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Principles of Protection Against Nuclear Smuggling

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Principles of Protection against Nuclear Smuggling

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The smuggling of nuclear materials is a matter of grave consequence, and if allowed to occur in sufficient amount, could lead to nuclear terrorism or nuclear proliferation. This paper describes a framework created for the Department of Energy's contribution to national and international efforts to prevent and detect nuclear smuggling. With such a framework, opportunities for rapid gains in smuggling prevention can be found as well as funding gaps.

The Department of Energy (DOE) was given a mission, in 1998, to engage in international assistance programs that would enable other nations to more effectively combat nuclear smuggling. The Office of Nonproliferation and Nuclear Security, specifically NN-43, began programs at that time specifically designed to assist Russia in this regard. Other portions of DOE also contribute, and cooperation between DOE and the Department of State has had a major effect on the work. This effort by DOE complements DOE's Material Protection, Control and Accounting (MPC&A) program, which works to improve security of nuclear materials at storage sites in the former Soviet Union. Because NN-43's charter is to assist in the intercept of materials that have slipped by the MPCA-type control systems, it is referred to as the Second Line of Defense (SLD) program. The initial direction of the SLD program was described by Cantuti[1].

NN-43 began work for SLD by organizing collaboration between itself and the Russian Federation State Customs Committee (RF SCC). This collaboration has continued to grow with time, as working relationships have been developed and strengthened.

Because the program was new and had no immediate precedents, NN-43 commissioned a study by the Lawrence Livermore National Laboratory (LLNL) of how to prioritize effort to make the most effective use of available funding. This study, which was completed in 1999, identified a series of issues involved with nuclear smuggling, pointed out some policy decisions that needed to be made, developed a methodology for prioritizing effort in assisting with detection equipment, and listed other avenues for assistance, specifically in training. This study has been supplemented and refined in the process of planning for NN-43 sponsored and supported work against nuclear smuggling. Many people have contributed to this planning process, both from the Department of Energy and from its national laboratories. The assistance provided by discussions with representatives of the RF SCC has been invaluable in improving the planning.

Effective contributions to counter smuggling efforts depend on understanding the threat posed by nuclear smugglers, by improving public awareness of the problem, by deterring potential smugglers and thieves of nuclear material from attempting smuggling, by providing nuclear detection equipment to equip border points, and by doing so in a way that maximizes its effectiveness, both by understanding the modus operandi of smugglers and by developing a symbiosis with other types of technology, and finally by training those who use these technologies. DOE is playing a role in each of these.

Threat Analysis

It is useful first to define the threat, which is then used to drive specifications and planning for technology and tactics. The exact numbers involved in the threat are not important here. It is enough to understand that the goal is to prevent the smuggling of sufficient quantities of weapon-usable material from a protected site to anywhere where it could be used for proliferation or terrorism. However, this should not be interpreted as a definition of some minimum amount of nuclear material that would be useful to detect and interdict. The useful amount can be smuggled in two, three or many individual smuggling trips, and so the quantity searched for may be considerably less.

This particular work has many antecedents, and is a common thread through nuclear security work. The information upon which is based comes from both sides of DOE. Part comes from the weapons side, where quantities of nuclear material needed for detonable devices are well understood. Part comes from the fuel side, where tradeoffs of enrichment and reprocessing versus theft and smuggling give indications of minimum amounts of different materials that a nation planning on proliferation would want to obtain.

These technical calculations are made keeping in mind who might be involved in terrorism and smuggling. Several academic and NGO-sponsored studies have been made that delve into possible specific threats, for example, Roberts[2], Maerli[3]. These provide an indication of the technical capabilities of possible actors involved, and this may modify the threat quantities.

A range of possible actions was determined in LLNL study, in two categories. One category involves promoting deterrence of nuclear smuggling by portraying the likely consequences of nuclear smuggling as mostly negative for smugglers. Another category involves detecting nuclear materials, transported by anyone at anytime.

Public Awareness

One of the things that public awareness of the problem of nuclear smuggling does is to increase the possibility that an aware member of the public who notices something relating to possible nuclear smuggling reports it to law enforcement officials. A large fraction of law enforcement actions begin or are helped to continue by the contribution of information, i.e., clues, by the public. There are many facets to public awareness. DOE's actions as a source for information of a quasi-technical nature, for the media or interested non-governmental organizations, allows information to be spread to the general public, as noted in Erickson[4]. DOE provides a wide variety of such programs, as evidenced by its webpages[5]. Outreach programs can be directed at personnel most likely to come in contact with smuggled goods, such as employees of shipping firms. Through DOE sponsorship of organizations such as the Center for Export Control (CEC), this awareness can be promoted. The CEC publishes a quarterly journal[6] for firms and other organizations associated with export control, and holds many seminars and workshops that spread information about export control, including nuclear materials, to those who come in contact with exported goods.

Deterrence and Demotivation of Potential Smugglers

Increasing the probability of detection is not the same thing as enhancing deterrence. What deters is perception. If the perception that nuclear smuggling is unlikely to succeed is spread to potential smugglers, deterrence will be achieved. The cost of such a campaign is likely less than actually enhancing the probability of detection. There are major pitfalls in such a campaign, however. These include the release of information that might enhance the capability of smugglers and the chance that the campaign will be unconvincing.

NN-43 has adopted a cautious approach in the release of information concerning its activities, and encourages those cooperating with it to do the same. News releases, such as the one covering the installation at Astrakhan's port[7], should provide enough information to indicate that borders and ports are being put under control, but not reveal any gaps in coverage or limitations in capability. Thus, any person with access to nuclear materials, or who might be contemplating smuggling them, would be influenced against it by the increased risk involved in trying to export these materials from a country using such equipment and the need to face the logistical or technical challenge of evading or dealing with it.

Another mode of deterrence involves social consequences. If smugglers believe that any success in nuclear smuggling will lead to a greatly enhanced effort to combat smuggling, they may be deterred. Similarly, understanding the catastrophic results of the use of nuclear explosions may deter those with moral conscience.

These types of campaigns do not only affect deterrence. One very important detection mode is through informants, either those involved in the criminal enterprise or those who incidentally learn of it. Increasing the impression among such people that nuclear smuggling is likely to lead to apprehension of those involved, and even if it were to succeed, to social catastrophe, is important. The likelihood of an informant coming forward to reveal planned or in-progress nuclear smuggling will increase.

Reduction in the economic needs of potential collaborators and informants is also useful. The Department of Energy has several programs that assist scientists and others involved with nuclear materials to engage in profitable enterprises, relieving some of the pressure caused by the economic crisis in the former Soviet Union. DOE directly funds some of these programs, and others are organized using international organizations such as the International Center for Science and Technology in Moscow, and the Science and Technology Center in Ukraine in Kiev. In a sense, the SLD program comes into play when all of these programs miss a particular situation, and nuclear smuggling occurs. SLD, as a backup to them, can benefit by knowing where they are most effective and where the effectiveness increases are still underway.

Detection Technology

Technology that can detect radiation can be used to provide detection of certain modes of smuggling of significant amounts of unshielded nuclear materials. For the last three years, DOE has been cooperating with the RF SCC to install such devices at key international border points, including airports, seaports, rail and road borders. Both DOE and the RF SCC have provided such equipment, but in order to ensure that maintenance and repair costs were kept to a minimum, identical devices have been used in both programs.

Equipment provided provides three capabilities. One is the ability to detect radiation on persons or vehicles passing through portal monitors. Portal monitors can be placed at all entries to an international boundary crossing so that all vehicles and personnel, along with their luggage or packages, entering the border site can be screened. Secondly, an ability for an individual customs officer to detect radiation without a portal monitor is important, so that officers moving near a radioactive source can detect it and have the safety of recognizing it during any searches they make. These smaller devices can be used to scan objects or people to determine the location of a radioactive source. In large facilities, such as airports or seaports, where there is a irremediable possibility that material is slipped through the facility boundary, these small detectors play the important role of detecting any material that has passed around the portal monitors but comes near a customs inspector.

The third type of equipment provided are spectrometers, able to indicate which radioactive isotope is present when a radiation alarm is sounded. The large majority of alarms are innocent, and these devices are needed to quickly determine this and allow the person or vehicle to pass.

Two processes are involved with the installation of portal monitors, both designed to ensure that the technology is used to maximum effectiveness. One process is the design of the coverage of the entire international crossing post, whether it is a complex international airport or a simple one-track rail line. The first step in the design process is a site survey, where both tangible and intangible factors are evaluated. Tangible factors include a reconnaissance of the possible pathways across the international boundary, which might include employee entrances to aircraft refueling locations, cargo gates, or mail depots at airports, or any other route by which any person could hide nuclear material on an outgoing vehicle, or carry it aboard. These surveys are no different for nuclear material than for drugs, but they need to be done to ensure that no holes in security exist. The threat analysis, discussed above, is useful here in estimating the capabilities of the person or group who might be smuggling. Other tangible factors concern the safety and security of the equipment itself. Detectors are fragile and expensive apparatus, and need to have arrangements made to prevent damage and theft.

The intangible factors include the cooperativeness of those in charge of the facility, the likelihood that equipment placed there would be kept in good condition, the availability of trained or trainable personnel to man it, and the reliability of the energy infrastructure. If these factors indicate the equipment would not be used well, the response is to place the equipment elsewhere, and to indicate the necessity of improving these conditions so that later rounds of equipment purchases can be directed to the places skipped.

Technology Suites

Furthermore, nuclear detection equipment can be combined with other technology. For example, X-ray examination of items would easily detect some shielding materials. These technologies are best deployed after a systematic analysis of possible modes and routes of smuggling. This analysis should be based on one goal, that of increasing the overall risk of detection of nuclear smuggling.

Shielding nuclear materials would typically involve lead or another heavy metal, capable of absorbing gamma rays. It may involve more as well. However a smuggler who is going to try to smuggle using shielding has to make an unwelcome choice: smuggle small quantities, which increases his risks of detection because he must make many trips, or to try and bring a large heavy metal mass across the border. With metal detectors or X-ray devices, or even physical search, this option can be made more risky.

Customs operations at border crossings can take advantage of a considerable variety of technologies to enhance their ability to search vehicles physically. Low technology such as mirrors on poles or drills to probe walls can be used, as can high technology such as ultrasonic scanners and laser distance measurers. By placing nuclear detection apparatus at locations where these options are used effectively, the effectiveness of the nuclear equipment in stopping nuclear smuggling is enhanced.

Site Prioritization

Applying detection capability to a border point does more than just detect nuclear materials or to provide a motivation for smugglers aware of such capability to either transport only smaller amounts of material or to use shielding. It also provides an impetus for smugglers to use alternate routes, which are hopefully more risky to them. Thus, the least risky smuggling routes (least risky to the smugglers) need to be equipped with detection equipment first.

The determination of the least risky routes involves a comprehensive evaluation of smugglers' risks. This is the second consideration that is used to determine if a border post should be equipped. A methodology to determine such routes has been developed by Erickson[8]. This methodology examines potential destinations and desired quantities of materials, potential origins of different types of nuclear materials, the criminology of smugglers and illicit arms brokers, shipping modes and traffic patterns, and law enforcement activity. From this mélange, a set of smuggling scenarios was developed that portray representative smuggling routes that appear to present the least risk to smugglers of nuclear material. These routes have been used to select the highest priority sites for DOE assistance to the RF SCC with detection equipment. For example, Astrakhan's port, which was mentioned above, was chosen for priority treatment because of its shipping routes, its proximity to nuclear materials, and its ability to handle container traffic. As noted before, other factors not included in the prioritization study played a role in the final decision to equip Astrakhan. These factors were determined in the site survey.

Training

A crucial enhancement to the risk of smuggling involves improving awareness and training on the part of all law enforcement officials, starting with customs and border patrol, but extending to traffic police and any other group that might come into contact with smuggling. Beyond awareness, however, those officials who are involved with direct searches for nuclear materials, or who use detection equipment for this purpose, need to understand the nature of the materials, their characteristics, and the radiation they emit. DOE and the RF SCC have been cooperating in this regard.

First was the identification of which officers had the most critical roles in stopping nuclear smuggling[9]. The first group is referred to as front-line officers, i.e., whose daily work involves interacting with persons and vehicles trying to cross the international boundary. They need to know how to do their job in such a way as to minimize the chance that nuclear materials will pass undetected. One part of this is the determination of the detailed procedures that are best suited for such detection, at each type of border crossing. The Russian Customs Academy (RCA) has the responsibility of determining such regularized procedures, and to spread the knowledge of them through the ranks of front-line officers. DOE has been cooperating with the RCA to produce a course for these officers and a manual that can be used both as a textbook and as a reference at the border crossings of Russia. This manual[10] covers all essential knowledge for such customs officers, including the physics of such materials, the equipment they will use, the procedures they should follow, health and safety concerns, relevant organizational and legal considerations, and, of course, the need for stopping nuclear smuggling.

The second group singled out as very important for training includes those specialist officers who deal with radioactive cargoes. These officers have the responsibility of ascertaining that there is no nuclear material hidden inside a radioactive shipment. Such shipments emit radiation, and are thus exempt from the use of border crossing detection equipment. They need to be checked, in a more detailed and thorough manner, to ensure that they only contain what their shipping documents state. Since such cargoes pose health and safety risks, this checking procedure needs to be done with more sophisticated equipment. Such training is planned to be prepared in a collaborative effort between DOE, the RF SCC and the RCA.

Summary

In summary, the principles of protection against nuclear smuggling include: 1) enhancement of public awareness, 2) reduction of motivations to smuggle, 3) detection technology applied to the smuggling routes that are initially least risky for nuclear smugglers, 4) use of a combination of equipment to make nuclear smuggling more cumbersome and involved, and 5) awareness and training for law enforcement and transport employees, especially front-line customs officers.

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