REDUCING THE NUCLEAR THREAT

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"The objective of the U.S. Department of Energy (DOE)/National Nuclear Security Administration (NNSA) Material Protection, Control, and Accounting Program is to support U.S. national security objectives by enhancing the security of vulnerable stockpiles of nuclear weapons and nuclear weapons-useable material and improve the ability to detect and interdict their illicit trafficking." This quote underscores the vital importance of this program. The program is helping Russia develop a system whereby Russia protects, controls, and accounts for its own nuclear weapons and weapons-usable nuclear materials. Implementing such a far-reaching program involves many challenges and is most often accomplished by supporting upgrades to critical facilities at the Russian sites having nuclear material. Installing upgraded systems reduces the risk of nuclear material theft and improves global security by denying terrorists and others the essential ingredients for nuclear explosives. A site may contain multiple facilities and tens to hundreds of buildings, many of which may contain nuclear materials that make them a proliferation threat. The scope of upgrades can be daunting and, due to limited funding, schedules, and other constraints, implementation priorities must be established. Both short-term (rapid) and long-term (comprehensive) upgrades have been implemented. Rapid upgrades place emphasis on reducing risk effectively and quickly.

I. INTRODUCTION

Safeguarding nuclear warheads and materials that can be used to make nuclear weapons and detecting and interdicting their illegal trafficking are primary national security concerns of the United States. Since 1993, the Departments of Energy (DOE) and Defense (DOD) have worked to improve security at sites housing weapons-usable nuclear material and warheads in Russia and other countries. In 1995, DOE established the Materials Protection, Control, and Accounting Program to implement these efforts.

II. THE UPGRADES PROGRAM

The security efforts focus on the threats posed to U.S. national security in Russia and are accomplished through the design and implementation of a scheme of upgrades. The goal of the upgrade process is the establishment of a system that deters unauthorized actions by an adversary and, where deterrence fails, detects, interrupts, and neutralizes those actions. The course of the upgrades is determined in cooperation with the facility staff.

The program incorporates upgrades in three areas; namely, physical protection (PP), material control and accounting (MC&A), and protective force (PF). These upgrades, taken as an aggregate, provide significant reduction in risk to theft and diversion of the target material. Protecting against sabotage is not an objective of the program. The approach used is based upon experience gained in protecting similar material in U.S. nuclear facilities and adapting those approaches to the unique situations encountered at Russian facilities. Balanced protection (no matter the route taken by an adversary, effective security elements will be encountered) and defense-in-depth (for the adversary to obtain the target material a sequence of measures would have to be defeated) are two hallmarks of the program.

II.A. Selection of Upgrades

Upgrades proposed are based on improving the Critical Detection Point (CDP). The CDP is the nearest point to the target where detection must occur to give the PF time to deploy and successfully interrupt the adversaries before they escape with the target material. The most effective upgrades will move the CDP closer to the target material. The time it takes the PF to assemble and move to intercept and stop the adversary after initial detection is the primary factor determining the CDP.

Upgrades selected and implemented depend upon various factors and include the physical configuration of the target material; the ease with which the material can be used in a nuclear device; the quantity of material; residence time of the material at specific locations; flow of the material through a process; and ease of transporting the material.

Priority is given to upgrades that offer the greatest benefit at the lowest cost and protect against multiple scenarios. Minimizing operational impact is critical for ensuring that installed upgrades will be accepted and used by site personnel.

During the upgrade selection process, and in conjunction with their Russian counterparts, an operational cost analysis (OCA) may be performed. An OCA examines all costs associated with proposed upgrades over the lifetime of the system. The results of the OCA can answer the question whether an upgrade can be sustained by the facility after U.S. support has been withdrawn.

The easier it is to use the material for nuclear weapons, the more comprehensive an upgrade may be selected. The effectiveness of the upgrades is evaluated in their ability to reduce the risk of theft or diversion. Facility insiders, those outside of the facility, and combinations of the two compose the threat posed to the nuclear material. The insider threat poses the highest risk of theft and is given the highest priority when developing upgrade strategies.

The program dictates a "target-out" approach wherein upgrades implemented at or close to the target take precedence over those implemented farther away from the target (e.g., at the perimeter of a site). Consolidation of vulnerable material into central locations is also explored early in the process. Successful consolidation reduces the number of buildings or facilities that contain target material.

Current Russian program elements are considered when upgrades are proposed. The ability of the facility to sustain the upgrades is a major consideration in the selection of the upgrades to implement.

Russian law requires that safety and security systems (includes systems discussed in this paper) must demonstrate that established requirements have been met before being permitted to operate. Certification and attestation are the mechanisms used to demonstrate compliance. Certification is a conformity assurance procedure by which a certification body gives written assurance (certificate) that a product, equipment, process or device conforms to a standard or specification. An accredited board issues attestation certificates verifying that the system or information system adheres to established criteria. Attestation requires on-site testing of the system.

II.B. Types of Upgrades

Due to the large number of facilities requiring upgrades and U.S. budget constraints, it is necessary to prioritize the upgrades into short- and long-term phases. These upgrades are traditionally termed "rapids" and "comprehensives." Rapids significantly reduce the risk of theft or diversion within a relatively short-time frame. Comprehensives comprise longer-term upgrades that are typically more expensive and require more time and resources to implement.

Compensatory measures such as increased guard postings or revised procedures are used to augment security during installation of the upgrades.

II.B.1. Rapid Upgrades

Rapid upgrades are distinguished by their simplicity, relatively low cost, and ease of implementation. They are intended to immediately improve the protection of the material. Examples of rapid upgrades include installing hardened doors and grates on windows; installing alarm devices; key and combination controls; consolidation of materials into secured, locked locations; search of personnel exiting protected material areas; and posting guards when nuclear materials are accessed. PP upgrades comprise most of the rapid upgrades. Training personnel and writing and implementing procedures are important components of the program.

II.B.2. Comprehensive Upgrades

The majority of MC&A upgrades fall under comprehensive upgrades. The objective of this portion of the program is to detect and deter unauthorized access and the theft and/or diversion of nuclear material. Major elements include a method of nuclear material control, nuclear materials accountability, and a system of measurements and measurement control. Establishing and tracking a quantitative nuclear material inventory is a key component of this portion of the overall program. These elements should be designed and integrated with the PP elements to provide deterrence and detection against insider and outsider adversaries.

Specific elements include access control, material surveillance, establishment of material balance areas, physical inventory taking, tamper-indicating devices, procedures, daily administrative checks, portal monitoring, accounting record systems (computer-based, if justified), inventory confirmation and verification measurements, and inventory difference control limits. Through these elements, a facility or site can track nuclear material inventories, document transactions, issue periodic reports, and identify material gains and losses.

Other comprehensive upgrades include the establishment of a Central Alarm Station (CAS) and closed-circuit television cameras placed on buildings and along perimeter fencing for assessing alarm conditions and conducting surveillance of personnel.

II.B.3. Protective Force Upgrades

The site PF carries out the assessment, response, and neutralization elements of the program. The following five areas should be addressed when contemplating PF upgrades: training, equipment, facilities, procedures, and duties. Response begins immediately after assessment and concludes with engagement of the adversary. Response time consists of the following elements: dispatching the PF, PF preparation (putting on vests, acquiring weapons, etc.), travel to a pre-determined location, and positioning for conflict. Neutralization is the act of stopping the theft or diversion. Neutralization begins when the adversary has been engaged and concludes when the adversary has aborted its actions or has been defeated.

Interruption causes an adversary to contend with PF personnel before accomplishing the theft of material. For interruption to occur, a well-trained PF, with resources equivalent or superior to the attacker, must arrive at the appropriate location in time to engage the adversary. This response should arrive within the expected delay time after the detection of an attempted, in-progress theft. Reinforcements, or a secondary (backup) PF, consisting of at least the equivalent of the initial armed personnel should arrive quickly enough to supplement the initial force in neutralizing the adversary.

Types of equipment and facilities include barracks, training areas, guard posts, vehicles, and communications capabilities. Duties and procedures surveys will address access control tasks, searches of personnel and vehicles, post and control duties, and response plans. Training levels of PF personnel are valuable indicators of PF capabilities. The weapons proficiency, physical fitness, and tactical training of personnel can have a significant impact on response to theft attempts.

PF upgrades may include basic personnel equipment (uniforms, load-bearing vests, and flashlights); review, enhance, and implement PF procedures; training facilities for PF personnel (CAS operator, response procedures, etc.); hand-held SNM and metal detectors for searches; performance testing program; vehicle search mirrors; response vehicles; hardened fighting positions or guard towers; intercom systems; and telephones positioned in strategic locations.

Inter- and intra-site truck and rail transportation should be evaluated and upgrades applied, as needed. Possible upgrades include armored trucks, nuclear material overpacks, escort vehicles, and radio communications.

II.C. Evaluation of Upgrades Effectiveness

Detection of the adversary, assessment of the threat by the system and personnel, delay of the adversary from reaching the target or leaving with it, and the response of the PF to interrupt and neutralize the adversary are parameters used to evaluate the overall system effectiveness.

A System Analysis (SA) systematically integrates the above elements to assess vulnerabilities addressed by current and proposed upgrades. The SA uses established, systematic tools to conduct the evaluation and produce system “effectiveness” ratings for defined scenarios and upgrades. The SA helps to answer the following question: To what extent has the level of risk to U.S. national security interests posed by defined threats been reduced by implementation of upgrades? To improve the accuracy of the SA Russian facility personnel should be involved in conducting the SA. The SA is also used to suggest possible upgrades.

Acceptance tests of individual elements and the system as a whole are conducted to ensure that the components and systems are performing as designed. Performance tests of the systems are also conducted to determine if projected risk reductions were achieved.

To ensure that the program is spending government resources appropriately, adequate assurances are obtained demonstrating that equipment and financial assistance are being used for their intended purpose; namely, to protect weapons and weapons-usable nuclear materials. Prior to the initiation of upgrades, mutually acceptable assurance procedures should be established. Defining how the programmatic requirements are met and then obtaining those assurances varies with the type of nuclear facility receiving the upgrades. Site and material characterization, as well as installation and operational assurances are required by the program. Physical access is the preferred method for obtaining the requisite assurances; however, access to some Russian sites has been an issue. Some facilities are more sensitive than others requiring different and innovative approaches. Assurance requirements and verification protocols are incorporated into the language of the contracts.

III. Conclusions

The MPC&A program is based upon three fundamental principles which, when taken as an aggregate, provide the necessary protection of weapons-usable material. The fundamental principles include upgrades in three areas: physical protection (PP), material control and accounting (MC&A), and protective forces (PF). Judicious application of U.S. resources and expertise is being applied in Russia in an effort to support the security of the U.S. by enhancing the security of vulnerable stockpiles of nuclear weapons and nuclear weapons-useable material and improve the ability to detect and interdict their illicit trafficking.

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