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On the Importance of MC&A to Nuclear Security

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By Martha Williams

Over the past fifty years, the threats posed by nuclear material and nuclear weapons have changed. These changes demand a new response. During the Cold War, the primary concern was that more States might establish programs to develop nuclear weapons. This is still a possibility, however, the concern of State proliferation of nuclear weapons has been joined by a new concern, namely the concern that a non-State actor might acquire a nuclear weapon or misuse nuclear or other radioactive material to create a disruptive nuclear security event.

Because the threat has changed, international and national approaches to nuclear security need to change. Measures should be adopted world-wide that respond to the potential for a non-State actor to acquire and misuse nuclear material. (The primary subject of this paper is containing nuclear material threats. However, the same concepts that apply to nuclear material apply to other radioactive material, and from this point forward "nuclear material" could be interchanged with "nuclear and other radioactive material.") The first step in preventing a non-State actor from acquiring nuclear material is for States to require nuclear facilities (i.e. organizations that possess nuclear material) to establish programs to maintain control over and account for the nuclear material that they possess.

Most States already require a program of accounting for and control of nuclear material as part of their international nuclear safeguards programs. Enhancing existing nuclear material control and accounting (MC&A) programs could help to address the evolved threat to nuclear security, in addition to improving safeguards. This paper addresses the need to enhance existing MC&A programs to accommodate the needs of nuclear security. If you know what nuclear material you have, if you know where it is, and if you would recognize if it had gone missing, then you have taken the first step toward protecting people and the environment from misuse of it—one of the primary goals of nuclear security.

Background

In 1956, 81 nations approved the statute creating the International Atomic Energy Agency (IAEA). The statute was meant to address the problem of how to use nuclear material for peaceful purposes (such as producing electricity) and prevent the spread of nuclear weapons. In the 1950s, the prevailing threat to safety and security was the possibility that additional States might develop nuclear weapons. Only States were thought to be technologically and financially capable of developing a nuclear weapon. With the passage of the statute, measures were to be established that would prevent States that did not already have nuclear weapons from developing a nuclear weapons program. These measures were referred to as "safeguards." They were designed to protect against State misuse of nuclear material and were aimed at a State's activities.

To protect against the threat that a rogue State might develop nuclear weapons, all States made commitments under international safeguards arrangements. Under Article III.A.5 of the Statute of the IAEA, which entered into force in 1957, the IAEA was authorized to "establish and administer safeguards designed to ensure that special fissionable and other materials, services, equipment, facilities, and information made available by the Agency or at its request or under its supervision or control are not used in such a way as to further any military purpose...." According to the statute, the IAEA's mission was "to deter the proliferation of nuclear weapons by detecting early the misuse of nuclear material or technology, and by providing credible assurances that States are honouring their safeguards obligations." The *IAEA Safeguards Glossary* explains the purpose of safeguards as follows: "Safeguards are applied by the IAEA to verify that commitments made by States under safeguards agreements with the IAEA are fulfilled."[1]

The agreement between the State and the IAEA is explained further in *The Structure and Content of Agreements between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons, INFCIRC/153 (Corrected)*, which says that the technical objective of safeguards is "the timely detection of diversion of significant quantities of nuclear material from peaceful nuclear activities to the manufacture of nuclear weapons or of other nuclear explosive devices or for purposes unknown, and deterrence of such diversion by the risk of early detection."[2]

A decade or so later, in 1968, the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) focused once again on the State. Nuclear-weapons States party to the treaty agreed not to transfer nuclear weapons or weapons technology to non-nuclear-weapon States, and non-nuclear-weapon States agreed not to pursue the development of nuclear weapons.

Four decades after the IAEA was created, in 1997, the Additional Protocol to Comprehensive Safeguards Agreements was approved by the IAEA Board of Governors. It has been used to create binding agreements between States and the IAEA, agreements that strengthen the effectiveness of the existing safeguards regime. The focus of the Additional Protocol continues to be the threat posed by a rogue State.

The new threat

The events of September 11, 2001, changed the focus of nonproliferation efforts. Prior to the terrorist attacks that day, an unspoken assumption of nonproliferation efforts was that only States were capable of developing a nuclear weapon. The science was complex and obscure; the technology, difficult to develop; the expense of developing and maintaining a weapons program, beyond the capability of most States.

After that day, a new set of threats emerged: a non-State actor might acquire a nuclear weapon from a nuclear weapons State and detonate it; a terrorist group might steal nuclear material for the purpose of building its own nuclear weapon; or a terrorist group might use illegally obtained nuclear material to construct an improvised nuclear device (IND). Upon reassessment, experts concluded that much of the scientific knowledge necessary for constructing a nuclear weapon was available to anyone with access to the internet. Furthermore, some terrorist organizations are well-funded and have the financial means to sustain building a nuclear weapon or IND; and they have devoted followers who are capable of stealing nuclear material without regard to personal safety. Detonating an IND could have the same destructive effect as detonating a nuclear weapon from a State weapons program.

The possibility also exists that a group with malicious intent might design and explode a radiological dispersion device (RDD) with the intent of dispersing nuclear or other radioactive material and killing innocent bystanders. RDDs are now perceived as a threat, perhaps not as worrisome as the threat of a nuclear weapon, but deadly and expensive to clean up nonetheless.

The safeguards that have been developed to deal with the threat posed by a rogue State can be enhanced to address the problem of a non-State actor with malicious intent. This is not to trivialize the threat initially addressed by safeguards, namely, the threat of diversion of nuclear material by the State for the purpose of developing a nuclear weapon. This is to suggest that measures put in place to deal with the old threat can be enhanced to respond to the new threat.

Responding to a new threat with a new approach

Responding to the new threat requires a new approach and new measures. In analyzing the revised threat, several key questions emerge whose answers could help in designing measures to protect against the new threat:

- How should States respond to the threat posed by a non-State actor?
- What additional protective measures are needed to counter the threat of a person or organization intent upon developing or stealing a nuclear weapon?
- What additional protective measures are needed to counter the threat of a person or organization intent upon stealing nuclear material and using it to fabricate a bomb?
- What additional measures should be taken to protect against someone who works for a nuclear facility, has authorized access to nuclear material or information (i.e. an insider),

and who is intent upon stealing nuclear material or assisting someone from outside the facility to do so?

These are questions for experts in all areas of nuclear security, especially MC&A experts. While safeguards agreements do not address these questions, safeguards measures can be enhanced to address the newly recognized threat represented by them. In particular, responding to the new threat requires broadening the goals of MC&A to include nuclear security.

Recognizing the need for a new approach

The new threat and the importance of new measures to counter the threat have been acknowledged in recent international resolutions and statements. The importance of MC&A to nuclear security was officially acknowledged in 2004 with U.N. Security Council Resolution 1540. This resolution urged States to "develop and maintain appropriate effective physical protection measures as well as measures to account for and secure nuclear materials in production, use, storage or transport." The *International Convention for the Suppression of Acts of Nuclear Terrorism* (ICSANT), which was opened for signatures in 2005, obligated States to develop measures to, *inter alia*, protect nuclear and other radioactive material from misuse. In 2006, the Global Initiative to Combat Nuclear Terrorism urged States to develop, if necessary, and improve accounting, control and physical protection systems for nuclear and other radioactive materials and substances. The 2010 Nuclear Security Summit work plan recognized "the importance of nuclear material accountancy in support of nuclear security." The communiqué from the 2012 Seoul Nuclear Summit stated, "We encourage all States to enhance their physical protection of and accounting system for nuclear materials…."

A State's nuclear security obligations are set forth in the *Convention on the Physical Protection of Nuclear Material* (CPPNM) and the amendment to it, which was agreed upon in 2005. In accordance with the CPPNM, States party to the convention and amendment are legally bound to protect nuclear material in use, storage, and transport, and to protect nuclear facilities. The CPPNM and its amendment also bind States party to the agreement to cooperate in locating and recovering stolen nuclear material.

The conventions, agreements, and joint statements mentioned in the preceding paragraphs recognize the need for a new approach to the threat of nuclear terrorism. They acknowledge the role that MC&A plays in ensuring nuclear security. They provide the basis for developing a new approach to nuclear security that includes MC&A and draws on the existing program designed for safeguards. What they do not do is provide details of an effective program for protecting nuclear material and nuclear facilities and, more to the point, they do not describe details related to design and implementation of a program to account for and control nuclear material.

Efforts to address the revised threat

The importance of MC&A to nuclear security has long been recognized by most MC&A practitioners. Protecting nuclear material by erecting walls, fences, vaults and other barriers is the obvious way to keep it inside a nuclear facility. But walls and fences cannot protect against a determined insider who has authorized access to nuclear material and information. An effective MC&A program can deter and detect actions taken by an insider intent on stealing nuclear material or assisting an outsider to do so. Furthermore, if there is a question of loss or theft from a facility that possesses nuclear material, that problem can only be resolved if there are records of the nuclear material quantities and locations.

In the Foreword to *Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Rev5)*, which was published in 2011, the new threat and nuclear security's role in responding to it are described as follows:

> The possibility that nuclear or other radioactive material could be used for malicious purposes cannot be ruled out in the current global situation. States have responded to this risk by engaging in a collective commitment to strengthen the protection and control of such material and to respond effectively to nuclear security events. States have agreed to strengthen existing instruments and have established new international legal instruments to enhance nuclear security worldwide. Nuclear security is fundamental in the management of nuclear technologies and in applications where nuclear or other radioactive material is used or transported.
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> Through its nuclear security programme, the IAEA supports States to establish, maintain and sustain an effective nuclear security regime. The IAEA has adopted a comprehensive approach to nuclear security. This recognizes that an effective national nuclear security regime builds on: the implementation of relevant international legal instruments; information protection; physical protection; material accounting and control; detection of and response to trafficking in such material; national response plans; and contingency measures.[3]

The IAEA Department of Nuclear Security recognizes the important role MC&A plays in securing nuclear material. It supports States' efforts by providing guidance, assistance, and technical support in establishing and maintaining a nuclear security regime. The IAEA Department of Safeguards has established safeguards agreements that rely on MC&A for reporting. The safeguards agreements allow the IAEA to inspect facilities and other entities in the State to verify the nuclear material quantities reported by the State. The IAEA Department of Security evaluates a State's nuclear security program at the request of that State, and efforts are underway to include all aspects of a nuclear security program, including MC&A, in such an analysis.

Other requirements for protecting nuclear facilities and nuclear material include an effective regulatory structure and legislative framework to build upon, and a program for maintaining control over nuclear material and accounting for it. Acknowledging that nuclear security consists of more than physical protection is the first step in addressing the threat posed by non-State actors.

Traditional MC&A systems

As noted earlier, traditional MC&A systems were developed for international safeguards reporting purposes and address the problem of diversion of nuclear material by a State for use in developing nuclear weapons. The concept of a State System of Accounting and Control (SSAC) was developed to protect the public by preventing the spread of nuclear weapons. These systems were developed in the pre-personal-computer days when record-keeping meant using paper and pen and, at best, a hand calculator.

The basic elements of an MC&A system exist within the structure of an SSAC. INFCIRC/153 lists the following commitments that are required of Safeguards Agreements under the heading “National System of Accounting for and Control of Nuclear Material”:

> 31. The Agreement should provide that pursuant to paragraph 7 above the Agency, in carrying out its verification activities, shall make full use of the State's system of accounting for and control of all nuclear material subject to safeguards under the Agreement, and shall avoid unnecessary duplication of the State's accounting and control activities.
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> 32. The Agreement should provide that the State's system of accounting for and control of all nuclear material subject to safeguards under the Agreement shall be based on a structure of material balance areas, and shall make provision as appropriate and specified in the Subsidiary Arrangements for the establishment of such measures as:
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> (a) A measurement system for the determination of the quantities of nuclear material received, produced, shipped, lost or otherwise removed from inventory, and the quantities on inventory;
> (b) The evaluation of precision and accuracy of measurements and the estimation of measurement uncertainty;
> (c) Procedures for identifying, reviewing and evaluating differences in shipper/receiver measurements;
> (d) Procedures for taking a physical inventory;
> (e) Procedures for the evaluation of accumulations of unmeasured inventory and unmeasured losses;

(f) A system of records and reports showing, for each material balance area, the inventory of nuclear material and the changes in that inventory including receipts into and transfers out of the material balance area;
(g) Provisions to ensure that the accounting procedures and arrangements are being operated correctly; and
(h) Procedures for the provisions of reports to the Agency

The material balance area (MBA) structure in use in SSACs is designed for the purpose of containing nuclear material within a designated area. An MBA might be a room, or it might be (and more often is) an entire facility. Transfers into and out of the MBA are recorded and reported; a physical inventory consists of taking an inventory of all nuclear material in the MBA; and a material balance is drawn that consists of comparing the total quantity of nuclear material that is supposed to be in the MBA with the quantity that is actually present. The safeguards approach is explained in more detail in the *Nuclear Material Accounting Handbook*, which was published by the IAEA Department of Safeguards in 2008.[4] Accounting and reporting is the main focus of the SSAC and the *Handbook*.

The primary concern of safeguards is quantities of nuclear material that are required for producing a nuclear weapon. These quantities are referred to as "significant quantities." Security, on the other hand, is concerned with small quantities as well as significant quantities. From a safeguards point-of-view, the quantity of concern for plutonium, i.e. the significant quantity, is 8 kilograms. This quantity was generally accepted when international safeguards were under development as the quantity needed for constructing a nuclear weapon. From a security point-of-view, however, losing control of 500 grams of plutonium, for example, would be a cause for alarm, and theft of as little as one gram of plutonium would be cause for concern. Misuse of very small quantities of nuclear material could cause harm to people and the environment.

Some States, but only a few, have developed MC&A programs that are adequate for nuclear security purposes. A program that is adequate for nuclear security would keep track of all nuclear material quantities and locations in near real time. It would rely heavily on computers. It would be updated frequently and would be capable of producing an up-to-date list of nuclear materials upon request. It would have information about where each nuclear material item is stored. It would be updated to reflect activities involving nuclear material and relocations within an MBA (as well as receipts and shipments outside the MBA), and would follow nuclear material as it is moved to storage or used in a production facility. This requires close interaction between the MC&A staff members who maintain records and control access to the nuclear material and the facility operations staff who use nuclear material, adding it to processing equipment and physically moving it.

Facility MC&A programs (and the State regulatory programs that oversee them) fall into essentially three categories: The most effective programs make distinctions between MC&A and safeguards reporting. They work closely with facility operations staff to maintain timely information on all nuclear material received, stored, used, or transferred. Programs in the middle category concentrate on compliance with the requirements of safeguards agreements and maintaining information on nuclear material batches, which is adequate for meeting the reporting requirements. Programs at the third level are programs that are under development or are undergoing change.

In States where MC&A programs are adequate for nuclear security, the international safeguards program is generally addressed separately from the program for accounting and control. In these States, the regulations for accounting and control address the problem of keeping track of nuclear material by maintaining an up-to-date database of quantities and locations whether in storage, during transport, or when undergoing processing. This first set of regulations concentrates on maintaining control over nuclear material and accounting for items of nuclear material as they move about the MBA. The requirements of the international agreements are addressed separately in a second set of regulations. The safeguards regulations put in place the measures necessary to fulfill the requirements of the international agreements, namely, annual reports of inventory, reports of shipments and receipts, the summary of the material balance, and verification inspections. The safeguards regulations concentrate on batches of nuclear material, which may consist of more than one item.

For the remaining States, MC&A programs would need to be enhanced to make them adequate for nuclear security. The place to start this process would be the regulations and guidance that affect MC&A programs. This process would involve changes to SSACs, as well as changes to facility-level MC&A systems.

Enhancing MC&A

The IAEA Department of Nuclear Security has developed an Implementing Guide outlining improvements to MC&A systems to make them responsive to security needs. This guide, *Use of Nuclear Material Accounting and Control for Nuclear Security Purposes at Facilities* (Nuclear Security Series No. 21), is scheduled for publication during 2014.[5]

The new security document emphasizes control of nuclear material, but continues to place equal emphasis on accounting, stressing the importance of accounting records that are complete and up-to-date. The new document describes the basic system elements, which include:

- management structure with clearly defined responsibilities;
- trained and qualified management and staff;
- written procedures covering all aspects of the MC&A program;

- complete records of all activities involving nuclear material including receipt, relocations within the facility, inventory (quantity and location of individual items), use, shipment, etc.;
- recommendations that MBAs be sub-divided to improve control and that transfers or re-locations of nuclear material within a facility be recorded so that items can be quickly located;
- systems for measuring all nuclear material at the facility and controlling the quality of measurements, including estimates of measurement uncertainty;
- periodic physical inventory takings (minimum: every 12 months) including comparison of the physical inventory and the accounting records (the book inventory) and resolution of all differences;
- evaluation and investigation of shipper-receiver differences;
- investigation and resolution of indications of missing material, and other discrepancies;
- a program to ensure the on-going quality and effectiveness of the MC&A system, including periodic tests of MC&A program performance and clearly defined criteria for evaluating the effectiveness of MC&A program elements;
- a program for frequently monitoring the presence of a random sample of items in storage, confirming identity and location; and
- a program for monitoring nuclear material during processing using statistical evaluation to compare process input-output differences with average differences (assuming the process is stable).

These elements are similar to the elements listed in INFCIRC/153. Notable additions are the sub-division of MBAs, preparation of records when nuclear material items are re-located within an MBA, and programs for testing the location of nuclear material that occur more frequently than annual physical inventories.

Instead of recording a wide-area location for nuclear material—the MBA—these elements emphasize the need for more exact location data. “Building Q” is not exact; “position E3 in the spent fuel pool” or “location Z5 on a storage shelf” is exact. Complete records that are updated for every relocation (or use) of nuclear material would make it possible to find items quickly or to recognize that they are not in their assigned locations, if loss or theft occurs.

The new security document continues to emphasize accounting for nuclear material, while placing additional emphasis on nuclear material control. Control elements described in the document include:

- administrative or technical controls that limit access to nuclear material and equipment;
- limiting access to nuclear material to authorized personnel performing authorized activities;

- use of standard operating procedures, which makes unauthorized activities more readily identifiable;
- limiting access to equipment used for processing or moving nuclear material to authorized personnel;
- limiting access to data related to nuclear material and equipment used for MC&A to authorized personnel;
- ensuring that unauthorized personnel cannot enter unlocked or open storage or processing areas undetected;
- ensuring that one individual alone cannot gain access to a controlled area (two-person rule);
- storing nuclear material not undergoing processing in locations with limited access (or ensuring that the equipment necessary for moving large items is controlled);
- ensuring that storage locations and equipment for moving large nuclear material items are locked and that keys are controlled;
- employing tamper-indicating devices and surveillance equipment to ensure the integrity of nuclear material items and information;
- placing radiation monitors (e.g. portal monitors) at entrances and exits to locations where nuclear material is used or stored to detect unauthorized removal of nuclear material; and
- ensuring that effective control measures are redundant and diverse enough to eliminate the consequences of a single-point failure.

Applying the recommended accounting and control measures increases the likelihood of identifying in a timely manner that nuclear material is missing. The goal is to identify loss or theft before the nuclear material can be removed from the facility. The MC&A measures applied should be redundant to prevent single-point failure, and they should be consistent with the attractiveness of the nuclear material.

There is no conflict between MC&A for safeguards and MC&A for nuclear security. Enhancing a States' SSAC and facility-level systems to improve nuclear security can only make the detection and deterrence of State-level diversion more effective. However, using MC&A for both safeguards and security requires that security and safeguards staffs cooperate at all levels.

The importance of cooperation between safeguards and security staffs cannot be overemphasized. One of the difficulties encountered in expanding a safeguards program to respond to nuclear security needs is establishing lines of communication (both formal and informal). Communication is important at the international level (between the IAEA Department of Safeguards and the IAEA Department of Nuclear Security), at the State level (between the State agency responsible for safeguards reporting and the State agency responsible for nuclear security), and at the facility level (between the facility organization responsible for safeguards and the facility organization responsible for security). Communication between these entities is important, but it is also important that each group understands and values the other's role. Members of the security staff need accounting information about nuclear material quantities and locations to respond to allegations of theft or loss, and they must work in concert with safeguards personnel to establish control over access to nuclear material. In the broadest terms, safeguards and security personnel share a common goal—detecting the misuse of nuclear material—and cooperation and communication are necessary to achieve it.

Achieving cooperation and communication can be difficult. In general, MC&A staff members are different personality types than physical protection staff members; this makes communication difficult. Budgets and conflict over limited resources, as well as overlapping responsibilities, can also make cooperation difficult. To overcome these obstacles, sometimes the importance of communication and cooperation must be established as a mandate from government authorities and upper-level management.

Communication among safeguards and security staff and safety and operations staff is also essential. Facility operations staff has operating information and records that are important for maintaining control over nuclear material. The reverse is also true: MC&A information compiled for safeguards reporting can improve safety and streamline operations. The additional MC&A information necessary to fulfill nuclear security requirements, for example, up-to-date records of nuclear material item quantities and locations, can also be useful for criticality control and managing facility operations. Two examples illustrate how MC&A information could have prevented or reduced the impact of related problems:

- a spill from a plutonium tank that continued six months after it was identified by safeguards staff, but was dismissed as unlikely by facility operations, thereby exacerbating the situation;
- a build-up of low-enriched uranium in an incinerator (known to facility MC&A staff, unknown to facility safety staff) that exceeded the design basis for criticality control, but which was informally (and fortunately) identified to safety staff before it caused a problem.

A program that provides for accounting and control at the item-level requires close cooperation between MC&A, security, operations, safety, and other nuclear facility staff. To enhance a facility's MC&A program in such a way, it may first be necessary to change the facility culture.

Addressing the insider threat

Accounting for individual items and small quantities of nuclear material and their current locations requires enhancing existing MC&A systems in most States to include all the accounting and control elements listed above. In general, these accounting measures should be adequate to confirm a diversion or theft within a few hours; control measures should be adequate to identify an attempted diversion or theft before the nuclear material has left the site.

If the objective of enhanced MC&A is to detect the theft of nuclear material and to deter such theft, then improving a State or a facility's capability to detect theft should further deter theft. Proper control of access to nuclear material—locked storage for nuclear material that is not undergoing processing, the use of surveillance equipment, and other control measures—should also serve to deter theft. Such an enhanced MC&A system would address the threat posed by non-State actors, small groups, and individuals. But what about the insider threat? Effective controls over nuclear material of the sort listed above would be essential for mitigating the risk of unauthorized removal by an insider as well.

When a problem is identified by a facility's MC&A system, insider theft is always a possibility and should be considered in the investigation. Examples of problems that should be investigated as potential indicators of theft include an item that is not in its assigned location, an excessive inventory difference, failure to complete records when nuclear material is relocated, unauthorized access to the MC&A computer system, an alarm from a portal monitor, an unexplainable broken tamper-indicating device on a container, unapproved access to a vault or storage facility, an unapproved shipment of nuclear material, a criticality alarm, etc. Problems such as these can leave the facility's nuclear material more vulnerable to theft, and safety may even be compromised. Failure to consider the possibility of insider theft when conducting an investigation of an MC&A event is also a failure of the MC&A system. Event investigations should always take into account the possibility that a theft or a potential theft may have occurred.

The same facility personnel who have responsibility for accounting for and control of nuclear material for safeguards can contribute to nuclear security and the protection of nuclear material. Operations groups at facilities have information about their nuclear material that forms the basis for safeguards, but this information is also helpful to nuclear security in detecting and deterring theft and in resolving cases or allegations of theft. Improving accounting and control systems can improve nuclear security in that it improves the capability to detect and prevent unauthorized removal of nuclear material. Keeping nuclear material under control and accounting for it is a mandate of nuclear security.

The traditional safeguards measures rely heavily on the annual physical inventory taking and batch accounting. But annually may not be often enough, and records of individual nuclear material items and their locations are necessary for resolving questions. This is not to say that the existing MC&A systems have failed. They perform as they were designed to perform. That is, they are capable of detecting State diversion of a significant quantity of nuclear material—enough for developing a weapon. The problem is that the threat has changed. Existing MC&A systems can be updated to respond to the new threat. A foundation has already been established for systems that are capable of responding to the new threat. What is necessary is upgrading the existing systems.

About the author

Ms. Martha Williams is a consultant in the areas of nuclear material control and safeguards. She is retired from the U.S. Nuclear Regulatory Commission, where she was a Senior Physical Scientist and led the team inspecting MC&A at commercial power reactors and fuel cycle facilities. She has extensive experience developing systems to control and account for nuclear material at both the facility level and as a regulator.

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[1] *IAEA Safeguards Glossary*, 2001 Edition, International Nuclear Verification Series No.3, IAEA, Vienna (2002).
[2] *The Structure and Content of Agreements between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons*, INFCIRC/153 (Corrected), IAEA, Vienna (1972).
[3] *Nuclear Security Recommendations on the Physical Protection of Nuclear Material and Nuclear Facilities,* INFCIRC/225/Rev.5, Nuclear Security Series No. 13, IAEA, Vienna (2011).
[4] *Nuclear Material Accounting Handbook*, Services Series No. 15, IAEA, Vienna (2008).
[5] *Use of Nuclear Material Accounting and Control for Nuclear Security Purposes at Facilities*, Nuclear Security Series No. 21, IAEA, Vienna (scheduled for publication in 2014).