THE IMPACT OF ANSI STANDARDS ON NUCLEAR PROLIFERATION AND SMUGGLING FISSILE MATERIALS INTO THE UNITED STATES

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Abstract

There has been an accelerating national interest in countering nuclear smuggling. This has caused a corresponding expansion of interest in the use of gamma-ray spectrometers for checkpoint monitoring, nuclear search, and within networks of nuclear and collateral sensors. All of these are fieldable instruments—ranging from large, fixed portal monitors to hand-held and remote monitoring equipment. For operational reasons, detectors with widely varying energy resolution and detection efficiency will be employed. In many instances, such instruments must be sensitive to weak signals, always capable of recognizing the gamma-ray signatures from nuclear weapons materials (NWM), often largely insensitive to spectral alteration by radiation transport through intervening materials, capable of real-time implementation, and able to discriminate against signals from commonly encountered legitimate gamma-ray sources, such as radiopharmaceuticals. Several decades of experience in classified programs have shown that all of these properties are not easily achieved and successful approaches were of limited scope—such as the detection of plutonium only. Source: National Military Strategy for Combating Weapons of Mass Destruction- 13 February2006

Introduction

The American public has generally recognized the dangers of weapons of mass destruction.[1] Less understood or well known is the fact that the most important threat to US national security may be the growing stockpiles of nuclear weapons grade fissile materials (plutonium and highly enriched uranium (HEU),[2] much of which is uncontrolled and unsecured in the former Soviet Union. Fissile materials [3] are the essential elements for nuclear bomb making. Access to these materials is the primary technical barrier to a nuclear weapons capability since the technological know how for bomb making is publicly available. Given the already prevalent availability of technology and information associated with building nuclear weapons the greatest threat and challenge to the nuclear nonproliferation regime, recently reaffirmed by the international community with the approval in May of 1995 of the indefinite extension of the Nuclear Nonproliferation Treaty (NPT), is controlling and limiting the spread of nuclear weapons usable fissile materials. The gravest danger our Nation faces lies at the crossroads of radicalism and technology. Our enemies have openly declared that they are seeking weapons of mass destruction, and evidence indicates that they are doing so with determination. The United States will not allow these efforts to succeed. We will build defenses against ballistic missiles and other means of delivery.

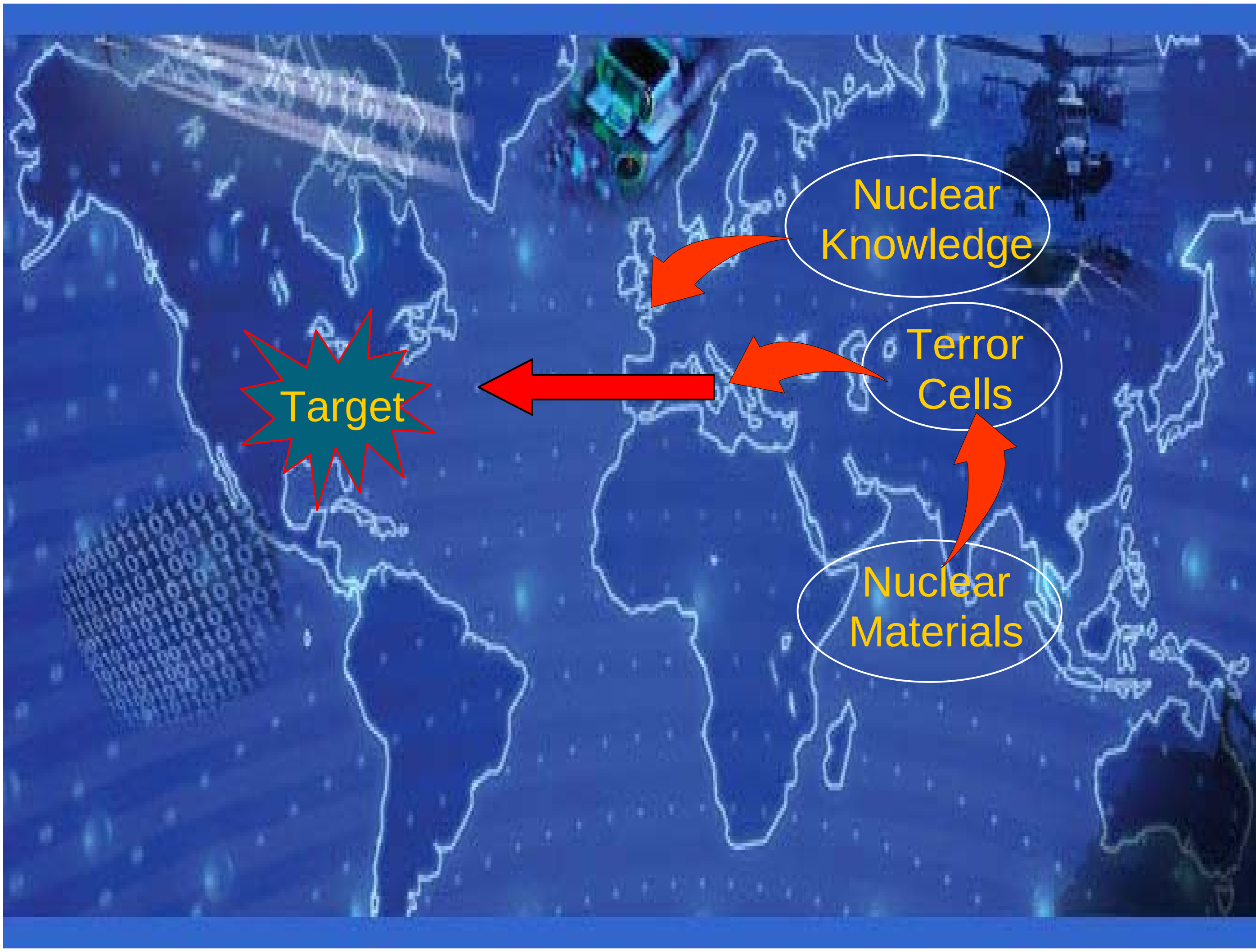
We will cooperate with other nations to deny, contain, and curtail our enemies' efforts to acquire dangerous technologies. And, as a matter of common sense and self-defense, America will act against such emerging threats before they are fully formed. We cannot defend America and our friends by hoping for the best. So we must be prepared to defeat our enemies' plans, using the best intelligence and proceeding with deliberation. History will judge harshly those who saw this coming danger but failed to act. In the new world we have entered, the only path to peace and security is the path of action. We are also guided by the conviction that no nation can build a safer, better world alone. Alliances and multilateral institutions can multiply the strength of freedom-loving nations. *U.S. Nuclear Weapons: Changes in Policy and Force Structure Amy F. Woolf Specialist in National Defense Foreign Affairs, Defense, and Trade Division, January 23, 2008,* The United States is committed to lasting institutions like the United Nations, the World Trade Organization, the Organization of American States, and NATO as well as other long-standing alliances. Coalitions of the willing can augment these permanent institutions. In all cases, international obligations are to be taken seriously. They are not to be undertaken symbolically to rally support for an ideal without furthering its attainment.

Freedom is the non-negotiable demand of human dignity; the birthright of every person—in every civilization. Throughout history, freedom has been threatened by war and terror; it has been challenged by the clashing wills of powerful states and the evil designs of tyrants; and it has been tested by widespread poverty and disease. Today, humanity holds in its hands the opportunity to further freedom's triumph over all these foes. The United States welcomes our responsibility to lead in this great mission

Since the end of the Cold War, a new nuclear weapons black market has sprung up in Moscow, Germany, and many other European countries. The growing black market, known to national security experts as the 'loose nukes' problem, has grown at such an alarming rates that it seems that just about any one can buy uranium, plutonium, and other weapons grade material on the street. U.S.allies, recognized nuclear states,[1] and non-nuclear powers alike worry about the possible consequences of loose nukes: Terrorist organizations like the Russian Mafia and the antifada becoming nuclear powers or the likelihood that some of these dangerous materials being transferred to rogue states like Iran, Iraq, or North Korea.

Even if the uranium and plutonium are not used to build nuclear technology, these materials are radioactive and therefore intrinsically dangerous to any one who comes in contact with them, particularly the smugglers themselves. Below is an illustrative map which captures Countries of interest for tagging, tracking and locating fissile or fissionable materials. "The greatest danger our Nation faces lies at the crossroads of radicalism and technology. Our enemies have openly declared that they are seeking weapons of mass destruction, and evidence indicates that they are doing so with determination. The United States will not allow these efforts to succeed.

U.S. General Accounting Office, Combating Nuclear Smuggling: GAO Report 07-347RMarch 2007
Jane's BioDefense Magazine MEGAPORTS INITIATIVE TO PREVENT NUCLEAR SMUGGLING 8-Jun-2005



Source: Defense Threat Reduction Agency Loose Nukes Brief- 04/10/05

It is now the strategic policy of the United States to use force preemptively to stop terrorists and their state supporters from attacking this country or its nationals, its facilities, and its allies. But this is a recent development. Until 9/11, the use of force to preempt attacks was not seriously discussed, let alone seriously undertaken. The model for fighting terror was based on the notion that terrorism is a crime, and that terrorists should be pursued as criminals. When President Clinton promised to "bring terrorists to justice" he meant that he would investigate them, tries to capture them, and when that was possible he would see that they were tried, convicted, and sent to prison. Preventing terrorist attacks became a game in which national security experts, the FBI, prosecutors, and intelligence personnel attempted to learn where and when attacks were to occur before they actually happened, so they could do their best to prevent them, or to reduce their impact. Source:

Controlling fissile materials is important because once these materials are acquired; construction of nuclear weapons is a relatively straightforward proposition for sophisticated terrorists or proliferant states. Even relatively unsophisticated terrorist groups could make a crude but workable nuclear bomb in the 10-to-100 kiloton range.[4] one physicist involved in the Manhattan Project noted:

With modern weapons grade uranium, the background neutron rate is so low that terrorists, if they had such material, would have a good chance of setting off a high yield explosion simply by dropping one half of the material onto the other half. Most people seem unaware that if separated U-235 is at hand it's a trivial job to set off a nuclear explosion. Even a high school kid could make a bomb in short order.[5]

Nuclear facility scientists, engineers, and other workers not only have a motive for nuclear trafficking they also have the opportunity. Security is more lax at most Russian nuclear facilities than at many ordinary office buildings in the US.

The chairman of a National Academy of Sciences panel that recently studied the problem of plutonium disposition observed firsthand the continuing deterioration of basic custodial and control arrangements over fissile materials, commenting that any day now we could wake up and read in the newspaper that enough material for a dozen bombs really has been stolen. . . .[10]

While security is incredibly lax, accountability is nonexistent. The facts about the magnitude of this problem are sobering: There is no national fissile material control and accounting in Russia. No one knows exactly how much plutonium or HEU they have, and at most sites they do not even know if any plutonium or HEU is missing.[11] The deputy chairman of the nuclear oversight agency Gosatomnadzor (GAN), Yuri Zubkov, said that Russia is facing a critical problem of establishing strict control and accounting for nuclear materials. We are just at the beginning.[12] Creating such a system will be a gigantic task. And while the system is slowly being built by a government beset with financial difficulties and rampant graft and corruption, struggling in an insecure world, it will be increasingly difficult for unpaid, desperate employees to resist the fortunes offered for an unaccounted fistful of radioactive doom

What are Fissile and Fissionable Materials?

Although sometimes used as a synonym for fissionable material, this term has acquired a more restricted meaning. Namely, any material fissionable by thermal (slow) neutrons. The three primary fissile materials are uranium-233, uranium-235, and plutonium-239
A *fissionable material* is composed of nuclides for which fission with neutrons is possible. All fissile nuclides fall into this category. However, also included are those nuclides that can be fissioned only with high energy neutrons. The change in binding energy that occurs as the result of neutron absorption results in a nuclear excitation energy level that is less than the required critical energy. Therefore, the additional excitation energy must be supplied by the kinetic energy of the incident neutron.
Nuclear Files.org *http://www.nuclearfiles.org/*

The reason for this difference between fissile and fissionable materials is the so-called odd-even effect for nuclei. It has been observed that nuclei with even numbers of neutrons and/or protons are more stable than those with odd numbers.

Therefore, adding a neutron to change a nucleus with an odd number of neutrons to a nucleus with an even number of neutrons produces an appreciably higher binding energy than adding a neutron to a nucleus already possessing an even number of neutrons.

Some examples of nuclides requiring high energy neutrons to cause fission are thorium-232, uranium-238, and plutonium-240. Table 4 indicates the critical energy (E_{crit}) and the binding energy change for an added neutron (BE_n) to target nuclei of interest. For fission to be possible, the change in binding energy plus the kinetic energy must equal or exceed the critical energy ($DBE + KE \geq E_{crit}$)

A method and associated apparatus for detecting concealed fissile, fissionable or special nuclear material in an article, such as a shipping container, is provided. The article is irradiated with a source of fast neutrons, and fast neutrons released by the fissile or fissionable material, if present, is detected between source neutron pulses. The method uses a neutron detector that can detect and discriminate fast neutrons in the presence of thermal neutrons and gamma radiation. The detector is able to process high count rates and is resistant to radiation damage, and is preferably a solid state neutron detector comprised of silicon carbide. *U.S. General Accounting Office, Combating Nuclear Smuggling: GAO Report 07-347RMarch 2007*

Typical Smuggling Scenario:

In September 2002 ABC News smuggled a 15-pound (6.8-kilogram) cylinder of depleted uranium metal, loaned by NRDC, into the United States, and televised the story on the first anniversary of the September 2001 terrorist attacks. In September 2003, the network did it again. It smuggled the same uranium cylinder into the country and aired another story on September 11, 2003.

Although the material is relatively harmless depleted uranium, weapon-grade uranium also would have passed through U.S. Customs without being detected. The lesson? Security procedures at U.S. borders cannot detect highly enriched uranium.

In 2002 the network shipped the depleted uranium cylinder, which is about the size of a soda can, by ocean freight from Istanbul to New York. In 2003, the network shipped it in a teak trunk from Jakarta to Long Beach, a port near Los Angeles.

In 2002 U.S. Customs inspected the shipping container at Staten Island in New York and failed to detect the uranium. In 2003, U.S. Customs inspected the container at Long Beach and again failed to detect it.

"The fact that ABC News was able to smuggle in what could have been weapon-grade uranium a second time speaks volumes about the failure of the Bush administration to secure nuclear weapon materials," said Tom Cochran, the physicist who heads NRDC's Nuclear Program. "We must eliminate the commercial use of weapon-usable uranium and reduce the inventories of highly enriched uranium used for weapons. U.S. Customs simply cannot stop it from being smuggled into the country."
http://www.nrdc.org/nuclear/furanium.asp The ABC News Nuclear Smuggling Experiment September 11, 2003

Do the US Standards Impact Our Ability to Defend Ourselves?

The American National Standards Institute (ANSI) coordinates development and use of voluntary consensus standards in the United States and represents the needs and views of U.S. stakeholders in standardization forums around the globe. ANSI N42.33 - Performance Criteria for Hand-held Instruments for the Detection and Identification of Radionuclide's. This standard addresses instruments that can be used for homeland security applications to detect and identify radionuclides, for gamma doserate measurement, and for indication of neutron radiation.

This standard specifies general requirements and test procedures, radiation response requirements, and electrical, mechanical, and environmental requirements. Successful completion of the tests described in this standard should not be construed as an ability to successfully identify all isotopes in all environments.

The ANSI standard goes on to specify technical performance requirements and performance testing requirements for those purchasing and using portable radiation survey meters and portable radiation detectors for Homeland Security and DOD applications. Furthermore, establishes design and performance criteria, test and calibration requirements, and operating instruction requirements for portable radiation detection instruments.

The following standards are under consideration;

- ANSI N 42.37 Training Requirements
- ANSI N 42.38 Spectroscopic Portal monitors
- ANSI N 42. 39 Portable Neutron Detectors
- ANSI N 42. 41 Active Interrogation System
- ANSI N 42. 42 Data Format
- ANSI N 42. 43 Mobile and Transport Systems
- ANSI N 42 xx Equipment in Extreme Environments
- ANSI N 42 xx Spectroscopic Personal Radiation Detectors
- ANSI N 42 xx Personal Radiation Dosimeters

Other applicable standards include; IEC 62401 - Alarming Personal Radiation Detectors (PRDs) for Border Radiation Monitoring, IEC 62327 – Hand-held instruments for the Detection and Identification of Radionuclide's and Additionally for the Indication of Ambient Dose-Equivalent Rate from Photon Radiation,

IEC 62244 - Installed Radiation Monitors for the Detection of Radioactive and Special Nuclear Materials at National Borders

- IEC 62401 - Alarming Personal Radiation Detectors (PRDs) for Border Radiation Monitoring
- IEC 62327 – Hand-held instruments for the Detection and Identification of Radionuclide's and Additionally for the Indication of Ambient Dose-Equivalent Rate from Photon Radiation
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Source: OMB Circular 119 http://www.whitehouse.gov/omb/circulars/a119/a119.html#13

ANSI developed the Radiation standards to;

- Set the baseline standard for capabilities needed
- Allow for comparison between instruments
- Leverage emergent technologies
- Minimize collateral damage-inadvertent exposure to radiation hazards

Voluntary Standards

Voluntary standards arise from a formal, coordinated, consensus-based and open process. Their development depends upon data gathering, a vigorous discussion of all viewpoints, and agreement among a diverse range of stakeholders. Many standards are written as voluntary standards. Interested parties may participate in the development voluntarily and the use of the finished standard is voluntary. The standards organization usually does not have any way to impose their use or to enforce compliance. [2] People and organizations may choose to use or not to use a published voluntary standard. Voluntary standards serve as the cornerstone of the distinctive U.S. infrastructure. Thousands of individuals, companies, labor, consumer and industrial organizations, and government agencies at the federal, state and local level voluntarily contribute their knowledge, talents and efforts to standards-setting activities. Some standards are written to be mandatory standards. *Source: OMB Circular 119 http://www.whitehouse.gov/omb/circulars/a119/a119.html#13*

When standards work poorly, they can:

- Constrain innovation and entrench inferior technologies.
- And hinder the development of interoperable systems
- Raise transaction costs and barriers to trade.

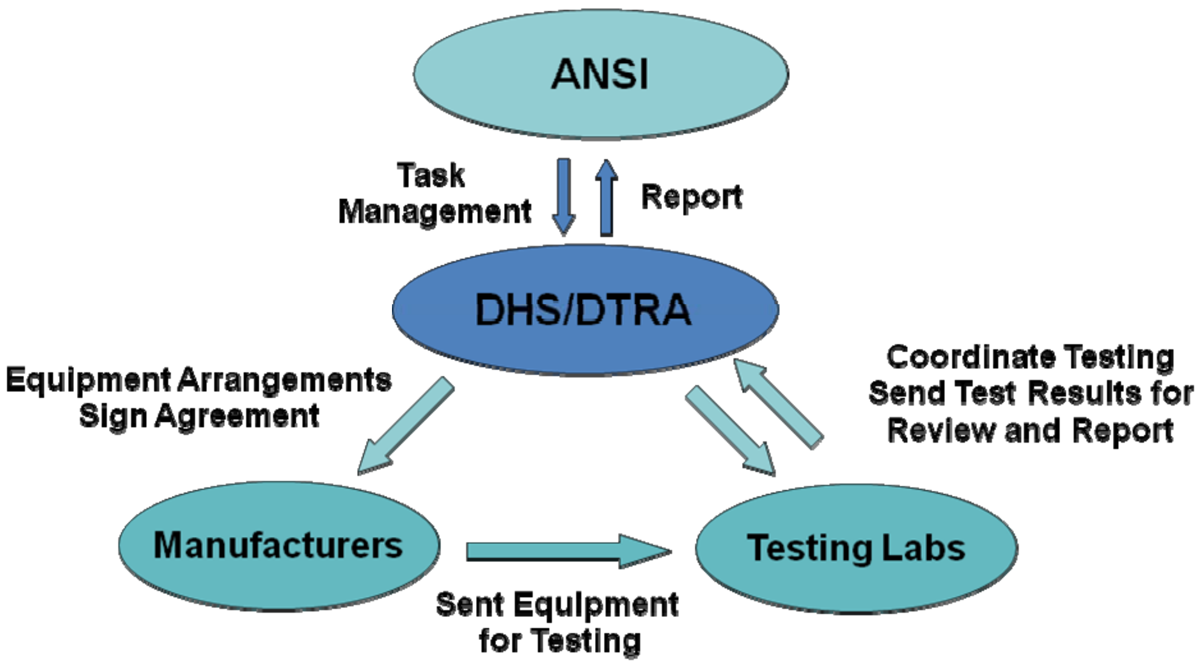
IMPACT OF STANDARDS ON SMUGGLING

Many global standards share these features of “extrinsic,” as opposed to “intrinsic” benefits to users, and the rise of new global standards allows cooperation among greater numbers of people than ever before. But it also threatens to edge out less dominant standards, and to stifle decentralized innovation. Nowhere are these dynamics clearer than in the fight over standards in high technology the performance criteria for active interrogation systems in homeland security applications are described in this standard. These systems are intended for non-intrusive inspection of closed containers, vehicles, and packages of a wide range of types and sizes. In these systems, the contents of an inspection zone are irradiated with penetrating ionizing radiation to determine the presence of a hidden substance-of-interest by the analysis of stimulated secondary radiations or nuclear-resonance absorption spectra that are indicative of the chemical and/or nuclides composition of the substance-of-interest

POSITIVE EFFECTS OF STANDARDS

- Promote market efficiency and expansion
- Foster international trade
- Encourage competition and lower barriers to market
- Speed diffusion of new technologies

TESTING OF ANSI STANDARDS



Source: National Institute of Standards and Technology

- Radiological tests: exposure rate, background, false alarm, gamma and neutron response, radionuclide identification
- Environmental tests: temperature, humidity, sealing
- Mechanical tests: mechanical shocks, vibration, drop test
- Electromagnetic tests: external magnetic fields, radio frequency, conducted disturbances (burst and radio frequencies), surges and oscillatory waves, electrostatic discharges

Present Gaps and Concerns

The Department of Defense and Other Governmental Agencies have not completely solved the illicit trafficking challenge; many areas of concerns are still requiring further investigation such as;

- False Negatives/False Positives
- Range of Passive Sensors are limited
- Stand Off Detection Capability not robust
- Calibration and maintenance of equipment once in the field
- Consistent Application of Technology
- Dose Consideration Personnel and Equipment
- Establish a threshold of performance
- Users should have a mechanism to ensure that instrument performance is not degraded with use
- Manufacturers need to provide a test result summary for each instrument shipped to user
- Acceptance testing performed by users for equipment purchased before deployment Users need to screen for dead on arrival instruments Standards for response

Conclusion

The United States has unique capabilities to support the National Security interest of the country to blunt the effects of smuggling. Many of these technologies pose significant hazard to human life. The potential human health effects of low doses of ionizing radiation such as those experienced in occupational and medical exposures are of great contemporary interest. The US government is acutely aware that we must continue to deploy systems not only to our seaports, but to our Northern and Southern land borders. We are working closely with US and Coalition partners to deploy both current and next-generation technologies in a timely manner. Whether we are providing systems to Ports of Entry or Border Patrol agents, the DOD and Other governmental agencies are committed to providing the best technologies that have the capabilities to successfully detect radiological and nuclear threats and the necessary operational support to ensure effective response. Key goals are to;

- Sustain our National Security interest in securing the boarders, ports and protect vital assets abroad
- Maintain vigilance on technology standards which may impact our ability to combat WMD smuggling

- Work with international standards agencies to ensure greater harmonization of standards
- Minimize technical barriers to trade

To interdict illicit trafficking, detection equipment should be available at borders, ports and airports and other monitoring points. The detection of attempts to smuggle nuclear and other radioactive materials at border crossings therefore remains an important aspect of the DOD nuclear security program, and the evaluation of States' capabilities to combat illicit nuclear trafficking constitutes an integral part of the US National Security Strategy. *Source:* ***U.S. Customs and Border Protection (CMB)*****. http://cbp.gov**

Department of Defense and Homeland Security has been given an important and complex task--develop a global nuclear detection architecture to combat nuclear smuggling and keep radiological and nuclear weapons or materials from entering the United States. This undertaking involves coordinating a vast array of programs and technological resources that are managed by many different agencies and span the globe. Since its creation 3 years ago, has conceptually mapped the current architecture and identified how it would like the architecture to evolve in the near term. ***U.S. Customs and Border Protection (CMB)*****. http://cbp.gov**

Nuclear forensics and nuclear attribution have become increasingly important tools in the fight against illegal trafficking in nuclear and radiological materials. This technical report documents the field of nuclear forensics and nuclear attribution in a comprehensive manner, summarizing tools and procedures that have heretofore been described independently in the scientific literature. This report also provides national policy-makers, decision-makers, and technical managers with guidance for responding to incidents involving the interdiction of nuclear and radiological materials. However, due to the significant capital costs of the equipment and the specialized expertise of the personnel, work in the field of nuclear forensics has been restricted so far to a handful of national and international laboratories. In fact, there are a limited number of specialists who have experience working with interdicted nuclear materials and affiliated evidence. *Nuclear Smuggling International Technical Working Group or ITWG. 25 Oct 2007 Technical Report Number UCRL-TR-235969 Lawrence Livermore National Laboratory (LLNL), Livermore, CA Number*

The loose nukes problem is slowly going away. That's the good news. The bad news is that there is still a plethora of materials available to the dedicated terrorist, located at a multitude of uncertainly guarded locations around the world. Much work remains to be done if we are to reduce the potential of future nuclear terrorism to zero. The U.S. government should undertake an examination of lessons learned (particularly what approaches work and what approaches do not) across the spectrum of counter-smuggling programs, including identifying areas for increased cooperation among these efforts. The examination should seek to identify best practices for assisting countries in halting smuggling, and propose strategies to unify the response to the underlying problem of porous borders.

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Download 4.8M PDF.

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