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National Nuclear Material Accounting in Support of Non-Proliferation

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"National Nuclear Material Accounting in Support of Non-Proliferation "

Abstract: The control and tracking of nuclear material being used for peaceful purposes is the corner stone to the success of a strong non-proliferation regime. The nation states using nuclear material for civilian purposes need a consistent, best practices method for national nuclear material accountancy. This paper will discuss the experiences and best practices of the large national nuclear material accounting systems and their use for tracking and accounting for nuclear material. The industry and nations engaged in all aspects of the fuel cycle must require international standards for tracking nuclear material and applying international accounting principals to accomplish confidence in the non-proliferation regimes of each nation. This paper will discuss the existing methods and systems and how these methods could be applied to an international perspective on national nuclear material accounting. The Russian and U.S. systems will be discussed as a basis for dialog on how to establish international standards and best practices for nuclear material accountancy in the global market place.

Introduction

More nations are looking to nuclear energy to solve their energy needs. Nation states that engage in the nuclear fuel cycle and generate nuclear power increase the transportation, use, and storage of nuclear materials. It is important to study the infrastructure needed to have confidence all States with nuclear capability are paying attention to control and accounting for their nuclear material. According to the IAEA, 30 countries have the capability to make weapons quickly.¹ As nuclear power becomes more important for countries in various stages of economic development and government stability, it is important to have reasonable controls so that this number doesn't expand.

The IAEA has recognized the importance of protecting nuclear materials that are being used for peaceful purposes by guidelines for nuclear material accounting and state system of accounting and control (SSAC). States that utilize nuclear material for civilian purposes have a responsibility to safeguard the material. Reliable accounting for and control of nuclear material is fundamental for a State's ability to fulfill their international nuclear non-proliferation obligations. One element of effective accounting and control is a national nuclear material accounting system (NNMAS). The requirement for a robust and enforceable NNMAS will influence accounting controls in place at all nuclear facilities within a State making it more difficult for State and non-state actors to proliferate. Materials accounting is needed to deter diversion of nuclear materials at the facility, ministry and State levels². Developing and implementing a NNMAS demonstrates to the world the State is responsible for the nuclear materials within its borders and that the State requires accountability from its nuclear facilities.

In the remainder of this paper, we will discuss the goals and objectives of a NNMAS, what an NNMAS looks like based on the Russian and U.S. models, and the non-proliferation risks

¹ Nonproliferation and Safeguards: Then and Now - Leonard Weiss (Santa Fe Workshop 4-2007)

² The Role for Nuclear Materials Accounting in Russia, Charles Hatcher, Los Alamos National Laboratory
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and threats of nuclear energy production, and how a NNMAS can help to reduce and mitigate these threats and risks. We will then open a dialogue to discuss how to develop standards and best practices for NNMAS.

Goals and Objectives of a national system

The goal of a computerized inventory control system is to support national and international nuclear non-proliferation. “One way of deterring and detecting theft is by instituting nuclear material controls systems on a national level and at facilities handling direct-use material.” *GAO Report “Nuclear Nonproliferation Status of U.S. Efforts to Improve Nuclear Material Controls in Newly Independent States”, March 1996.*

One of the objectives of a NNMAS is to provide an accurate point-in-time understanding of the current levels and values of inventory both locally and centrally. This accurate understanding allows the State to create reports on nuclear material inventory to satisfy domestic and international safeguard requirements.

Another objective of a NNMAS is to assess and verify the accounting and control measures in place at nuclear facilities. A thorough, accurate and complete measurement-based national inventory management system can verify the effectiveness of protection and control measures at the facility. Reduction of risk of theft and diversion is achieved by a layered approach to protection and control both at the facility and at the national level.. Nuclear material control and accounting systems at the site provide the first line of defense. A comprehensive, timely national system provides another layer.

The national system also has a function in the oversight and management of nuclear material at organizations. Management uses national nuclear material accounting data to support approval for use and transfer of material, accounting of material in-transit, determining discrepancies and differences, and inspections.

The elements of a NNMAS

“The first barrier to preventing nuclear and other radioactive materials being moved from a controlled environment to an uncontrolled environment is an effective national system for the accountability, control and security of these materials.” *International Conference on Security of Material 14 august 2001.* National nuclear material accounting includes accounting for nuclear materials held in the State and appropriately reporting this information to other internal and external organizations. A robust system would include the elements listed below.

- Regulations
- Information System
- Technical requirements for nuclear material accounting (standard nuclear material classification codes and reporting requirements)
- Compliance assurance (audits, inspections)
- Technical support

It is the experience in both the U.S. and Russian Federation that each of these elements must be developed to successfully implement an NNMAS. For example, nuclear material inventory and accounting data cannot be collected by an information system without regulatory support. Nuclear facilities cannot successfully report to the NNMAS without technical support. The data collected cannot be considered reliable without compliance assurance, and the data will not be consistent without good technical requirements.

Regulations provide the legal framework for nuclear facilities to implement nuclear material accounting systems and to report inventory and accounting data to a NNMAS. The regulatory structure should specify who needs to report, what needs to be reported in terms of nuclear material kinds and quantities, how often it should be reported, the format for reporting, and how the information will be verified.

An information system collects the data from the nuclear facilities and stores it in such a way that it can easily be queried. An effective information system will ensure that information based on the data collected is available to nuclear material managers, to government agencies, and to the public in the form of reports tailored to meet the specific information and need-to-know requirements of each user group.

Technical requirements include a standard nuclear material classification and coding system. A well-designed classification and coding system will ensure that data collected can be analyzed across the complex and reported on consistently. Compliance assurance means that there is a method to ensure that the data reported to the NNMAS reflects the book inventory of the reporting facilities and that regulations and technical guidelines are being met. Technical support is necessary to train and support the reporting facilities.

A NNMAS is further defined by the types of nuclear material data is collected, the input reports submitted by nuclear facilities, the frequency of reporting, and the outputs generated from the NNMAS.

Types of material reported

All materials usable in nuclear activities should be reported and tracked by the NNMAS., whether the material is at a government facility or is privately owned.

Inputs

Typically, a NNMAS receives inventory level and inventory change reports on a periodic basis. Material balance reports are created by the NNMAS by taking a beginning inventory level, applying the inventory changes received for a reporting period, and calculating the material balance. Inventory changes include shipments, receipts, burn-up and physical inventory corrections.

Frequency of reporting

Report frequency is determined by an algorithm that takes into account the attractiveness, control, measurement and physical protection of the material. The U.S. system takes a

graded approach to report frequency requiring more frequent reporting of the most attractive and/or vulnerable materials.

Reconciliation

Verification of the accuracy of the inventory level and transaction reports received by the NNMAS is by periodically producing a material balance report based on data reported to the NNMAS and comparing that balance to new inventory reports received from facilities. Discrepancies are noted and must be resolved by the facilities sending corrected inventory reports or additional inventory change reports. The more frequent reconciliation is required, the more confidence nuclear material managers at the national level can have in the data collected in the NNMAS.

Outputs

The NNMAS produces reports such as nuclear material registries, reports on exports and imports for customs agencies, reports to meet IAEA and other international treaty obligations. The NNMAS can also be used to produce reports for facilities inspectors. It can also provide a national nuclear material manager with historical data to perform trending analysis and support the decision to decommissioning or licensing decisions.

Non-Proliferation issues with nuclear fuel cycle

Insider threat

Because of the complexity of the nuclear fuel cycle it is feasible that a savvy insider could divert enough special nuclear material (SNM) to be used in a nuclear weapon. A robust NNMAS would enforce consistent accounting practices at the facility level and could arguably enable analysts at the national level to detect such diversions through analytic techniques.

Increased transport / imports / exports

Using nuclear materials for peaceful purposes such as energy generation increases the chance for nuclear material to be stolen or diverted to non-peaceful purposes. Nuclear energy generation increases the import, transport, and export of nuclear materials for a State. That State is responsible for being able to locate and account for the use of all nuclear materials that either cross or are used within its borders.

IAEA and other international agreements on the use of nuclear material

Nuclear Weapons States (NWS) agree not to transfer "nuclear weapons or other nuclear explosive devices" and "not in any way to assist, encourage, or induce" a non-nuclear weapon state (NNWS) to acquire nuclear weapons (Article I). An NNMAS is needed to uphold their agreement in terms of being able to demonstrate that nuclear material necessary to make nuclear weapons is not being sold, transported, or otherwise diverted to a NNWS or rogue state.

Non Nuclear Weapons States agree not to not to "receive," "manufacture" or "acquire" nuclear weapons or to "seek or receive any assistance in the manufacture of nuclear

weapons" (Article II). NNWS parties also agree to accept safeguards by the International Atomic Energy Agency (IAEA) to verify that they are not diverting nuclear energy from peaceful uses to nuclear weapons or other nuclear explosive devices (Article III). NNWS need an NNMAS to provide IAEA with verifiable evidence of where their nuclear material is, what the quantities are and what it is being used for. By regulating reporting to an NNMAS, States can push reliable, consistent nuclear material accounting and control practices down to the facility level.

Dialogue to develop standards and best practices for a NNMAS

What materials need to be tracked?

At a minimum, the information collected by a NNMAS should meet the guidelines for the establishment of nuclear material accounting and control established by the IAEA. The starting point would be as early in the fuel cycle as is required by the States international obligations. The termination point should be when the material is no longer usable for any nuclear activity.

The material balance from each MBA must follow IAEA guidelines and requirements. The NNMAS also sets the standards for Material Unaccounted For (MUF) or Inventory Difference (ID), shipper/receiver differences and variances to determine what is practical and yet can be analyzed for improper actions.

Who needs to report?

Any facility that uses nuclear materials in quantities at or above levels established by the State and international agreements (IAEA) must be required to report to the NNMAS.

Frequency of reporting

Frequency of reporting should be established by the State using a graded approach. The material most likely to be diverted should have higher standards than the less likely proliferators. This is determined through a quantitative algorithm that can include the category of material, inspection regime, type of production facility, ability to divert through poor or good physical protection and the Material Control and Accounting (MC&A) procedures in place.

The need for timely reporting is recognized at both the national and international levels. Mandating timely reporting to a NNMAS fosters timely accounting practices at the facility level. In other words, facilities will be more apt to record inventory levels and changes in a timely manner if they are required to report and balance to a national system.

At a minimum inventory levels from all sites should be sent to the national system annually although more frequent reporting would be optimal in terms of threat reduction and nuclear material management. Changes in inventory should be sent as they happen or within an established reporting period. Balancing or reconciling the national and site systems is imperative in order to have confidence the information in the national system matches the site's inventory. It is important for the State nuclear material managers to be

able to determine the industry wide accountability so that material cannot be moved during physical inventory taking (PIT) in order to hide it from the inspectors.

Business needs vs. standard accounting

There is a trade-off between the business needs of the operator and national accounting requirements. To minimize this trade-off, it is important to integrate the business accounting and inventory systems so that the reporting inventory levels and changes to the NNMAS becomes a normal part of day to day business. The infrastructure to transfer the information to the national system should be a part of the decision to build and operate nuclear facilities within the nuclear fuel cycle. An operator cannot sacrifice safeguards and security for business objectives. The State, through regulations, must require the accounting and control of the material from the conceptual phase of a nuclear facility through design and implementation. These measures will also make the MC&A methodologies and procedures a normal part of the daily operation of the plant.

All organizations that are responsible for nuclear material need a local, MBA level accounting system. They each need to report directly to the national system at a frequency that allows for national responsibility for the material within the country. Most countries with energy related nuclear industry require an annual national accounting combined with the reporting of inventory changes throughout the year. There are self-protecting elements to the fuel cycle, but it is important to look at the whole picture and weigh the costs, risks, and benefits of accountancy. Combining inventory accounting and business accounting into one system makes it more likely both will be kept current and accurate. This also makes possible most of the elements of reporting needed both from a business and non-proliferation perspective.

- National accounting
- Reporting for foreign obligation on non-proliferation
- Contractual reports and accounting
- Reports for transfers of nuclear material
- Material balance reports

Conclusion

With an accurate well designed national accounting system the State will be able to apply good management techniques to the industry along with the non-proliferation controls required to be a good citizen of the world. The IAEA will be able to inspect to the same standards throughout the country and internationally. The international community will have assurance the obligations to control and not proliferate are being met by the State.

A National Nuclear Material Accounting system provides the standards and guidelines for nuclear material control and accountancy for a State's nuclear industry. These standards and guidelines should be used as nuclear facilities are designed and built to integrate nuclear material control and accounting into the facilities' operation.

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