

Use of NMAC for the Evaluation of Physical Protection

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1. Introduction

The Nuclear Material Accounting and Control (NMAC) system has been used as a safeguards approach. It has been a basic tool for detecting any unauthorized removal of nuclear material by a state [1]. Recently, there have been attempts to use the NMAC system for nuclear security purposes. Nuclear security measures are designed to protect nuclear facilities and their materials from adversaries such as non-state actors from both outside and inside a facility [2]. At the facility level, an NMAC system can help to deter and detect the unauthorized removal of nuclear material by maintaining an accurate inventory, including information related to its location. An effective NMAC system can detect insider activities and assess any irregularity involving nuclear material. Therefore, an NMAC can be a useful tool for evaluating a physical protection system at nuclear facility. In this study, elements of an NMAC system at the facility level were identified based on a draft document prepared by the IAEA [1]. An evaluation sheet on the NMAC system was also developed by analyzing these elements.

2. Elements of an NMAC system

An NMAC system consists of a variety of elements and its effectiveness depends on the performance of its individual elements and their interactions with each other.

2.1 Managing an NMAC system

These elements include: structure, documentation and procedures, functions and responsibilities, control over changes, as well as staffing and training. A facility should have an organization that has the ultimate responsibility for the protection and control over its nuclear material. An effective design and implementation of an NMAC system requires the establishment of Material Balance Areas (MBAs). For facilities under IAEA safeguards, MBAs can be established with an agreed between the IAEA and a state. This agreement must be specified in the facility attachments, together with its inventory and flow Key Measurement Points (KMPs). A nuclear facility operator should develop written policies and procedures to ensure the continuity of knowledge of and control over its nuclear material. Any change to any part of the NMAC system should not degrade the performance of

the system. In order to maintain the effectiveness of the NMAC system, a sufficiently trained staff should be provided.

2.2 Records

A record keeping system is a primary component of NMAC. The overall records management system should conform to the international standards. This includes accounting records, operating records and other supporting document. Accounting records should be updated as soon as practicable when any movement or inventory change occurs.

2.3 Physical Inventory Taking of Nuclear Material

Nuclear facility operators should conduct a periodic physical inventory of their nuclear material stocks in every MBA. The frequency at which this inventory should be taken is dependent on the quantities and category of nuclear material stored. The total quantity of nuclear material calculated (based on the physical inventory) should be compared to the total quantity of nuclear material indicated by the book inventory. The MUF (Material Unaccounted For) should be considered in this calculation.

2.4 Nuclear Material Control

A nuclear material control system should be established in order to control the handling, processing or storing of nuclear materials. Multiple control measures are needed to ensure continuous monitoring lack of control, even for a short period of time, increases the possibility of unauthorized removal of material.

2.5 Other Elements

The other elements of the NMAC that should be considered include:

- Measurements and measurement quality control,
- Movement of nuclear material
- Detection, investigation, and resolution of irregularities
- Assessment and performance testing of the NMAC system

3. Evaluation Elements

3.1 Selection of Evaluation Elements

In this study, attributes that can be used for the evaluation of PP of a nuclear system were selected from among elements of the NMAC. This includes the organization of NMAC, MBA, records management, PIT(Physical Inventory Taking), nuclear material control, movement of nuclear material and assessment and performance testing of the NMAC system.

3.2 Development of Evaluation Sheet

Questionnaires for each these attributes were made to assist when giving consideration to international standards and domestic legal framework. The NMAC system for nuclear security is slightly different from that of international safeguards. The purpose of the NMAC system for international safeguards is to keep a state from illegal moving nuclear material, so that all the NMAC measures focus on the COK (continuity of knowledge). The purpose of the NMAC system for nuclear security is to detect and prevent of the unauthorized removal of nuclear material by a non-state actor. In order to accomplish this purpose, frequency of PIT should be shortened and the size of the MBA should be smaller than that of international safeguards. An evaluation sheet should be made based on these characteristics. Table 1 shows a nuclear security evaluation sheet for the NMAC system. The results of the evaluation can be quantified if a numerical value is given to each questionnaire.

Table 1. Evaluation sheet for the NMAC system

Attribute	Implementation	Check
Organization	• None	
	• Same organization for safeguards	
	• Separate organization for NS	
MBA&KMP	• None	
	• Established	
Records Management	• None	
	• Accounting records only	
	• Accounting records and operation records	
PIT	• None	
	• Once in a year	
	• Every three month	
	• Less than three month	
Nuclear Material Control	• None	
	• One control measure	
	• Multiple control measure	
Nuclear Material Movement	• None	
	• Documentation only	
	• Documentation and verification	
Assessment	• None	
	• Assessment program only	
	• Assessment program and periodic performance test	

Comparison between the facilities in terms of the NMAC system is possible using this table. It will be included as an important measure in PP evaluation methodology that is under development. The NMAC system is a useful tool for detecting and protracting against insider attacks. This evaluation sheet will complement existing PP methodologies that only focus on outsider threat.

4. Conclusion

The NMAC system has been used as an important measure in safeguards. The system is useful in detecting and preventing insiders from acquiring nuclear material. Many countries are considering adopting the NMAC system for their own nuclear security. The IAEA has also recognized the importance of the NMAC system for strengthening the nuclear security regime. The Agency is preparing to publish a document on the use of the NMAC for nuclear security as implementation guide [3]. The NMAC system consists of several elements such as management, nuclear material control, nuclear material movement and PIT. Those elements can be used as attributes for evaluating the NMAC system at a nuclear facility. In this study, all the elements comprising the NMAC system were extracted and major elements that were seen as significant for evaluating the system were selected. In addition, questionnaires on each selected element were developed. These questionnaires reflected the underlying purpose of the NMAC system for nuclear security. The NMAC measures have a unique role in helping to detect insider threats. It can be a major component in the evaluation methodology of PP that is currently developed by the KINAC.

REFERENCES

- [1] IAEA Nuclear Energy Series, No. NF-T-4.5, Technical Features to Enhance Proliferation Resistance of Nuclear Energy Systems
- [2] IAEA NSS #13, Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Rev. 5)
- [3] IAEA Nuclear Security Series, Use of Nuclear Material Accounting and Control for Nuclear Security Purposes at Facilities