Enhancement Programs

Alternative	A	B	C (Base)	D	E	F	G	H
NG Partner Tiers/Groups	3	3	2	2	1	0	1	0
Caches	3	2	2	1	1	0	1	1
Test Bed	Yes	Yes	Yes	Yes	Yes	Yes	No	No

Note that Alternative C is the recommended "Base" program—"base" because there are decision points where the program can be changed. On the one hand, in FY17 a decision could be made to shift to Alternative E, that is, to continue the experimental test bed, the first "tier" of seven NG FETs and the USEUCOM cache, but not fund an additional tier of five NG FETs or creation of a second cache. On the other hand, at any time up to FY19 it would be possible, while maintaining a smooth program profile, to direct increased funding to expand the number of NG FETs or caches to more than 12 and 2, respectively. FEP Alternatives A and B are examples of such a plan.

The IDA team did not seek to quantify the effectiveness of the various FEPs, e.g., in terms of probability of recapturing a loss nuke from Russia or in deterring attempts to steal nuclear materials or weapons in Russia. It is clear that one tier is better than none, that two tiers are better than one, and that adding a third group of countries would either extend that coverage or thicken the European defenses. Likewise, increasing the numbers of caches (or their size) increases the number (and length) of perimeters that can be established. The IDA team judged that Alternative C is a good starting place, with flexibility to adjust to further assessments that can only be done when participants recognize that the establishment of an FEP is serious business.

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5. Extensibility to Other Scenarios

The notional scenario used to evaluate possible FEPs is based on the possibility of a loss of control over a nuclear weapon or weapon-usable nuclear material at a storage site in the Russian Federation, in a time frame about 10 years from now. This scenario was selected for several reasons. In the first place, as noted in the NNSA report to Congress of March 2015, the deterioration in relations between the United States and Russia has stopped the former close cooperation, which has resulted in a loss of transparency regarding nuclear security in Russia that had prevailed since the early 1990s. This implies to the IDA team that over several years, the security of Russian nuclear stockpiles may well deteriorate. Even if security does not deteriorate there, outside observers will not be able to verify its level of effectiveness. Secondly, the enormous size of Russia's nuclear stockpile, combined with any reduction in nuclear security, results in a considerable overall vulnerability and thus a considerable risk of loss of material. The great quantity of material in Russia, dispersed at many different sites, will also naturally draw the attention of any potential malefactors, who wish to obtain nuclear material.

There are three general categories of land routes out of Russia that would most likely be taken by smugglers of nuclear contraband: Eastern Europe, the Caucasus, and Central Asia. The IDA team began its analysis focusing on the first two of these categories, in part because of the excellent, productive relations the United States has with most nations bordering Russia in Europe. These positive relations extend to military-to-military cooperation on several levels. This gives DOD the advantage of already working through established contacts and relationships, such as the NG SPP. These relations could ease the expansion of existing cooperation to the establishment of a capability to contain, search for, and recover "loose" nuclear material within the territory of a Russian neighbor.

The IDA Team considered adding a third group of NG FETs, corresponding to a third tier of partner nations, and a third and fourth cache. It decided to recommend only two FET groups and two caches because their added value was clear in the team's view, even though not quantifiable with currently available information. The addition of a third tier in Eastern Europe or a group of countries in Central Asia or Southeast Asia was not of such clear value as to make the team want to support such action until more detailed examination. This can be done as the recommended FEP is being deployed without disrupting a smooth overall deployment, should an expansion be selected before FY22.

In addition to functioning as an important initiative to respond to Russia's new opacity, the FEP and its alternatives proposed in this document can serve as a "proof of principle." That is, it will be possible to demonstrate that the FEPs developed to counter this scenario would enhance the capability of DOD to respond effectively to a loss of control over nuclear material in a particular case. Lessons derived from analyzing the capabilities of the FEPs will also be useful in countering other plausible loose-nuke scenarios across the globe. Similar FEP components can be applied to other cases, although for some scenarios, additional elements may have to be developed. Modifications of the FEP to counter other scenarios would properly be the subject of a further document.

The FEPs discussed in this document might be found to require additions or modifications to increase their effectiveness in some alternative scenarios. They will be useful in the current scenario and in other plausible ones as well. But in addition, they provide a baseline that can be readily modified to deal with scenarios in other parts of the world.

Other potential sources of nuclear material escaping regulatory control may conceivably be found in Asia. These sources may lead to different, challenging scenarios. There may be significant differences in requirements to CNT, due to the land pathways that would dominate consideration in the European context. Emphasis in European scenarios is on land transportation, with maritime and air possibilities secondary. These considerations could be reversed in the context of most Asian geography and potential pathways for transporting nuclear contraband.

An expanded FEP to counter Asian scenarios would include an additional equipment cache located nearer to South and Southeast Asia than Germany or CONUS. Further, the inventory of the cache might be significantly different; for example, the radiation detection equipment used would be that suited to detecting radioactive material on a ship, when used by a boarding party. Finally, closer military collaboration with some regional states would be of help in planning and accomplishing search and recovery of loose nuclear material, as this document envisions for the European theater by using established U.S. National Guard relationships with various nations.

It may also be the case that technically different barriers and search protocols will be in order for Asian scenarios, due to the many geographical differences relative to a European scenario. These could be elucidated and evaluated using the experimental test bed, one of the four components of the FEPs presented in this document.

In an East Asian context, it might also be useful to consider collaborations with highly capable partners, on a peer-to-peer level, for responding quickly to a regional loose-nuke. Japan and the Republic of Korea are two regional powers that have world-class technical resources, and which are seriously concerned with this threat (and others) emanating from North Korea. Another technically impressive and nearby nation that has good relations with the United States is Singapore, and going somewhat further afield, another technically advanced U.S. ally is Australia. Dedicated government-to-government collaborations with such states, for the purpose of dealing with a loose-nuke in the region, could be of great help in the event of a crisis.

6. Steps for Implementation

If a decision is made to initiate one of the options proposed here, an early effort to begin initial preparation is advised. The IDA team recommends starting preliminary efforts for the experimental test bed in calendar year 2015 and for the Test Bed White Team and the HQ no later than early calendar 2016. This implies applying residual FY15 funding that could maintain momentum until FY16 funds become available, probably in early CY 2016, when greater funding would be in order. Table 1 illustrates that the initial amount of funding needed is quite small: about $400,000 in FY15, to be expanded to $1.5 million for FY16.

The activities[18] that could be started essentially immediately with minimal, early funding would include the following:

- refining cost estimates and evaluating possibilities for cost reduction (e.g., by borrowing equipment already stored by the military and determining whether existing forward-deployed storage facilities could be used);
- surveying current modeling and simulations capabilities within DOD that could be applied to analyzing and assessing wide-area search techniques in the test bed;
- beginning to compile and apply lessons learned from analogous types of searches by law enforcement authorities and the military;
- initiating efforts to set up the test bed's "White Team," which will design and control experiments and testing; and
- arranging an entry for implementation of a CNT option in the Guidance to Develop the Force (GDF) and Guidance to Employ the Force (GEF).

In terms of timelines for actual equipment, the equipment purchases and training proposed in the CNT FET and cache components are neither new nor large. The IDA team estimates that it would take about three years, under normal procedures, for first deliveries to arrive, starting with initial negotiations with one of the services. The time and processes needed for acquiring large (approximately in the hundreds) quantities of a battlefield intrusion system are illustrative. This system would be used to help set up perimeters within a partner nation, as part of the procedures for responding to a loose-nuke scenario, as described in Chapter 2. The estimated timeline is shown in Table 3.

[18] Additional funding would be needed to conduct the survey of experienced "Russia hands" and Intelligence Community Russian specialists to broaden the judgment base regarding the security of Russian nuclear stockpiles.

Table 3. Timeline for Acquiring a Battlefield Intrusion System

2015	Negotiate with Service (e.g., JPEO) to get system in the pipeline
2016	
• January	Service begins preliminary FY 18–22 program and FY18 budget
• July/August	Service submits POM and budget
• August–mid-Oct	OSD POM issue review and OSD/OMB budget review
• Mid-Oct–mid-Nov	CAPE prepares PDMs/Comptroller prepares PBDs
• December	OSD submits proposed FY18 budget to OMB
2017	
• February	President submits to Congress proposed FY18 budget
• March–May	Congressional authorizers and appropriators hold hearings, etc.
• June–July	Authorization bills reconciled in conference and passed
• Aug–Sept	Appropriations bills reconciled in conference and passed More likely, continuing resolutions is passed
2018	
• January	FY18 funds become available to use
• March–April	Contract let for more systems
• September	First delivery on new contract

JPEO - Joint Program Executive Office
OMB – Office of Management and Budget
OSD – Office of the Secretary of Defense
PBD – program budget decision
PDM – program decision memorandum
POM – program objective memorandum

This is only one of several categories of equipment required for deployment in a cache. The implication is that to receive the first deliveries towards the end of calendar year 2018, it would be necessary to begin the process as soon as possible, in calendar year 2015. The 2018 time frame is what is currently proposed in the base case, as described earlier. This is likely typical of the kinds of equipment being proposed for the caches.

7. Summary and Conclusions

Of the alternative FEPs that have been considered, the recommended alternative, whose cost profile is presented in Table 1, is the option with two caches (one in Europe and one in North America) and two tiers of partners that border on Russia (12 nations). This proposed base program is a moderately sized initial effort. A more extensive program, such as Alternative A, could achieve greater depth of an Eastern European defense or an extension of that the defense to Central Asia or Southeast Asia, because it includes an additional cache and an additional group of perhaps 6 nations to collaborate with U.S. NG units (resulting in 18 rather than 12 nations in all).[19] This alternative would cost approximately 30% more than the base program in the out years of 2024–2027. Initial costs would be identical to the base program. However, a decision to expand beyond the base case to this alternative, in principle, could be delayed until 2022, since the extra expenditures to reach the larger Alternative A would not need to be allocated until FY24.

If decision-makers decided to start with one of the less extensive alternatives, as described in Appendix E, they could reserve the potential of expanding to a more expensive but more effective set of possibilities for a few years. There are several options. From Table E-5, for example, if decision-makers were to decide to start with just one cache and one tier of NG-partner nation programs (seven nations), total expenditures over six years (FY15–20) would be kept down to about $86 million. At the end of FY20, the option of staying with the same rate of outlays would keep expenditures at about $27 million a year. The expenditures would be even lower if using the test bed only for table-top exercises and giving up field exercises. Possibly, it could be apparent at that point that field exercises would add little to the overall capability to respond to a loose-nuke. Giving up field exercises would result in a cost reduction of about $6 million to $7 million a year, reducing total expenditures to only $20 million.

Alternatively, if decision-makers decide that the program looks successful and manageable, they may wish at the end of FY20 to raise the NG component to two tiers (12 nations), requiring an additional outlay of about $13 million per year beyond the minimal one cache to one tier combination (assuming the field exercises would now be included). Such a decision would have determined that the additional likelihood of a successful recovery of a loose-nuke would be significantly enhanced to the degree that a 65% increase in expenses would be justified.

[19] These possibilities are discussed in Appendix A.

The reader can use Table 1 in the main body and Tables E-1 to E-7 (in Appendix E) to make other estimates of yearly and total costs between FY15 and FY27 under various assumptions, either by

(1) starting small and assuming decision points to expand to more comprehensive alternatives, when the lesser options actually enter acquisition;

(2) deciding on the more extensive options from the beginning, as shown in Table 1 and Table E-2; or

(3) using a lesser option and reserving the possibility of augmenting the FEPs at a later date.

Clearly, it also would be possible, if outlays for the base case begin in FY15, to reduce, rather than to expand, the eventual FEP, perhaps based on evolving political or fiscal imperatives. Note that budget outlays for the second cache and the second tier of NG partnerships are not planned to spend obligations before FY20. Thus, a decision to reduce the scope from the base case could be made as late as 2019.

This IDA document is intended to provide a clear blueprint on which DOD could begin work. Naturally, as work begins and proceeds, additional examination of the components, their specific applications, and their coordination with various complementary initiatives will take place. The proposed coordinating headquarters will pick up the lead for doing so as it is formed.

Appendix A
Employing National Guard Force Enhancement Teams in Support of a Countering (Clandestine) Nuclear Threats Strategy

A. Overview

In 1993, the National Guard (NG), in support of the U.S. European Command (USEUCOM), began to establish state-to-FSU[1] nation "State Partnerships." The State Partnership Program (SPP) expanded over the years to include nations in the areas of responsibility (AORs) of all the geographic combatant commands. As of 2015, there are 74 security arrangements involving 68 nations. A variety of funding sources in the Department of Defense (DoD) support military-to military, military-to-civil, and civil-to-civil initiatives between a given state and its partner nation.

Typically, SPP relationships begin with high-level familiarization activities that are necessary (but largely symbolic) for relationship building and evolve into substantive programs that benefit both parties (the state National Guard unit and the foreign military partner), the respective combatant command, and, more generally, the United States. Two examples of significant and strategically relevant effects of SPP are

- the Georgia National Guard's support of follow-on GTEP (Georgia Train and Equip) efforts and
- the Ohio-Hungary OMLT (Operational Mentoring Liaison Teams) that trained Afghan security forces during Operation Enduring Freedom.

Since 2010, 32 percent of USEUCOM's initiatives have been SPP based at a cost of only 20 percent of the Command's budget. Former Supreme Allied Commander, Europe (SACEUR), and USEUCOM Commander Admiral James G. Stavridis has stated "The SPP is, dollar for dollar, my best EUCOM investment."[2]

Given U.S. national security, defense, and military strategy emphasis on building partner capabilities and capacity, NG personnel could train, organize, and equip as force

[1] FSU – Former Soviet Union.

[2] USEUCOM web page, http://useucom.mil/key-activities/partnership-programs/national-guard-state-partnership-program, accessed 15 September 2015.

enhancement teams (FETs) in support of countering (clandestine) nuclear threats (CNTs). NG capabilities and the strong and enduring relationships that have been established with key U.S. partners could be leveraged to build partner-nation capabilities and capacity in support of the CNT mission set. The remainder of Appendix A describes such a system.

B. Objective

The objective is to organize, train, and equip teams of U.S. and partner-military personnel who are capable of establishing motivated and capable partner-nation units that can carry out CNT missions (described below in paragraph C.1) under the auspices of their respective force development teams (FDTs) and, when appropriate, in coordination with U.S. military personnel. The NG units that specialize in the SPP are called FETs.

To meet this objective, the Institute for Defense Analyses (IDA) team proposes to go as far as possible within the SSP framework without disrupting ongoing activities. The team recognizes that nations outside the SPP framework, which otherwise would be candidates for inclusion in the groups laid out below, must be addressed within other frameworks. These nations are listed in the following sections, but the IDA team lacked time and resources to identify specific frameworks.

Other complications exist for some other candidates with which SPP works because as of 6 August 2015 they are members of the Russian-led Eurasian Economic Union[3] (EAEU) whose purpose is to provide for the free movement of people, goods, services, and capital among members, including the dominant member, Russia. They also are members of the Collective Security Treaty Organization (CSTO), a Russian-dominated military alliance that, among other things, carries out joint exercises.[4] These nations are noted in what follows, but the IDA team lacked time and resources to explore how their involvement in EAEU and CSTO would affect their participation in the CNT program as described in this document.

[3] The members of the EAEU are Armenia, Belarus, Kazakhstan, the Kyrgyz Republic, Russia, and Tajikistan. More information about EAEU is available at http://www.eurasiancommission.org. The same countries are also members of the CSTO. Serbia and Afghanistan are observers, not members, of the EAEU.

[4] More information on CSTO is available at http://www.globalsecurity.org/military/world/int/csto.htm. As an example of CSTO exercises, the annual exercise was conducted in late August 2015 in the Pskov region of Russia near Estonia and Latvia. Simulated rapid reaction forces conducted a joint operation to contain an armed conflict with the aim of restoring territorial integrity and defending constitutional order in a simulated CSTO member state. CSTO members developed tasks for destroying irregular armed formations.

C. System for Guard FETs in Support of the CNT Mission Set

This system comprises the following elements:

1. **Day-to-Day and Surge Missions:** The FETs will focus on the following missions:
   a. Developing plans and operation orders (OPORDs) for potential and actual contingencies.
   b. Establishing and maintaining inclusion and exclusion zones and perimeters,[5] notably including border security.
   c. Interdicting the clandestine transportation or transfer of weapons or weapons-related material.
   d. Although not among the initial missions of FETs, depending on results of the Experimental Test Bed component, two additional missions may be added:
      1) Searching for and detecting weapons and weapons material in wide areas.
      2) Building relationships with local civilians, encouraging them to provide useful intelligence, and collecting intelligence.
2. **First tier of nations and NG partner states:** The following pairings represent the first set of seven priority nations and NG partner states. They are the first tier for a lost device in Russia in that each nation borders Russia.[6]
   a. Ukraine and California
   b. Lithuania and Pennsylvania
   c. Azerbaijan and Oklahoma
   d. Latvia and Michigan
   e. Estonia and Maryland
   f. Republic of Georgia and Georgia
   g. Poland and Illinois

[5] This document places particular emphasis on this mission area. IDA team members observed that NG personnel were trained and experienced in consequence management operations, which involved this mission, among others.

[6] Finland, Belarus, and Norway also share land borders with Russia. However, National Guard SPP partnerships do not exist with them. Further, Belarus is a member of the Russian-dominated CSTO and EAEU, which complicates its ability to participate in a regional CNT program. Cooperation with such countries will have to be separate initiatives.

Two to three years after the first tier is launched, a second set of five nations and NG states could be brought into the program. They are the second tier in that each country borders a country that borders Russia:[7]

a. Romania and Alabama
b. Moldova and North Carolina
c. Czech Republic and Texas and Nebraska (both states are partnered with the Czech Republic)
d. Hungary and Ohio (Ohio is partnered with both Serbia and Hungary)
e. Slovakia and Indiana

(A sixth pair is Armenia and Kansas. Armenia is a member of CSTO and EAEU, which will complicate its ability to participate in a regional CNT program. *Cooperation with such countries will have to be separate initiatives.* Therefore, it is not included in the second tier despite its geographic location.)

A third set of nine nations and NG states pairs is one option that could be added in another two to three years (see list below). The first four of these are an Eastern European third tier in that each borders a second tier country.[8] The other five are more distant, but are included here because by the time this group would be formed, future studies may have revealed that a combination involving more of the five countries would be in order. For the present, the IDA team is using the number six as representative of a likely number of states in this set.

a. Bulgaria and Tennessee
b. Serbia and Ohio
c. Slovenia and Colorado
d. Croatia and Minnesota
e. Albania and New Jersey[9]
f. Macedonia and Vermont

[7] Turkey and Sweden also share borders with first tier countries. However, National Guard SPP partnerships do not exist with them. Cooperation with such countries will have to be separate initiatives.

[8] Austria, Germany, and Greece also share borders with second tier countries. However, National Guard SPPs do not exist with them; therefore, cooperation with such countries will have to be separate initiatives.

[9] Albania, Bosnia, Kosovo, Macedonia, and Montenegro are not strictly third tier, but these countries are included here nonetheless because of their special geographic position in the Balkans where smuggling is endemic.

g. Kosovo and Iowa

h. Bosnia and Maryland

i. Montenegro and Maine

The number of partner nations are scalable when required by funding limitations and/or changing mission requirements. For example, if funding is very limited, decision-makers could activate relations with only the first tier countries.[10] Further, all examples given previously are located in the USEUCOM AOR. Decision-makers could, of course, select partnerships in other combatant command AORs.

Another example: instead of a third group in Europe, a third group could be assembled in Central Asia,[11] consisting of candidate countries from tiers one through three:

a. Kazakhstan and Arizona (first tier)

b. Kyrgyzstan and Montana (second tier)

c. Mongolia and Alaska (first tier)

d. Tajikistan and Virginia (third tier)

e. Uzbekistan and Mississippi (second tier)

There is no NG SPP relationship with Turkmenistan (a second tier candidate) so it would be dealt with through a different framework of cooperation.

Alternatively, a group could assemble in Southeast Asia, consisting of the following pairs:

a. Bangladesh and Oregon

b. Cambodia and Idaho

c. Indonesia and Hawaii

d. Philippines and Guam & Hawaii

e. Thailand and Washington

f. Vietnam and Oregon

[10] Discussions of funding limitations on the extent of CNT elements are given in Chapter 7 and Appendix E of this IDA document.

[11] Kazakhstan, Kyrgyzstan, and Tajikistan are members of the Russian-led CSTO and EAEU, which will complicate their ability to participate in a regional CNT program. Cooperation with such countries will have to be through separate initiatives.

3. **Composition of the NG FETs and Partner Nation FDTs:** Each NG FET would consist of a Mission Commander, or MC (O-6); an Operations Chief, or OC (O-5); six Tactical Officers, or TOs (O-3s)); and six Tactical Specialists, or TSs (E-7s to E-9s). The MC and OC would be full-time personnel while the TOs and TSs would be experienced traditional Guardsmen able and willing to commit to extended active duty.

   Seven U.S. Army military occupational specialties (MOSs) and U.S. Air Force specialty codes (AFSCs) would be represented on the FET: chemical, communications, intelligence, logistics, medical, rotary aviation, and security. All military personnel would have experience in consequence management operations and, ideally, have participated in previous SPP activities with their respective partner nations and state NGs. NG personnel assigned to NG special forces (SF) units or who have prior active duty SF experience would be given special attention in the selection process. The NG FET tour commitment would be five years for the MC and OC and three years for the other team members.

   The partner-nation FDTs would consist of a corresponding number of personnel with a similar rank structure. All commissioned personnel would ideally possess at least a 2–2 English language capability.[12] Partner nation FDT members would be selected based on the following criteria: past performance, leadership potential, language skills, and demonstrated willingness to advocate for the CNT missions. The defense attaché's office would be a valuable resource for vetting partner-nation personnel.

4. **Initial training requirements:** A significant amount of training is required for FETs to ensure mission success. For costing purposes, this description assumes that training would consist of the following elements:

   a. Six months of country-required specific language and cultural training: Training would be at an in-state NG facility where berthing and messing are available. There would be a dedicated instructor.[13] See section 5.c below for more details on the organization of language instruction. Ideally,

[12] The first digit in a fluency rating is for reading and writing, while the second digit is for speaking ability. A 3–3 language fluency rating in a relevant foreign language is commonly required of U.S. Foreign Service personnel assigned to overseas State Department postings. A 2–2 capability should suffice for this program.

[13] Alternatively, language and culture training could be conducted at the Defense Language Institute, Monterey, California, (with support from the Defense Language Institute, San Antonio, Texas). The IDA team estimates that this alternative likely would be about one-third more expensive than the proposed approach. Defense Threat Reduction Agency (DTRA) also has considerable expertise in organizing foreign-language training.

commissioned NG personnel who complete the training would possess a 3–3 level of language fluency.

b. One to two months of CNT-specific training are provided by the Defense Threat Reduction Agency (DTRA) and its Defense Threat Reduction University's Defense Nuclear Weapons School (DNWS) at Kirtland AFB, New Mexico.[14] Specifically, about 70 hours of distance-learning courses are taken at an NG base (in parallel with language study) in addition to a 5-day course at Kirtland AFB, and a 5-day exercise at Fort Belvoir, Virginia.

1) DNWS distance-learning course, Introduction to Combating Weapons of Mass Destruction in the 21st Century (WMD-21) (12 hours)

Synopsis: WMD-21 provides an overview of WMD threats to and vulnerabilities of the United States in terms of homeland defense and DoD antiterrorism and force protection. This course introduces laws, plans, directives, policies, and guidance that affect DoD's role in CBRN (chemical, biological, radiological and nuclear) response.

Objectives:

- Provide an overview of WMD threats to and the vulnerabilities of the United States in terms of homeland defense and DoD antiterrorism and force protection.
- Introduce laws, plans, directives, policies, and guidance that affect DoD's role in CBRN disaster response.
- Compare roles and responsibilities of key government agencies responsible for WMD incidents.
- Examine DoD roles in WMD incident response, homeland defense, and command structures, integration with federal response agencies, and deployable DoD assets.
- Understand the procedures to obtain DoD assets for WMD consequence management response.
- Understand the medical response considerations for a WMD incident.

[14] The descriptions of DNWS courses were drawn from its catalog in March 2015. The catalog is revised periodically. The current revision may be found at www.dtra.mil/Portals/61/Documents/ 2015_catalog_final_8-22-15.

- Understand the WMD decontamination process and planning considerations.
- Become familiar with the operational aspects of a WMD incident.

2) DNWS distance-learning course, Weapons of Mass Destruction Command, Control, and Coordination (WMDC3) (40 hours)

   Synopsis: WMDC3 is a distance-learning course covering the spectrum of WMD threats from terrorist motivation to employing CBRN through coordination of effective response within the National Response Framework (NRF) and National Incident Management System (NIMS).

   Objectives:

   - Provide an overview of current WMD threats to and vulnerabilities of the United States in terms of federal homeland defense and DoD anti-terrorism and force protection.
   - Introduce and detail the federal plans and DoD directives, policies, and guidance that affect DoD's role in CBRN response.
   - Compare roles and responsibilities of U.S. government agencies in mitigating WMD incidents.
   - Understand procedures for requesting DoD WMD response assets for application in a WMD consequence management response.
   - Provide tools to installation commanders and Federal-agency executives for requesting and applying DoD response assets into their local plans.

3) DNWS distance-learning course, Applied Radiological Response Techniques Level 1 (ARRT-1) (16 hours)

   Synopsis: ARRT-1 is an introductory distance-learning course for response technicians wanting to obtain the basic knowledge behind technical radiological response actions and decisions. This course will provide basic concepts of radiological science, identify aspects of radiation instrumentation theory, and identify concepts of radiation exposure and contamination control actions. Federal regulations and planning reports and radiation surveys are also presented.

   Objectives:

   - Survey concepts of radiological science.
   - Identify aspects of radiation instrumentation theory to practical applications.

- Identify basic concepts of radiation exposure and contamination control actions.
- Select applicable federal regulations relating to radiation exposures.
- Identify the elements of planning a radiation survey.
- Identify the elements of presenting reports based on regulatory requirements.

4) Tactical Radiological and Nuclear Operations Course (TRNOC) (5 days)

Synopsis: TRNOC is a five-day training evolution tailored for the special operations community. This course provides fundamental radiological and nuclear information to tactical units, such as U.S. Army Rangers and special forces, who may encounter radiological and nuclear hazards and associated materials. Students will complete training at DNWS, Technical Evaluation Assessment Monitor Site (TEAMS) and various other sites to demonstrate that they have met course objectives.

Objectives

- Describe, understand, and apply national policy and mission-applicable guidance and restrictions.
- Describe and understand fundamentals of radiation and units of measurement.
- Describe and understand biological effects of ionizing radiation and Operational Exposure Guidance (OEG) as identified by applicable Service-specific and joint publications.
- Describe and understand isotopes of concern, basic nuclear physics, and basic device design.
- Describe and understand expedient decontamination techniques.
- Understand and apply proper threat assessment.
- Understand and demonstrate proper application of safety precautions in a tactical environment.
- Demonstrate proper application of radiation monitoring instruments in a tactical environment.
- Demonstrate proficiency in basic radiological search, site survey, and area characterization methods.
- Apply proper radioisotope identification techniques.

c. A one-week CNT operations exercise at Fort Belvoir, Virginia. Team members learn to operate all the equipment that is in each cache to be able to teach it to partner-nation people.

5. Notional operational approach: After the initial training of the FETs, the following steps depict how the program may be operationalized. Note that at the beginning of this sequence, five to seven FETs will already have received basic training as described in section 4 above.

   a. Senior planning conference: The George C. Marshall Center in Germany hosts senior-level officials from the Office of the Secretary of Defense, USEUCOM, the National Guard Bureau, relevant Country Teams, and partner nations; and relevant Adjutants General. The purpose is to (1) outline the CNT mission and the role of the NG FETs, (2) establish C3 relationships, (3) introduce (virtually) FETs and partner nation FTDs, and (4) determine—in broad-brush terms—a three to four-year timeline for FET-related efforts in the National Guard CNT. The coordination headquarters, described in Chapter 3, Section C, of this document would be responsible for this conference.

   b. Acquisition of equipment and material: Costing assumes each NG FET member would be issued a laptop and a smart phone.

   c. Language and cultural training: All NG FET personnel would receive training at an in-state NG facility where messing and berthing would be available with a dedicated instructor, 4 hours per day in class (officers in the morning, enlisted personnel in the afternoon), 4 hours individual study, 5 days per week for 24 weeks for officers and for 12 weeks for enlisted.

   d. CNT-based FDT and FET Training: DTRA provides two weeks of training at U.S.-based venues of its choosing. NG FET teams and partner nation FDTs train together.

   For costing, assume that they use the Defense DNWS Nuclear Emergency Team Operations (NETOPS) course at Kirtland AFB. (Note that a distant-learning primer is a prerequisite.) Assume four days for all people to do the prerequisite at Kirtland with the NG FET acting as mentors for the FDTs. Then they all take the course together.

   Synopsis: NETOPS is a 10-day course that offers hands-on nuclear response training for members of a nuclear emergency response team. Subject matter includes modules on basic nuclear physics, biological effects of radiation, response processes and capabilities, radiation detection equipment, contamination control stations, surveys, and command and control. The course culminates with three daily field-training exercises during which students fully dress out in anti-contamination clothing, use Radiation Detection, Identification, and Computation (RADIAC) equipment, and perform realistic nuclear emergency team functions at the DNWS live radioactive training sites.

Objectives:

- Demonstrate an understanding of basic nuclear physics, biological effects, and protection.
- Identify potential hazards and explain personal protection applications.
- Describe national response plans and the requirement for a military response.
- Demonstrate use of radioactivity monitoring instruments
- Explain radiation dosimetry and the use of a dosimeter.
- Collect radioactive airborne samples.
- Demonstrate accident patterns and plotting.
- Properly don anti-contamination clothing.
- Set up and operate a contamination control station.

Prerequisite: Completion of *Nuclear Emergency Team Operations Primer* (NETOPS Primer) distance-learning course (40 hrs).

Synopsis: The NETOPS Primer is a distance-learning course that includes modules on biological effects of radiation and the response processes and capabilities, radiation detection equipment, contamination control stations, surveys, and command and control functions related to nuclear emergencies.

Objectives:

- History of nuclear weapons accidents
- Basic nuclear physics
- Principles of nuclear weapons
- Terrorist use of radiological materials and their effects
- Types of radiation and their characteristics
- Radiation protection measures
- Radiological, biological, and effective half-lives

- Fission, fusion, and chain reactions
- Materials used in nuclear weapons
- Personal protective equipment
- Commonly used radiation detection, identification, and computation (RADIAC) kits
- Types of respiratory protection equipment and protective clothing
- Types of monitoring devices used in personnel protection
- Site characterization and survey plotting
- Contamination Control Station (CCS) site selection factors and decontamination concepts
- Airborne radiation sampling
- The role of the explosive ordnance disposal (EOD) team
- U.S. national policy directives and DoD directives, and the National Response Framework
- Response phases of a nuclear weapons accident
- Initial Response Force (IRF) and Response Task Force (RTF) responsibilities, continental United States (CONUS) and outside CONUS (OCONUS)
- National Defense and Security Areas
- Homeland Security Presidential Directive – 5 (HSPD-5)

e. This report includes a compact disc with cost details. Many of these details are keyed to the following sections.

f. Deployment to the AOR: The FETs deploy to the AOR (in this example, to USEUCOM-based facilities close to the partner nations). The USEUCOM staff conducts a three-day table top exercise (TTX) for all NG FETs and their partner nation FDTs. The purpose is to familiarize the teams with CNT missions, establish trust relationships, and prioritize CNT-related activities that will be conducted. For costing, assume that TTXs can be combined so that only one would need to be conducted for each group of five-to-seven partner nations. (This reduces USEUCOM staff time and travel but does not affect costs of FETs and FDTs.) Deployment involves initial coordination with DTRA, USEUCOM, Special Operations Command, Europe, and the Embassy Country Teams. This would be managed by the coordination HQ described in section 3.D of the basic report.

g. In-country planning: In conjunction with and after the TTX, the FETs and FDTs conduct country-specific needs assessments and identify and prioritize training requirements, establish a training schedule, and tentatively set exercise dates. Subsequently, the FDTs identify units that will undergo training, participate in follow-on exercises, and conduct CNT-related missions. The initial focus is on supporting their own civil authorities in operating enhanced border controls and establishing and operating perimeters around inclusion or exclusion zones (mission area C.1.b. above). Later work could expand to other mission areas as appropriate to each partner nation. The cost of forming these units and other partner-nation costs are borne by the partner and are not include in U.S. costs for this component.

h. CNT-related training and exercises: The in-country training follows a rhythm:

   5) Note that training partner units noted in section a above involves, among other things, teaching them to employ the equipment in the cache(s). This involves small U.S. teams being in-country with sample equipment often. Assume one U.S. officer and three U.S. enlisted persons in-country for two two-week stints each quarter. (Also assume that one of the fifty people assigned to a cache accompanies these training missions.)

   6) There would be additional planning and training of the FET and FDT officers with USEUCOM and partner-nation military staffs. For costing purposes, assume that the FET MC and OC and three TOs would be in-country for one two-week stint each quarter (not overlapping the training visits of the U.S. teams mentioned in item 1) above) to conduct mission-specific and C3 planning and training. For costing assume that they are accompanied by a USEUCOM officer. Also, assume that one of the 50 people assigned to a cache accompanies these planning and training missions.

i. Day-to-Day and Surge Missions: Subsequent to the second quarter, partner-nation units are capable of augmenting their own civil agencies:

   1) Border control officials to strengthen border security.

   2) Interior Ministry officials in establishing internal checkpoints, defenses around cities, or other exclusion zones, and around inclusion zones.

3) Further, for any of these missions, NG FET team members deploy to serve as advisors. Also some Cache personnel deploy with their equipment, and USEUCOM officers deploy to assist.
4) These crisis operations were not costed in this task.
5) These activities are undertaken by each group of five to seven FETs and FDTs.

6. Costs

Table A-1. Estimated Yearly Outlays for National Guard State Partnership Program Component for One, Two, and Three Groups (FY15, $M)

FY	15	16	17	18	19	20	21	22	23	24	25	26	27
1st tier	0.0	0.0	0.0	11.6	6.9	6.9	7.5	6.9	6.9	7.5	6.9	6.9	7.5
+2nd tier	0.0	0.0	0.0	11.6	6.9	6.9	15.8	11.7	11.7	13.1	11.7	11.7	13.1
+ 3rd tier	0.0	0.0	0.0	11.6	6.9	6.9	15.8	11.7	11.7	23.0	17.6	17.6	19.6

See the annotated Excel workbook on the accompanying compact disc for further cost detail.

7. Ancillary Issues

- An additional advantage for the National Guard and the states of the units participating in this FEP component is the additional skill sets that are useful were there ever to be a loose nuke search in the United States. In addition, search and interdiction capabilities are augmented by such training. Also, already existing cooperation and relations with partner nations are strengthened.
- The National Guard may welcome the opportunity to gain such additional skills, but also may be expected to resist this activity if it were an unfunded mandate: support, in terms of resources, funding, and billets, would likely have to be provided to gain support.
- The IDA team suggests that the concepts of NG FETs and equipment caches destined for the European theater are very much in line with current thinking on energizing NATO defenses.

Appendix B
Nuclear Gear Reserves (Caches)

A. Introduction

This appendix addresses the issues of stronger defenses, using specialized equipment and people trained to use it. Many countries have border controls that are porous; they also lack equipment and trained personnel to establish anti-nuclear smuggling perimeters within their borders. This may be a rational day-to-day approach when presuming that nuclear weapons and weapon grade materials are securely under the control of responsible governments. Also in these situations, delays in traffic flow resulting from close inspections of individuals and vehicles are often judged unacceptable. However, should a “loose nuke” situation arise somewhere, there will be a demand for stronger defenses and a greater tolerance for inconvenience in a number of countries—which countries will depend on the specific situation.

An underlying assumption of this appendix is that such a crisis would last for days, perhaps even weeks, but not months or years.

The details of what will constitute such stronger defenses also will be idiosyncratic, but all will call for specialized equipment and people who know how to use it. On the one hand, training people in every country that might need them, while a significant task, is certainly within the realm of what can be done over a period of years. On the other hand, maintaining stocks of equipment needed for stronger defenses in every country that might need them would be prohibitively expensive, especially because the specific combinations of equipment that will be needed may vary from event to event.[1]

A cache of equipment maintained by a cadre of specialists who can draw out a set of equipment tailored to a particular situation and take it to the place it is needed would provide the reserve economically. Day-to-day, the specialists could train people in the various countries to employ the equipment properly. One such cache likely will be

[1] While the emphasis in this research is on assisting partner-nation forces establishing perimeters, situations may arise in which U.S. forces will need to establish perimeters. For example, U.S. forces may need to cordon off one or more suspected weapons of mass destruction (WMD) sites while specialized units establish control of the facilities and any material hidden in or near them. Alternatively, U.S. forces may need to augment or establish protective perimeters around areas to be protected temporarily from WMD attack. Such areas could range from a U.S. deployed base to the United States itself. In the latter case, DoD forces would be augmenting Department of Homeland Security or Department of Justice capabilities.

insufficient because of the time required to transport equipment from any one storage location to likely locations of need. This appendix examines one, two, and three locations, plus a fourth location for certain equipment, as detailed in the following sections.

B. Problem

There is clearly a potential for the Department of Defense (DoD) to be directed to support operations to locate and secure loose nuclear weapons or materials. In almost all cases, the operations will involve two different kinds of operations: (1) establish perimeters or defense layers and (2) search and retrieve the loose nuke. In the first operation, the first perimeter blocks the escape of the loose nuke from an area in which it is thought to be. Other layers will be established to block further travel should the first perimeter be breached or to protect certain areas, for example, national capitals. Searching people, vehicles, aircraft, and vessels for illicit drugs, illegal immigrants, smuggled cigarettes, and explosives is almost an art form. A considerable and still-developing body of expertise exists to do this. The specialists in charge of the equipment caches will be qualified to execute and teach these skills to allied personnel, for example. In addition, radiation detectors will remain useful in securing perimeters; generally people and vehicles crossing a perimeter will be frisked using a radiation detector.

The second kind of operation is to search the area where the loose nuke is thought to be. It bears emphasis that—perhaps paradoxically—localizing loose nuclear material in a small enough area where radiation detectors will be useful is not likely to involve the detection of emitted radiation. Currently, localization will depend on good intelligence and police work used to find illicit drugs, escaped convicts, illegal immigrants, cigarette smugglers, unlicensed stills, and improvised explosive device networks. A considerable and still-developing body of expertise is evolving to these ends. Until the U.S. military can learn to do better than that (probably by employing multiple intelligence, surveillance, and reconnaissance (ISR) sensors and on-the-ground investigators, supported by improved search models and advanced fusion and analysis capabilities), the caches will focus primarily on the first type of operation.

With that caution in mind, the following section describes what a cache could contain. The people and equipment listed here are but one illustration. The Institute for Defense Analyses (IDA) team judges this as a reasonable example, but arguments could be made for different mixes or larger numbers. The precise numbers will be determined as National Guard (NG) force enhancement teams (FETs), cache operators, partner-nation Force Development Teams (FDTs), and the combatant command staff work out plans for various scenarios.

C. Caches

For the initial analysis, the IDA team assumed a maximum of three basic caches, with one cache, for example, assigned to the following:

- United States European Command (USEUCOM), notionally at Ramstein Air Base (AB), Germany;
- U.S. Pacific Command (USPACOM), notionally at Anderson AFB, and
- The continental United States (CONUS), notionally at Andrews Joint Air Base, outside Washington, DC, in Maryland.

The IDA team later developed a recommended alternative with two caches, details of which are presented in the body of this document. One cache is assigned to USEUCOM and the other is assigned to a CONUS location. Each cache contains the following equipment:

- Detectors for use by local forces (advised by Americans) in securing perimeters:
  - Four hundred Battlefield Anti-Intrusion Systems (AN/PRS-9 BAIS), each one to detect and gain[2] early warning of potential penetrators over a 450-plus meter front between checkpoints.
  - Four hundred Lighting Kit Motion Detection (AN/GAR-2 LKMD) motion-activated (infrared (IR) and microwave) warning and illumination (visible light, IR, and strobe) system for warning of imminent penetration and illumination of the penetration attempt where it occurs.
  - Four hundred hand-held gamma detectors.
  - One hundred backpack gamma-neutron detectors.
  - Ten high purity germanium (HPGe) radioactive isotope identification detectors (RIID).
  - Five hundred Monocular Night Vision Devices (AN/PVS-14 MNVD), which are lightweight, head-mounted single objective lens devices consisting of a state-of-the-art image intensifier sensor, an uncooled long-wave infrared camera, and a miniature display to provide high resolution fused imagery.

[2] BAIS and LKMD have been developed under the auspices of the Physical Security Enterprise and Analysis Group (PSAG) under the Office of the Deputy Assistant Secretary of Defense for Nuclear Matters in the Office of the Assistant Secretary of Defense for Nuclear, Chemical and Biological Defense (ODASD(NCB/NM)).

- Sensors to augment local searchers: 50 sense-through-the-wall sensors (AN/PPS-26 STTW), which provide the capability to detect and locate people through walls from a standoff distance of up to 20 meters.
- Individual or "luggable" communications equipment:
  - One hundred man-portable, laptop-like, voice and data transmitter and receivers.
  - Ten Iridium satellite communications sets. (It is assumed that the Joint Communications Support Element (JCSE) of the U.S. Transportion Command will provide the necessary headquarters (HQ) type communications equipment.)
  - Two Counterintelligence and Human Intelligence Automated Reporting and Collection Systems (CHARCS) [3] to automate support to manage information collection.
  - Three 100 kilowatt (kW) electric generators for equipment operation and battery charging in the field and other support equipment.
- Ten chemical-biological (CB) detectors for force protection.
- Other equipment could be added.[4] However, these were not costed or otherwise considered in the IDA team deliberations.
- Fifty people will maintain the equipment and importantly teach and assist others to employ it.
  - Thirty-five operations specialists, trained in perimeter operations, physical search techniques, and interview techniques.
  - Ten communicators and analysts (command, control, and communications will be provided mostly by JCSE, which will deploy a communications suite with the cache).
  - Five equipment maintenance and repair technicians.

[3] CHARCS is the Army's counterintelligence (CI) and human intelligence (HUMINT) tactical collection and reporting system. CHARCS provides automation support for information collection, reporting, investigations, source, and interrogation operations. The first component is the AN/PYQ-8 Individual Tactical Reporting Tool (ITRT), which provides collection and processing devices for individual HUMINT team member or CI agents. The second component is the AN/PYQ-3 CI/HUMINT Automated Tool Set (CHATS), which provides the team leader (who normally directs a three- to five-member team) and an Operational Management Team with tools to process and manage team-collected information and with a robust set of peripheral devices such as printers, scanners, and cameras to assist the collection mission.

[4] For example, Ahura Explosive Detection System has been used by military and U.S. state officials.

All of these numbers derive from an assumed operating concept that local personnel (either in the host nation or in the United States, state, local, or tribal personnel) provide the vast majority of assets such as manpower, transportation assets, electricity, and logistics for at least a week. Equipment that has been pre-selected for the scenario that has arisen in the course of pre-crisis planning and training involving United States and partner-nation personnel is taken from the nearest cache and—accompanied by an appropriate number of specialists—deployed on less than four hours' notice by pre-arranged airplanes from their station. The equipment and personnel land a few hours later at the international airport nearest their destination and proceed in host-nation transport. If more equipment is needed than appears to be in one cache, it may be drawn—along with a suitable number of personnel—from another cache and deployed as quickly, but it will take longer to arrive.

1. Special CONUS cache

For its initial analysis, the IDA team assumed that there would be a CONUS reserve cache designed to contain relatively heavy and bulky equipment intended to be deployed less rapidly than the equipment in the basic caches. This reserve cache would have the following:

- Fifty people
- A communications hub consisting of air-transportable modules that are assembled to provide the following:
  - a central information fusion and analysis center, and
  - a command and control center co-located with the communications and fusion centers.
- Ten vehicle-mounted radiation sensors, each with a man-portable, laptop-like voice and data transmitter and /receiver
- Twenty transportable vehicle portal detectors
- Ten trailer-transportable radiographic devices on their trailers[5]

The requests received very likely will call for all pre-planned help to be on the scene ASAP. As a first approximation, most of the equipment and personnel would be expected to be in-country within 24 hours, and the remainder there in 96 hours. This is much faster

[5] As an example, several gamma-ray imaging systems, under the trade name VACIS, are priced in several versions at around $1 million per unit. They are listed by Leidos, Inc., in online sales brochures. The all-terrain version, drawn by a pickup truck, might be most appropriate (https://www.leidos.com/products/security/all-terrain-vacis). The costs have not been included in Table B-1 as they would increase the numbers considerably.

than normal military deployment planning, but the requesters likely will argue that a capability arriving after four days will be too late to be of use.

In the end, the IDA team did not carry this reserve cache into any FEP: with a deployment schedule of one new cache every three years, this reserve cache would not appear until after the planning period.

D. Summary of Recommendations

This appendix proposes, among other things, that DoD work over 10 to 12 years to accomplish the following objectives:

- Form two caches of various sensors and support equipment and 50 personnel to mentor the locals or general purpose forces. Their mission is to establish perimeters around broad areas consisting of tens, hundred, and thousands or more square km so that within those perimeters, others can search for and localize loose nuclear devices and radioactive material to within a small area (e.g., one km^2) in a variety of scenarios.
- Provide appropriate training to the specific units and individuals assigned to work in the small area. For example, interpreters, translators, document exploitation specialists, and interrogators will need to be trained in CBRN terminology in both English and their other languages.

E. Costs

Table B-1 summarizes detailed cost calculations shown in the compact disk that accompanies this report, and show the costs of acquiring and maintaining various numbers of caches, expressed in millions of dollars by fiscal year (FY).

Table B-1. Estimated Yearly Outlays for Caches (FY15 $M)

FY	18	19	20	21	22	23	24	25	26	27	28	29	30
1 cache	6.8	8.7	10.5	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
2 caches	6.8	8.7	10.5	14.2	16.0	17.9	14.7	14.7	14.7	14.7	14.7	14.7	14.7
3 caches	6.8	8.7	10.5	14.2	16.0	17.9	21.5	23.4	25.3	22.1	22.1	22.1	22.1

The costs of one cache will increase if one cache is paired in an FEP with two NG FET groups. The cost of one cache also will increase if it does not have a NG FET group with which to work, because more cache personnel will need to be hired to perform training work that is done by the Guard in the recommended plan. See the annotated Excel workbook on the accompanying compact disc for cost details.

F. Observations

The IDA team offers the following observations concerning the caches discussed in this appendix.

- The effectiveness of the pre-positioned caches depends strongly on timely warning.
- The location of the first cache would be at Ramstein Air Base in Germany, and the second at Andrews Joint Air Base, Maryland. The appropriate location of the third cache might be at Anderson Air Force Base on Guam; the most reasonable location would follow from decisions where to add a third group of nations to the National Guard FET component.
- The limitation of the cache staff to 50 persons implies that the National Guard FETs will do most of the training of partner-nation personnel.
- The concepts of National Guard FETs and equipment caches destined for the European theater are in line with current thinking on energizing NATO defenses.
- If required, the build-up of caches could be accelerated, assuming a larger impulse of funding in earlier years.
- If desired in a U.S. domestic loose nuke situation, the caches could be used to augment the equipment otherwise available for establishing perimeters and searches in a crisis in the United States.

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Appendix C
Experimental Test Bed

A. Introduction

The idea is not new that the Department of Defense (DoD) needs to improve its capability to search a wide area within a perimeter.

In its October 2012 briefing to the DASD(NCB/NM),[1] a team from the Institute for Defense Analyses (IDA),[2] recommended that the DASD take the lead in a set of efforts to conduct a joint capability technology demonstration (JCTD) or field experiment to better understand what a multi-intelligence discipline approach to wide-area search within a perimeter could achieve.

The January 2014 report of the Defense Science Board Task Force on Assessment of Nuclear Monitoring and Verification Technologies envisioned a set of experiments to explore and develop both the full range of technical and operational capabilities that would be needed for a wide range of counter (clandestine) nuclear threats (CNT) scenarios, and also the test capabilities that would be necessary to conduct the experiments.

The full scope of the experiments and test bed cannot be known today but will be determined iteratively from the results of the initial or early experiments and ongoing analysis. However, to judge what might be involved to build the capability to conduct strategically significant experiments in the time frame of 2022–2027, this appendix lays out a notional path along which more and more demanding (and useful) experiments are performed by an increasingly capable organizational arrangement, called the test bed.

1 Deputy Assistant Secretary of Defense for Nuclear Matters, Office of the Assistant Secretary of Defense for Nuclear, Chemical and Biological Defense.

2 Also reported in Robert Bovey et al., *(U) Countering Nuclear Threats: Portfolio Management and Strategic and Capability* Frameworks, IDA Document D-4766, (Secret) (Alexandria, VA: Institute for Defense Analyses, March 2013).

B. Proposed Approach (By Calendar Year (CY))

1. CY2015 Activities

CY2015 Experiment

- The objective of the CY2015 experiment is to develop a multi-year plan of experiments/exercises that will allow DoD to assess current CNT capabilities and develop improved ones, working from initial small-scale experiments to later larger ones. (Preliminary descriptions of the notional experiments are given in the following sections.)

CY2015 Test-Bed Building

- Plan the details of the White Team that will design and develop the experiments and exercises.
- Nominate promising existing DoD and U.S. government (USG) systems and ongoing research and development (R&D).
- Assemble information on several real-world facilities and places that could be used for field testing.
- Begin work to create on a computer a simulated environment to explore CNT scenarios and plan experiments.

2. CY2016 Activities

CY2016 Experiment

- Conduct computer simulations to identify drivers of search performance and to help estimate the areas in which field exercises will take place. (For costing purposes, this paper assumes the area to be 100 km^2, 1,000 km^2, and 10,000 km^2.)

CY2016 Test-Bed Building

- Create the White Team at the beginning of 2016, initially six (two officers and four civilians). The IDA team judged that this is a minimum number to accomplish the work described below for CY2016 through CY2022.
- By the end of 2016, the White Team will assemble the following:
  - Lessons learned from counterterrorism campaigns for the CNT tasks.
  - Detailed descriptions of capabilities and costs of existing DoD/USG systems and ongoing R&D that were nominated in 2015.
  - Detailed reports on real-world facilities and places nominated (previously in 2015) for field testing.

- Library of existing directives, concept plans, operation orders, etc., pertaining to CNT and compare and contrast them.
- Detailed plan for the CY2017 experiment in detail, which will include testing the application of minimum cut set analysis to planning perimeters globally.
- Revise 10-year plan for experiments and for standing up and employing test bed.

3. CY2017 Activities

CY2017 Experiment

- Perform the first experiment, which will consist of three table top exercises (TTXs) supported by computer simulation to understand establishing a perimeter around an area.

  Note: For sake of concreteness, think in terms of an area of about 100 square km. (If the area were a circle, its circumference would be about 35 km; if a square, the edges would amount to 40 km.) This should be done for different terrains, with a TTX for each type (such as a terrain with few means of travel because of mountains or swamps, an open terrain, or an urban terrain).

  Each TTX has two test objectives to validate: (1) approximate capabilities of existing DoD and USG systems and those in R&D for use in establishing and operating a perimeter and (2) the existing directives for such activities.

- Test the computer modeling of a wide-area search for a diverted weapon or equivalent material, with the initial objective being to estimate the approximate capabilities of existing DoD and /USG systems and those in R&D.

CY2017 Test-Bed Building

- Establish the first Red Team consisting of three contractors to play the role of non-state groups who plan and execute diversions of single weapons or an equivalent amount of weapons grade material. The contractor organization, provider of the three contractors, will also commit to providing as many as 12 additional people for preparing for, conducting and debriefing exercises.
- Augment the White team with three contractors.
- Conduct negotiations with the top 6 to 10 real-world facilities and places nominated in 2015 (and researched in 2016) for field testing. Select two or three candidates.
- Plan the second set of experiments in detail.

- Conduct negotiations with Services, defense agencies and other government agencies for loan of equipment need for field exercises.[3]

4. CY2018 Activities

CY2018 Experiment

- Perform the second experiment, which will consist of the following:
  - A field exercise in which an (active or reserve) company-size unit deploys to a region in the United States, and, acting as Blue Team, establishes a perimeter around an area as described in the 2017 exercise. Blue will be equipped with appropriate detection equipment as determined by White Team. The Red Team (augmented by more contractors to create about six smaller red teams) seeks to penetrate at points and by methods determined by White Team, but unknown in advance by Blue. This implies that tests will take place in six 5-km. wide sectors. Only very general intelligence feeds will be provided to Blue. Over three days approximately 20 individual experiments will be conducted. (**Note:** These field tests only address perimeter penetrability.)
  - Perform a second set of three TTXs supported by computer simulation to understand searching an area around which a perimeter has been established in order to narrow the location of a source from a large area to an area of about one square km. The large area will be about 1,000 square km. If a circle, its circumference would be about 112 km and its diameter approximately 36 km. If a square, each side would be about 32 km.
  - Three TTXs will allow consideration of different terrains: One TTX for mountains or swamps, one for open fields and forests, and one for urban terrain. In each case, two test objectives will be (1) to validate approximate capabilities of existing DoD and USG systems and those in R&D for use in conducting a search and (2) to validate the existing directives.

CY2018 Test-Bed Building

- Expand White Team to 12 members: 2 officers, 4 civilians, and 6 contractors. Establish a physical office in the Washington, DC, area suitable for classified operations of 20 White Team people and 10 Red Team people.

[3] The IDA team notes that the White Team will need to arrange for the loan of equipment for field tests because the caches will not be created yet.

- Plan the third experiment(s) in detail. From this point on White Team plans experiments one year in advance.

5. CY2019–2020 Activities

CY2019–2020 Experiment

- Conduct one wide-area search experiment per year in which the task is to narrow the location of a source from a large area to an area of about 1 square km.
  - In 2019 and 2020, the large area will be about 1,000 square km; if a circle its circumference would be about 112 km and its diameter approximately 36 km. If it is a square, each side would be about 32 km. **Note:** These are the first actual *area* searches.
  - Simulated intelligence feeds will be provided by White Team controllers in addition to Red Team activities.
  - For costing purposes, assume that the Blue Team consists of 600 people and that it has the use of a UAV ISR asset.
- In each of 2019 and 2020 experiments, conduct two TTXs addressing the transition from large areas to small area. For planning purposes now, assume the large area will be 1,000 km^2 and the small area will be 1 km^2.

CY2019–2020 Test-Bed Building

- Expand White Team to 17 in 2019 and in 2020 to 20: 2 officers, 4 civilians and 14 contractors
- Expand Red Team to six contractors in 2019 and nine in 2020. The contractor organization will remain committed to providing an additional 12 people for preparing for, conducting and debriefing exercises.

6. CY2021–2022 Activities

CY2021–2022 Experiment

- Conduct one wide-area search experiment per year in which the task is to narrow the location of a source from a large area to an area of about 1 square km.
  - In 2021 and 2022, the large area will be about 10,000 square km; if a circle, its circumference would be about 355 km and its diameter approximately 113 km. If a square, each side would be about 100 km.
  - Simulated intelligence feeds will be provided by White Team controllers in addition to Red Team activities.

- For costing purposes, assume that the Blue Team consists of 900 people and that it has the use of an unmanned aerial vehicle for intelligence, surveillance, and reconnaissance asset.

- In each of 2021 and 2022 experiments, conduct two TTXs addressing the transition from large areas to small area. For planning purposes, now assume the large area will be 10,000 km^2 and the small area will be 1 km^2.

CY2021‑2027 Test-Bed Building

- Maintain the White and Red Team sizes.

7. CY2023–2027 Activities

CY2023–2027 Experiment

- Repeat each year the FTX and TTXs described for 2021 and 2022, varying the terrain and other features of the experiment in accordance with the test plan.

CY2023–2027 Test-Bed Building

- For the purpose of costing test-bed building activities, , assume that the White and Red teams remain at the size they were at the end of 2020.

C. FY Costs for CY2015–CY2027 Experiments

Table C-1. Estimated Yearly Outlays for Experimental Test-Bed (FY15 $M)

Year	15	16	17	18	19	20	21	22	23	24	25	26	27
MS&A	0.2	1.0	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
+TTX	0.2	1.0	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
+ FTX	0.2	1.0	3.4	5.0	9.5	11.1	11.6	11.6	11.6	11.6	11.6	11.6	11.6

MS&A – modeling, simulation, and analysis. TTX – table-top exercise. FTX – field exercise.

See the annotated Excel workbook on the accompanying compact disc for further cost detail.

Appendix D
Complementary Initiatives

A. Overview

The technical aspects, potential for catastrophic consequences, and geopolitical context of nuclear weapons in the hands of state and non-state actors bent on employing them for nefarious purposes require a tailored and time-sensitive response on the part of the United States and its partner nations. Data generated by intelligence, surveillance, and reconnaissance (ISR) assets must be accurately analyzed and quickly channeled to combatant commanders. Once these processes have identified a *hot spot*, appropriate ISR assets and processes must be brought to bear in a more focused manner. A hot spot is a specific area where a nuclear weapon or nuclear weapons material is or may be out of regulatory control. Also, forces must be deployed to locations where they can take action.

The remainder of this appendix describes a system that rapidly brings theater and tactical ISR, and U.S. and partner forces, to bear on hot spots. This appendix also posits a system for the United States European Command (USEUCOM) area of responsibility (AOR), but it could be extrapolated for other combatant commands with appropriate modifications.

B. Objective

The objective of the complementary initiatives discussed in this appendix is to establish a system that will bring ISR and forces to bear on a hot spot to detect, interdict, and safely neutralize nuclear weapons and nuclear weapons material that are likely to be employed against the United States, its partner nations, and/or its national interests.

C. Overall Approach to the Problem

The material that follows is based on a combined U.S.–North Atlantic Treaty Organization (NATO)–partner-nation solution to the problem of loose nuclear weapons and nuclear weapons material. The overall approach consists of the following:

1. Building on close working relationships between the United States and partner nations through the National Guard State Partnership Program (NG SPP) and developing counter (clandestine) nuclear threat (CNT) related capabilities within the ranks of partner-nation militaries;

2. Establishing processes that will rapidly employ ISR assets to provide on-scene commanders and higher authorities with actionable information on the scope, nature, and identity of threats and their perpetrators;
3. Creating a tailored command, control, and communications (C3) system that is well-exercised and capable of both efficiently leading and/or managing operations and keeping higher headquarters and authorities abreast of the situations; and
4. Providing support (coordination with other NATO nations and non-NATO partner nations, ISR, advisors, detection and sensor equipment) to partner nation forces who will lead and conduct CNT missions.

D. Geopolitical Dimension

From a NATO-USEUCOM perspective and in the context of the greatest likelihood of loose nuclear weapons and weapons material, the Institute for Defense Analyses (IDA) team assumed that planners would consider the arc from the Baltic Sea to the Black Sea and Caucasus (primarily the nations from the former Soviet Union or FSU). Further, the team assumed that when confronting potential loose nuke scenarios, the solutions would involve multiple nations. In considering how this alliance should best respond, planners would address (1) logistics and logistics hubs, (2) multi-nation operational plans and forces, and (3) command, control, communications, computers and intelligence (C4I).

SACEUR (Supreme Allied Commander, Europe) is invested by NATO with broad authorities to lead military operations on behalf of the Alliance. As such—and given the gravity of the CNT mission set—SACEUR will likely specify the elements of a C4I system (under the auspices of a NATO Standing Joint Task Force Headquarters, or SJTF HQ) and ensure an appropriately rigorous and thorough joint and combined planning and exercise regimen to prepare for CNT missions. Some of the nations that might be involved in a CNT operation are not NATO members. Therefore, SACEUR—through USEUCOM—would develop Memoranda of Understanding (MOUs) with those nations. The MOUs would cover protocols related to basing, employment of forces and related command relationships, logistics, and support to be provided by the United States and other NATO members.

In his dual capacity as Commander, USEUCOM, and SACEUR, the Commander would also task subordinate organizations at USEUCOM to support CNT operations. Deputy Commander, USEUCOM, would exercise these authorities at USEUCOM Headquarters (HQ) in Stuttgart, Germany.

The systems and processes that will be outlined in the remainder of this paper are akin to how the U.S. National Response Framework[23] is executed in times of domestic catastrophes. Under that plan, any number of sovereign states (eight states in the case of the projected response to a major earthquake along the New Madrid Fault in the region along the Mississippi River) would send forces and equipment as part of a coordinated federal response. The military aspect of the response would be led by a two-star Flag Officer appointed by Commander, USNORTHCOM. Through planning, exercising, and formulation of C3 protocols, what seems complicated becomes standard operating procedure and amenable to meeting time-sensitive requirements in a comprehensive and responsive manner.

E. ISR Assumptions

The narrative that follows is based on the following assumptions regarding ISR:

1. ISR assets are high demand and low density (HD/LD). Therefore, these assets will only be focused when the broad ISR array has detected a hot spot.
2. Once a hot spot has been identified, scarce ISR assets are brought to bear in a more focused manner.
3. Existing intelligence organizations—within and outside DoD—have personnel with expertise in CNT, including its relationship to counter terrorism.

F. System for Rapid Deployment of Forces and ISR for CNT Missions

While the current Observe-Orient-Decide-Act (OODA) Loop suffices for most instances, it may not be responsive enough for CNT missions with deployment requirements specified in hours, not days. This appendix posits a 12-hour window from the time actionable intelligence is received until the time forces arrive on station.

The system for rapid deployment of forces and ISR for CNT missions is designed to address ISR and force requirements for accomplishing CNT and NP missions. It includes the following components:

1. Availability of Main Operating Base and Forward Operating Locations (FOLs): ISR and other support forces would initially stage at the main operating base, Ramstein Air Base, Germany. They would then deploy to one or more of five FOLs currently used by U.S. forces in the AOR. The FOLs include facilities in Lithuania, Poland, Romania, Bulgaria, and Turkey. Once deployed, and if mission

[23] The National Response Framework is available through the Federal Emergency Management Agency, U.S. Department of Homeland Security, http://www.fema.gov/national-response-framework, accessed 18 September 2015.

requirements dictate, U.S. forces and partner-nation units would be able to conduct operations at partner-nation bases. Access to the partner nation is enhanced through ongoing SPP relationships between U.S. National Guard organizations and their respective SPP partner nations.

2. Access to USEUCOM's Nuclear Gear Reserve (Cache): This capability is designed to support rapid response operations and includes both equipment and personnel, as discussed in Appendix B. The USEUCOM cache is housed and maintained at Ramstein Air Base, Germany. The detector-based assets will support operations to increase border security and establish other secure perimeters. Also, sensors will be used to augment local search operations. Communication assets will provide tactical-level capabilities.

   Personnel assigned to the cache will have responsibilities associated with training and pre-event planning with NATO, USEUCOM force providers—including National Guard force enhancement teams (FETs)—and partner nations. The training will provide partner-military personnel the skills to use the detection, sensor, and communications equipment in carrying out CNT missions. The pre-event planning will provide the cache instructions as to how many of which pieces of equipment to deploy. Additional instructions will cover the priority order of equipment deployment and detailed pre-arrangements for transport of equipment directly to predetermined locations in the partner nation, accompanied by selected cache personnel.

3. Missioning of Theater and Tactical ISR: Once a credible threat is ascertained, additional theater and tactical ISR assets would be focused on the hot spot and surrounding region. These additional assets would include some or all of the following:

   a. Overflights by manned U.S. and other NATO aircraft. For example, the U.S. Army operates a number of MC-12W and C-12 fixed wing aircraft that host various ISR sensor systems. One such ISR sensor system is the Enhanced Medium Altitude Reconnaissance and Surveillance System (EMARSS), of which the Army plans to acquire 36 of these. The EMARSS system will consist of an electro-optical/infrared (EO/IR) full motion video (FMV) sensor, a communications intelligence (COMINT) collection system, an aerial precision geolocation system, line-of-site (LOS) tactical and beyond line-of-site (LOS/BLOS) communications suites, and two operator workstations. EMARSS aircraft will be located within Aerial Exploitation Battalions (AEB), which are assigned to the U.S. Army Intelligence and Security Command (INSCOM). EMARSS would be assigned to Ramstein AB, or a Forward Operating Location (FOL). Once there, they (EMARSS units, namely, the operators, maintenance crews, and other support personnel) would stand strip alert and be tasked as needed.

b. Remotely piloted aircraft (RPA) surveillance. RPAs provide real-time intelligence with far longer time on station than manned aircraft. However, routinely, the United States does not fly RPA missions in the USEUCOM AOR. It is assumed that the gravity of the CNT mission would warrant approval (pre-arranged in the event of such a mission requirement) from NATO. Assuming that to be the case, upon receipt of credible intelligence, RPAs capable of conducting intelligence gathering, would be assigned to Ramstein AFB, or to a FOL. Once there, they (RPA units, i.e., operators, maintenance crews, and other support personnel) would stand strip alert and be tasked as needed.

c. Signals intelligence (SIGINT)_support is provided by U.S. Army, Europe (USAREUR) units based in Germany and/or Italy.

d. Focused collection by U.S./other NATO/partner nation of HUMINT related to the CNT mission would be examined in pre-event planning and executed as appropriate. To ensure responsive (timely and comprehensive) ISR, SACEUR would take the lead to obtain a standing authorization from NATO to employ the ISR assets listed above. This authorization would specify CNT missions, ISR assets by NATO nation, areas for employment of ISR, and protocols for C4I and intel sharing. In addition, SACEUR would be responsible for semi-annual TTXs to exercise the process of focusing ISR for CNT missions based on a set of potential scenarios.

4. CNT Mission-Capable Forces from Partner Nations: Earlier, Appendix A described how the National Guard State Partnership Program (SPP) could be leveraged to build CNT-related mission capabilities in the forces of up to 18 partner nations (Tiers 1–2 bordering European Russia and a third tier). Specific tasks that need support from the capabilities that are being discussed in this appendix include the following:

   a. Strengthening border security and establishing temporary barriers inside countries to create containments or exclusion zones in a country.

   b. Interdicting the clandestine transportation/transfer of nuclear weapons or nuclear material across these borders and barriers.

   c. Although not among the initial missions of FETs, depending on results of the experimental test bed component, two additional tasks may be added:

      1) Searching for/detecting nuclear weapons and/or weapons material in wide areas.

2) Building relationships with local civilians, encouraging them to provide useful intelligence, and collecting intelligence.

It is these forces (approximately a battalion for each nation) that will be employed for ground operations in support of CNT missions. NATO and USEUCOM will support ground operations through logistics, C4I, medical, explosive ordnance disposal (EOD), and specialized equipment (e.g., sensors, detection devices). Priority CNT missions will likely include those related to establishing and maintaining inclusion/exclusion zones and perimeters, border security, force protection, searches/detection operations, and force protection.

5. Mission Support from a CNT Response Force (RFOR): Upon tasking from USEUCOM, MARFOREUR and USAREUR[24] would be responsible for organizing, training, and equipping three RFOR-capable units to provide specialized support to partner forces, which will actually lead and carry out CNT missions. The RFORs would only be involved in ground missions in the most extreme situations.

   Each RFOR would be on an increased readiness posture for four-month increments. This posture would require the unit to be on station at Ramstein AB within six hours of notification and to deploy by air thereafter to be held in reserve with the SJTF HQ. Each RFOR[25] would consist of two squads of experienced infantry-type personnel, commanded by an O-5, an EOD team, a medical squad, and two interpreters provided by Country Teams from the respective partner militaries.

   NAVEUR, based on tasking from the Commander, USEUCOM, will form a naval/naval air response force (e.g., coastal patrol boats, P-8 aircraft) from assets already in place during steady-state operations. The naval response force can be on station (i.e., in the hot spot area identified through ISR, if it is near the sea) within the 12-hour window established in this appendix. U.S., NATO, and other friendly naval forces are normally conducting operations in the Baltic, Mediterranean, and Black Seas; Azerbaijani and perhaps Kazakh units provide the only friendly coverage in the Caspian Sea. Normally, the United States would provide naval liaison personnel on the ships and aircraft of NATO and partner nations.

[24] MARFOREUR – U.S. Marine Forces, Europe. USAREUR – U.S. Army, European Command.

[25] The RFOR is not costed in this document because it consists entirely of forces otherwise occupied until called for in a crisis.

6. National Guard Forces—Augmenting USEUCOM, Country Teams, and Partner Nations by NG FETs: NG force enhancement teams (FETs), with intimate knowledge of SPP nations, will be valuable augmentees to USEUCOM, Country Teams, deployed HQs, and partner nations. In some cases, elements of the FETs will already be on-station in the USEUCOM AOR. If not, with proper prior preparations, they can deploy from CONUS in a relatively short period of time (about 24 to 36 hours) directly to their partner nation or other assignment (USEUCOM HQ, joint task force headquarters , or embassy) by commercial air.

   A core competency of the individual states' National Guard units (both Army and Air) is *consequence management*. Rapid response is common to the success of both CM and CNT missions. The National Guard routinely trains for and conducts CM operations and participates in combined CM training as part of the SPP. Further, 10 Homeland Response Forces (HRFs) have been established, trained, and resourced to provide USNORTHCOM and requesting states with robust CM forces to augment local civilian first responders and the initial deployment of nearby state NG forces. HRF-related planning and logistics experiences can serve to build capabilities for use in the event of CNT operations and, as an ancillary benefit, would be of great use in terms of preparing partner-nation personnel and organizations for consequence management and humanitarian relief operations.

   The pre-crisis establishment of NG FETs and their work with partner nations are detailed previously in Appendix A. This involves extensive work with USEUCOM staff to plan and rehearse responses to warning of a loose nuclear device or material. It also involves three major types of training:

   a. U.S.-based training to bring NG FETs, which will be composed of selected officers and senior noncommissioned officers (NCOs) with special forces, infantry, and security backgrounds—to proficiency in CNT and to communicate in the language of their partner nation.

   b. U.S.-based programs that bring small partner-nation force development teams (FDTs) comprising 15 to 20 personnel to train in the United States with their NG FET.

   c. Partner nation-based training conducted by small teams (squad-size) of NG FET and cache personnel, with elements of the partner-state FDT, for military units in the respective SPP nations. The focus of this training would be establishing inclusion/exclusion zones and perimeters in support of wide-area searches. This training would be designed to develop—in advance of actual CNT contingencies—competent cadres of partner-nation personnel who can respond readily to CNT contingencies by leading and conducting CNT missions.

7. Augmentation of the Country Team(s): Once ISR assets have identified a potential hot spot, USEUCOM would provide a team of military personnel to augment the respective Country Team(s). Each such augmentation team would include an officer from the relevant NG FET and three- to four specialists with expertise in relevant areas (i.e., regional terrorist networks, nuclear weapons/ weapons material, locals likely to abet terrorists or others seeking to use or move nuclear weapons/material, locals likely to support U.S./partner-nation CNT/NP missions, potential transit routes and concealment locations, and methods to collect near-real-time intelligence), enhanced computer and communications systems and systems operators, and, if appropriate, a security detachment.

   Intelligence specialists would be dispatched from the Command's intelligence center in the United Kingdom. Communications/computer personnel will be diverted from regular Reserve Component Combat Communications Squadron/ Group/Wing deployments to USEUCOM to support the Country Team augmentation.

8. Force Deployment and Sustainment Capabilities: USAFE and USAREUR would give precedence to the CNT missions for required aircraft, air crews, and associated logistics personnel through Air Tasking Orders (ATOs). Deployment priorities are in the order of the following items: nuclear gear cache and associated personnel to the affected partner nations, supporting theater and tactical ISR, SJTF HQ, RFOR, and partner nation CNT forces (to FOLs or other mission sites)

   Specifically, aircrews, support personnel, and aircraft would be responsible for loading, transporting, and sustaining the cache, tactical ISR, the SJTF HQ, and the RFOR. Aircraft likely would include six C-130J Hercules and six UH-60 Blackhawks. The Hercules would provide initial lift, medevac, and resupply/sustainment; the Blackhawks would provide tactical airlift to mission sites and, if needed, kinetic interdiction. Aircraft would initially stage at Ramstein AB. Ramstein also would receive in-coming medevaced personnel.

9. Senior-level Crisis Action Team (CAT): The USEUCOM J3 (Operations) (two-star) would chair the CAT. Additional members would include the Policy Advisor (POLAD) J2 (1-star), J5 (Strategic Plans and Policy) (two-star), an O-6 from SOCEUR, and—through secure video conferencing— either the U.S. ambassador(s) or Deputy Chiefs of Mission (DCMs) from the relevant partner nations. The CAT would carry out guidance from the Commander, USEUCOM, direct ongoing missions, task subordinate units (e.g., USEUCOM directorates,

USAFE, and MARFOREUR), and request support from NATO/partner nations through the USEUCOM Commander.

10. Combined C3: Before the event, SACEUR will establish a Combined SJTF HQ to ensure optimal situational awareness, fact-based decision-making, and time-sensitive flow of information—and to all key stakeholders, from senior political leaders in the affected nations to front-line military forces. The SJTF HQ provides command and control from a centralized secure facility in a political and/or military center closest to the identified threat.

    A likely Combined SJTF Commander would be Commander, SOCEUR. The individual in the Flag Officer position would possess the knowledge and experience to exercise leadership in a situation of rampant confusion and ambiguity.

    The HQ needs to be scaled to the size of the force—including provisions for command and coordination of NATO and partner-nation assets—based on the initial mission assessment of the Senior-level CAT. The SJTF HQ will number approximately 60 officers and will be staffed, primarily, by NATO and USEUCOM staff officers (from the intel, operations, logistics, plans and policy, and C4I directorates who possess country-specific and/or capability-specific expertise) plus interagency personnel from the fields of energy, countering nuclear threats, law enforcement, diplomacy, air traffic control, public health and medicine, and domestic support services such as food, shelter, and the like. The HQ will be augmented by a Flag Officer Liaison from each NATO and partner nation that will potentially provide operational forces to the CNT missions. These liaisons will be in close contact with their respective military chiefs. Integral to the HQ will be the Joint Communications Support Element, which rapidly delivers secure, reliable, and scalable communications capabilities.

11. NATO/Partner Nation Assets: Non-U.S. NATO nations and other partner nations will provide useful assets, including AWACS (Airborne Warning and Control System), coastal patrol craft, various detection and interdiction capabilities, and intelligence. The United States will augment as necessary. This analysis does not include specific concrete consideration of non-U.S. NATO capabilities. For example, as of the summer of 2015, NATO is setting up command posts in six eastern European locations: Lithuania, Latvia, Estonia, Poland, Bulgaria, and Romania. How these might be employed when established is not addressed here because sufficient information on them is not yet available. The following steps in the notional operational approach represent a linear perspective of how this system might be operationalized.

a. ISR assets deployed on a day-to-day basis detect a potential hot-spot. Intelligence is transmitted to, among other nodes, USEUCOM's intelligence center.

b. USEUCOM's J3 seeks and is granted authority to alert the SJTF HQ, the cache, NG FETs, RFOR and theater and tactical ISR crews; all organizations adopt a "ready" posture, for example:

   1) Cache personnel assemble designated equipment and move it to designated airfield location for loading. When aircraft is available they load their gear and proceed to the pre-agreed destination, where they will be met by partner-nation personnel.

   2) In the United States, National Guard FET personnel board early commercial flights to Europe.

   3) Others ensure all personnel are available and, if not, suitable substitutes are identified, to inspect personal and organizational equipment for usability and completeness and prepare equipment for loading.

   4) Further "readiness" measures include moving the appropriate number of C-130 aircraft to the ramps for loading or reserving civil air transportation at commercial air hubs. As noted in I above, the first available aircraft/flight proceeds.

c. Partner nation forces assume an enhanced CNT readiness posture.

d. Simultaneously, respective ambassadors are notified of the potential threat and the Command's preparatory actions.

e. CAT becomes operational. Cache equipment and personnel deploy to the partner nation(s). SJTF HQ is deployed to the FOL.

f. Country Team(s) is/are augmented by military personnel.

g. Theater and tactical ISR are "targeted" to collect intelligence related to the hot spot.

h. RFOR is deployed forward to vicinity of the SJTF HQ (FOL, bare base, or partner-nation airfield) and awaits tasking from the SJTF Commander.

i. USEUCOM intel center receives the latest intel collected from theater and tactical ISR assets. Fusion product is submitted to the CAT, SJTF HQ, and operators in the field, as appropriate.

j. CAT recommends either two or three courses of action (COAs) to the USEUCOM Commander. Recommendations include requests for assets from NATO nations/other partner nations.

k. USEUCOM Commander decides on the COA and relays the decision to the CAT and SJTF HQ. Communications systems/protocols are established to link SJTF HQ with NCAs.

l. CAT informs partner nation(s) that USEUCOM forces are ready to support the conduct of CNT missions. Assets from NATO/partner nations are coordinated through the NATO apparatus and/or Ambassadors.

m. Partner nation forces conduct CNT missions with support from U.S. cache personnel and equipment, and NG FET personnel; national, theater and tactical ISR continues to focus on hot spot and other related regions.

n. The partner-nation commanders (assisted by their FDT commander and their U.S. advisors —probably the respective Force Enhancement Team Commander) report and provide assessment of the mission to the SJTF HQ and CAT. They correlate this assessment with ISR-provided intelligence and determine what, if any, additional U.S. missions should be conducted.

o. Sustainment missions are conducted as needed.

p. CAT briefs USEUCOM Commander periodically, who reports to National Command Authorities.

Note: This system presupposes a rigorous exercise regimen involving the United States, other NATO nations, and other partner nations. Further, item *b* is, in effect, recommending a willingness to respond with first steps to what may turn out to be a false alarm to avoid the possibility of arriving too late to be effective in a real case.

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Appendix E
Costs for Alternative Force Enhancement Packages

Different mixes of the four components produce alternative force enhancement packages (FEPs). That is, they vary the number of National Guard Counter (Clandestine) Nuclear Threat (NG CNT) tiers, caches, and experimental test bed programs. Headquarters (HQ) elements vary somewhat to fit with the variations of the other components. The alternatives (to the base case) that were considered are discussed in this appendix. Their components were summarized originally in Table 2, which is repeated here as Table E-1.

The costs displayed in this appendix are planning estimates, not budget quality estimates. To estimate the approximate cost of these components, a research team from the Institute for Defense Analyses (IDA) employed its professional judgment to construct notional instantiations of them. The instantiations are described in Appendixes A through D and involved judgments at several points. Professional judgments were made as to how they would be created and operated, and that particular numbers of people and equipment would be reasonable in applications to countries that neighbor Russia from the Baltics to the Caspian Sea and perhaps into Central Asia.

The costs of alternative notional components were then estimated using the Department of Defense (DoD) planning factors for personnel and group activities,[1] the United States General Services Agency Global Supply Catalog prices[2] or prices recently paid for equipment, and sometimes commercial costs. The IDA team judged that the proposed components could fit into existing facilities and therefore no new facilities would be required.

[1] Available in Cost and Economics Office of the Deputy Assistant Secretary of the Army (DASA-CE), *Army Cost and Factors Handbook (CFH)*, 2010, and Office of the Under Secretary of Defense (Comptroller), "FY2016 DoD Military Personnel Composite Standard Pay and Reimbursement Rates." March 9, 2015.

[2] Available at http://www.gsa.gov.

Table E-1. Alternative Force Enhancement Programs

Alternative	A	B	C (Base)	D	E	F	G	H
NG Partner Tiers	3	3	2	2	1	0	1	0
Caches	3	2	2	1	1	0	1	1
Test Bed	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Representative costs (FY 2015 $M)								
FY15–17	6	6	6	6	6	5	1	1
FY18–22	163	163	163	150	135	49	86	46
FY23–27	266	230	201	164	136	58	78	42
FY15–27	435	399	370	320	276	112	165	89

The first option is a more extensive variant termed Alternative A, which includes three equipment caches and force enhancement teams (FETs) for 18 partner nations arranged into three groups. The 18 FETs would be grouped into the two Eastern European tiers and a third group would be either a third Eastern European tier or deployed in Central Asia or Southeast Asia. As with the baseline case, two caches would be located in the areas of responsibility (AORs) in the U.S. European Command (USEUCOM) and the U.S. Northern Command (USNORTHCOM). However, the location of the third cache and the third group would be determined after an assessment that would, at a minimum, include 1) an assessment of potential threats of loss of control over nuclear material in the region and 2) the mitigation of risk that would result from the emplacement of the additional cache and from the regional location of the third group. The cost and estimated timelines for Alternative A are given in Table E-2. The time needed to reach a completed deployment is extended by three years relative to the base case, and the out-year (FY2023–2027) costs are nearly a third greater.

Table E-2. Costs for Alternative A (FY15 $M)

Years	15	16	17	18	19	20	21	22	23	24	25	26	27
NG Prtnr	0	0	0	11.6	6.9	6.9	15.8	11.7	11.7	23.0	17.6	17.6	19.6
Caches	0	0	0	6.8	8.7	10.5	14.2	16.0	17.9	21.5	23.4	25.3	22.1
Test bed	0.2	1.0	3.4	5.0	9.5	11.1	11.6	11.6	11.6	11.6	11.6	11.6	11.6
Common	0.2	0.4	0.4	1.1	1.1	1.0	1.1	1.1	1.0	1.1	1.1	1.0	1.1
Total	0.4	1.5	3.8	24.4	26.0	29.5	42.2	40.1	42.0	56.7	53.2	55.1	57.4

Another option is Alternative B. This hybrid between Alternative A and the base FEP would include two caches but keeps three groups (18 nations) of NG FETs. An estimated set of yearly costs for this option is presented in Table E-3. The third group will be formed in FY24. (The costs of the base case (Alternative C) are displayed in Table 1 in the body of this IDA document.)

Table E-3. Costs for Alternative B: Hybrid FEP, Intermediate Between Base, and Alternative A (FY15 $M)

Year	15	16	17	18	19	20	21	22	23	24	25	26	27
NG Prtnr	0	0	0	11.6	6.9	6.9	15.8	11.7	11.7	23.0	17.6	17.6	19.6
Caches	0	0	0	6.8	8.7	10.5	14.2	16.0	17.9	14.7	14.7	14.7	14.7
Test bed	0.2	1.0	3.4	5.0	9.5	11.1	11.6	11.6	11.6	11.6	11.6	11.6	11.6
Common	0.2	0.4	0.4	1.1	1.1	1.0	1.1	1.1	1.0	1.1	1.1	1.0	1.1
Total	0.4	1.5	3.8	24.5	26.1	29.5	42.3	40.2	41.9	40.4	44.9	44.8	46.9

Lesser cases could also be considered if it were determined that fewer resources were available. For example, one lesser alternative (Alternative D) could include only one cache but maintain two groups of NG FET partner nations and the test bed. The corresponding cost table is given in Table E-4.

Table E-4. Costs for Alternative D: One Cache and Two Tiers of NG-Partner States (FY15 $M)

Year	15	16	17	18	19	20	21	22	23	24	25	26	27
NG Prtnr	0	0	0	11.6	6.9	6.9	15.8	11.7	11.7	13.1	11.7	11.7	13.1
Cache	0	0	0	7.3*	9.2	11.0	7.9	7.9	7.9	7.9	7.9	7.9	7.9
Test Bed	0.2	1.0	3.4	5.0	9.5	11.1	11.6	11.6	11.6	11.6	11.6	11.6	11.6
Common	0.2	0.4	0.4	1.1	1.1	1.0	1.1	1.1	1.0	1.1	1.1	1.0	1.1
Total	0.5	1.5	3.8	25.0	26.6	30.0	36.3	32.3	32.2	33.6	32.3	32.2	33.6

* With one cache supporting two tiers, cache costs will be as much as $ 0.5 million higher each year because of added need for cache personnel to travel to more training events.

Still less extensive alternatives may be imagined. If, for example, decision-makers may wish to try out a system with fewer FEPs because of their own risk assessments or simply a desire to test the effectiveness of the concept before committing to a larger investment. One could start with just one cache in the USEUCOM AOR, one group of NG FETs, with or without the test bed. Or one could proceed with only the test bed or with only a single cache. These alternatives are presented in Tables E-5 through E-8.

Considering the relative effectiveness of the various alternatives, the team concluded that the greater the number of (non-collocated) caches, the less time would be needed to deploy pre-positioned equipment to the area of crisis. Similarly, the more tiers of collaborating nations, the greater the likelihood of an effective response to an incident in a nation that has become the site of illicitly transported nuclear material. The trade-offs between *cost* and a *rapid and effective response* cannot be more precisely determined in advance because the specific events that will unfold are unpredictable: even if one limits consideration to an incident that starts with loss of material in Russia, there are many escape routes that the material could take, and there are different Tier 1 and Tier 2 nations that could become locations requiring a crisis response.

Table E-4. Costs for Alternative E – Test Bed, One Cache, and One Tier (Seven Nations) of NG FETs (FY15 $M)

Year	15	16	17	18	19	20	21	22	23	24	25	26	27
NG Prtnr	0	0	0	11.6	6.9	6.9	7.5	6.9	6.9	7.5	6.8	6.8	7.5
Cache	0	0	0	6.8	8.7	10.5	7.4	7.4	7.4	7.4	7.4	7.4	7.4
Test bed	0.2	1.0	3.4	5.0	9.5	11.1	11.6	11.6	11.6	11.6	11.6	11.6	11.6
Common	0.2	0.4	0.4	1.1	1.1	1.0	1.1	1.1	1.0	1.1	1.1	1.0	1.1
Total	0.5	1.5	3.8	24.5	26.1	29.5	27.6	27.0	26.9	27.6	26.9	26.8	26.9

Table E-5. Costs for Alternative F – Test Bed Only (FY15 $M)

Year	15	16	17	18	19	20	21	22	23	24	25	26	27
Test bed	0.4	1.0	3.4	5.0	9.5	11.1	11.6	11.6	11.6	11.6	11.6	11.6	11.6

Table E-7. Costs for Alternative G – One Cache and One Tier (Seven Nations) of NG FETs (FY15 $M)

Year	15	16	17	18	19	20	21	22	23	24	25	26	27
NG Prtnr	0	0	0	11.6	6.9	6.9	7.5	6.9	6.9	7.5	6.8	6.8	7.5
Cache	0	0	0	6.8	8.7	10.5	7.4	7.4	7.4	7.4	7.4	7.4	7.4
Common	0.2	0.4	0.4	1.1	1.1	1.0	1.1	1.1	1.0	1.1	1.1	1.0	1.1
Total	0.2	0.5	0.5	19.5	16.6	13.4	16.0	15.3	15.2	16.0	15.3	15.2	16.0

Table E-8. Costs for Alternative H – One Cache Only (FY15 $M)

Year	15	16	17	18	19	20	21	22	23	24	25	26	27
Cache	0.4	0.4	0.4	7.8*	9.7	11.5	8.4	8.4	8.4	8.4	8.4	8.4	8.4

* The cost of the cache will increase by about one million dollars per year starting in FY18 and beyond to add personnel to compensate, in part, for activities that the NG FETs would have been accomplishing in alternatives that include them.

Appendix F
Illustrations

Tables

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Appendix G
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Appendix H
Abbreviations

$B	billion dollars
$M	million dollars
AEB	Aerial Exploitation Battalions
AFB	Air Force Base
AFSC	Air Force Specialty Code
AISR	Airborne Intelligence Surveillance and Reconnaissance
AN/GAR-2 LKMD	Light Kit Motion Detection sensor, model AN/GAR-2
AN/PPS-26 STTW	Sense Through The Wall sensor, model AN/PPS-26
AN/PRS-9 BAIS	Battlefield Anti-Intrusion System, model AN/PRS-9
AN/PVS-14 MNVD	Monocular Night Vision Device, model AN/PVS-14
AOR	area of responsibility
ARRT-1	Applied Radiological Response Techniques Level 1
ASAP	as soon as possible
ASD(NCB)	Assistant Secretary of Defense for Nuclear, Chemical, and Biological
ATO	Air Tasking Order
BLOS	beyond line-of-site
C2	command and control
C3	command, control, and communications
CAT	Crisis Action Team
CB	chemical-biological
CBRN	chemical, biological, radiological and nuclear
CCS	Contamination Control Station
CDR	commander (of a combatant command)
CDRUSEUCOM	Commander, United States European Command
CHARCS	Counterintelligence and Human Intelligence Automated Reporting and Collection Systems
CI	counterintelligence
CM	consequence management
CNT	Counter (Clandestine) Nuclear Threat
COA	courses of action
COCOM	combatant command
CONUS	continental United States
COS	Chief of Staff
CST	Civil Support Team
CSTO	Collective Security Treaty Organization
CWMD	countering weapons of mass destruction
CY	calendar year

DASA-CE	Deputy Assistant Secretary of the Army for Cost and Economics
DASD	Deputy assistant Secretary of Defense
DASD(NCB/NM)	Deputy Assistant Secretary of Defense (Nuclear, Chemical and Biological Defense/Nuclear Matters)
DHS	Department of Homeland Security
DNWS	Defense Nuclear Weapons School
DoD	Department of Defense
DOE	Department of Energy
DOJ	Department of Justice
DOS	Department of State
DTRA	Defense Threat Reduction Agency
EACU	Eurasian Economic Union
EMARSS	Enhanced Medium Altitude Reconnaissance and Surveillance System
EO/IR	electro-optical/infrared
EOD	explosive ordnance disposal
FBI	Federal Bureau of Investigation
FDT	Force Development Team
FEP	force enhancement package
FET	force enhancement team
FMV	full motion video
FOL	Forward Operating Location
FSU	Former Soviet Union
FTX	field exercise
FY	fiscal year
GAO	U.S. Government Accountability Office
GCC	geographic combatant command
GDF	Guidance to Develop the Force
GEF	Guidance to Employ the Force
GSA	General Services Administration
GTEP	Georgia Train and Equip
HD/LD	high demand/low density
HPGe	high purity germanium
HQ	headquarters
HRF	Homeland Response Forces
HSPD-5	Homeland Security Presidential Directive –5
HUMINT	human intelligence
IDA	Institute for Defense Analyses
INSCOM	Intelligence and Security Command
IOC	Initial Operational Capability
IR	infrared
IRF	Initial Response Force
ISR	intelligence, surveillance, and reconnaissance
JCSE	Joint Communications Support Element
JCTD	joint capability technology demonstration
JPEO	Joint Program Executive Office
JPEO	Joint Program Executive Office

kW	kilowatt
LOS	line-of-sight
MARFOREUR	Marine Corps Forces, Europe
MC	Mission Commander
MISO	Military Information Support Operations
MOS	Military Occupational Specialty
MS&A	modeling, simulation, and analysis
NATO	North Atlantic Treaty Organization
NAVEUR	United States Naval Forces, Europe
NCB	nuclear, chemical biological
NETOPS	Nuclear Emergency Team Operations
NG	National Guard
NG SPP	National Guard State Partnership Program
NIC	National Intelligence Council
NIMS	National Incident Management System
NNSA	National Nuclear Security Administration
NOFORN	Not Releasable to Foreign Nationals
NP	non-proliferation
NRF	National Response Framework
OASD	Office of the Assistant Secretary of Defense
OASD(NCB)	Office of the Assistant Secretary of Defense for Nuclear, Chemical, and Biological Defense
OC	Operations Chief
OCONUS	outside continental United States
ODASD(NCB/NM)	Office of the Deputy Assistant Secretary of Defense for Nuclear Matters
OEF	OPERATION ENDURING FREEDOM
OEG	Operational Exposure Guidance
OMB	Office of Management and Budget
OMLT	Operational Mentoring Liaison Teams
OMT	Operational Management Team
OODA	Observe-Orient-Decide-Act
OPORD	operation order
OSD	Office of the Secretary of Defense
OSD	Office of the Secretary of Defense
PBD	program budget decision
PDM	program decision memorandum
POM	program objective memorandum
PPBE	Planning, Programming, Budgeting and Execution (system)
PSAG	Physical Security Enterprise and Analysis Group
R&D	research and development
RADIAC	radiation detection, identification, and computation
RFOR	Response Force
RIID	Radioactive Isotope Identification Detectors
RPA	Remotely Piloted Aircraft
RTF	Response Task Force
SACEUR	Supreme Allied Commander, Europe

SF	special forces
SJTF	Standing Joint Task Force
SPP	State Partnership Program
TEAMS	Technical Evaluation Assessment Monitor Site
TO	Tactical Officer
TRNOC	Tactical Radiological/Nuclear Operations Course
TTP	tactics, techniques, and procedures
TTX	table-top exercise
UAV ISR	Unmanned Aerial Vehicle for Intelligence, Surveillance and Reconnaissance
USAFE	United States Air Force, Europe
USAREUR	United States Army, Europe
USEUCOM	United States European Command
USG	U.S. government
USNORTHCOM	United States Northern Command
USPACOM	United States Pacific Command
USSOUTHCOM	United States Southern Command
WMD	weapon of mass destruction
WMDC3	Weapons of Mass Destruction Command, Control, and Communications

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6. AUTHOR(S)
Bovey, Robert L.
Fainberg, M. Anthony
Bashaw, Vernon D.
Brooks, Linton F.
Celec, Frederick S.
Cuda, Daniel L.
Dubin, Rachel D.
Harvey, John R.
Heady, S. Curtis
Wagner, Richard L.

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Institute for Defense Analyses
4850 Mark Center Drive
Alexandria, VA 22311-1882

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Office of Countering Nuclear Threats
Office of the DASD(NCB/NM), Room 3B884 the Pentagon
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14. ABSTRACT
In the 2022–2027 time frame, the United States and its allies will continue to face the threat of a state or non-state actor seeking to deliver clandestinely a nuclear weapon or improvised nuclear device to a U.S. or allied city, or to another target and detonating it there. This document discusses how the future threat may differ from the current one in 2015. It postulates candidate force enhancement packages (FEPs) that would be sensible for the Department of Defense to obtain in the interim, and to participate in the interagency and work with international partners to counter weapons of mass destruction. An IDA research team created a notional scenario involving either criminals or terrorists moving a single nuclear device or significant quantities of materials used in nuclear weapons into or across Europe, Central Asia, and North America. The proposed FEPs were derived from an IDA analysis based on this scenario.

15. SUBJECT TERMS
Clandestine, nuclear, counter weapons of mass destruction (CWMD), counter nuclear threats (CNT), weapon of mass destruction (WMD), force enhancement package (FEP), scenarios, National Guard (NG), State Partnership Program (SPP), test bed, Nuclear Gear Reserves (caches), threat assessment, terrorist, cyberattack, Baltics.

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