



# DRAFT REGULATORY GUIDE

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## DRAFT REGULATORY GUIDE DG-5057

(Proposed Revision 3 of Regulatory Guide 5.29, dated June 2013)

# SPECIAL NUCLEAR MATERIAL CONTROL AND ACCOUNTING SYSTEM FOR NON-FUEL CYCLE FACILITIES

## A. INTRODUCTION

### Purpose

This regulatory guide (RG) describes methods and procedures that the staff of the U.S. Nuclear Regulatory Commission (NRC) considers acceptable for implementation and maintenance of a special nuclear material (SNM) control and accounting system.

This RG applies to non-fuel cycle facilities authorized to possess or use SNM in a quantity greater than 350 grams of contained uranium-235, uranium-233, or plutonium or any combination thereof, including nuclear reactors licensed under 10 CFR Part 50 or 52 and storage installations licensed under 10 CFR Part 72. These facilities also include licensees authorized to possess SNM under 10 CFR Part 70, but who are not subject to Subpart H of 10 CFR Part 70 or the requirements in Subparts C, D, or E of 10 CFR Part 74.

### Applicable Rules and Regulations

- Title 10, Part 74, of the Code of Federal Regulations (10 CFR 74) (Ref. 1), “Material Control and Accounting of Special Nuclear Material,” requires the control of, and accounting for, SNM at fixed sites and for documenting the transfer of SNM.
- Within 10 CFR Part 74 Subpart A, “General Provisions,” 10 CFR 74.3 “General Performance Objectives,” requires that licensees who are authorized to possess or use SNM in a quantity greater than 350 grams of contained uranium-235, uranium-233, or plutonium, or any combination thereof, implement and maintain a material control and accounting (MC&A) program that enables licensees to achieve the general performance objectives in a timely manner.
- 10 CFR Part 74 Subpart B, “General Reporting and Recordkeeping Requirements,” establishes the MC&A performance requirements for SNM at non-fuel cycle facilities.

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This regulatory guide is being issued in draft form to involve the public in the development of regulatory guidance in this area. It has not received final staff review or approval and does not represent an NRC final staff position. Public comments are being solicited on this draft guide and its associated regulatory analysis. Comments should be accompanied by appropriate supporting data. Comments may be submitted through the Federal-rulemaking Web site, <http://www.regulations.gov>, by searching for Docket ID : NRC-2015-0120. Alternatively, comments may be submitted to the Rules, Announcements, and Directives Branch, Office of Administration, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001. Comments must be submitted by the date indicated in the *Federal Register* notice.

Electronic copies of this draft regulatory guide, previous versions of this guide, and other recently issued guides are available through the NRC’s public Web site under the Regulatory Guides document collection of the NRC Library at <http://www.nrc.gov/reading-rm/doc-collections/reg-guides/>. The draft regulatory guide is also available through the NRC’s Agencywide Documents Access and Management System (ADAMS) at <http://www.nrc.gov/reading-rm/adams.html>, under Accession No. ML15015A271. The regulatory analysis may be found in ADAMS under Accession No. ML15015A294.

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- 10 CFR 74.11, “Reports of loss or theft or attempted theft or unauthorized production of special nuclear material,” requires, in part, that licensees notify the NRC of any such events within one hour of discovery.
- 10 CFR 74.13, “Material status reports,” requires, in part, that licensees who possess one gram or more of irradiated or non-irradiated SNM submit material balance reports and physical inventory listing reports to the Nuclear Material Management and Safeguards System (NMMSS).
- 10 CFR 74.15, “Nuclear material transaction reports,” requires, in part, that licensees complete transaction reports when transferring, receiving, or making adjustments to one gram or more of contained uranium-235, uranium-233, or plutonium.
- Within 10 CFR 74.19, “Recordkeeping,” 10 CFR 74.19(a) requires, in part, that licensees – other than those that are subject to 10 CFR Part 74 Subparts C, D, or E – keep records that show the receipt, inventory (including location and unique identity), acquisition, transfer, and disposal of all SNM in their possession.
- Within 10 CFR 74.19, 10 CFR 74.19(d) requires, in part, that nuclear reactors and storage installations shall establish, document, implement, and maintain an item control system.
- Within 10 CFR 74.19, 10 CFR 74.19(b), and (c), require, in part, that licensees establish, maintain, and follow written MC&A procedures, and that they conduct physical inventories of all SNM at intervals not to exceed once every twelve (12) months.
- Within 10 CFR 74.19, 10 CFR 74.19(e) requires, in part, that licensees maintain adequate safeguards against tampering with and loss of records.

### **Related Guidance**

- NUREG-1065, “Acceptable Standard Format and Content for the Material Control and Accounting Plan Required for Special Nuclear Material of Low Strategic Significance,” Revision 3 (Ref. 2), provides additional guidance on various MC&A program elements. This includes general performance objectives, item control systems, physical inventories, and recordkeeping and reports.

### **Purpose of Regulatory Guides**

The NRC issues RGs to describe methods that the staff considers acceptable for use in implementing specific parts of the agency’s regulations, to explain techniques that the staff uses in evaluating specific problems or postulated accidents, and to provide guidance to applicants. RGs are not substitutes for regulations and compliance with them is not required. Methods and solutions that differ from those set forth in RGs will be deemed acceptable if they provide a basis for the findings required for the issuance or continuance of a permit or license by the Commission.

### **Paper Reduction Act**

This RG contains information collection requirements covered by 10 CFR Part 74 that the Office of Management and Budget (OMB) approved under OMB control number 3150-0123. The NRC may

neither conduct nor sponsor, and a person is not required to respond to, an information collection request or requirement unless the requesting document displays a currently valid OMB control number.

## **B. DISCUSSION**

### **Reason for Revision**

This revision (Revision 3) addresses new aspects in support of the amendments to MC&A regulations in 10 CFR Part 74. The previous revision of RG 5.29 (Revision 2) endorsed the guidance in American National Standards Institute (ANSI) N15.8-2009, "Material Control Systems – Special Nuclear Material Control and Accounting Systems for Nuclear Power Plants" (Ref. 3), as providing an acceptable approach to meet in part the MC&A requirements in Subpart B of 10 CFR Part 74 at nuclear power plants. This RG expands the scope of the guidance to cover additional MC&A requirements that may be added to Part 74, and this RG also covers all non-fuel cycle facilities including nuclear reactors, storage installations, and certain licensees authorized to possess and use SNM in a quantity greater than 350 grams of uranium-235, uranium-233, or plutonium or any combination thereof.

Proposed revisions to 10 CFR Part 74 were published for public comments on November 8, 2013, (78 FR 67225). In the SRM for the proposed rulemaking (SECY-08-0059, "Rulemaking Plan: Part 74 - Material Control and Accounting of Special Nuclear Material," dated February 5, 2009), the Commission directed the staff to revise certain existing guidance documents to be consistent with any new and proposed revised MC&A requirements. This RG is one of six guidance documents being revised to reflect the revision of the regulations.

### **Background**

Control and accounting for SNM at non-fuel cycle facilities is considerably less complex than at fuel cycle facilities, because the material is usually maintained in a readily identifiable per-item basis such as a fuel rod. Maintaining proper control is necessary to ensure that licensed material is adequately accounted for in a manner that provides continuity of control throughout the total cycle of possession and use.

The MC&A process is designed to use control and monitoring measures to prevent or detect a loss of licensed material when it occurs, or soon thereafter. Additionally, statistical and accounting measures are used to maintain knowledge of the quantities of SNM present in each area of a facility. Physical inventories and material balances are used to verify the presence of licensed material, or to detect the loss of such material after it occurs, such as in cases of theft involving an insider. The item control and records systems provide the capability to promptly locate and confirm the existence of any specific item or group of items upon demand, thus protecting against unauthorized and unrecorded removal of items, or of material from items.

The general performance objectives (GPOs) stated in 10 CFR 74.3 require the implementation and maintenance of an MC&A program that enables the licensee to achieve the objectives in a timely manner. An adequate MC&A program will satisfactorily implement the corresponding capabilities. The GPOs are directed at maintaining knowledge of items (the term item is defined in 10 CFR 74.4), which is done through the collection and recording of information. Loss of material is detected through activities such as conducting a physical inventory, which provides information to verify the accuracy of the MC&A records at a site. MC&A information is essential to detecting and resolving any actual or potential loss, theft, diversion, or misuse of licensed material. Restricting access to MC&A records reduces the likelihood that these records could be tampered with in a manner that would invalidate the information they contain (i.e., concealing the loss, theft or diversion of items containing source material or SNM).

In 2009, ANSI issued a voluntary revised MC&A standard, ANSI N15.8 2009, that explicitly

covers all SNM possessed under license where each physical inventory “shall be conducted in all item control areas (ICAs), including: (1) new fuel storage areas; (2) irradiated fuel storage areas; (3) reactors; (4) independent spent fuel storage installations; and (5) areas containing non-fuel SNM.” This ANSI standard applies exclusively to nuclear power reactors.

### **Harmonization with International Standards**

The International Atomic Energy Agency (IAEA) has established a series of guides and standards that address MC&A issues. These IAEA guides and standards are designed to assist Member States to achieve appropriate levels of security over nuclear materials. Pertinent to this RG, the IAEA Nuclear Services Series No. 15, “Nuclear Material Accounting Handbook” (Ref. 4), issued May 2008, provides recommendations for best practices and methods used to account for nuclear material. While 10 CFR Part 74 pertains primarily to MC&A of SNM, the NRC staff reviewed this IAEA document and found that this RG is consistent with the security principles provided in the IAEA Nuclear Services Series No. 15.

### **Documents Discussed in the Staff Regulatory Guidance**

This RG endorses the use of one or more codes or standards developed by external organizations, and other third party guidance documents. These codes, standards and third party guidance documents may contain references to other codes, standards or third party guidance documents (“secondary references”). If a secondary reference has itself been incorporated by reference into NRC regulations as a requirement, then licensees and applicants must comply with that standard as set forth in the regulation. If the secondary reference has been endorsed in a regulatory guide as an acceptable approach for meeting an NRC requirement, then the standard constitutes a method acceptable to the NRC staff for meeting that regulatory requirement as described in the specific regulatory guide. If the secondary reference has neither been incorporated by reference into NRC regulations nor endorsed in a regulatory guide, then the secondary reference is neither a legally-binding requirement nor a “generic” NRC approved acceptable approach for meeting an NRC requirement. However, licensees and applicants may consider and use the information in the secondary reference, if appropriately justified, consistent with current regulatory practice, and consistent with applicable NRC requirements.

## C. STAFF REGULATORY GUIDANCE

The staff considers conformance with the guidance in ANSI N15.8-2009 to be an acceptable approach to meet, in part, the MC&A requirements in Subpart B of 10 CFR Part 74 at nuclear reactors. This ANSI standard applies exclusively to nuclear power reactors. In addition, the staff positions below apply to various types of non-fuel cycle facilities, as discussed in each staff position.

### 1. General Performance Objectives

The GPOs in 10 CFR 74.3 are directed at maintaining knowledge of SNM, which is done through collection and recording of information. The guidance in this section on GPOs applies to all non-fuel cycle facilities, including nuclear reactors and storage installations, and certain licensees authorized to possess and use SNM in a quantity greater than 350 grams of uranium-235, uranium-233, or plutonium or any combination thereof.

- A. Maintain accurate, current, and reliable information on, and confirm the quantities and locations of SNM in its possession.
- (1) The purpose of this GPO is to verify the presence of all SNM held by the licensee, and to detect the occurrence of any significant loss, including possible theft or diversion. The licensee should maintain current information on all such SNM, and have in place an MC&A program that provides timely, accurate, and reliable information about the quantity and location of SNM in the licensee's possession.
  - (2) Valid information should be maintained on each item that confirms both the element and the isotope (such as uranium-233, uranium-235, or Plutonium), and weight that should be based on measured values or on other reliable factors. Reliable information means that the quantity values are known, and that item locations are specific enough so as to provide for the retrieval of the items in a prompt manner. Reliable information also means that the quantities and locations of all classes of material and items listed in the accounting records are correct and verifiable.
  - (3) The licensee should accurately account for all SNM that is received and shipped by maintaining reliable records based on accurate measurements. When a shipment is received, the licensee should begin monitoring the movement and location of the material within the facility using item control procedures to monitor the location and integrity of items. All recorded SNM quantities associated with receipts, shipments, discards, and ending inventory need to be based on valid measurements. Licensees maintain a detailed system and applicants demonstrate they have a detailed and accurate record keeping system for the generated data that provides knowledge of the material's location in a timely manner.
  - (4) The licensee should verify the presence of all SNM that its accounting records show is present at the facility. The MC&A program should be capable of verifying the presence of 100 percent of all uniquely identified SNM items that are listed in the accounting records, and should enable the licensee to verify the identity and integrity of all encapsulated items, and items affixed with tamper-indicating seals.
  - (5) The physical inventory program should be managed and maintained independent of the operations organization.

- B. Detect, respond to, and resolve an anomaly indicating a possible loss, theft, diversion, or misuse of SNM.
- (1) The purpose of this GPO is to ensure that a licensee develops and implements a formalized program to detect, respond to, and resolve an anomaly indicating a possible loss of SNM, including possible theft or diversion.
  - (2) Resolution of such indicators means that the licensee has made a determination that a theft or loss of SNM has or has not occurred. Resolution should include a review of the MC&A accounting records for possible omissions, incorrect entries, transcription errors, or calculation errors. The location designations of the items should be specific enough to provide for the retrieval of the items in a prompt manner. Reliable information means that the quantities and locations of SNM and items listed in the accounting records are correct and verifiable. The operations area in which the anomaly occurred should be identified, the associated inventory information verified, and measurements conducted as needed to confirm any loss of material.
  - (3) A possible loss detected during a material balance closure should be investigated.
  - (4) How an anomaly is resolved depends on the type of indicator. Various types of anomalies at facilities could occur from a wide range of possible underlying scenarios (e.g., from unidentified or inadequately monitored loss mechanisms, simple theft, or complex diversions).
  - (5) Licensee management should be immediately notified if an apparent loss of SNM, including theft or diversion, is detected. Licensee management should be informed of the situation and, as appropriate, request additional resources to investigate the loss of SNM.
- C. Permit rapid determination of whether an actual loss, theft, diversion, or misuse of SNM has occurred.

The purpose of this GPO is to ensure that a licensee's MC&A program provides the licensee with adequate capability to detect and quickly respond to indications of possible loss, theft, diversion, or misuse of SNM, and to rapidly determine whether or not a loss, theft, diversion, or misuse of SNM has occurred.

- D. Provide information to aid in the investigation and recovery of missing SNM in the event of an actual loss, theft, diversion, or misuse.
- (1) The purpose of this GPO is to ensure that if the NRC or another government agency deems it necessary to conduct an investigation of an actual loss, theft, diversion, or misuse of SNM, the licensee will be ready to assist the investigating agency to perform its investigation.
  - (2) The agency may require the licensee to provide any information the agency considers relevant to recover SNM. The burden will be on the licensee to provide all information that the licensee recognizes as relevant, as opposed to providing only information that the investigators request.
- E. Control access to MC&A information to preclude loss, theft, diversion, or misuse of SNM.

- (1) The purpose of this GPO is to ensure that access to MC&A data is adequately controlled, to minimize the risk that SNM will be lost, stolen, diverted or misused.
- (2) Methods to control access to MC&A information, access control, material containment, and material surveillance should be multi-layered, to eliminate the consequence of a single-point failure.
- (3) An effective quality assurance program description should minimize the possibility of potential failures for the MC&A program. These control measures can provide necessary checks and balances that contribute to control access to MC&A information.

## **2. Item Control System**

The regulations in 10 CFR 74.19(d) require that certain licensees establish, document, implement, and maintain an item control system. As discussed below, licensees implementing and maintaining an item control system also need to keep in mind the requirements of 10 CFR 74.11, 74.13, and 74.15. The guidance in this section on item control systems applies only to nuclear reactors and storage installations.

### **A. Elements of an Item Control System**

- (1) Computer database for tracking specific accountable SNM item data, such as item unique identifier, isotopic mass, elemental mass, item description and specific location.
- (2) Records of material receipts with DOE/NRC Form 741 data, material shipments with shipper number, and material processing data that may be needed at the local facility. Item control data should be protected from unauthorized changes.
- (3) Periodic inventories of SNM to verify the presence of all accountable material on record at the site.
- (4) A measurement program or methods of calculations, as applicable to particular operations of the facility, with the capability to determine the SNM characteristics needed to establish or authenticate material items.
- (5) A measurement control program that assures an adequate level of measurement capability and accuracy to meet operational and security requirements.
- (6) Procedures that describe the roles and responsibilities for individuals, training requirements for individuals to perform selected tasks, and the separation-of-duty between MC&A personnel and operations.

### **B. Characteristics of an Adequate Item Control System**

- (1) The item control system ensures that items are stored and handled or subsequently measured in a manner such that unauthorized removals of individual items or material from items will be detected.
- (2) In order to promptly locate a given item, sufficient current information should be recorded. Items should have an assigned unique identifier as well as measured element and isotope quantity.



- (3) The item control system should be able to collect and quickly provide item inventory data when needed for regular inventories, or for quick response when an item needs to be located. The capability to re-measure a suspect item should be available when needed.
- (4) An item control system should identify, by position title, the individual responsible for overseeing the system. Positions of those individuals who have significant item control system responsibilities also should be identified.
- (5) Non-SNM items stored with items containing SNM should be clearly identified as such to preclude SNM items from being mistaken for non-SNM items.

C. Establishing an Item Control Numbering System

- (1) Each item must be identified in the material control records by a unique number or other unique identifier (e.g., a physical description of the item) and location, as required by 10 CFR 74.19(a)(1).
- (2) Descriptions should be provided of the item records showing how items are identified for each material type and each type of container. If the unique number on a tamper indicating device (TID) is the basis for providing the unique item identity, the MC&A program documentation should:
  - (a) describe the type of TID used;
  - (b) describe how the TIDs are obtained and what measures are carried out to ensure that duplicate (counterfeit) TIDs are not manufactured;
  - (c) describe how the TIDs are stored, controlled, issued, and accounted for; and
  - (d) describe how TID usage and disposal records are maintained and controlled.

Similar information should be provided for other methods of unique item identity (e.g., labels).

- (3) Tailor the item numbering system to fit the type of operation. The identifier may contain alphanumeric characters to aid the material custodians in recognizing the item. For example, an item number may be either P0000 (P is a part); C0000 (C is a container) or A0000 (where A is an assembly). Item numbers should be assigned at material receipt, along with both element and isotopic weights. When opening a sealed container holding material that is an “item” as defined in 10 CFR 74.4, the contents should receive individual item numbers if not already applied.
- (4) For items subject to the item control system, the following are considered acceptable means for providing unique identity:
  - (a) a unique alpha-numeric identification on a tamper-indicating seal applied to a container of SNM;
  - (b) a unique alpha-numeric identification permanently inscribed, embossed, or stamped on the container or item itself; and

- (c) a uniquely pre-numbered (or bar-coded) label applied to each item having good adhesive qualities such that its removal from an item would preclude its reuse.
- (5) Although a TID is an acceptable means for providing an item with a unique identity, it is not the best practice for all applications. When possible, use of TIDs should be limited to the purpose of detecting whether a container was tampered with or opened.

D. Applying MC&A Control Numbers to SNM Items

Not all SNM items permit the attachment of a label with an MC&A control number. The MC&A control number can be placed on an adhesive label which in turn is then placed on a plastic bag, metal container or other fixture that holds the SNM item. Paragraphs (1), (2) and (3) below provide examples.

- (1) A small SNM item such as a fuel pellet is placed into a plastic bag that is then heat-sealed. The MC&A control number is placed on an adhesive label which is placed on the bag. MC&A measurements may then record a gross weight of the bag.
- (2) Identity Cards
  - (a) A large SNM item is containerized; the container is sealed with a TID. The MC&A control number of the SNM item is placed on a card which is put on the container. The container also gets an MC&A control number on an adhesive label which is placed on the outside of the container. The TID number is duplicated on an adhesive label which is placed on the container. The MC&A measurements team perform the needed measurements of the SNM and container.
  - (b) While performing inventory, the following may occur: The TID is examined for tampering, and the number of the applied TID is verified with the MC&A record, with the TID number applied on the container. The container is inspected for possible tampering and the container number is verified with the MC&A record. The MC&A control number of the SNM item is verified with the number on the SNM card. If the data matches and no tampering has occurred, the presence of the SNM item is accepted for inventory purposes.
- (3) MC&A control numbers may get “nested” when packaging material. For example, three SNM fuel pellet items are placed in a small container and the container is sealed with a TID. The small container is repackaged into a larger cask with other accountable SNM items and the cask sealed with a TID. MC&A measurements are performed during packaging as needed to confirm the validity of the material being containerized. The MC&A record could then show:

Cask ABC, TID number T234	
SNM Part	P345
SNM Part	P456
Container	C001, TID123
Fuel pellet	P789
Fuel pellet	P678
Fuel pellet	P890

This accountability hierarchy shown in the MC&A record indicates that Cask ABC with its TID234 is the only item that needs to be inspected and verified for inventory.

E. Item Input Control and Receipt of SNM

For SNM received at the licensee's facility, the licensee needs to:

- (1) contact the shipping vendor in the event the SNM does not arrive as scheduled. Initiate an investigation and resolve;
- (2) verify the integrity of the shipping container and tamper-safing devices, and resolve any problems identified;
- (3) verify that the quantity (item count) and unique identification numbers are in agreement with those indicated on the shipper's documents;
- (4) take appropriate steps to resolve and reconcile any differences in quantities or identification numbers.

F. Review of Fuel Supplier's Values

The site or its representative should review the adequacy of the fuel supplier's MC&A program used in establishing the quantities and assays of SNM. In the event of a significant discrepancy between the fuel supplier's values for SNM quantities and assays and those determined by the site using the industry standard (i.e., two-sigma deviation), the cause of such discrepancies should be investigated with the fuel supplier and the differences should be resolved and reconciled expeditiously.

G. Documentation

The material custodian should report the receipt of each item containing SNM, by serial number or other unique identifier, to the accounting group. The receipt of SNM should be documented in the material control records and the book inventory as required in 10 CFR 74.19(a). Each licensee that receives or transfers an item containing one gram or more of contained uranium-235, uranium-233, or plutonium must submit to the NMMSS database a Nuclear Material Transaction Report, in accordance with 10 CFR 74.15(a).

H. Item Output Control and Shipment

Procedures should be established to provide for:

- Verification and recording of the serial number or unique identifier of each item containing SNM;
- Recording of the quantities of SNM contained in each item;
- Reporting the quantity of SNM shipped;
- Verification of compliance with regulations, including licensing, transportation, and security requirements for shipment; and

- Reporting the completion of each shipment to the accounting group. Care should be taken to assure that SNM is not shipped inadvertently with shipments of non-SNM.

#### I. Damaged Cladding

Damage to reactor fuel cladding, where rod structural integrity has been compromised, has the potential to result in inadvertent physical separation and dispersal of components from the fuel rod. Upon visual identification of inadvertent physical separation, an estimate of the irradiated SNM quantity and an engineering evaluation concerning the origin of the SNM should be made and documented. The amount of irradiated SNM that has been lost must be reported, as required by 10 CFR 74.13(a)-(b). Methods used to estimate SNM quantities include, for example, engineering calculation, engineering evaluation, physical measurement of fuel rod length, destructive or non-destructive measurement, and count of the number of pellets retrieved or missing. Unique item control numbers are assigned as needed.

#### J. Non-Fuel SNM Items

Non-fuel SNM items are items containing SNM that are not intended for use as fuel (e.g., fission detectors). The licensee should provide current knowledge of the location, identity, and quantity of non-fuel SNM items that are not exempt from item control system. Should the licensee seek relief from the 10 CFR 74.19(d) requirement, the licensee will need to submit specific exemption requests in accordance with 10 CFR 74.7, "Specific Exemptions." In addition, the licensee should provide a listing of non-fuel SNM items exempted from the item control system with their quantities, locations, and discuss the basis for the exemptions.

Non-fuel SNM items that can be considered for exemptions from the item control system are:

- (1) items which contain a small, often minuscule, quantity of SNM (e.g., less than 0.01 gram of uranium-235), such as irradiated incore and excore nuclear detectors retained in high radiation areas,
- (2) items which acquire a small quantity of SNM through normal reactor processes, such as laundry, waste streams, filters, or contaminated equipment, or
- (3) any licensee-identified items containing small quantities of non-fuel SNM located within inaccessible locations.

#### K. Reducing Vulnerability to SNM Loss or Diversion From Insider Actions

- (1) Within a particular site, the areas of increased vulnerability to loss or diversion of SNM should be identified and evaluated with the assistance of appropriate security personnel. Certain facility locations where SNM is accessible can provide increased opportunities for an insider to acquire SNM. Therefore, any area of increased vulnerability should receive increased vigilance to prevent loss or diversion of material.
- (2) Locations with easiest insider accessibility to SNM are those where increased safeguards are most needed.
- (3) Locations where presumed empty containers are removed from a work area may be a security concern. Apply TIDs to verified empty containers to prevent them from being

used as carriers for SNM out of a work area.

- (4) Time of accessibility to SNM should be kept as short as reasonable, and workers not needed for the immediate task accessing SNM should be moved away from the SNM.
- (5) In addition to preventing the actual loss or diversion of material, consideration should be given to resolving false loss or diversion claims. In this regard, licensees should be able to perform a careful inventory on short notice to prove that there was no loss of SNM from the site.

L. Item Control Methodology and Procedures

- (1) As part of the item control system, a licensee should maintain a system that:
  - (a) verifies that items shown in the MC&A records are actually stored and identified in the manner indicated in the records;
  - (b) verifies that generated items and changes in item locations are properly recorded in the MC&A record system in a timely manner; and
  - (c) can detect, with high probability, any real loss of items, or SNM from items. Licensees should devise and use technically acceptable statistical methods for evaluating SNM quantities with a 95% confidence level.
- (2) As part of its item control system, a licensee should conduct the following activities at least monthly:
  - (a) for each item inventory stratum, compare the actual storage status to the recorded status of a sufficient sample of randomly selected items from the item control system records; and
  - (b) for each item inventory stratum, check the accuracy of the MC&A records for a sufficient sample of randomly selected items from each storage area.
- (3) The actual frequency of the above activities, and the size of the random sample, should be a function of the expected discrepancy rate based on prior operational experiences/observations. The MC&A program or procedure should specify:
  - (a) minimum monitoring frequencies associated with each storage area;
  - (b) discrepancy rates that trigger more frequent monitoring frequencies; and
  - (c) commitments for resolving discrepancies.

M. Investigation and Resolution of Item Anomalies/Discrepancies

- (1) In its internal procedures, the licensee or license applicant should include statements of the MC&A procedures and controls to ensure that all incidents involving missing or compromised items or falsified item records will be investigated. A compromised item is:

- (a) one displaying evidence of tampering; or
  - (b) an unencapsulated and unsealed item assigned to a controlled, limited-access storage area that is found elsewhere.
- (2) if any unencapsulated and unsealed item is located after having been determined to be missing, or if an item is found to be compromised, its contents should be reestablished by measurement (e.g., by NDA or by weighing, sampling, and analysis). Discrepancies should be resolved in accordance with the MC&A program procedures.

### 3. Physical Inventories

The regulations in 10 CFR Part 74.19(c) require that licensees conduct a physical inventory of all SNM in their possession under license at intervals not to exceed 12 months. The guidance in this section on physical inventories applies to all non-fuel cycle facilities, including nuclear reactors and storage installations, and certain licensees authorized to possess and use SNM in a quantity greater than 350 grams of uranium-235, uranium-233, or plutonium or any combination thereof.

- A. All accountable SNM items and materials should be physically verified to be present and in the location documented in the accounting record.
- B. A physical inventory is a determination on a measured basis of the quantity of special nuclear material on hand at a given time. The methods of physical inventory and associated measurements may vary depending on the material to be inventoried and the process involved.
- C. Physical inventories are performed according to the required schedule, special requests, or procedural requirements, and verify item identities, locations and characteristics as recorded in the MC&A database. Anomalies are resolved to achieve a correct accounting record. Licensees are required to promptly report any loss of SNM to the responsible NRC office in accordance with 10 CFR 74.11.
- D. Physical Inventory Procedures
  - (1) The MC&A program procedures should contain a description of the inventory methodology, including cutoff of materials movement and inventory minimization procedures, and should identify all measurements (including sampling) sufficient to meet the requirements of 10 CFR Part 74. The procedures should also contain sufficient information to show how the total in-process inventory for SNM is obtained.
  - (2) The MC&A program procedures should describe special item storage and handling or tamper-indicating methods, which are used to ensure that the previously measured and recorded SNM content values can be used for inventory purposes without re-measurement. In addition, the procedures should outline how item identities are verified and how tampering with the contents of items will be detected or prevented.
- E. Physical Inventory Practices
  - (1) Unique identification should be provided for each item on inventory and inventory records should be maintained showing the identity, location, along with the element and isotopic quantity of SNM for these items.
  - (2) Document all transfers of SNM between designated internal control areas within the

licensee's site.

- (3) Maintain and follow procedures for confirming the validity of prior measurements associated with unencapsulated and unsealed items on ending inventory.
- (4) Maintain and follow physical inventory procedures to assure that:
  - (a) the quantity of SNM associated with each item on ending inventory is a measured value;
  - (b) each item on ending inventory is listed and identified to assure that all items are listed and no item is listed more than once;
  - (c) cutoff procedures for transfers and processing are established so that all quantities are inventoried and none are inventoried more than once; and
  - (d) cutoff procedures for records and reports are established so that only transfers for the inventory and material balance interval are included in the records for the material balance period in question.
- (5) Upon completion of the physical inventory, all book and inventory records, for total plant and individual internal control areas, should be reconciled and adjusted to the results of the physical inventory.
- (6) Perform measurements for element and isotope content on all quantities of SNM not previously measured.
- (7) Inspect TIDs to verify that their integrity is not damaged.

F. Written Procedures

Each physical inventory should be conducted according to written procedures that:

- (1) assigns inventory duties and responsibilities;
- (2) specifies the extent to which each internal control area and process is to be shut down, cleaned out, and/or remain static;
- (3) identifies the basis for accepting previously made measurements and their limits of error;
- (4) designates applicable measurements or calculations to be made for physical inventory purposes and the procedures for making these measurements or calculations;
- (5) specifies frequencies (i.e., intervals) when physical inventories of all licensed SNM in each area or facility is to be performed; and
- (6) reconciles and adjusts the book record of quantity of element and isotope content, as appropriate, to the results of the physical inventory.

G. Performing the Inventory

- (1) Persons performing the inventory generally include personnel independent from site

operations, the material custodian and MC&A measurements personnel with equipment.

- (2) A book inventory listing, derived from the MC&A record system, should be generated just before the actual start of each physical inventory; such listing should include all of the SNM that the records indicate the licensee possesses at the inventory cutoff time.

- (3) Intact Assemblies and Fuel Component Containers

For intact fuel assemblies and fuel component containers, an item count is sufficient. If the contents of an assembly or a fuel component container are accessed, the contents should be physically reinventoried before the assembly or container can be treated as a single item for inventory purposes.

- (4) Fuel Components not part of Intact Assembly

For fuel components that are not part of an intact assembly, physically captured in an assembly, stored in a sealed container, or stored in a fuel component container, each component should be inventoried.

- (5) Sealed Containers

For sealed containers, verification of the unique identifier and integrity of the tamper-safing device is sufficient for inventory purposes.

- (6) Reactor

Before fuel assemblies are loaded into a reactor, the unique identifier and location of each item should be visually verified. After the reactor vessel is reassembled, the reactor is considered one item for inventory purposes.

- (7) Non-fuel SNM

For non-fuel SNM, the method of physical inventory depends on the method of storage and use.

- (a) For installed components, verification should be performed at the time of installation, and administrative procedures and controls should be established so that records concerning the location and unique identity are accurate.
- (b) For non-installed components stored in primary containment, administrative procedures and controls should be established so that records concerning the location and unique identity are accurate when the reactor is at power, and verification should be performed during refueling outages.
- (c) For non-fuel SNM containers, verification of the unique identifier and item count of the containers is sufficient. If the contents of the container are accessed, the contents should be physically re-inventoried or administrative procedures should be in place to ensure the integrity of the contents before the container can be treated as a single item for inventory purposes.



## H. Calculations

### (1) Element and Isotopic Computations

Methods of computation should be established and utilized for determining the total element and isotopic composition of licensed SNM and source material items. The computed values are the basis for material status reports, as required in 10 CFR 74.13, and transaction documents, as required in 10 CFR 74.15.

### (2) Analysis of Results

Refinement of the element and isotopic computations used in determining the content of items should be considered as new technologies evolve. For reprocessed fuel, this may include a collection and comparison of reprocessing plant measurement data with computed data for fuel assemblies.

## I. Additional Guidance

- (1) Inventory personnel should arrive ready to perform the inventory having all forms, inventory lists, appropriate clothing and shoes, flashlights, tools and writing equipment. The inventory team should have the required training on inventory procedures and workplace safety, radiation protection equipment and safety equipment.
- (2) The inventory should be scheduled so that the SNM is available to be checked. The material custodian should be prepared to provide any needed safety briefings and escort the inventory team as needed for an efficient, complete and accurate record to be obtained without unnecessary time delays.
- (3) Two authorized persons should compare the results from the inventory to the official MC&A records. The inventory results must be documented with signatures of the reviewing persons and dated per 10 CFR 74.19(e).
- (4) Any discrepancies between the MC&A records and inventory records should be investigated. Decisions regarding the reconciliation of these discrepancies and actions taken should be documented along with the actions taken.

## 4. Recordkeeping

The regulations in 10 CFR 74.19(a) require that licensees keep records that show the receipt, inventory (including location and unique identity), acquisition, transfer, and disposal of all SNM in their possession. The regulations in 10 CFR 74.19(e) require that licensees maintain adequate safeguards against tampering with and loss of records. The guidance in this section on recordkeeping applies to all non-fuel cycle facilities, including nuclear reactors and storage installations, and certain licensees authorized to possess and use SNM in a quantity greater than 350 grams of uranium-235, uranium-233, or plutonium or any combination thereof.

- A. Accurate records are required for licensees to meet current operational needs, support inventories of SNM, assist in investigating suspected loss or diversion of SNM, and satisfy both historical and current operational needs. Accordingly, the records should be included as part of routine quality management system (QMS) audits.

- B. Collect and maintain records regarding the SNM onsite, SNM characteristics, material location, handling procedures, and dates. To meet these 10 CFR 74.19(a) and 10 CFR 74.19(e) requirements, a database is normally established to organize the data, generate reports of current holdings as well as maintain historical information.
- C. A licensee's material accounting records should be based on measured values, to assure that all documented SNM quantities are accurate. Control the MC&A record system in such a manner that the record of an item's existence cannot be destroyed or falsified without a high probability of detection.
- D. The MC&A program should maintain records of all onsite SNM. For each item, the data of record should contain the unique item number along with the associated key characteristics. These characteristics include the net isotopic weight, element weight, any unique identifier, and specific location. Accounting records should be maintained with up-to-date location information for all items under control. To accomplish current item information, records of all SNM internal transfer, reconstitution, acquisition, inventory, and shipment (including disposal) should be generated and maintained.
- E. Data presented for inclusion into the database should be written down with the signature of the individual providing the data. Data should be accepted only from authorized individuals who certify the accuracy of the data. The input data should be retained for a period of time as a historical document to assist in resolving any future data entry concerns or questions.
- F. The MC&A records kept on a computer should be "backed-up" on reliable media or memory systems that can serve the business needs in case of power outage, equipment failure or malicious destructive events. Notations on the input data showing the identity of the input individual can be useful in resolving data concerns. Calculation details relating to an "inventory difference" should be approved by a competent reviewer and also be retained for future reference.
- G. MC&A data used to resolve shipper-receiver differences should be retained as an information resource, to answer future questions or concerns, and such data may also be useful for training during changes in personnel.
- H. MC&A measurement equipment should be calibrated with NIST-traceable standards, be rechecked for calibration during use, and be tested. Measurement records of initial SNM measurements, SNM inventory measurements, and records relating to the resolution of failed measurements need to be retained in a location with access restricted to only authorized personnel.
- I. MC&A records should receive the appropriate level of protection needed for security purposes. Because MC&A records may contain information that identifies potential weaknesses in material protection, access to such records should be restricted to authorized individuals. For example, if an "insider threat individual" has knowledge of the measurement data used to validate items of SNM, the insider could more easily establish conditions to falsify a future measurement that would otherwise identify the loss of SNM. Likewise, information that would permit access to SNM items in storage or use should be restricted to authorized individuals.
- J. Maintain adequate safeguards against tampering with and loss of records. Records may be maintained in the original or reproduced copy and may be stored in electronic media. All records should be maintained in an auditable form, available for inspection, for at least 3 years. To

ensure retrievability of records, electronic backup copies should be maintained at a location(s) protected from unauthorized access, theft, sabotage, or damage.

## D. IMPLEMENTATION

The purpose of this section is to provide information on how applicant and licensees<sup>1</sup> may use this guide and information regarding the NRC's plans for using this regulatory guide. In addition, this section describes how the NRC staff complies with the backfitting provisions found in 10 CFR Part 50 (Ref. 5), specifically 10 CFR 50.109, 10 CFR 70.76, 10 CFR 72.62, or any applicable finality provisions in 10 CFR Part 52 (Ref. 6), in its use of this regulatory guide.

### Use by Applicants and Licensees

Applicants and licensees may voluntarily<sup>2</sup> use the guidance in this document to demonstrate compliance with the underlying NRC regulations. Methods or solutions that differ from those described or referenced in this regulatory guide may be deemed acceptable if they provide sufficient basis and information for the NRC staff to verify that the proposed alternative demonstrates compliance with the appropriate NRC regulations.

Licensees may use the information in this regulatory guide for actions that do not require NRC review and approval. Licensees may use the information in this regulatory guide or applicable parts to resolve regulatory or inspection issues.

### Use by NRC Staff

The NRC staff does not intend or approve any imposition of the guidance in this regulatory guide. The NRC staff does not expect any existing licensee to use or commit to using the guidance in this regulatory guide, unless the licensee makes a change to its licensing basis. The NRC staff does not expect or plan to request licensees to voluntarily adopt this regulatory guide to resolve a generic regulatory issue. The NRC staff does not expect or plan to initiate NRC regulatory action that would require the use of this regulatory guide. Examples of such unplanned NRC regulatory actions include issuance of an order requiring the use of the regulatory guide, generic communication, or issuance of a rule requiring the use of this regulatory guide.

The staff may discuss with licensees various actions consistent with staff positions in this regulatory guide, as one acceptable means of meeting the underlying NRC regulatory requirement. Such discussions would not ordinarily be considered backfitting even if prior versions of this regulatory guide are part of the licensing basis of the facility. However, unless this regulatory guide is part of the licensing basis for a facility, the staff may not represent to the licensee that the licensee's failure to comply with the positions in this regulatory guide constitutes a violation.

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<sup>1</sup> In this section, "licensees" refer to holders of, and "applicants" refer to applicants for: (1) operating licenses for nuclear power and non-power reactors under 10 CFR Part 50; (2) combined licenses under 10 CFR Part 52; (3) standard design approvals and standard design certifications under 10 CFR Part 52; (4) licenses issued under 10 CFR Part 70 authorizing the possession or use of SNM in a quantity greater than 350 grams of contained uranium-235, uranium-233, or plutonium or any combination thereof; and (5) specific licenses issued under 10 CFR Part 72.

<sup>2</sup> In this section, "voluntary" and "voluntarily" mean that the licensee is seeking the action of its own accord, without the force of a legally binding requirement or an NRC representation of further licensing or enforcement action.

If an existing licensee voluntarily seeks a license amendment or change and (1) the NRC staff's consideration of the request involves a regulatory issue directly relevant to this new or revised regulatory guide, and (2) the specific subject matter of this regulatory guide is an essential consideration in the staff's determination of the acceptability of the licensee's request, then the staff may request that the licensee either follow the guidance in this regulatory guide or provide an equivalent alternative process that demonstrates compliance with the underlying NRC regulatory requirements.

## GLOSSARY

<b>accessible</b>	A location at a facility from which SNM could be acquired without leaving evidence of the acquisition ( <i>i.e.</i> , without tools or other equipment to obviously violate the integrity of the containment).
<b>accounting</b>	A system that documents the quantities of special nuclear material (SNM) held on current inventory by the licensee, and includes tracking of receipts, shipments, and measured discards, and transfers of SNM.
<b>accounting records</b>	The written records ( <i>e.g.</i> , documents, spreadsheets, databases) whether electronic or hardcopy, prepared in the accounting SNM inventories. For example: SNM inputs and outputs tracking, quantities measurements, receipts and shipping papers, transfers of SNM to shippers and between licensees.
<b>anomaly</b>	An unusual event, incongruity, inconsistency, or inventory discrepancy indicating a possible loss, theft, diversion, or misuse of SNM.
<b>calibration</b>	The process of determining the numerical relationship between the observed output of a measurement system and the value, based upon reference standards, of the characteristic being measured.
<b>inventory discrepancy</b>	An inventory difference that is rejected by a statistical test with a 90% power (or better) probability of detecting an apparent gain or loss.
<b>element</b>	Uranium or plutonium, as appropriate.
<b>estimate</b>	A specific numerical value arrived at by the application of an estimator.
<b>inventory difference</b>	The arithmetic difference obtained by subtracting the quantity of SNM tabulated from a physical inventory from the book inventory quantity. Book inventory quantity is equivalent to the beginning inventory (BI) plus additions to inventory (A) minus removals from inventory (R), while the physical inventory quantity is the ending inventory (EI) for the material balance period in question (as physically determined). Thus mathematically, $ID = (BI + A - R) - EI$ or $ID = BI + A - R - EI$ . <i>ID</i> is sometimes also referred to as <i>material unaccounted for (MUF)</i> .
<b>item</b>	Any discrete quantity or container of special nuclear material or source material, not undergoing processing, having a unique identity and also having an assigned element and isotope quantity.
<b>item control system</b>	A system tracking the creation, identity, element and isotopic content, location, and disposition of all items, which enables the licensee to maintain current knowledge of each item.

<b>material balance</b>	The determination of an inventory difference (ID).
<b>material balance closure</b>	A routine, periodic evaluation of SNM quantities discovered during a physical inventory against the recorded quantities, with acceptable correction factors potentially applied to balance disparities in SNM quantity.
<b>material control and accounting (MC&amp;A)</b>	A program to control and account for certain types of nuclear material used at a licensed facility, including SNM and source material. The MC&A program serves to deter and detect any loss, theft, diversion, misuse, or unauthorized removal, production, or enrichment of nuclear material.
<b>material custodian</b>	An individual authorized and qualified by the licensee who is responsible for controlling the movement of all SNM into, out of, and within a material balance area.
<b>measurement</b>	Includes sampling and means the determination of mass, volume, quantity, composition or other property of a material where such determinations are used for special nuclear material control and accounting purposes.
<b>measurement system</b>	All of the apparatus, equipment, instruments and procedures used in performing a measurement.
<b>NIST</b>	The National Institute of Standards and Technology, which is an agency of the U.S. Department of Commerce.
<b>physical inventory</b>	Determination on a measured basis of the quantity of special nuclear material on hand at a given time. The methods of physical inventory and associated measurements will vary depending on the material to be inventoried and the process involved.
<b>receipt</b>	Special nuclear material received by a licensee from an off-site source.
<b>reconciliation</b>	The process of evaluating and comparing licensee reports required under this part to the projected material balances generated by the Nuclear Materials Management and Safeguards System. This process is considered complete when the licensee resolves any differences between the reported and projected balances, including those listed for foreign obligated materials.
<b>removal</b>	As used to denote removal from inventory, is measured quantities of special nuclear material contained in: <ol style="list-style-type: none"> <li>1) shipments;</li> <li>2) waste materials transferred to an onsite holding account via a DOE/NRC Form 741 transaction;</li> <li>3) measured discards transported offsite; and</li> <li>4) effluents released to the environment.</li> </ol>
<b>special nuclear material (SNM)</b>	Plutonium, uranium-233, uranium enriched in the isotope uranium-233 or in the isotope uranium-235, and any other material which the Commission, pursuant to the provisions of section 51 of the Atomic Energy Act of 1954, as amended, determines to be special nuclear material, but does not include source material; or any material artificially enriched by any of the foregoing, but does not include source material.

<b>SRD (shipper-receiver difference)</b>	The disparity (difference) between quantities of SNM and items reported in the shipper's report against the quantities of SNM and items measured or otherwise determined by the receiver after receipt of the material.
<b>storage installation</b>	an independent spent fuel storage installation or monitored retrievable storage installation for spent fuel and radioactive waste, as defined under 10 CFR Part 72.
<b>TID (tamper- indicating device)</b>	A device affixed to a container or vault to detect or otherwise provide evidence of unauthorized access to the contents of the container or vault.
<b>vault</b>	A windowless enclosure with walls, floor, roof and door(s) designed and constructed to delay penetration from forced entry.



## REFERENCES<sup>3</sup>

1. *U.S. Code of Federal Regulations (CFR)*, “Material Control and Accounting of Special Nuclear Material,” Part 74, Chapter 1, Title 10, “Energy”
2. NUREG-1065, “Acceptable Standard Format and Content for the Material Control and Accounting Plan Required for Special Nuclear Material of Low Strategic Significance,” Revision 3, U.S. Nuclear Regulatory Commission, Washington, DC.
3. American Nuclear Standard Institute N15.8-2009, “Methods of Nuclear Material Control—Material Control Systems—Special Nuclear Material Control and Accounting Systems for Nuclear Power Plants,” American National Standards Institute, New York, NY, February 18, 2009.<sup>4</sup>
4. International Atomic Energy Agency Nuclear Security Series No. 15, “Nuclear Material Accounting Handbook,” Vienna, Austria, 2011.<sup>5</sup>
5. CFR, “Energy” Chapter 1, “Domestic Licensing of Production and Utilization Facilities,” Part 50, Chapter 1, Title 10, “Energy”
6. CFR, “Licenses, Certifications, and Approvals for Nuclear Power Plants,” Part 52, Chapter 1, Title 10, “Energy”

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<sup>3</sup> Publicly available NRC published documents are available electronically through the NRC Library on the NRC’s public Web site at <http://www.nrc.gov/reading-rm/doc-collections/> and through the NRC’s Agencywide Documents Access and Management System (ADAMS) at <http://www.nrc.gov/reading-rm/adams.html>. The documents can also be viewed online or printed for a fee in the NRC’s Public Document Room (PDR) at 11555 Rockville Pike, Rockville, MD. For problems with ADAMS, contact the PDR staff at 301-415-4737 or (800) 397-4209; fax (301) 415-3548; or e-mail [pdr\\_resource@nrc.gov](mailto:pdr_resource@nrc.gov).

<sup>4</sup> Copies of American National Standards Institute (ANSI) standards may be purchased from ANSI, 25 West 43rd St, 4th floor, New York, NY 10036; telephone (212) 642-4900 and fax (212) 398-0023. Purchase information is available at the ANSI web-based store at <http://webstore.ansi.org/>.

<sup>5</sup> Copies of International Atomic Energy Agency (IAEA) documents may be obtained through their Web site <http://www.iaea.org> or by writing the International Atomic Energy Agency, P.O. Box 100 Wagramer Strasse 5, A-1400 Vienna, Austria.