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Nuclear Weapons Physical Protection Principles

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ABSTRACT

Since its founding in 1957, the International Atomic Energy Agency (IAEA) has focused on the protection of nuclear materials and nuclear facilities used for peaceful purposes. The international community has worked through the IAEA to promote the peaceful use of nuclear energy, and to inhibit its use for any military purpose, including nuclear weapons. To achieve these goals, a number of international treaties, including the Convention on the Physical Protection of Nuclear Material (CPPNM) and its amendment have been developed to ensure States adhere to common physical protection principles. In addition, the IAEA has developed a consensus series of nuclear security series publications to provide fundamental objectives and essential elements of a State's national nuclear security regime and recommendations for implementing an effective regime. No similar efforts have been accomplished with the nuclear weapons states for the protection of nuclear weapons and nuclear facilities associated with defense work. The ultimate goal of the international community should be nuclear disarmament, but as long as nuclear weapons exist, protecting them is of paramount importance. This paper will propose a common set of core principles specifically for physical protection of nuclear weapons to be used as the basis for future international agreements and to reduce the danger that nuclear weapons could end up in the hands of terrorist organizations.

INTRODUCTION

After World War II, nuclear weapons were developed by a number of countries. The primary security concerns regarding these programs were espionage and theft or loss of control of a weapon. Each country dealt with these concerns independently with a few exceptions, while at the same time civilian applications of nuclear power rapidly expanded throughout the world.

In the U.S., the Atomic Energy Act of 1954 established the Atomic Energy Commission (AEC) with a mandate to regulate and license nuclear reactors to ensure their safe operation. Negotiations began shortly after in 1955 to establish the International Atomic Energy Agency (IAEA) to promote the peaceful and safe uses of nuclear energy in line with the efforts of the U.S. AEC. The First Geneva Conference on Peaceful Uses of Atomic Energy was held in August 1955, and played an important role in promoting international cooperation through the IAEA.[i] The focus of the international efforts through the IAEA were initially focused on safety of nuclear energy and on preventing State level proliferation of nuclear materials. In 1972, the IAEA published informal recommendations on the physical protection of nuclear material, and in 1975 formally published the document as INFCIRC/225.[ii] This was followed by the development of the Convention on the Physical Protection of Nuclear Material (CPPNM), which entered into force in 1987, and the Amendment to the CPPNM, which entered into force in 2016. The Convention and the Amendment are legally binding international instruments in the area of physical protection of nuclear material.

Significant effort has been made to foster international cooperation regarding the physical protection of nuclear material and nuclear facilities used for peaceful purposes, but similar efforts have not been conducted for protecting the nuclear weapons of the nuclear weapons states. An act of nuclear terrorism would affect all states within the international community and international cooperation to address the potential threats to nuclear weapons as well as to nuclear material and facilities is more important than ever.

President Obama's concerns about the threat of nuclear terrorism led to the organization of a Nuclear Security Summit in 2010 in Washington, DC. Subsequent Nuclear Security Summits were held in Seoul in 2012, The Hague in 2014, and a final summit in Washington, DC in 2014. The summits addressed many issues related to nuclear terrorism and nuclear security, but one of the ongoing, somewhat controversial topics was protection of nuclear weapons. The Communiqué[iii] issued by the White House after the 2010 summit stated that the participants: "Reaffirm the fundamental responsibility of States, consistent with their respective international obligations, to maintain effective security of all nuclear materials, which includes nuclear materials used in nuclear weapons…"

This topic was reintroduced leading up to the summit in the Hague, with the argument that roughly 80% of the world's nuclear material was in military programs, resulting in a gap, as the IAEA international instruments only applied to nuclear material used for peaceful purposes. However, the concept was again controversial, and no further agreements were reached beyond the compromise reached during the 2010 summit that security of military use nuclear materials was a national responsibility. Although the international community affirmed that protection of nuclear weapons is a national responsibility, this paper proposes a set of nuclear weapon protection principles to serve as the starting point for future international cooperation.

PROPOSED NUCLEAR WEAPON SECURITY PRINCIPLES

In April of 2009, during a visit to Prague, Czech Republic, President Barack Obama stated: "The existence of thousands of nuclear weapons is the most dangerous legacy of the Cold War…In a strange turn of history, the threat of global nuclear war has gone down, but the risk of a nuclear attack has gone up."[iv] Although the long-term goal of the international community should be nuclear disarmament, the destructive power of nuclear weapons makes protecting them of paramount importance as long as they exist. To ensure that nuclear weapons do not pose an undue threat to the international community, nuclear weapons states must take measures to ensure their weapons are safe, secure, reliable, and kept under positive control at all times. The following three principles are proposed as a high-level framework for nuclear weapons security.

PRINCIPLE 1: FOUR PILLAR APPROACH TO NUCLEAR WEAPONS PROTECTION

A comprehensive, integrated approach to nuclear weapons protection should be developed by nuclear weapons states, consisting of the four pillars of safety, use control, physical protection, and incident response. An integrated, multi-disciplinary approach to incorporating these four pillars will help ensure nuclear weapons are provided effective protection. These pillars are defined as:

- **Safety** – Measures designed to minimize the possibility of a damage resulting from equipment failure, human errors, or acts of nature.

- **Use Control** – Measures that may include electronic and mechanical features designed to protect against unauthorized use of a nuclear weapon.
- **Physical Protection** – Measures that may include active or passive systems to protect a nuclear weapon from unauthorized access and to prevent loss or damage.
- **Incident Response** - Measures designed to respond to a damaged or recovered nuclear warhead and render it safe.

PRINCIPLE 2: PHYSICAL PROTECTION SYSTEM STRATEGIES

For physical protection of nuclear weapons, a State should establish a primary physical protection system strategy of denying unauthorized access to nuclear weapons. This should be the main objective of physical protection. It can be achieved by taking measures to prevent an attempt at unauthorized access from occurring, but if it is attempted, to prevent successful completion of the malevolent act.

Measures can be taken by a State to deter, detect, and disrupt potential threats before a malevolent act is attempted. These measures include implementing physical protection measures that appear robust to potential adversaries, increase uncertainty, and increase the difficulty of an attack, along with State intelligence programs to detect and disrupt potential threats before they are attempted. If these measures fail, a physical protection system should be designed to ensure rapid detection of an adversary's intention as far away from the nuclear weapons as practical through a system of alarms, sensors, procedural requirements, and human surveillance, barriers to delay an adversary's actions, and a response sufficient to stop a defined threat from gaining unauthorized access to nuclear weapons.

If the primary strategy of denial of access fails, a State should establish a secondary strategy of planned measures to immediately regain control of a nuclear weapon by recapturing a location with nuclear weapons on a site under the unauthorized control of a threat, or by locating and recovering a nuclear weapon that has been removed from a site.

PRINCIPLE 3: SYSTEM ENGINEERING PRINCIPLES TO DESIGN AND EVALUATE PHYSICAL PROTECTION SYSTEMS

At a high-level, the design and evaluation of any complex system requires developing clear objectives of the system, building a system to meet the objectives, and then testing the design to determine if it sufficiently meets those objectives. If the system does not meet the objectives, it can be redesigned in an iterative process until the objectives are met. In some cases, if a design does not meet the defined objectives the objectives can be revisited to ensure they are accurate and realistic. These are the core principles of systems engineering, an iterative process known as design, build, test.

A systems engineering based physical protection outline or framework was developed nearly 50 years ago as the basis for the design and evaluation of physical protection systems, illustrated in Figure One.

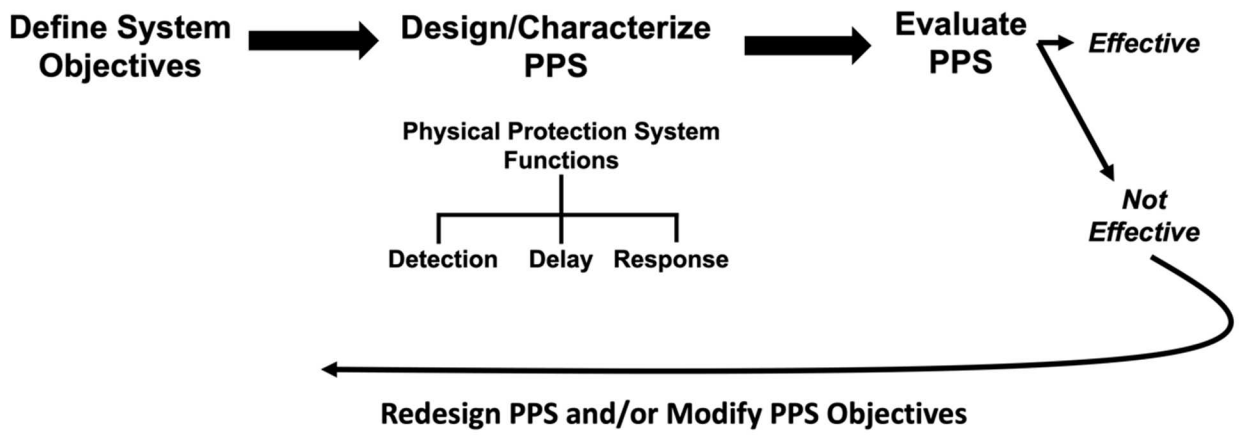

Figure 1. Design and Evaluation Process Outline

In the framework, the first step involves defining the objectives of a physical protection system, which includes identifying what is being protected, in this case nuclear weapons, and the threat or threats to protect it from. The second step consists of designing new physical protection systems or characterizing existing systems with the physical protection measures designed to achieve the three physical protection functions of detection, delay, and response. These three functions are measures to detect potential threats attempting to commit a malevolent act, barriers designed to increase difficulty and delay a threat from completing a malevolent act, and a response sufficient to stop a threat. The last step of the framework is the conduct of evaluations and performance tests to provide assurance that the physical protection system meets its defined objectives.

CONCLUSIONS

Nuclear terrorism is a real threat, and the international community has cooperated extensively to improve the security of nuclear material and nuclear facilities used for peaceful purposes. However, as addressed in the four Nuclear Security Summits, a gap exists in international collaboration on the protection of nuclear weapons. Three fundamental nuclear weapon security principles are proposed as a basis for future collaboration, and they include: development of a comprehensive protection program comprised of the four pillars of safety, use control, physical protection, and incident response; implementation of a physical protection system with a primary strategy of denial of unauthorized access to nuclear weapons and a secondary strategy of recapture and recovery; and use of a systems engineering framework to provide assurance that implemented physical protection systems meet the defined objectives of a State.

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