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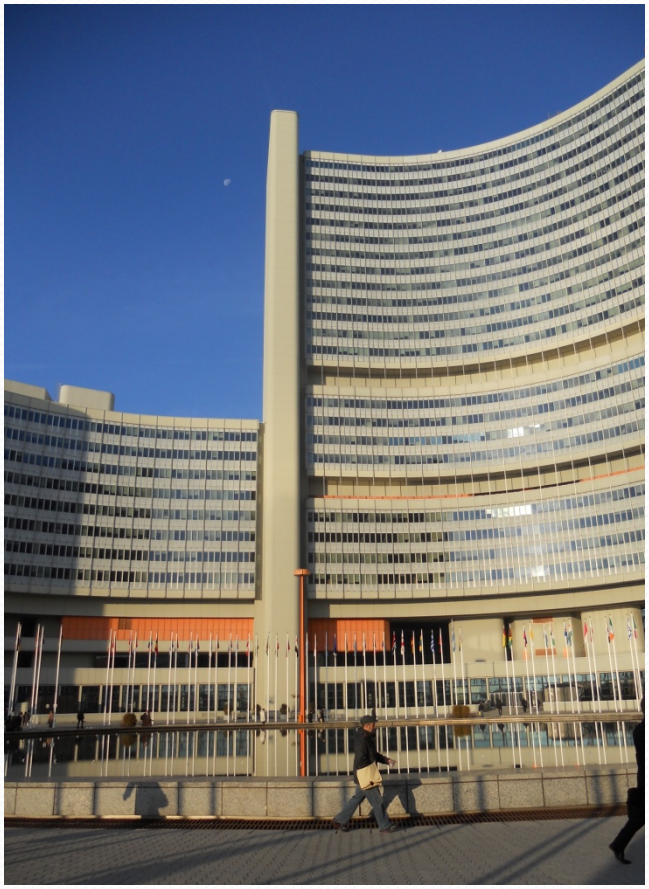
New IAEA Publication on Material Accounting and Control for Nuclear Security

Martha Williams

New IAEA Publication

- "The Use of Nuclear Material Accountancy and Control for Nuclear Security at Facilities"
  - Published as part of the IAEA Nuclear Security Series
  - Limited distribution for review in January 2012
- Responds to the concern that nuclear or other radioactive material could be used for malicious purposes – a global security risk



New IAEA Publication

- The intent of publications in the IAEA Nuclear Security Series is to assist States by presenting objectives and essential elements of a State's nuclear security regime:
  - Nuclear Security Fundamentals
  - Recommendations
  - Implementing Guides
  - Technical Guidance

- This new publication was developed by a working group with members from several States (primarily U.S., Russia, Japan, France, UK, Sweden, Belgium).

Objective

- The objective of the publication is to describe the use of nuclear material accounting and control systems at a facility to enhance overall nuclear security
  - Deter and detect unauthorized removal of nuclear materials
  - Protect against the facility insider
- Nuclear material accounting and control has been used traditionally for Safeguards, but it is also important to Security.
- Theft or unauthorized removal of nuclear material is a source of concern for Security, Safety, and Safeguards.

Mandate

- 2004 - UN Security Council Resolution 1540
  - 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.
- 2006 - Global Initiative to Combat Nuclear Terrorism
  - Develop, if necessary, and improve accounting, control and physical protection systems for nuclear and other radioactive materials and substances.
- 2010 - Nuclear Security Summit Work Plan
  - Recognized "the importance of nuclear material accountancy in support of nuclear security."
- 2012 - Communiqué from the Seoul Nuclear Summit
  - "We encourage all States to enhance their physical protection of and accounting system for nuclear materials…."

Why material accounting & control?

- Physical measures can be taken to protect against theft, but physical protection measures cannot resolve allegations or questions of theft.
- The question "Has an item been stolen?" can only be answered by an accounting system with complete and up-to-date records of the facility's nuclear material.
- Effective control over nuclear material is essential for mitigating the risk of theft or unauthorized removal.
- Accounting records of nuclear material locations and quantities are necessary for resolving questions of theft.

Guidance on NMAC for NS

- The new guidance introduces the acronym NMAC: Nuclear Material Accountancy and Control.
  - The new acronym was introduced to distinguish this application of material accounting and control from the use of MC&A systems in some countries exclusively for reporting to the IAEA.
- There is <u>no</u> conflict between MC&A for safeguards and NMAC for nuclear security.
- There are <u>no</u> additional NMAC or MC&A requirements for NRC licensed facilities.
  - Requirements reflecting this guidance already exist in the U.S. MC&A program
  - The difference between this guidance and existing U.S. guidance, if any, is the increased emphasis on communication between security and MC&A staffs.

NMAC system

- The basic elements of an NMAC system exist within the structure of the State System of Accounting and Control as described in International Safeguards Agreements.
  - IAEA INFCIRC/153 (corrected)
- Safeguards documents emphasize accounting for nuclear material, but acknowledge that some control is necessary.
  - IAEA "Nuclear Material Accounting Handbook," Services Series No. 15, 2008
- NMAC (and the new guidance document) emphasizes control of nuclear material, but it does not reduce the existing emphasis on accounting.

Basic system elements

- Management structure with clearly defined responsibilities
  - Trained and qualified management and staff
  - Written procedures covering all aspects of the NMAC program
- Complete records of all activities involving nuclear material
  - Including receipt, relocations within the facility, inventory (quantity and location), shipment, etc.
- Systems for measuring all nuclear material at the facility
- 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

Basic system elements

- Monitoring nuclear material between physical inventories
  - Periodic tests of the presence of a random sample of items in storage, confirming identity and location
  - Monitoring nuclear material during processing using statistical evaluation of process input-output differences by comparison with average differences (assuming the process is stable)
- A program to assure the on-going quality and effectiveness of the NMAC system
- Investigation and resolution of anomalies or discrepancies
- Maintaining control over all nuclear material items

Control elements

- Only authorized personnel have access to nuclear material.
- Only authorized personnel have access to equipment used for processing or moving nuclear material.
- Only authorized personnel have access to data related to nuclear material and equipment used for NMAC.
- Unauthorized personnel cannot enter unlocked or open storage or processing areas undetected.
- One individual alone cannot gain access to a controlled area (two-person rule).

Control elements

- Nuclear material not actually undergoing processing is stored in locations with limited access.
- Radiation monitors (e.g. portal monitors) are placed at entrances and exits to locations where nuclear material is used or stored to detect unauthorized removal of nuclear material.
- Effective control measures should be redundant and diverse to eliminate the consequences of a single-point failure.

Responsibility for control

- Control elements may be the responsibility of the physical protection staff or they may be the responsibility of the NMAC (or MC&A) staff.
- Everyone handling nuclear material shares responsibility
- Control elements must also meet operations and safety requirements.
- All facility staff with responsibility for control of nuclear material, including operations, NMAC, physical protection, and safety, should communicate and coordinate activities.

Synergy **Efficiency** **Effectiveness**

Purpose

- Accounting and control are essential to detecting and preventing theft of nuclear material.
- Nuclear security requires accounting and control.
- Where responsibilities overlap, material control, material accountancy, physical protection, operations, and safety personnel must work together.

System lapses

- When a problem occurs with a facility's material accounting and control system, insider theft is always a possibility and should be cause for concern.
- Event investigations should consider possibility of theft.
- In observed failures of MC&A systems in U.S. facilities, the facilities' nuclear material was more vulnerable to theft because of the failures.
- Safety may also have been compromised.

System lapses, Example 1

- A fuel manufacturing facility typically received fresh uranium fuel pellets from another fuel manufacturer for use in manufacturing rods. After the pellets were removed from their containers by the rod manufacturer, the empty containers were returned to the pellet manufacturer.

- Some containers that were thought to be empty, but that actually contained fresh fuel, were shipped offsite without the proper labels and permits.

System lapses, Example 1

- Problem: The nuclear material was shipped without proper identification and was more vulnerable to theft.
- Resolution: The pellet manufacturer was surprised to find pellets in the returned containers. Re-weighing of the pellet containers and measurement of a sample of pellets confirmed that the containers had not been emptied by the rod manufacturer and that the pellets were the same pellets shipped originally to the rod manufacturer.
- Root cause: Poor record-keeping and poor shipping practices (failure to note that the containers were not empty).
- Enforcement actions were taken and changes were made to improve implementation of MC&A.

System lapses, Example 2

- A fuel manufacturing facility that had discontinued operations was removing non-nuclear waste in preparation for decommissioning. Boxes of empty zirconium rods that had never been loaded with pellets were shipped to a zirconium recovery facility.

- When the zirconium recovery facility opened a box of rods, it discovered that the rods were not empty, but contained uranium pellets.

System lapses, Example 2

- Problem: Not only had the fuel manufacturing facility shipped nuclear material without the proper identification, it had shipped it to a zirconium facility that was not licensed to accept nuclear material.
- Resolution: The intact rods were returned to the fuel manufacturing facility.
- Root cause: Poor shipping practices, use of untrained personnel to prepare a shipment, poor record-keeping, and inadequate management practices.
- Enforcement actions were taken and changes were made to improve the MC&A program.

System lapses, Example 3

- During a physical inventory, a fuel manufacturing facility found a container of highly enriched uranium for which there was no record. The material was the product of an intermediate processing step. When the material had been removed from the process and placed in a container, no record had been prepared to indicate what was in the container or even that the item existed.
- Problem: Until the physical inventory occurred and the unrecorded container was found, the material was more vulnerable to theft. No one would have known the container (and the material) was missing because there was no record of it.

System lapses, Example 3

- Resolution: The history of the container (where it came from and when) was investigated and resolved, and a record was created for it.
- Root cause: Failure to follow procedure, inadequate management oversight, inadequate monitoring of nuclear material during processing, failure to create complete records of output from a processing step.
- Enforcement actions were taken and changes were made to improve the MC&A program.

Mitigating the risk of loss

- Many more examples exist of situations where ineffective material accountancy and control practices placed nuclear material items at risk.
- A properly designed and implemented nuclear material accounting and control system could have prevented the incidents described in these examples.
- Lack of adequate control measures, poor identification information on the actual containers and/or poor records contributed to the incidents.
- Effective management practices plus employee training in nuclear material accounting and control could have prevented the incidents.
- Control and accounting are essential to detecting and deterring theft or unauthorized removal of nuclear material.