



60 Years

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Atoms for Peace and Development

International Conference on Physical Protection of Nuclear
Material and Nuclear Facilities

Accounting and Controls for Timely Detection of a Malicious Act

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Robert K. Larsen, Division of Nuclear Security

Discussion Topics

- Binding instruments for domestic Nuclear Material Accounting and Control (NMAC)
- NMAC
- Nuclear material accounting
 - Material balance area
- Timely detection
- Nuclear material control

Binding Instrument – UNSCR 1540



- 2004 - UN Security Council Resolution 1540 under Chapter VII of the United Nations Charter, Paragraph 3 (a and b)

*“Decides also that all States shall take and enforce effective measures to establish domestic **controls** to prevent the proliferation of nuclear, chemical, or biological weapons and their means of delivery, including by establishing appropriate **controls** over related materials and to this end shall:*

- (a) Develop and maintain appropriate effective measures to **account for** and secure such items in production, use, storage or transport
- (b) Develop and maintain appropriate effective physical protection measures”

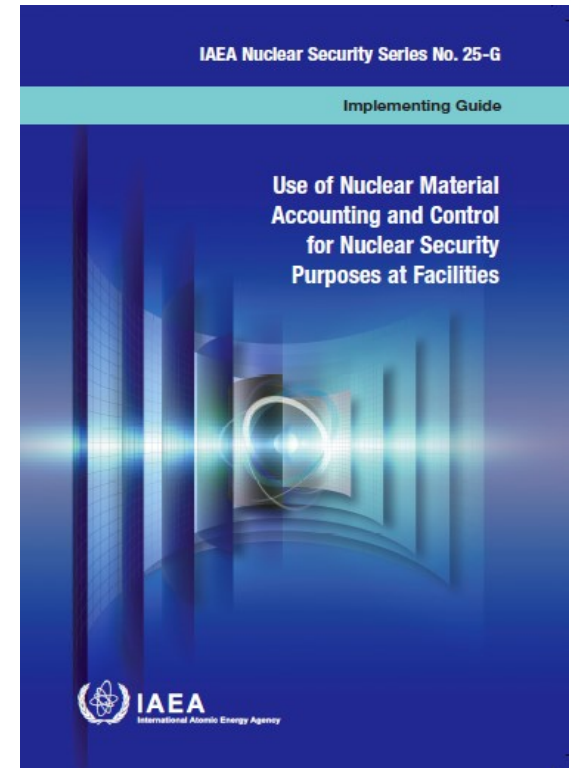
Binding Instrument – CPPNM

- 2005 – Amendment to the Convention on Physical Protection of Nuclear Material (CPPNM) – the only international legally binding instrument in the area of physical protection of nuclear material
 - Establishes measures related to the prevention, detection and punishment of offenses relating to nuclear material
 - Establishes legally binding requirements for States Parties to protect nuclear facilities and material in peaceful domestic use, storage, and during transport
 - Provides for expanded cooperation between and among States to:
 - Regarding rapid measures to locate and recover stolen or smuggled nuclear material
 - Mitigate any radiological consequences of sabotage, and
 - Prevent and combat related offenses

What is an NMAC System?

An NMAC system is “an integrated set of measures designed to provide information on, control of and assurance of the presence of nuclear material, including those systems necessary to establish and track nuclear material inventories, control access to and detect loss or diversion of nuclear material, and ensure the integrity of those systems and measures”.

(NSS 25-G, Glossary)



Purpose of Accounting

“Activities carried out to establish the quantities of nuclear material present within defined areas and the changes in those quantities within defined periods”

(Safeguards Glossary)



Examples of Accounting Elements

- Nuclear Security Series 25-G clearly identifies the following accounting measures:
 - Material balance areas (MBAs)
 - Measurement systems
 - Evaluation of accuracy and precision of measurements
 - Procedures for review of shipper and receiver measurements
 - Procedures for taking a physical inventory
 - Procedures for evaluation of accumulations of unmeasured inventory and losses
 - Records and reports

Material Balance Area

- MBAs are established based on criteria such as material types, processes, and functions. The intent is to define geographical areas around the nuclear material processes or stores in such a way that the accuracy with which the material balance can be established.
- An MBA should be established in such a way that: (a) the quantity of nuclear material in each movement into or out of the MBA can be determined; and (b) the physical inventory of nuclear material in each MBA can be determined when necessary.

Accounting Considerations

- Accounting is usually a delayed detection
- May not identify an adversary but rather just shows something is “wrong” or not normal
 - *(e.g., could be a process leak or insider activity)*
 - Example of leak:
 - Thermal Oxide Reprocessing Plant (THORP), Sellafield, UK August 2004 to April 2005
 - Loss of 83,000 liters of reprocessing liquid containing 22,000 kgs of nuclear fuel and 160 kgs of Plutonium.

Insider Scenario

Chemical engineer for space program

- Major role: dispense HEU to research teams
- The insider started removing small quantities (25-70 grams) of HEU as UO_2 powder while his colleagues were out of the room:
 - Removed ~1% of the 3% 'irretrievable loss'
 - 20 to 25 diversions over a 5-month period
- Stored the HEU at his home

Timely Detection

- Nuclear material accounting has its limitations
 - Accounting measures alone do not achieve the security fundamental need for immediate detection in order to secure a timely response
- Nuclear material controls in concert with physical protection most often allows for sensing and assessment to provide for timely detection and response
- Controls is where NMAC and physical protection converge

Accounting + Control + Physical Protection = Timely Detection

Purpose of Nuclear Material Control

- The main purpose of nuclear material control measures is to maintain continuity of knowledge of the nuclear material
 - To deter and detect any actions that could lead to its unauthorized removal or misuse
 - Intended for use against non-State actor

Examples of Material Controls

Administrative:

- Administrative checks
- Surveillance (e.g., two-person rule)
- Compartmentalization
- Separations of duty
- Checks during movements of nuclear material
- Item monitoring

Technical:

- Access controls
- Restraints / tie-down
- Tamper-indicating devices (TIDs)/seals
- Dual locks and key control
- Manned nuclear material portal monitors with hand-held monitoring equipment (nuclear material and metal)

Administrative Checks

Looking for
Gross
Anomalies

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BUILDING 371 DAILY ADMINISTRATIVE CHECK

AREA	TIME	VERIFICATION TASK	INSPECTION RESULTS		
MBA 1375-01					
Vault 1101		Outer Surfaces	<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
		Inner Surfaces	<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
		Door Integrity	<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
		Alarm Systems	<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
Vault 1208		Outer Surfaces	<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
		Inner Surfaces	<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
		Door Integrity	<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
		Alarm Systems	<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
1375-30					
Room 3602 WCGE		Door Integrity	<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
MBA 1375-31					
Vault 3331		Outer Surfaces	<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
		Inner Surfaces	<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
		Door Integrity	<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
		Alarm Systems	<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
MBA 1375-38					
Room 1103		Tank (s) Volume	<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
		Tank Integrity	<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
MBA 1375-45					
Multiplicity Counter		Items located	<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
Room 3541		TIDs Intact	<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
MBA 1375-49					
Vault 3337		Outer Surfaces	<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
		Inner Surfaces	<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
		Door Integrity	<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
		Alarm Systems	<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
MBA 1375-50					
Vault 3606		Outer Surfaces	<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
		Inner Surfaces	<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
		Door Integrity	<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
		Alarm Systems	<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A

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BUILDING 371 DAILY ADMINISTRATIVE CHECK (continued)

AREA	TIME	VERIFICATION TASK	INSPECTION RESULTS		
MBA 1375-50 (continued)					
Vault 3327		Outer Surfaces	<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
		Inner Surfaces	<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
		Door Integrity	<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
		Alarm Systems	<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
MBA 1375-70					
Stacker/ Retriever			<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
Windows in Sub Basement			<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
Walls			<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
Doors			<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
Stairwell #1			<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
MST Teams					
2 person rule			<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A
Radio compliance			<input type="checkbox"/> SAT	<input type="checkbox"/> UNSAT	<input type="checkbox"/> N/A

Comments: _____

Performed By: _____ /
 NMC Personnel Date

- Deficiencies identified and submitted to Building Management
- No deficiencies

Reviewed By: _____ /
 NMC Building Lead Date

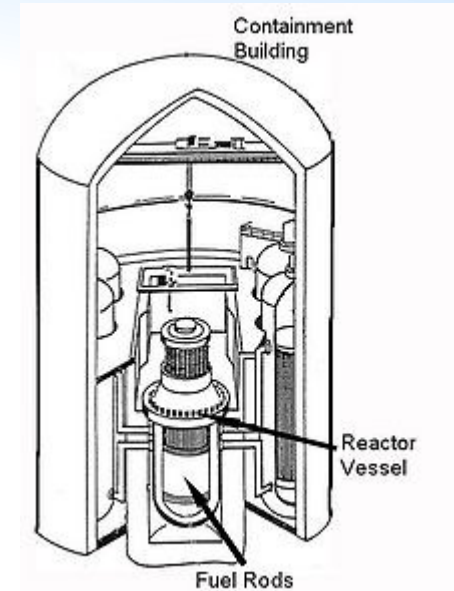
Two-person Rule

- The two-person rule is utilized as a material surveillance method for higher quantities and more attractive nuclear material or sabotage targets. The two authorized and knowledgeable persons should be physically located where they have an unobstructed view of each other and actions concerning the nuclear material.



Material Containment

- The purpose of material containment is deterring and detecting any actions that could lead to the unauthorized removal or misuse of nuclear material
- Material containment can be provided by the structural features of a facility, containers, or equipment that are used to establish the physical integrity of an area or items
 - examples include boundaries (*i.e.*, protected area), buildings, MBAs, vaults, storage cabinets, casks
- Material containment is most effective when used with material surveillance



Separation of Duties

- Separation of duties is the division of activities into steps that are performed by different organizations or persons acting independently
- Separation of duties serves as an additional measure to deter and detect insider threats
 - one individual alone should not be authorized to both handle nuclear material and update records

Checks During Movements of Nuclear Material

- Nuclear material is particularly vulnerable during movements
- In NSS 25-G, “movements” is defined as:
 - Shipments and receipts between facilities
 - Transfers within a facility between material balance areas
 - Relocations within a facility material balance area



Monitoring Nuclear Material Items

- An item is a discrete container of nuclear material or a discrete piece of nuclear material
 - Uniquely identifiable
 - Separate and discrete
 - Presence and integrity are verifiable
- Information verified during monitoring includes integrity, location, and identification
- Items of nuclear material should be monitored between scheduled physical inventories

Control of Access to Nuclear Material, Related Equipment, and Data

- The facility operator should develop and maintain a system for controlling access to nuclear material and nuclear material accounting data and equipment consistent with the graded approach.
- The facility operator should identify persons who have a need to access nuclear materials and should allow access to only those persons.

Delay – Tie-downs or Restraints

- For outsiders, barriers are designed to delay penetration of areas and have only limited impact on insiders
- For insiders, barriers should be designed to increase time required to complete the malicious act
- Additional benefits include:
 - Provide deterrence
 - Increase likelihood of detection
- Example: caging material containers



Tamper Indicating Devices

- Tamper indicating devices (TIDs) are devices with a unique identifier that are applied to objects for the purpose of detecting unauthorized access
- They do not protect the physical integrity of the object
- They are designed to indicate that access has occurred



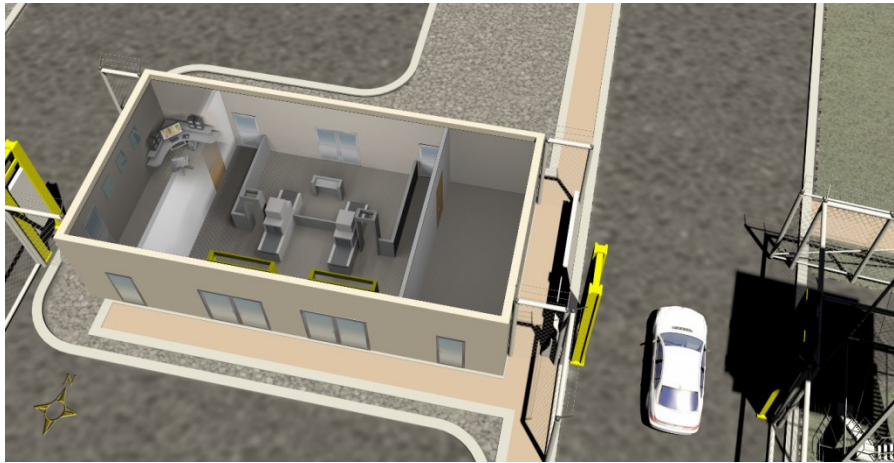
Key and Access Code Control

- Keys and access codes to secured areas where nuclear material is stored (or associated equipment) should be controlled to ensure authorized access.
 - Multiple keys/locks combined with key control can be used to assist with the two-person rule



Portal Monitors and Hand-held Equipment

- Portal monitors should be implemented in conjunction with physical protection systems so portals are properly staffed for surveillance and response.
 - Must be properly configured, installed, functional, performance-tested frequently, and calibrated using standards that represent the material types used within the facility.



Complementing Material Accounting with Material Control

- Material accounting (MA) and material control (MC) are complementary
 - Where MA is weak, MC should be strong
 - Where MC is weak, MA should be strong



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Thank you!