

**REGULATIONS FOR RADIOCHEMICAL FACILITIES IN THE UNITED STATES**

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**Introduction**

The nuclear enterprise as we know it came into being during World War II. Radiochemical facilities involve complex chemical processes that make it difficult for material control and accounting (MC&A) to close material balances with a high degree of precision. A principle tenant in a material protection control and accounting (MPC&A) system is that physical protection provides the protection of the material. Material control and accounting (MC&A) is implemented to provide assurance that physical protection measures have been effective, and in case they fail, to provide delayed detection of the loss. These systems must provide protection against both the external and internal threats.

Material accounting can be based on traditional physical inventories and closing a material balance, process monitoring to provide more frequent tests, or a combination of these two approaches. Typically, process monitoring techniques are used to monitor and track material flows, and limits on campaign uncertainties establish measurement/accounting accuracy requirements. Measurement programs must address both accurate measurements of inputs and outputs, as well as estimation/measurement of in-process inventories and equipment holdup.

Regulations in the United States have been developed that include both performance and compliance requirements to provide a defense in depth approach addressing the unique characteristics of each facility. Regulations address administrative controls, material control and material accounting. MC&A plans are negotiated between regulatory agencies and facilities to develop a site-specific approach. An overview of the regulations and their implementation in the United States is provided.

**Atomic Energy Act**

The Atomic Energy Act was first issued in 1946 to create the Atomic Energy Commission and provide for the control of nuclear energy. The Atomic Energy Act of 1954, as amended, directed the Atomic Energy Commission (AEC) to regulate the receipt, manufacture, production, transfer, possession, use, import, and export of special nuclear material (SNM) in order to protect the public health and safety, and to provide for the common defense and security.

## General Aspects of the State System of NMC&A

The Energy Reorganization Act of 1974 separated functions for the oversight and regulation of the licensed facilities and provided a distinction between government owned nuclear materials and private owned nuclear materials. The licensing and related regulatory functions were transferred to the Nuclear Regulatory Commission (NRC). The NRC regulations are issued as law in the Code of Federal Regulations. Other functions were assigned to the Department of Energy, as well as oversight of facilities operated for the its defense missions for nuclear material production, processing, and use. The DOE requirements are issued as DOE Orders.

### **DOE Orders**

The DOE requirements for Safeguards and Security are contained in the 5630 series of the DOE the Orders. DOE Order 5633.3B contains the primary requirements for material control and accounting. Other Orders in this series address such topics as inspections and assessments and reporting to the national accounting data base. The requirements in DOE Order 5633.3B are subdivided into three functional areas: 1) Program Administration, 2) Material Accounting, and 3) Material Control. Each section contains a combination of compliance and performance requirements.

The Program Administration element of MC&A includes those functions that, while not a direct element of protecting and accounting for nuclear materials, are essential for the MC&A program to perform well. The elements include having documented plans and procedures, training, and a system of internal reviews and assessments to ensure that the program performs as intended.

The Material Accounting element includes those functions necessary to account for the nuclear material and report on its status. The functions are: an accounting system, a physical inventory program, measurements and an associated measurement control program, material transfers, and documentation and reporting.

The Material Control element includes those functions to provide for timely detection. Those functions are: access control, material surveillance, material containment, and detection elements.

DOE has developed a wide variety of guidance documents and training programs to assist sites in developing programs to meet the individual elements of the requirements in the DOE Orders. These included such document are standard formats for MC&A Plans, technical procedures, and technology evaluations, such as for measurements or tamper-indicating devices.

### **NRC Regulations**

The principle requirements for the material control and accounting at licensed facilities are found in Title 10, Code of Federal Regulations, Part 70 (10 CFR 70), "Special Nuclear Material" and Part 74 (10 CFR Part 74), "Material Control and Accounting of Special Nuclear Material." The requirement in 10 CFR Part 70 were promulgated by the NRC following the Energy Reorganization Act of 1974. These regulations focus on periodic physical inventories and closing a material balance to determine a plant-wide inventory difference (ID) and its associated uncertainty. Some facilities with complex chemical processes were having difficulties in conclusively resolving large inventory differences. A Task Force was established to review MC&A performance at the various facilities and make recommendations to provide greater assurance that nuclear materials have not been diverted (USNRC 1978). Feasibility studies were conducted at several facilities to gain experience and identify specific procedures that might be used. A set of reform amendments were drafted for facilities processing significant quantities of plutonium and highly enriched uranium and issued for review and comment.

The reform amendments were issued for implementation in 1987 as 10 CFR Part 74 Subpart E, along with guidance documents to assist licensees in complying with the new requirements.

These Reform Amendments are a performance-oriented regulation that emphasizes timely detection of nuclear material losses and provides more conclusive resolution of discrepancies. This is accomplished by taking advantage of process controls, production controls, and quality controls already in place. The regulations in Subpart E were divided into process monitoring, item monitoring, alarm resolution, and quality assurance and accounting. Goals and system capabilities were specified, and licensees then developed specific methods to achieve them.

The requirements separate items facilities from bulk handling facilities. Item monitoring defines units with unique characteristics such that removal of nuclear material would be apparent. The intent of this requirement is to ensure timely plant-wide detection of the loss of items that amount to a goal quantity of nuclear material. To achieve this capability, the licensee is expected to verify the presence and integrity of selected SNM items on a periodic basis. The required frequency of tests for missing items is graded according to the relative attractiveness of the material type in the item, the ease with which the item could be diverted without being observed, and the degree of surveillance and containment provided for by the physical security. If SNM is not tamper-saved, stored in a vault, or permanently CAA that provides protection at least equivalent to tamper-saving, encapsulated, or in samples containing less than a threshold amount, it is not considered an item and the SNM is subject to the in-process control requirements for bulk material.

The goal of the quality assurance and accounting requirements in 10CFR Part 74 is to assure that the MC&A system is performing as intended. Because the requirements in Part 74 are performance oriented, each facility must implement a management structure that provide clear lines of responsibilities and a system of checks and balances. Quality assurance requirements address management structure, personnel qualification and training, measurement control, physical inventories, internal controls, and accounting.

### **NRC Guidance Documents**

The principal requirements with respect to SNM licensing are found in Title 10, Code of Federal Regulations, Part 70 (10 CFR Part 70), "Special Nuclear Material" and Part 74 (10 CFR Part 74), "Material Control and Accounting of Special Nuclear Material." Paragraph (b) of §70.22 of 10 CFR Part 70 specifies that special nuclear material control and accounting (MC&A) information must be provided in a license application to show how compliance with the fundamental nuclear material control requirements of §70.58, §74.31, §74.33 or §74.51 will be accomplished. The NRC issued guidance documents to suggest a standard format and content for use in preparing material control and accounting plans. One example is NUREG-1280, Standard Format and Content Acceptance Criteria for the Material Control and Accounting (MC&A) Reform Amendment, issued for the requirements for facilities with significant quantities of Strategic Special Nuclear Material in Subpart E of 10 CFR Part 74. These guidance documents typically provide an intent and scope statement for each requirement and the acceptance criteria that will be used by the NRC in evaluating the adequacy of submitted plans.

The NRC has also issued other guidance and reference documents focusing on specific aspects of MC&A. For example, *Statistical Methods for Nuclear Materials Management* (1988) was issued to assist licensees in choosing statistical methods for specific applications and address both the general background and specific examples.

### **International Safeguards**

The United States is party to the Nonproliferation Treaty. The United States negotiated an agreement with International Atomic Energy Agency (IAEA) for the application of international safeguards in the US, which was signed in 1980. The requirements for international safeguards

## General Aspects of the State System of NMC&A

at DOE facilities are contained in DOE Order 1270.2B and the NRC requirements are contained in 10 CFR Part 75. The IAEA began implementing safeguards at licensed facilities in 1980. On September 27, 1993, President Clinton offered to make nuclear materials excess to national security needs available for safeguards. In 1994, the IAEA began implementing safeguards at facilities that previously supported the nuclear weapons complex.

### **Summary**

The United States has a well developed regulatory system that has been evolving since the inception of the nuclear enterprise over 50 years ago. The regulations have been developed in a deliberate and process, that included public input as well as that of regulators and regulated. Separate regulations have been developed in the United States for licensed and DOE defense facilities. These regulations have been published and are available to the public. The regulations have evolved over the years as facilities changed, external conditions changed, and experience was gained. Over the history of this regulatory development, radiochemical facilities have presented some unique challenges. These regulations now contain a combination of performance and compliance requirements to allow facilities to develop a site-specific approach to material control and accounting.

### **References**

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